1. In reference to dynamic balancing of a rotating masses system which statement is not true?
(a) If the system is statically balanced, it is dynamically balanced also
(b) If the system is dynamically balanced, it is statically balanced also
(c) The resultant couple due to all the inertia force during
(d) The center of mass of the system lies on the axis of rotation.

2. In case of reciprocating masses, secondary unbalanced force
(a) half
(b) one third
(c) n times
(d) $\frac{1}{n}$ times
of the amplitude of primary unbalanced force, where n = L / r , where L = length of connecting rod and r is the length of crank.

3. In locomotives where primary forces are partially balanced, the maximum magnitude of the unbalanced force along the perpendicular to the line of stroke is known as
(a) hammer blow
(b) tractive effort
(c) swaying couple
(d) crank effort

4. The natural frequency of vibration of a spring mass system
(a) $2\pi\sqrt{g/\delta}$
(b) $\frac{1}{2\pi}\sqrt{g/\delta}$
(c) $\frac{1}{2\pi}\sqrt{\delta/g}$
(d) $\sqrt{\frac{\delta}{g}}$
where δ = static deflection of the spring under the mass

5. With viscous damping the frequency of damped vibrations, as compared to the frequency of undamped vibrations, is
(a) less
(b) more
(c) same
(d) can be more or less depending on damping

6. The whirling speed of a rotating shafts, carrying a masses at the centre as
(a) more than the natural frequency of transverse vibrations
(b) less
(c) equal
(d) more or less depending on the stiffness of the shaft

7. If the value of Poisson's ratio is zero, then it means that
(a) the material is rigid
(b) the material is ideal plastic
(c) there is no longitudinal strain in the material
(d) longitudinal strain in the material is infinite.

8. On a plane having maximum or minimum principal stress, the tangential stress will be
(a) minimum
(b) maximum
(c) zero
(d) infinity

9. Mohr's circle can be used to determine the following stress on inclined surface.
(a) Principal stress
(b) Normal stress
(c) Maximum shear stress
(d) All the above

10. Two solid shafts are made of same material and have their diameters D and D/2. The ratio of strength of bigger shaft to smaller one is torsion is
(a) 4
(b) 2
(c) 8
(d) 16

11. Power of 100 kW is to transmitted by each of two separate shafts A and B. The shaft A is turning at 250 rpm and B is turning at 300 rpm. Which shaft must have larger diameter?
(a) A
(b) B
(c) Both will have same diameter
(d) None of the above

12. The maximum twisting moment that a shaft can resist is a product of permissible shear stress and
(a) moment of inertia
(b) polar modulus
(c) polar moment of inertia
(d) torsional rigidity

13. The deflection of a beam can be reduced by
(a) increasing the span
(b) decreasing the depth
(c) providing greater end restraints

(d) all the above

14. A cantilever beam carries a load W uniformly distributed over its entire length. If the same load is placed at the free end of the same cantilever, the ratio of maximum deflection in the first case to that in the second case will be

(a) 3/8 (b) 8/3
(c) 5/8 (d) 8/5

15. Beam deflections, calculated on the basis of deformation due to bending moment alone, are more accurate if

(a) it is a long beam
(b) it is a short beam
(c) the beam is uniformly loaded its span
(d) the beam has only simple supports

16. Two beams, having identical dimensions and loads, but of different materials, will have

(a) identical stresses but different strains
(b) identical stress and strain both.
(c) identical strain but different stresses
(d) different stress and strain both.

17. An I-section beam is preferable over a rectangular section beam because

(a) It reduces bending moment
(b) it reduces shearing force
(c) it is economical
(d) it is easily available

18. The deflection in a beam is maximum where the slope is

(a) minimum (b) maximum
(c) zero (d) changes sign

19. Castigiliano's theorem can be used for bodies undergoing

(a) elastic deformation
(b) only linear elastic deformation
(c) elastic or plastic deformation
(d) deformation without any change in its volume

20. In a thick cylinder subjected to internal pressure

(a) circumferential stress is positive and the radial stress is negative
(b) circumferential stress is negative and the radial stress is positive.
(c) both stresses are negative
(d) both stresses are positive

21. When two cylinders are shrink fitted, one inside the other

(a) Circumferential stresses developed in both the cylinders are of same nature (tensile)
(b) Radial stresses developed in both the cylinders are of same nature (compressive).
(c) Circumferential stress at the inside surface of the inner cylinder is zero.
(d) Circumferential stress at the outside surface of the outer cylinder is zero.

22. Slenderness ratio of a column is defined as (Le/t) where 'Le' is the effective length of the column and 't' is the

(a) smallest dimension of the cross-section
(b) largest dimension of the cross-section
(c) radius of gyration of the cross-section
(d) radius of the circle with the same area as that of cross-section

23. A hollow circular section with outer diameter 8 cm and inner diameter 6 cm is subjected to buckling. The radius of gyration of the section is

(a) 2.5 cm (b) 2.0 cm
(c) 1.5 cm (d) 1.0 cm

24. A heavy steel rod of uniform cross-sectional area, suspended vertically down, will have through out its length

(a) uniform stress and strain both
(b) uniform stress but non-uniform strain
(c) non-uniform stress and strain both
(d) uniform strain but non-uniform stress.

25. The theory of failure suitable for ductile material is

(a) maximum principal stress theory
(b) maximum principal strain theory
(c) maximum shear stress theory
(d) none of the above

26. A shaft subjected to pure torsion is to be designed. The yield stress of the material is 280 N/mm^2 and Poisson ratio = 0.3. Which of the following theories of failure gives the largest diameter of the shaft?

(a) Maximum principal stress theory
(b) Maximum shear stress theory

(c) Maximum principal strain theory
(d) Shear strain energy theory

27. The crystal structure of all the following materials is FCC except of
(a) tungsten (b) copper
(c) aluminium (d) nickel

28. Vectorial sum of the Bergers vector of dislocations at a nodal point is
(a) zero (b) 1
(c) -1 (d) none of the above

29. Young's modulus of timber is influenced by its
(a) grain orientation (b) thickness
(c) surface area (d) all the above

30. Toughness of materials is mostly measured by
(a) creep test
(b) fatigue test
(c) hardness test
(d) impact test

31. Proof stress of a material is
(a) Its ultimate tensile stress
(b) its yield stress
(c) cohesive stress derived by inter-atomic forces in its atoms
(d) stress required to produce a specified plastic strain

32. Strain hardening occurs by
(a) annealing of anchored dislocations
(b) mixing certain elements in the regular matrix of the material
(c) plastic deformation of the material
(b) inducing compressive stresses on the metal surface

33. Creep failure of materials can be resisted by
(a) using low melting temperature metals and alloys
(b) dispersion hardening
(c) stress relieving of the material
(d) mixing organic materials to the metal matrix.

34. Minimum creep rate is
(a) slope of secondary portion of creep curve
(b) occurrence of creep at the start of loading
(c) creep rate of some element which has negligible creep deformation
(d) creep rate in the tertiary region of the creep curve

35. The fatigue facture is generally considered
(a) brittle fracture
(b) ductile fracture
(c) cleavage fracture
(d) creep fracture

36. The fatigue resistance of a material is reduced by
(a) permanent residual compressive stress
(b) mechanically hardening the surface
(c) chemically hardening the surface
(d) poor surface finish

37. Degree of polymerization has been defined as
(a) average number of per units per polymer chain molecule.
(b) the number of times a polymer is heated and moulded
(c) the temperature upto which a polymer can be heated before it melts.
(d) none of the above.

38. For addition polymerization, this statement is true.
(a) Requires cross-linking of chemical groups
(b) Requires unsaturated mers
(c) Leads to formation of thermosets
(d) Produces polymers which cannot be remoulded by heat and pressure.

39. The conductivity of a pure semi-conductor
(a) increases exponentially with temperature rise
(b) decreases exponentially with temperature rise
(c) is proportional to temperature change
(d) does not follow any law

40. The total current through a semi-conductor is given by
(a) sum of currents due to electrons and holes.
(b) difference of currents due to electrons and holes.
(c) product of currents due to electrons and holes
(d) ratio of currents due to electrons and holes

41. Super –conductivity is

(a) complete disappearance of electrical resistivity at very low temperatures.
(b) comparative value of different electrical conductors.
(c) transition of an electrical conductor to an electrical insulator
(d) superheating of a conductor

42. Ceramic materials are
(a) complex compounds containing both metallic and non-metallic elements
(b) same as crystalline solids
(c) formed by metallic bonds
(d) low melting point materials

43. At room temperature iron is
(a) para magnetic (b) ferromagnetic
(c) ferro electric (d) dielectric

44. Hard magnetic materials
(a) have large hysteresis loop area
(b) have higher hardness physically
(c) have large coercive force
(d) all the above

45. The Polarisation of a dielectric is
(a) formation of dipoles in a dielectric material
(b) alignment of dielectric material with earth poles
(c) removal of electrons from dielectric material so as to give it a change
(d) none of the above

46. When a dielectric is introduced into an air capacitor which of the following quantity changes?
(a) Potential difference
(b) Electric field intensity
(c) Temperature of the capacitor
(d) Electric charge

47. In Merchant's analysis of metal cutting, the following assumption has not been made:
(a) Deformation takes place in a shear zone
(b) deformation is two dimensional
(c) Effect of strain hardening is neglected
(d) Effect of shear strain rate is neglected

48. The Merchant shear angle relationship is given by the following equations.
(a) $\varphi = \frac{\pi}{2} - (\beta - \alpha)$
(b) $\varphi = \frac{\pi}{2} - \frac{1}{2}(\beta - \alpha)$
(c) $\varphi = \frac{\pi}{4} - (\beta - \alpha)$
(d) $\varphi = \frac{\pi}{4} - \frac{1}{2}(\beta - \alpha)$
Where φ = shear angle
β = friction angle
α = rake angle

49. The machinability rating of SAE 1212 is
(a) 45% (b) 60 %
(c) 70% (d) 100 %

50. In Taylor's tool life equation $VT^n = C$, the constant n and C depends upon
1. work piece material
2. tool material
3. feed
Of these statements
(a) 1, 2 and 3 are correct
(b) Only 1 and 2 are correct.
(c) Only 1 and 3 are correct
(d) Only 2 and 3 are correct

51. The ultrasonic machining uses for comparing the ease of machining of different materials:
1. tool life
2. cutting force
3. surface finish
Of these
(a) 1, 2 and 3 are true
(b) Only 1 and 2 are true
(c) Only 2 and 3 are true
(d) Only 1 and 3 are true

52. The following criteria are used for comparing the ease of machining of different materials:
1. tool life
2. cutting forces
3. surface finish
Of these
(a) 1, 2 and 3 are true
(b) Only 1 and 2 are true
(c) Only 2 and 3 are true
(b) Only 1 and 3 are true

53. The metal in electrochemical machining process is removed by
(a) ionization and shearing

(b) transfers of electrons
(c) chemical action and abrasion
(d) migration of ions towards the tool

54. The tool materials generally used in electro discharge machining are
1. Copper
2. Brass
3. Mild Steel
Of these
(a) 1, 2 and 3 are true
(b) 1 and 3 are true
(c) 2 and 3 are true
(d) 1 and 2 are true

55. In rolling the following is true:
(a) $V_i > V > V_f$
(b) $V_f > V > V_i$
(c) $V_f > V_i > V$
(d) $V_i > V_f > V$
Where V_i- initial velocity
V_f- final velocity
V = roll velocity

56. In deep drawing, the portions of the workpiece around the corners of the punch and the die are subjected to
(a) pure radial drawing
(b) longitudinal drawing
(c) bending
(d) none of the above

57. Continuous chips will be formed when machining speed is
(a) high
(b) low
(c) medium
(d) irrespective of cutting speed

58. The tool signature comprises
(a) 6 elements (b) 7 elements
(c) 5 elements (d) 4 elements

59. Which of the following is not the characteristic of explosive forming?
(a) Low capital investment
(b) Component formed in one shot
(c) Both die parts- male and female are needed
(d) Large size parts can be formed easily

60. The primary texture on surface results due to
(a) normal action of the tool in production process
(b) flaws in material
(c) vibrations in the cutting process
(d) non-uniformity of the cutting process.

61. The main advantage of jigs and fixtures are
1. reduction in set up time
2. reduction in cost of machining
3. work of marking the top is eliminated
Of these
(a) 1, 2 and 3 are true
(b) 1 and 2 are true
(c) 1 and 3 are true
(d) 2 and 3 are true

62. The term ‘value’ in value engineering refers to
(a) total cost (b) utility of the product
(c) selling price (d) depreciated value

63. Percent idle time for men or machines is found by this method.
(a) Time study (b) ABC analysis
(c) Work sampling (d) Motion study

64. Simplex method is concerned with which of the following?
(a) Break-even analysis
(b) Value analysis
(c) Linear programming
(d) Queuing theory

65. In which one of the following purchase systems, the ordering and carrying costs are same?
(a) Schedule buying
(b) Sale supply agreement
(c) Speculative purchasing
(d) Batch purchasing

66. For an item in a factory store, buffer stock to be provided, is fixed at 50 units. Average demand for the item is 65 units per week. Time between placing and receiving of order is 2 weeks. The recorder point for the item is
(a) 80 units (b) 115 units
(c) 130 units (d) 180 units

67. In ABC analysis maximum attention is on those items which are
(a) most expensive (b) surplus
(c) in more demand (d) perishable

68. The number of basic variables in a transportation problem is at the most
(a) m (b) n
(c) m + n (d) m + n -1
Where m = number of constraints
n = number of decision variables

69. The following control chart tells about the consistency of the process
(a) $\bar{X}$ (b) R
(c) p (d) C

70. In a 'C' chart the value of C is 25. The upper control limit is equal to
(a) 20 (b) 30
(c) 33.66 (d) 40

71. In unbounded solution of linear programming problem, the value of objective function
(a) can be increased indefinitely
(b) can be decreased indefinitely
(c) can be increased or decreased indefinitely
(d) remain same

72. If the arrivals are completely random in a queue, then the probability distribution of number of arrivals in a given time follows:
(a) Normal distribution
(b) Poisson distribution
(c) Binominal distribution
(d) Exponential distribution

73. Which type of material control is needed on the imported items?
(a) Loose control
(b) Tight control
(c) Ordinary control
(d) No control is needed

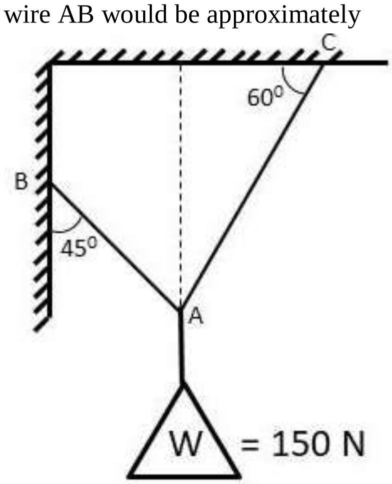
74. The demand and supply time of four orders are given below:
Order No. Demand time
Supply time
(a) 6 4
(b) 10 12
(c) 26 20
(d) 34 24
Which order has the most appropriate priority for production?

75. Which of the following control is included in a material management function?
(a) Inventroy control (b) Process control
(c) Production control (d) Quality control

76. Manager of a production unit has four orders. All the four orders have different critical ratio of scheduling. Which ratio should be given priority?
(a) 0.5 (b) 1.0
(c) 1.5 (d) 2.0

77. A block of mass m is sliding on a rough horizontal plane with a velocity v. If the velocity reduces to v/2 in 30 m, the block will be brought to rest in next
(a) 10 m (b) 20 m
(c) 25 m (d) 30 m

78. An object, weighing 150 N hangs from a point A by two wires AB and AC. The tension in the wire AB would be approximately



(a) 77 N (b) 86 N
(c) 99 N (d) 50 N

79. Two spheres, each weighing 50 N and of diameter 20 cm, rest in a cylindrical vessel of 40 cm diameter. The reaction at the point of contact between two spheres will be
(a) 50 N (b) 100 N
(c) zero (d) 66.67 N

80. If the five forces acting at a point be represented in magnitude and direction by the sides of a pentagon taken in order, the forces will produce the state of
(a) translation (b) rotation
(c) equilibrium (d) plane motion

81. A particle inside a hollow sphere of radius R, having coefficient of friction μ can rest upto height of
(a) $R(\mu - 1)/\sqrt{\mu}$ (b) $R(\sqrt{\mu} - 1)/\sqrt{\mu}$
(c) $R(\mu - 1)/\mu$ (d) $\frac{R\left(\sqrt{1+\mu^2}-1\right)}{\sqrt{1+\mu^2}}$

82. The rotation of a pulley is defined by the relation
$$\theta = t^4 + t^2 + 2$$
where θ is measured in radians and t in seconds. The value of angular velocity after 2 seconds will be
(a) 22 radians/sec (b) 50 radians/sec
(c) 20 radians/sec (d) 36 radians/sec

83. A bullet of mass M is placed on a horizontal surface. The surface is moving upwards. If the acceleration of the surface is f, then force causing motion will be
(a) $M(g + f)$ (b) $M(g - f)$
(b) $M(f - g)$ (d) $M f$

84. A bullet of mass 50 gm strikes a wooden sphere of mass 950 gms with a speed v m/s. The bullet gets embedded in the block and the combined system rises to height 0.25 m above the horizontal. The speed of the bullet is approximately(g = 10 m/s^2)
(a) 25 m/s (b) 45 m/s
(c) 75 m/s (d) 100 m/s

85. Assertion (A):
If a solid sphere and an identical hollow sphere are allowed to roll down on an inclined plane, the solid sphere reaches the bottom first.
Reasoning (R):
The moment of inertia of the solid sphere is greater than that of hollow sphere.
Select the answer using the code given below:
Code:
(a) Both (A) and (R) are true
(b) (A) is true, (R) is false
(c) (A) is false, (R) is true
(d) Both (A) and (R) are false

86. A particle starts from rest with a constant acceleration α meters/sec^2. After some time, it decelerates at a uniform rate β meters/sec^2 till it comes to rest. If the total time taken between two rest position is t, the maximum velocity acquired by the particle would be
(a) $[(\alpha + \beta)/(\alpha - \beta)]t$
(b) $[(\alpha\beta)/(\alpha - \beta)]t$
(c) $\left(\frac{\alpha + \beta}{2}\right)t$
(d) $\left(\frac{\alpha + \beta}{2t}\right)$

87. The point on the cam with maximum pressure angle is called
(a) pitch point (b) trace point
(c) cam centre (d) none of the above

88. In belt drive, the power transmitted
(a) increases with increase in initial tension
(b) increases with decrease in initial tension
(c) increases with increase in initial tension upto a contain value of tension
(d) does not depend on initial tension

89. Centrifugal tension in belts
(a) increases the power transmitted
(b) decreases the power transmitted
(c) has no effect on the power transmitted
(d) increases the power transmitted upto a certain speed and then decreases

90. A dynamometer is a device for measuring
(a) torque exerted by machine
(b) power developed by machine
(c) power absorbed by machine
(d) all the above

91. Which one is the correct statement?
(a) The flywheel influences the cycle variation of the prime mover.
(b) The flywheel influences the variation of load demand on prime mover.
(c) The flywheel influences the mean speed of prime mover
(d) The flywheel influences the mean torque developed by prime mover

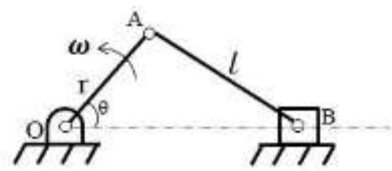
92. Out of governor A and B, if the governor A has a larger lift than B for a given fractional change in speed,
(a) Governor B is said to be more sensitive than A
(b) Governor A is said to be more sensitive than B
(c) Both the governor are equally sensitive
(d) None of the above

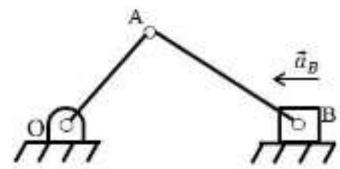
93. A spring controlled governor is said to be unstable when variation of controlling force F
(a) F remains constant for all values of r
(b) F increases as r increases
(c) F decreases as r increases
(d) F increases as r decreases

Answer

1 (a)	21 (a)	41 (a)	61 (a)	81 (d)
2 (d)	22 (c)	42 (b)	62 (b)	82 (d)
3 (a)	23 (a)	43 (b)	63 (a)	83 (d)
4 (b)	24 (c)	44 (d)	64 (c)	84 (b)
5 (a)	25 (c)	45 (a)	65 (*)	85 (a)
6 (c)	26 (b)	46 (d)	66 (d)	86 (b)
7 (a)	27 (a)	47 (b)	67 (a)	87 (a)
8 (c)	28 (c)	48 (d)	68 (d)	88 (a)
9 (d)	29 (a)	49 (d)	69 (b)	89 (b)
10 (c)	30 (d)	50 (a)	70 (d)	90 (b)
11 (a)	31 (d)	51 (d)	71 (a)	91 (a)
12 (b)	32 (c)	52 (a)	72 (b)	92 (b)
13 (c)	33 (*)	53 (d)	73 (b)	93 (c)
14 (a)	34 (a)	54 (d)	74 (b)	
15 (*)	35 (a)	55 (b)	75 (c)	
16 (a)	36 (d)	56 (c)	76 (*)	
17 (c)	37 (a)	57 (a)	77 (a)	
18 (d)	38 (*)	58 (b)	78 (a)	
19 (b)	39 (a)	59 (c)	79 (c)	
20 (a)	40 (a)	60 (*)	80 (c)	

2. Balancing of reciprocating masses





Acceleration of slider B

$$a_B = \omega^2 r\left(\cos\theta + \frac{\cos 2\theta}{n}\right)$$

Inertia force act on slider

$$ma_B = m\omega^2 r\cos\theta + m\omega^2 r\frac{\cos 2\theta}{n}$$

$m\omega^2 r\cos\theta$ = Primary force
$m\omega^2 r\frac{\cos 2\theta}{n}$ = Secondary force

Maximum primary force is equal to $m\omega^2 r$
Maximum secondary force is equal to $\frac{m\omega^2 r}{n}$

4. Natural frequency of spring mass system

$$\omega = \sqrt{\frac{K}{M}}$$

$$K\,\delta = mg$$

δ = Static deflection of spring.

$$\frac{K}{M} = \frac{g}{\delta}$$

$$\omega = \sqrt{\frac{g}{\delta}}$$

$$\omega = 2\pi f = \sqrt{\frac{g}{\delta}}$$

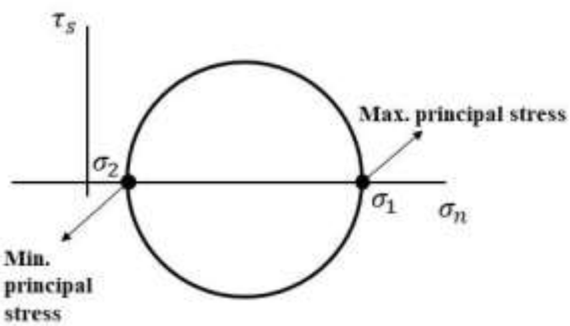
$$f = \frac{1}{2\pi}\sqrt{\frac{g}{\delta}}\ \text{Hz}$$

5. Angular frequency of damped vibration

$$\omega_d = \sqrt{1-\xi^2}\,\omega_n$$

$\omega_d < \omega_n$ (damped natural frequency is less than un damped natural frequency).

8. Mohr' Circle for Bi-axial stress condition

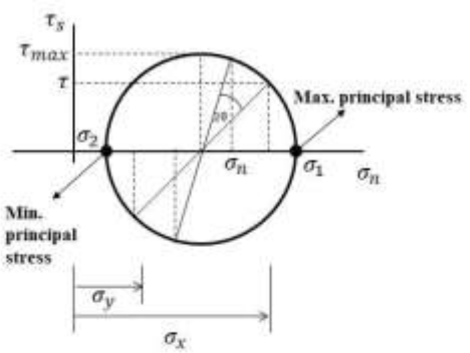


σ_n → Normal stress

τ_s → Shear stress

At maximum and minimum principal stress, shear stress is equal to zero.

9 .



σ_1, σ_2 → Principal stresses

σ_n → *Normal stress at any arbitary plane inclined to θ degree to X-plane.*

τ_{max} → Max. Shear stress

10. Torsional Formulae for circular shaft

$$\frac{T}{J} = \frac{\tau_{max}}{R}$$

J = polar moment of inertia

For circular shaft J = $\frac{\pi R^4}{2}$

$$T = \tau_{max}\frac{\pi R^3}{2}$$

$$\frac{Maximum\ \ torque\ \ transmited\ by\ bigger\ shaft}{Maximum\ \ torque\ \ transmitted\ by\ small\ shaft}$$

$$= \left(\frac{Radius\ of\ bigger\ shaft}{Radius\ of\ smaller\ shaft}\right)^3 = \left(\frac{R}{R/2}\right)^3$$

= 8

11. Power = Torque × angular speed

If two shaft transmits equal power then

$$T_A\omega_A = T_B\omega_B$$

Given N_A = 250 rpm, N_B = 300 rpm

$$T_A \times 250 = T_B \times 300$$

$$\frac{T_A}{T_B} = \frac{300}{250} = \frac{6}{5} = 1.2$$

$$\frac{T_A}{T_B} = \left(\frac{R_A}{R_B}\right)^3 = 1.2$$

$$R_A > R_B$$

Radius of shaft A is greater than radius of shaft B.

12. Torsional formulae for circular shaft

$$\frac{T}{J} = \frac{\tau_{max}}{R}$$

$$T = \tau_{max} \times \frac{J}{R}$$

$\frac{J}{R}$ = Polar modulus

Maximum torque transmitted is equal to maximum permissible shear stress multiply by polar modulus.

14. Deflection of free end subjected to uniformly distributed load.

$$\delta_1 = \frac{WL^3}{8EI}$$

Deflection of free end subjected to point load at free end.

$$\delta_2 = \frac{WL^3}{3EI}$$

$$\frac{\delta_1}{\delta_2} = \frac{3}{8}$$

16. Stress = $\frac{P}{A}$ andStrain = $\frac{PL}{AE}$

If load and area of cross section same then stress in both beam should be same. But for different material strain are different.

18. For maximum deflection, slope should changes sign.

In simply supported beam subjected to uniformly distributed load , maximum deflection occur at mid span of beam. At this point slope is zero and slope of curve changes also.

In cantilever beam subjected to point load at free end , maximum deflection occurs at free end. At free end slope is non-zero , also sign of slope doesn't change at all.

20. Internal pressure P_i = P

External pressure P_0 = 0

inner radius = a

outer radius = b

$$\sigma_r = A - \frac{B}{r^2}$$

$$\sigma_\Theta = A + \frac{B}{r^2}$$

$$A = \frac{p_i r_i^2 - p_0 r_0^2}{r_0^2 - r_i^2} = \frac{pa^2}{b^2 - a^2}$$

$$B = \frac{(p_i - p_0) r_i^2 r_0^2}{(r_0^2 - r_i^2)} = \frac{pa^2 b^2}{b^2 - a^2}$$

$$\sigma_r = \frac{pa^2}{b^2 - a^2} - \frac{pa^2 b^2}{b^2 - a^2}\frac{1}{r^2} = \frac{pa^2}{b^2 - a^2}\left(1 - \frac{b^2}{r^2}\right)$$

$$\left(1 - \frac{b^2}{r^2}\right) < 0$$

$$\sigma_r < 0$$

(Radial stress are compressive in nature.)

$$\sigma_\Theta = \frac{pa^2}{b^2-a^2} + \frac{pa^2b^2}{b^2-a^2}\frac{1}{r^2} = \frac{pa^2}{b^2-a^2}\left(1 + \frac{b^2}{r^2}\right) > 0$$

(Circumferential stress are tensile in nature.)

21. Shrink Fit

$\sigma_r = A - \frac{B}{r^2}$ $\quad A = \frac{p_i r_i^2 - p_0 r_0^2}{r_0^2 - r_i^2}$ $\quad B = \frac{(p_i - p_0) r_i^2 r_0^2}{(r_0^2 - r_i^2)}$

For inner cylinder ,

outer radius r_0 = b

inner radius r_i = a

A = $-\frac{Pb^2}{b^2-a^2}$ and B = $-\frac{Pb^2a^2}{b^2-a^2}$

$$\sigma_\theta = \frac{-pb^2}{b^2 - a^2} - \frac{Pb^2a^2}{b^2 - a^2}\frac{1}{r^2}$$

Circumferential stress at inner surface of inner cylinder. r = a

$$\sigma_\theta = \frac{-pb^2}{b^2 - a^2} - \frac{Pb^2a^2}{b^2 - a^2}\frac{1}{a^2} = -\frac{2pb^2}{b^2 - a^2}$$

Radial stress in inner cylinder

$$\sigma_r = -\frac{pb^2}{b^2 - a^2} + \frac{pa^2b^2}{b^2 - a^2}\frac{1}{r^2}$$

$$= -\frac{pb^2}{b^2 - a^2}\left[1 - \frac{a^2}{r^2}\right] < 0$$

For outer cylinder

$r_0 = c$, $r_i = b p_i = p$ and $p_0 = 0$

A = $\frac{pb^2}{c^2-b^2}$ and B = $\frac{pb^2c^2}{c^2-b^2}$

Radial stress in outer cylinder

$$\sigma_r = \frac{pb^2}{c^2 - b^2} - \frac{pb^2c^2}{c^2 - b^2}\frac{1}{r^2}$$

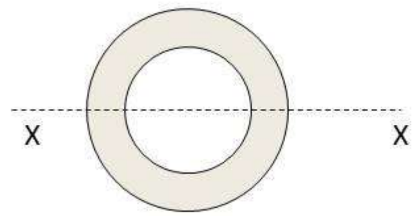
$$\sigma_r = \frac{pb^2}{c^2 - b^2}\left[1 - \frac{c^2}{r^2}\right] < 0$$

Hoop stress at outer surface

$$\sigma_\theta = \frac{pb^2}{c^2 - b^2} + \frac{pb^2c^2}{c^2 - b^2}\frac{1}{c^2}$$

$$\sigma_\theta = \frac{2pb^2}{c^2 - b^2}\ (Tensile)$$

23.



$I_{xx} = \frac{\pi R^4}{4} - \frac{\pi r^4}{4}$ (R = 4 cm, r = 3 cm)

$I_{xx} = \frac{\pi(4^4 - 3^4)}{4}$ $\quad A = \pi(4^2 - 3^2)$

$k^2 = \frac{I_{xx}}{A} = \frac{25}{4} = 6.25$ $\quad$ k = 2.5 cm

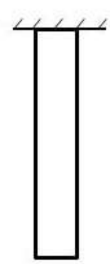
24.

$$\sigma = \frac{Load}{Area}$$

Load is vary along the length. Therefore stress is also varying along the length.

$$\varepsilon = \frac{\sigma}{E}$$

It means strain is also varying along the length



25. The theory of failure suitable for ductile material are maximum shear stress theory and maximum distortion theory.

The theory of failure suitable for brittle material are maximum principal stress theory.

26. $\frac{T}{J} = \frac{\tau_{max}}{R}$

For solid shaft, J = $\frac{\pi R^4}{2}$

$\tau_{max} = \frac{2T}{\pi R^3}$

$R = \sqrt[3]{\frac{2T}{\pi \tau_{max}}}$

Maximum shear stress occur at outer fiber of circular shaft.

(a) Failure on the basis of maximum principal stress theory

Maximum principal stress at a point should be less than yield stress in uni-axial tensile test experiment.

Solid shaft subjected to pure torsion, state of stress at outer fibre is pure shear condition.

Maximum principal stress is equal to maximum shear stress.

$\sigma_{p,max} = \tau_{max}$

$\sigma_{p,max} \leq \sigma_{yt}$

$\tau_{max} \leq \sigma_{yt}$

$R = \sqrt[3]{\frac{2T}{\pi \tau_{max}}} = \sqrt[3]{\frac{2T}{\pi \sigma_{yt}}}$

(b) Maximum shear stress theory

$\tau_{max} = \frac{\sigma_{yt}}{2}$

$R = \sqrt[3]{\frac{2T}{\pi \tau_{max}}} = \sqrt[3]{\frac{4T}{\pi \sigma_{yt}}}$

(c) Maximum principal strain theory

$\varepsilon_1 = \frac{\sigma_1}{E} - \vartheta \frac{(\sigma_2 + \sigma_3)}{E}$

$\sigma_1, \sigma_2, \sigma_3$ are principal stress at outer surface of solid shaft.

For pure shear condition,

$\sigma_1 = \tau_{max}, \quad \sigma_2 = 0, \quad \sigma_3 = -\tau_{max}$

$\varepsilon_1 = \frac{\tau_{max}}{E} - \vartheta \frac{(0 - \tau_{max})}{E} = \frac{1+\vartheta}{E} \tau_{max}$

$\varepsilon_1 \leq \frac{\sigma_y}{E}$

$\frac{1+\vartheta}{E} \tau_{max} \leq \frac{\sigma_y}{E}$

$\tau_{max} = \frac{\sigma_y}{1+\vartheta}$

$R = \sqrt[3]{\frac{2T}{\pi \tau_{max}}} = \sqrt[3]{\frac{2(1+\vartheta)T}{\pi \sigma_{yt}}} = \sqrt[3]{\frac{2.6T}{\pi \sigma_{yt}}}$

(d) Shear strain energy theory

$\sigma_{yt}^2 = \sigma_x^2 + \sigma_y^2 - \sigma_x \sigma_y + 3\tau_{xy}^2$

In pure shear , $\sigma_x = \sigma_y = 0$

$\sigma_{yt}^2 = 3\tau_{xy}^2$

$R = \sqrt[3]{\frac{2T}{\pi \tau_{max}}} = \sqrt[3]{\frac{2\sqrt{3}T}{\pi \sigma_{yt}}}$

Maximum shear stress theory gives us largest diameter of the shaft.

58. Tool signature 0 – 7 – 6 – 8 – 15 – 16 – 0.8

1. Back rake angle (0^0)
2. Side rake angle (7^0)
3. End relief angle (6^0)
4. Side relief angle (8^0)
5. End cutting edge angle (15^0)
6. Side cutting edge angle (16^0)
7. Nose radius (0.8 mm)

66. Reorder point = Safety stock + lead time × consumptions rate.

Reorder point = 50 units + 2 weeks × 65 units per weeks.

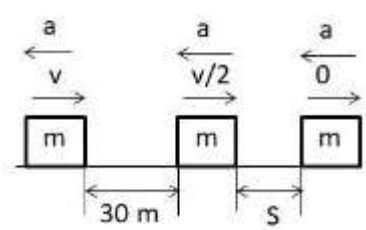
= 180 units

70. Upper control limit in C-chart

UCL = $\bar{C} + 3\sqrt{\bar{C}}$

= 25 + 3 $\sqrt{25}$ = 40

77.



$v^2 = u^2 + 2aS$

Given u = v , v = v/2, S = 30

$\frac{v^2}{4} = v^2 + 60a$

a = - $\frac{v^2}{80}$

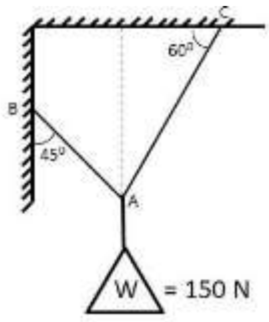
known initial velocity is u = v/2,

When it stop, final velocity v = 0

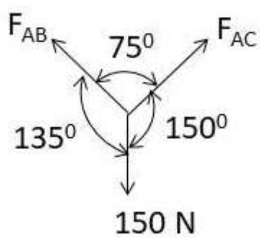
$0^2 = \frac{v^2}{4} - 2\frac{v^2}{80}S$

S = 10 m

78.



Free body diagram at joint A



$$\frac{150}{\sin 75^0} = \frac{F_{AB}}{\sin 150^0}$$
$$F_{AB} = 78 \text{ N}$$

82. $\theta = t^4 + t^2 + 2$

$$\frac{d\theta}{dt} = 4t^3 + 2t$$

t = 2 sec

$\frac{d\theta}{dt} = 4 \times 2^3 + 2 \times 2 = 36$rad/s

84.Mass of bullet = 50 gm

Mass of wooden sphere = 950 gms

Initial velocity of bullet = v m/s.

Let after bullet strike to wooden sphere, common velocity of both bullet and wooden sphere is v_f .

Linear momentum after collision = Linear momentum before collision

$(50 + 950)v_f = 50 \times v$

$v_f = 0.05v$

Take wooden sphere and bullet as a system.

Kinetic energy of after collision is equal to change in potential energy during raising of sphere and bullet.

$\frac{1}{2} \times 1 \times v_f^2 = 1 \times 9.81 \times 0.25$

v_f = 2.214 m/s

velocity of bullet = v_f / 0.05 = 44.28 m/s

86. Initial velocity of a particle u = 0 m/s from 0 to t', particle moves with constant acceleration α.

Velocity after time t' $= u + \alpha t'$

$V(t') = \alpha t'$

From time t' to t, particle moves with constant deceleration β.

$V(t) = 0 = V(t') - \beta(t - t')$

$0 = \alpha t' - \beta(t - t')$

$$t' = \frac{\beta t}{\alpha + \beta}$$

Maximum velocity reaches at t' = $\alpha t' = \frac{\alpha\beta t}{\alpha+\beta}$

1. In ABC analysis the following is not true for 'C' items:
(a) Low consumption value
(b) Low control
(c) Bulk ordering
(d) Accurate forecasting for material planning

2. At the economic order quantity level the following is true:
(a) Procurement cost is not optimum
(b) Holding cost is minimum.
(c) Procement cost is equal to carrying cost
(d) Cost of shortage is minimum.

3. A necessary condition for a queen system to have settled down to steady state is that utilization factor is
(a) = 0.5 (b) = 1
(c) > 1 (d) < 1

4. In an assembly line the cycle time is equal to the
(a) maximum time of all station times
(b) average time of all station times
(c) sum of all station times
(d) time for total work content

5. In linear programming a basic feasible solution
(a) satisfies constraints only.
(b) satisfies constraints and non-negativity restrictions.
(c) satisfies non-negativity restriction only.
(d) optimizes the objective function.

6. Monte Carlo solutions are extremely useful in queuing problems, because
(a) they involve multistage consideration
(b) they can't be analysed mathematically
(c) they verify mathematical results
(d) none of the above

7. Coefficient of variation of a given set of data is obtained from the following formula:
(a) $\sigma \times mean$
(b) $\sigma \div mean$
(c) $\sqrt{\sigma \times mean}$
(d) $\sigma \div mean$
where σ = Standard deviation

8. In reference to value engineering which of the following area is affected by value analysis?
(a) Raw material (b) Profit
(c) Overheads (d) Labour cost

9. The number of pieces inspected per lot is generally greatest in the following sampling plan
(a) single (b) double
(c) multiple (d) none of the above

10. The annual demand for a product costing Rs. 100 per piece is 1600. Ordering cost per order is Rs. 100. The holding cost is Rs. 2 per unit per year. The economic order quantity is
(a) 200 (b) 282
(c) 400 (d) 564

11. Customers arrive at a single window system according to a Poisson input process with a mean rate of 30 per hour. If the time required to serve a customer has an exponential distribution with a mean of 90 seconds, then the average waiting time of a customer will be
(a) 3 min (b) 4 min
(c) 4.5 min (d) 6 min

12. The following is not the characteristics of linear programming problems solved graphically:
(a) The boundaries of the regions are lines or planes.
(b) There are corners on the boundary
(c) The region of feasible solution has concavity property
(d) Objective function is represented by a line or plane for its any fixed value.

13. In a queue if the arrivals follow the Poisson distribution, then the inter arrival time will follow
(a) Possion distribution
(b) Exponential distribution
(c) Normal distribution
(d) None of the above

14. A non-degenerate solution to a linear programming problem with 4 rows and 8 variables would have the following number of basic variables:
(a) 4 (b) 5
(c) 8 (d) 12

15. A simplex is defined as a 'n' dimensional polyhedron with exactly following number of vertices :
(a) n - 1 (b) n
(c) n +1 (d) n + 2

16. The ultrasonic machining uses an oscillator that converts the 50 Hz power supply into high frequency power of the following range :
(a) 2 kHz (b) 5 kHz
(c) 10 kHz (d) 30 kHz

17. The energy responsible to remove metal in EDM process is known as
(a) Electro – mechanical energy
(b) Electro-thermal energy
(c) Electro-magnetic energy
(d) Electro-chemical energy

18. LASER stands for
(a) Light Amplification by Strong Emission of Radiation
(b) Light Amplification by Stimulated Emission of Radiation
(c) Light Amplification by Stimulated Emission of Radiation
(d) Light Amplification by Stimulated Emission of Radioactivity

19. The following is not the characteristic of explosive forming:
(a) Low capital investment
(b) Component formed in one shot
(c) Both die parts –male and female are needed
(d) Large size parts can be formed easily

20. The following is not correct in gauging:
(a) Go end of a plug gauge is longer than no Go end
(b) Go gauges are given tolerance in the tolerance zone
(c) Wear allowance is provided on the Go end of the gauge
(d) Go gauges check the minimum metal conditions

21. In Merchant's analysis in metal cutting assumes that
(a) the deformation zone is a shear zone
(b) rake edge is zero
(c) the tool edge is blunt
(d) the deformation is 3-dimensional

22. The following is not the characteristic of pneumatic comparators :
(a) It is possible to have very large magnification.
(b) The gauging member is not in contact with the part to be measured.
(c) The scale is generally not uniform
(d) It has large number of moving parts.

23. Bushes are provided in drilling jigs
(a) to guide the drill
(b) to provide marking for the hole
(c) to clamp the job
(d) none of the above

24. According to the principles of location in jigs and fixtures, the body gets fixed in space if following number of degrees of freedom are eliminated:
(a) 3 (b) 4
(c) 5 (d) 6

25. In metal cutting shear angle is the angle between shear plane and
(a) tool face (b) job surface
(c) horizontal plane (d) vertical plane

26. Which of the following is NOT the characteristics of USM (Ultra Sonic Machining)?
(a) High machining rate
(b) High accuracy
(c) Good surface finish

27. A standard ground drill has a point angle of
(a) 98^0 (b) 108^0
(c) 128^0 (d) 118^0

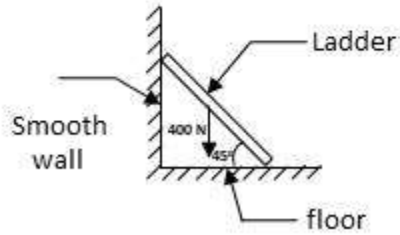
28. In EDM the metal removal rate (M) changes with discharge voltage (V) in the following manner:
(a) $M \propto V$ (b) $M \propto \frac{1}{V}$
(c) $M \propto V^2$ (c) None of the above

29. The following electrolyte is used in electrochemical machining process:
(a) Brine solution (b) Kerosene oil
(c) Transformer oil (d) Air

30. In Taylor's tool life equation $VT^n = C$, the constants n and C depend upon
(a) work piece material and tool material.
(b) tool material and feed
(c) work material and feed
(d) work piece material, tool material and feed

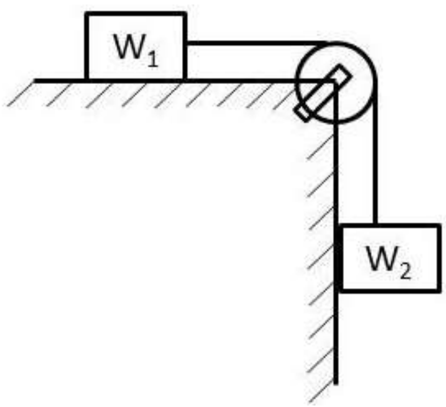
31. Effect of a force on a body depends upon
(a) line of action of force
(b) direction of force
(c) magnitude of force
(d) all of the above

32. A ladder (weight 400 N) leans against a smooth wall as shown below. What is the value as shown below. What is the value of coefficient of friction between the ladder and the floor when ladder is about to slip?



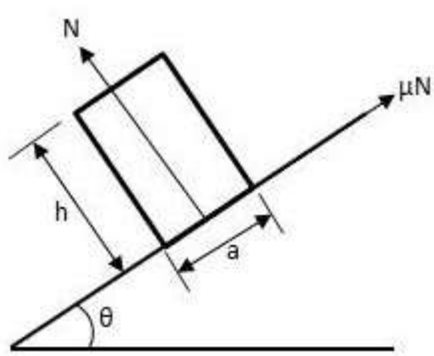
(a) 0.250 (b) 0.500
(c) 0.354 (d) 0.707

33. A weight W_1 on a smooth table is connected by a light cord passing over a smooth pulley to another weight W_2 which is free to move vertically as shown in the figure. The tension in the cord will be



(a) W_1 (b) $W_2 - W_1$
(c) $\frac{W_1W_2}{W_2-W_1}$ (d) $\frac{W_1W_2}{W_1+W_2}$

34. An uniform rectangular block of height 'h' and width 'a' rests on an inclined surface where the coefficient of static friction is μ. If the angle of inclination θ is slowly increased the block will tip over before sliding when



(a) $\mu = ah$ (b) $\mu < \frac{a}{h}$
(c) $\mu > \frac{a}{h}$ (d) $\mu < \frac{h}{a}$

35. A rope having a weight of 600 N and 15 m free length hangs from a drum. The work done in winding up the rope will be
(a) 40 Joules (b) 4500 Joules
(c) 9000 Joules (d) 13500 Joules

36. A stone is thrown vertically up with a velocity of 19.6 m/s. The time taken to attain maximum height is
(a) 1 s (b) 2 s
(c) 3 s (d) 9.8 s

37. A hammer of mass 1000 kg drops from a height of 60 cm on a pile of mass 500 kg. If the pile comes to rest after penetrating 5 cm into the ground, then the loss of potential energy of the system will be
(a) 245.25 Nm (b) 735.75 Nm
(c) 3922.776 Nm (d) 4658.526 Nm

38. On a horizontal ground of a projectile is fired at an angle α with the horizontal with an initial velocity of 'u', then the time of flight is equal to
(a) $\frac{u \sin\alpha}{g}$ (b) $\frac{u \cos\alpha}{g}$
(c) $\frac{2u \sin\alpha}{g}$ (d) $\frac{2u \cos\alpha}{g}$

39. A car with a speed V m/s can be stopped in a minimum distance **x** when brakes are applied. If the speed become nV, then the minimum distance over which the car can be stopped with brakes will be
(a) **x/n** (b) nx
(c) n^2x (d) x/n^2

40. A lift carries a weight of 1 kN and is moving with a uniform acceleration of 2.4m/s^2. If the lift is moving upwards, then the tension in the cables supporting lift will be
(a) 1244.9 N (b) 755.1 N
(c) 1211.3 N (d) 1745.3 N

41. Which of the following motion of cam roller-follower leads to the lowest jerk?
(a) Uniform (b) Simple harmonic
(c) Cycloidal (d) Parabolic

42. A simple spring mass vibrating system has a natural frequency N. If the spring stiffness is halved and the mass is doubled, then the natural frequency will become

(a) $\frac{N}{2}$ (b) 2 N

(c) 4 N (d) 8 N

43. Corioli's component acceleration exists whenever a point moves along a path that has

(a) rotational motion

(b) linear displacement

(c) tangential displacement

(d) centripetal acceleration

44. In a belt drive, if the pulley diameter is doubled keeping the tension and belt width constant then it will be necessary to

(a) increase the key length

(b) increase the key depth

(c) increase the key width

(d) none of the above

45. Cam size depends upon

(a) base circle radius

(b) pitch circle radius

(c) prime circle radius

(d) dwell angle

46. The kinetic chain having N links will have the following number of inversions:

(a) N – 3 (b) N -2

(c) N -1 (d) N

47. The point on the cam with maximum pressure angle is called

(a) pitch point (b) trace point

(c) cam centre (d) None of the above

48. If the ball masses of a governor have same speed for all radii of rotation, it is said to be

(a) stable (b) hunting

(c) isochronous (d) sensitive

49. For a small centre distance which of the following power transmission method gives constant velocity ratio?

(a) Gear drive (b) Chain drive

(c) Rope drive (d) All of the above

50. When the axes of first gear and last gear of compound gear train are coaxial, then gear train is called

(a) epicyclic gear train

(b) reverted gear train

(c) simple gear train

(d) none of the above

51. A rigid link AB of length '$2l$' rotates about the fixed point A with constant angular velocity ω. The acceleration of point B will be

(a) zero

(b) $2l\omega^2$, directed along perpendicular to AB

(c) $l\omega^2$, directed along BA

(d) $2l\omega^2$, directed along BA

52. Static balancing is satisfactory for low speed rotors but with increasing speeds, dynamic balancing becomes necessary because

(a) the unbalanced couples are caused only at higher speeds.

(b) the effect of unbalances are proportional to the speed.

(c) the effect of unbalances are proportional to the square of the speed.

(d) none of the above.

53. A flywheel is fitted to the crank shaft of an engine having indicated work per revolution E. If the permissible limits of the coefficeints of fluctuation of energy and speed are K_e and K_s respectively, then the kinetic energy of the flywheel is equal to

(a) $\frac{2K_eE}{K_s}$ (b) $\frac{K_eE}{2K_s}$

(c) $\frac{K_eE}{K_s}$ (d) $\frac{K_sE}{2K_e}$

54. The unbalanced force due to reciprocating parts of the single cylinder engine

(a) can be balanced completely

(b) cannot be balanced partially

(c) can be balanced partially

(d) None of the above

55. In a forced vibration system for what value of frequency ratio $\left(\frac{\omega_r}{\omega_n}\right)$ the transmissibility is same for all values of damping factors?

(a) 1 (b) 2

(c) $\sqrt{2}$ (d) $\frac{1}{2}$

56. Clutch is used between the prime mover and the driver machinery to

(a) enable on load starting

(b) protect the prime mover from over loading

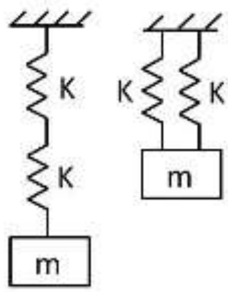
(c) enable the driven machinery accelerate properly.

(d) enable frequent engagement and disengagement between the two units.

57. Self locking shoe brakes are useful for
(a) automobiles
(b) elevators
(c) mine haulage drum shafts
(d) bicycles

58. The function of absorption type dynamometer is
(a) to absorb the heat production in braking action.
(b) to measure the power of a prime mover by absorbing and transforming the available energy.
(c) to measure the power transmitted by a prime mover without causing any interruption.
(d) to measure the power transmitted by a prime mover without causing any interruption.

59. Two identical springs of constant K are connected in series and parallel as shown in the figure. A mass m is suspendend from them. The ratio of their frequencies of oscillations will be



60. In which of the following teeth profile the phenomenon of interference of interference does not occur at all?
(a) Cycloidal (b) Involute
(c) Spiral (d) Spiral

61. Principal stresses at a point in plane stressed element are $\sigma_x = \sigma_y = 50$ N/cm^2. Normal stress on the plane inclined at 45^0 to the X-axis will be
(a) 0 (b) 50 N/cm^2
(c) 70.7 N/cm^2 (d) 100 N/cm^2

62. An elastic material which does not obeyb Hooke's law is called
(a) non –linearly elastic material
(b) plastic material
(c) anisotropic material
(d) none of the above

63. The maximum shear stress in Mohr's circle is equal to
(a) chord of circle
(b) radius of circle
(c) diameter of circle
(d) one fourth diameter of circle

64. Strain rosettes are used to
(a) produce strains for testing purposes.
(b) relieve strain in heavily loaded components
(c) measure strain
(d) analyse property of materials

65. The maximum stress developed in a cantilever of 1 cm square cross-section and 1 m long with a load of 100 N at the free end will be
(a) 10 N/cm^2 (b) 600 N/cm^2
(c) 1000 N/cm^2 (d) 60 kN/cm^2

66. In a homogenous, isotropic elastic material, the modulus of elasticity E in terms of G and K is equal to
(a) $\frac{G+3K}{9KG}$ (b) $\frac{3G+K}{9KG}$
(c) $\frac{9KG}{G+3K}$ (d) $\frac{9KG}{3G+K}$
Where G is modulus of rigidity and K is bulk modulus.

67. The equivalent length of a column supported firmly at both ends is (l = length of column)
(a) 0.5 l (b) 0.707 l
(c) l (d) 2 l

68. The strain energy stored per unit volume in a solid shaft under torsional stress τ is equal to
(a) $\tau^2/4G$ (b) $\tau^2/16G$
(c) $5\tau^2/16G$ (d) $7\tau^2/16G$
where G = modulus of rigidity

69. A thick cylinder is subjected to an internal pressure of 60 MPa. If the hoop stress on the outer surface is 150 MPa, then the hoop stress on the internal surface is
(a) 105 MPa (b) 180 MPa
(c) 210 MPa (d) 330 MPa

70. In a thick cylinder subjected to internal pressure p, the radial stress at the outer surface is
(a) zero (b) p
(c) – p (d) 2p

71. The ratio of the maximum shear stress developed in a beam of rectangular section and the average shear stress is equal to
(a) 1 (b) $\frac{4}{3}$
(c) $\frac{3}{2}$ (d) None of the above

72. The distance of the neutral axis from the centroid for a curved beam of large curvature depends upon
(a) bending moment and initial curvature of the beam.
(b) bending moment and initial curvature of the neutral surface.
(c) initial curvature and shape of the section of the beam.
(d) initial curvature and depth of the section.

73. A cantilever beam is defined by a load applied at its free end. If the length of the beam is doubled, then the deflection compared to earlier case will be changed by a factor of
(a) $\frac{1}{8}$ (b) $\frac{1}{2}$
(c) 2 (d) 8

74. The buckling load will be maximum for a column if
(a) One end is clamped and the outer is free.
(b) both ends are clamped
(c) both ends are hinged
(d) one is clamped and the other is hinged

75. If the cross-section of a member is subjected to a uniform shear stress of intensity 'τ', then the strain energy stored per unit volume is equal to
(a) $\frac{\tau^2}{2G}$ (b) $\frac{\tau^2}{G}$
(c) $\frac{\tau}{G^2}$ (d) $\frac{\tau^2}{G^2}$
where G is moduls of rigidity.

76. The distribution of stress along a section of curved bar subjected to a bending moment tending to increase its curvature is
(a) linear (b) uniform
(c) parabolic (d) hyperbolic

77. A solid shaft of diameter 16 mm is subjected to a twisting moment of 256×10^{-3} Nm. The maximum shearing stress produced is
(a) 2π N/mm^2 (b) π N/mm^2
(c) $\frac{1}{\pi}$N/mm^2 (d) $\frac{1}{2\pi}$N/mm^2

78. The torsional rigidity of a shaft is equal to
(a) I_p/G (b) $I_p \times G$
(c) $\frac{G}{I_p}$ (d) G × Z
where I_P = polar moment of inertia.
G = modulus of rigidity.
Z = section modulus

79. A tower is to be designed to have same compressive stress at all sections under a load and its own weight. Its cross-section should be of the shape
(a) uniform (b) taper
(c) parabolic (d) none of the above

80. In the analysis of a cylinder using thick cylinder formulae to thickness of the cylinder is
(a) greater than or equal to 20
(b) greater than or equal to 30
(c) less than 20
(d) none of the above

81. The crystal structure of the following material is not FCC :
(a) Tungsten (b) Copper
(c) Aluminium (d) Nickel

82. Highest electrical resitivity exists in
(a) platinum wire
(b) nichrome wire
(c) silver wire
(d) kanthal wire

83. The residual magnetic flux density is more in
(a) metallic magnets (b) ceramic magnets
(c) graphite (d) iron

84. The crystal structure of most of the common metals is
(a) cubic (b) rhombohedral
(c) tetragonal (d) triclinic

85. The imperfection in the crystal structure of metal is called
(a) slip (b) dislocation
(c) cleavage (d) impurity

86. The crystal structure of brass is
(a) BCC (b) FCC
(c) HCP (d) None of the above

87. Super conduction in metals is observed in the following temperature range :
(a) below 10 K (b) around 10 ^{0}C
(c) above 100 K (d) around 100 ^{0}C

88. The elastic stress strain behavior or rubber is
(a) linear (b) non-linear
(c) unpredictable (d) none of the above

89. As the temperature increases
(a) fatigue life and fatigue limit decrease
(b) fatigue life increases but fatigue limit decreases
(c) both increase
(d) none is affected

90. Slow plastic deformation of metals under steady load is known as
(a) fatigue (b) creep
(c) endurance (d) strain hardening

91. The ductile brittle transition temperature for a material increases
(a) by making the grain coarser
(b) by removing sharp notches from it
(c) by using low strain rate
(d) none of the above

92. Polymers can be strengthened by
(a) non-crystallising them
(b) avoiding cross linking.
(c) chain stiffening through hanging of bulky group of atoms.
(d) heat treating

93. The number of atoms per unit cell in a BCC structure is
(a) 2 (b) 4
(c) 9 (d) Infinite

94. The measure of energy required to break a material is called
(a) ductility (b) brittleness
(c) hardness (d) toughness

95. In tensile tests conventional stress strain curves at rupture
(a) same stress value
(b) higher stress value
(c) lower stress value
(d) higer stress value upto elastic limit

96. The term value in value engineering refers to
(a) total cost (b) utility of the product
(c) selling price (d) depreciated value

97. ABC analysis deals with
(a) Controlling inventory costs
(b) Analysis of process chart
(c) Flow of material
(d) Ordering schedule of job

98. Upper control limit on the C-chart is equal to
(a) $2\bar{C} + \sqrt{\bar{C}}$
(b) $\bar{C} + 3\sqrt{\bar{C}}$
(c) $3\left(\bar{C} + \sqrt{\bar{C}}\right)$
(d) $2\bar{C} + 3\sqrt{(1+\bar{C})}$

99. Which statement is not correct in single sampling plan ?
(a) Acceptance number need not be zero.
(b) No sampling plan can give complete protection against the acceptance of defective product.
(c) Fixed sample size tends toward constant quality protection.
(d) Sampling plans with same (percent) samples give same quality protection.

100. In a 'C' chart the value of C is 36. the upper control limit of the chart is equal to
(a) 114 (b) 126
(c) 90 (d) 54

ANSWER

1 (d)	21 (a)	41 (c)	61 (b)	81 (a)
2 (c)	22 (b)	42 (a)	62 (a)	82 (d)
3 (d)	23 (a)	43 (a)	63 (b)	83 (d)
4 (d)	24 (d)	44 (c)	64 (c)	84 (a)
5 (b)	25 (b)	45 (a)	65 (d)	85 (b)
6 (b)	26 (a)	46 (d)	66 (c)	86 (b)
7 (b)	27 (d)	47 (a)	67 (a)	87 (a)
8 (b)	28 (c)	48 (c)	68 (a)	88 (b)
9 (a)	29 (a)	49 (a)	69 (c)	89 (c)
10 (c)	30 (d)	50 (b)	70 (a)	90 (b)
11 (c)	31 (d)	51 (d)	71 (c)	91 (a)
12 (c)	32 (b)	52 (c)	72 (c)	92 (c)
13 (b)	33 (d)	53 (b)	73 (d)	93 (a)
14 (a)	34 (c)	54 (c)	74 (b)	94 (d)
15 (b)	35 (b)	55 (c)	75 (a)	95 (c)
16 (d)	36 (b)	56 (d)	76 (d)	96 (b)
17 (b	37 (c)	57 (b)	77 (c)	97 (a)
18 (b)	38 (c)	58 (c)	78 (b)	98 (b)
19 (c)	39 (c)	59 (b)	79 (c)	99 (a)
20 (d)	40 (a)	60 (a)	80 (a)	100 (d)

1. ABC analysis (Always Better Control analysis)
% of items % Value

A – 10 %   A – 70%
B – 20%   B – 20%
C – 70%   C – 10%

C-items

- Low consumption value
- Low control
- Bulk ordering

2. Economic order quantity

Total Cost = Ordering cost + Inventory cost

Let D is annual demand of a unit. Q is order quantity.

No. of orders = $\frac{Demand}{Quantity\ order}$

$N = \frac{D}{Q}$

Ordering cost = No. of order × Cost per order

$= \frac{D}{Q} \times C_0$

Inventory cost = $\frac{Q}{2} \times C_h$ (C_h = holding cost)

Total Cost (T.C)= $\frac{D}{Q} \times C_0 + \frac{Q}{2} \times C_h$

To minimize total cost, $\frac{d(T.C.)}{dQ} = 0$

$$\frac{d(T.C.)}{dQ} = -\frac{D}{Q^2}C_0 + \frac{C_h}{2} = 0$$

$$\frac{C_h}{2} = \frac{D}{Q^2}C_0$$

$$\frac{Q\,C_h}{2} = \frac{D}{Q}C_0$$

Inventory cost = Ordering cost (Procurement cost)

3. Queuing theory

Utilisation factor = $\frac{Average\ arrival\ rate\ (\lambda)}{Average\ service\ rate\ (\mu)}$

- The mean service rate is higher than the arrival rate ($\mu > \lambda$)

Utilisation factor < 1

5. Linear programming

A basic feasible solution: All such solutions which satisfy given constraints and all variables are non-negative variable.

10. Economic Order Quantity (EOQ)

$$Q = \sqrt{\frac{2C_0D}{C_h}}$$

C_0 → Ordering cost
D → Demand
C_h → Holding cost

Demand D = 1600 units

Ordering cost C_0 = Rs. 100

Holding cost C_h = Rs. 2

$$Q = \sqrt{\frac{2 \times 100 \times 1600}{2}} = 400 \text{ units}$$

11. Average waiting time in the queue

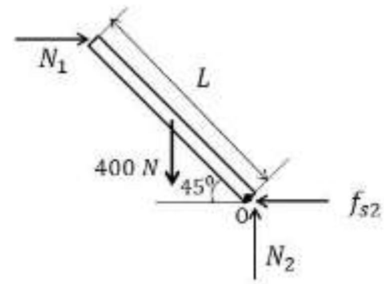
$$W_q = \frac{\lambda}{\mu(\mu - \lambda)}$$

λ → Arrival rate
μ → Service rate
λ = 30 person per hour
μ = 1 person per 90 sec
= 40 persons per hr

$$W_q = \frac{30}{40(40-30)} = \frac{3}{40}\,hr = \frac{3}{40} \times 60 \text{ min}$$

= 4.5 min

32.



$N_2 = 400\,N$ - - - - - (1)

$N_1 = f_{s2}$ - - - - - - - -(2)

$$\sum M_o = N_1\frac{L}{\sqrt{2}} - 400\frac{L}{2\sqrt{2}} = 0$$

N_1 = 200 N

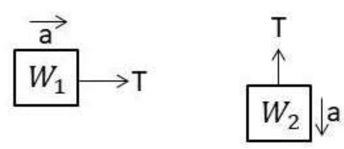
$f_{s2} = 200\,N$ (By Equation - 2)

At limiting conditions, $f_{s2} = \mu N_2 = 200\,N$

$\mu \times 400 = 200\,N$

$\mu = 0.5$

33.



$\frac{W_1}{g}a = T$ - - - - - - - - - - - (1)

$\frac{W_2}{g}a = \frac{W_2}{g}g - T$ - - - - - - (2)

$$\frac{W_2}{g}a = \frac{W_2}{g}g - \frac{W_1}{g}a$$

$$a = \frac{W_2}{W_1+W_2}g$$

$$T = \frac{W_1W_2}{W_1+W_2}$$

35. $W = mgh_{C.G}$

$= 600 \times \frac{15}{2}$ = 4500 Joules

36. Initial velocity u = 19.6 m/s,

At maximum height velocity v = 0 m/s

v = u + at

0 = 19.6 − 9.8 t

$t = 2$ sec

38. $y = u_y t - \frac{1}{2}gt^2$

At time of flight T , y = 0

$0 = u_y t - \frac{1}{2}gt^2$

$t = \frac{2u_y}{g} = \frac{2u \sin\alpha}{g}$

39. $v^2 = u^2 + 2ax$

v = 0

$0 = v^2 + 2ax$

$a = -\frac{v^2}{2x}$

u = nV

$0 = n^2V^2 - 2\frac{V^2}{2x}x'$

$x' = n^2x$

40. $ma = T - mg$

$T = m(a + g)$

$T = \frac{10^3}{9.8}(2.4 + 9.8)$

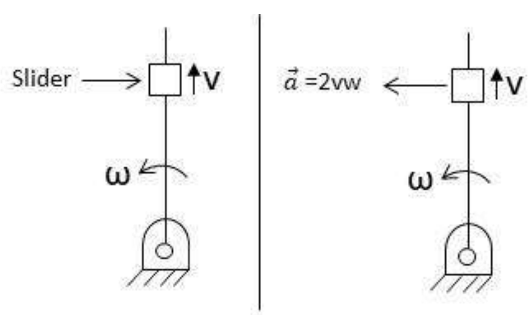
$T = 1244.9$ N

42. $\omega = \sqrt{\frac{k}{m}}$

$m' = 2m$, $k' = k/2$

$\omega' = \sqrt{\frac{k/2}{2m}} = \frac{1}{2}\sqrt{\frac{k}{m}} = \frac{\omega}{2}$

43.



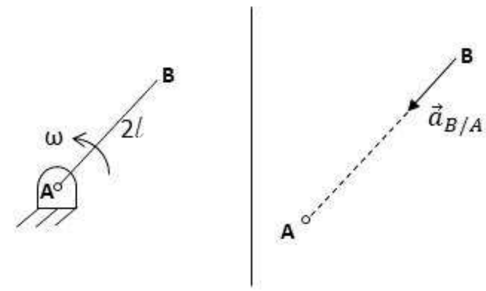
Slider moves along rotating link. Coriolis acceleration act on slider.

46. If number of link on kinematic chain is N. Number of inversion is equal to number of link on kinematic chain.

49. For power transmission for a small centre distance, gear drive is used.

50. When the axes of first gear and last gear of compound gear train are coaxial, the gear train is called reverted gear train.

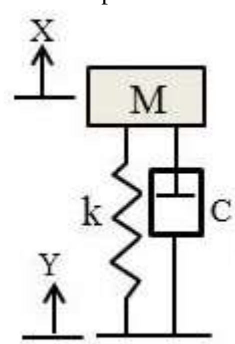
51.



Acceleration of point B with respect to point A

$\vec{a}_{B/A} = (2l)\omega^2 along\ B\ to\ A$

55. Base excitation problem



EOM: $M\ddot{X} = -K(X - Y) - C(\dot{X} - \dot{Y})$

$M\ddot{X} + C\dot{X} + +KX = KY + C\dot{Y}$

For harmonic base excitation: Y = $Y_0 \sin\omega t$

$M\ddot{X} + C\dot{X} + +KX = KY_0 \sin\omega t + C\omega\cos\omega t$

Transmissibility ratio is defined as ratio of magnitude of maximum displacement of mass M and magnitude of maximum displacement of base.

TR = $\frac{X_0}{Y_0} = \frac{\sqrt{K^2+(C\omega)^2}}{\sqrt{(K-M\omega^2)^2+(C\omega)^2}}$

if $K - M\omega^2 = -K$ then TR is equal to one for all value of frequency ratio (ω/ω_n)

$2K = M\omega^2$

$\frac{\omega^2}{\frac{K}{M}} = \frac{\omega^2}{\omega_n^2} = 2$

$\frac{\omega}{\omega_n} = \sqrt{2}$

59. Spring connected in series:

Equivalent stiffness

$\frac{1}{k_e} = \frac{1}{k_1} + \frac{1}{k_2}$

$k_e = \frac{k_1 k_2}{k_1 + k_2}$ (if $k_1 = k_2$)

$k_e = \frac{k}{2}$

Spring connected in parallel:

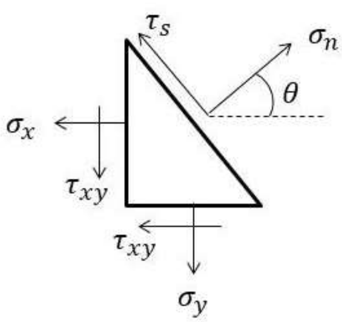
Equivalent stiffness

$k_e = k_1 + k_2 = 2k$

$\frac{\omega_{series}}{\omega_{parallel}} = \sqrt{\frac{\frac{k}{2}}{2k}} = \frac{1}{2}$

60. Interference occur in involute profile. In cyclodial profile interference does not occur at all.

61.



$\sigma_x = \sigma_y = 50$ N/cm^2 and $\tau_{xy} = 0$

Shear stress at a plane make an angle of 45^0 from x-axis

$\tau_{\theta = 45^0} = \frac{\sigma_y - \sigma_x}{2} \sin 2\theta + \tau_{xy} \cos 2\theta$

$\tau_{\theta = 45^0} = \frac{50-50}{2} \sin 90^0 + 0 \cos 90^0 = 0$

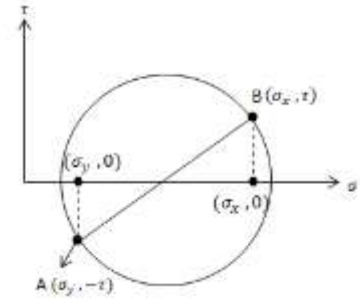
Normal stress at a plane make an angle of 45^0 from x-axis

$\sigma_n = \frac{\sigma_x + \sigma_y}{2} + \frac{1}{2}(\sigma_x - \sigma_y) \cos 2\theta + \tau_{xy} \sin 2\theta$

$\sigma_n = \frac{50+50}{2} + \frac{50-50}{2} \cos 90^0 + 0 \sin 90^0$

$= 50$ N/cm^2

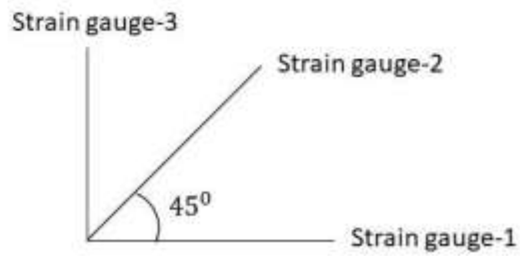
63. Mohr circle for 2-D stress condition,



Maximum shear stress is radius of Mohr's circle,

$$\tau_{max} = \frac{AB}{2} = \frac{\sqrt{(\sigma_x - \sigma_y)^2 + (\tau + \tau)^2}}{2}$$

64. Strain rosettes are used to measure strain at the surface of a body.



Strain gauge-1 measure strain along x –axis.

Strain gauge-2 measure strain in direction of 45^0 from x-axis.

Strain gauge-3 measure strain along y-axis.

65. $\sigma_{max} = \frac{M \times y_{max}}{I} = \frac{100\,N \times 1\,m \times \frac{1}{2} \times \frac{1}{100}\,m}{\frac{1\,cm^2 \times 1\,cm^2}{2}}$

$\sigma_{max} = 6 \times 10^4$ N/cm^2

67. Critical buckling load of fixed-fixed end

$$P_{cr} = \frac{4\pi^2 EI}{L^2}$$

Effective length $L_e = \frac{L}{2}$

69. Thick cylinder

Internal pressure $P_i = 60$ MPa

External pressure $P_0 = 0$ MPa

Radial stress at inner surface

$\sigma_{r,i} = -P_i = -60$ MPa

Radial stress at outer surface

$\sigma_{r,o} = -P_o = 0$ MPa

Hoop stress at outer surface

$\sigma_{\theta,o} = 150$ MPa

For thick cylinder

$\sigma_r + \sigma_\theta =$ Constant

$\sigma_{r,i} + \sigma_{\theta,i} = \sigma_{r,o} + \sigma_{\theta,o}$

$$-60 + \sigma_{\theta,i} = 0 + 150$$
$$\sigma_{\theta,i} = 210 \text{ MPa}$$

70. If a thick cylinder subjected to internal pressure p, then radius stress at outer surface is equal to zero.

$\sigma_{r,o} = -P_0$

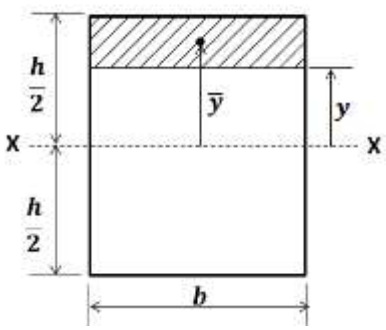
P_0 → outer surface pressure

$\sigma_{r,o}$ → radial stress at outer surface

If outer pressure is equal to zero.

$\sigma_{r,o} = 0$

71.



First moment of shaded area about XX

$Q = A x \bar{y}$

A→ Area of shaded region

$\bar{y}$ → Centroid of shaded region

$$A = \left(\frac{h}{2} - y\right) b$$
$$\bar{y} = y + \frac{h}{4} - \frac{y}{2} = \frac{h + 2y}{4}$$
$$Q = b\left(\frac{h}{2} - y\right)\left(\frac{h + 2y}{4}\right)$$
$$= \frac{b(h - 2y)(h + 2y)}{8} = \frac{b(h^2 - 4y^2)}{8}$$

Area moment about xx

$$I_{xx} = \frac{bh^3}{12}$$

Shear stress at distance y form neutral axis

$$\tau = \frac{VQ}{Ib} = \frac{V\frac{b(h^2-4y^2)}{8}}{\frac{bh^3}{12}b} = \frac{3V}{2bh}\left(1 - 4\left(\frac{y}{h}\right)^2\right)$$
$$\tau = \frac{3V}{2A}\left(1 - 4\left(\frac{y}{h}\right)^2\right)$$

Maximum shear stress occurs at y =0

$$\tau_{max} = \frac{3V}{2A}$$

Average shear stress

$$\tau_{avg} = \frac{\text{Shearforce}}{\text{Area}} = \frac{V}{A}$$
$$\tau_{max} = \frac{3}{2}\tau_{avg}$$

73. If a beam is subjected to a load P at free end then deflection at free end.

$$\delta_{\text{free end}} = \frac{PL^3}{3EI}$$

If length of beam is doubled

$$\delta' = \frac{8PL^3}{3EI} = 8\delta$$

74. Critical buckling load

(a) Both ends fixed: $P_{cr} = \frac{4\pi^2 EI}{L^2}$

(b) One end is fixed and other is free: $P_{cr} = \frac{\pi^2 EI}{4L^2}$

(c) Both end is hinged: $P_{cr} = \frac{\pi^2 EI}{L^2}$

77. Maximum shear stress

$$\tau_{max} = \frac{T \times R}{J}$$

Polar moment of inertia

$$J = \frac{\pi R^4}{2}$$
$$\tau_{max} = \frac{2T}{\pi R^3} = \frac{2 \times 256 \times 10^{-3}}{\pi \times (8\times10^{-3})^3} = \frac{1}{\pi} \text{ N/mm}^2$$

100. $UCL_L = \bar{C} + 3\sqrt{\bar{C}}$

$= 36 + 3\sqrt{36} = 54$

1. Whitworth quick return mechanism is obtained by inversion of
(a) slider crank mechanism
(b) kinematic chain
(c) five link mechanism
(d) roller cam mechanism

2. Dielectric strength is :
(a) the magnitude of electric field necessary to cause significant current passage through a dielectric material
(b) shock load which a dielectric material can bear
(c) maximum temperature upto which a dielectric material does not melt
(d) maximum current which can pass through a dielectric

3. The relationship between stress and strain for a linearly elastic, isotropic and homogenous material can be expressed with the help of the following independent constant :
(a) two (b) three
(c) six (d) nine

4. When a body, acted upon by several forces, is in rotational equilibrium, the sum of clockwise moments of the forces about any point is equal to the sum of anticlockwise moments of the forces about the same point. The above statement is called
(a) D' Alembert's principle
(b) Principle of moments
(c) Theorem of parallel axes
(d) Theorem of perpendicular axis

5. The tool life is said to be over if:
(a) a poor surface finish is obtained
(b) sudden increase in power and cutting force with chattering takes place
(c) overheating and fuming due to friction start
(d) all the above

6. A car and reciprocating follower mechanism can be represented by an equivalent:
(a) slider crank mechanism
(b) quick return motion mechanism
(c) rack and pinion system
(d) nut and bolt system

7. The escape velocity of a body on earth
(a) increases with the increase of its mass
(b) decreases with the increase of its mass
(c) remains unchanged with variation of its mass
(d) varies as the square of the change in mass

8. It is proposed to study the numbers of missing rivets at aircraft final inspection. The control chart to be used is:
(a) 'p' chart
(b) 'c' chart
(c) 'R' chart
(d) 'σ' chart

9. If two bodies, one light and other heavy, have equal kinetic energy, which one has a greater momentum?
(a) the heavy body
(b) the lighter body
(c) both have equal momentum
(d) unpredictable

10. The number of effective atoms per unit cell in FCC structure is:
(a) one (b) four
(c) six (d) two

11. ABC analysis deals with:
(a) analysis of process chart
(b) flow of material
(c) controlling inventory costs
(d) ordering schedule of job

12. The area under stress-strain curve in tensile loading gives the magnitude of:
(a) proportional limit
(b) yield point
(c) toughness property
(d) creep strength

13. Motion of an edge dislocation on a plane perpendicular to the glide plane is known as :
(a) cross slip (b) vacany diffusion
(c) climb motion (d) creep

14. The ratio of the length of a column to the minimum radius of gyration of the cross sectional area of the column is known as:
(a) slenderness ratio
(b) buckling factor
(c) compression factor
(d) column factor

15. The following statements are in reference to friction force.
(a) it is independent of the area of contact.

(b) It is dependent on the materials in contact.
(c) It is directly proportional to the normal force.
(d) It is dependent on the sliding velocity.
Of these statements:
(a) (i), (ii) and (iii) are correct
(b) (ii), (iii) and (iv) are correct
(c) (i), (iii) and (iv) are correct
(d) (i), (ii) , (iii) and (iv) are correct

16. Actual breaking stress for brittle materials is much lower than the theorectical cohesive strength because:
(a) tiny cracks exists into the mass of the materials
(b) foreign atoms are present into the mass of these materials
(c) very large number of dislocations are present
(d) None of the above

17. Undercutting in involute teeth is undesirable because:
(a) strength of gear tooth is reduced
(b) appearance of gear tooth is spoiled
(c) minimum number of teeth required on pinion will increase
(d) interference will increase

18. Simply supported beams of steel, cast iron, concrete and timber are subjected to uniromly distributed load of same intensity over their entire span. The span lengths and cross sectional dimensions are also the same. The deflection will be minimum in:
(a) steel beam (b) timber beam
(c) cast iron beam (d) concrete beam

19. In EDM, the metal removal rate (M) changes with discharge voltage (V) in the following manner:
(a) $M \, \alpha \, V$ (b) $M \, \alpha \, \frac{1}{V}$
(c) $M \, \alpha \, V^2$ (d) $M \, \alpha \, V^3$

20. Purpose of governors in internal combustion engines is to :
(a) eliminate speed fluctuations
(b) regulate fuel supply to the engine
(c) replace the flywheel
(d) provide smooth output torque

21. At the economic order quantity level, the following is true:
(a) procurement cost is minimum
(b) holding cost is minimum
(c) procurement cost is equal to carrying cost
(d) cost of shortage is minimum

22. Work sampling observations are taken on the basis of :
(a) convience (b) random numbers
(c) fixed intervals (d) fixed timings

23. The velocity ratio of two pulley connected by an open belt or cross belt is:
(a) directly proportional to their diameter
(b) inversely proportional to the diameter
(c) directly proportional to the square of their diameter
(d) inversely proportional to the square of their diameter

24. The bucking load will be maximum for a column, if:
(a) one end is clamped and the other is free
(b) both ends are clamped
(c) both ends are hinged
(d) on end is clamped and the other is hinged

25. In a Mohr's circle, the maximum shear stress is:
(a) equal to the radius of the Mohr's circle
(b) larger than the radius of Mohr's circle
(c) less than the radius of Mohr's circle
(d) equal to the diameter of the Mohr's circle

26. Which one of the following remains constant during the flight of projectile?
(a) horizontal component of velocity
(b) momentum
(c) vertical component of velocity
(d) sum of its kinetic energy and potential energy

27. Machinability tends to decrease with
(a) increase in hardness and increase in tensile strength
(b) increase in strain hardening tendencies
(c) increase in carbon content, hard oxides, and carbides
(d) decrease in grain size

28. In the analysis of a cylinder, the formulae for thick cylinders are used when the ratio of the inner diameter to the thickness of the cylinder is
(a) larger than or equal to 20
(b) less than 20
(c) larger than or equal to 30

(d) none of the above

29. The stress in true stress-strain curves is applied load divided by:
(a) initial cross sectional area
(b) instantaneous cross sectional area
(c) least cross sectional area formed for all values
(d) none of the above

30. A heavy string is attached at two ends at the same horizontal level. If the central deflection is very small, it approaches the following curve:
(a) catenary
(b) parabola
(c) hyperbola
(d) elliptical

31. For a kinematic chain of n links, total number of possible inversions are:
(a) n +1 (b) $\frac{n(n-1)}{2}$
(c) n (d) n^2

32. In simple harmonic motion, we have conservation of :
(a) kinetic energy
(b) potential energy
(c) momentum
(d) total energy

33. The motion of piston in a slider crank mechanism is nearer to simple harmonic motion if the ratio between the length of connecting rod and crank is :
(a) unity (b) small
(c) large (d) very large

34. In order to avoid whirling of a shaft, it must run at :
(a) a speed equal to its one of the natural frequencies of vibration
(b) some multiple of its one of the natural frequencies of vibration
(c) a speed much below or much higher than its any one of the natural frequencies of vibration
(d) moderate speeds with sufficient number of supports along its length

35. A ball is dropped vertically downwards from the top of a building, and another one is thrown horizontally. Which will strike the ground first?
(a) one dropped vertically
(b) one thrown horizontally
(c) both will strike simultaneously
(d) it will depend on their mass

36. A partially filled tank is being carried on a truck moving with constant acceleration. The water level of free surface in the tank:
(a) will remain horizontal
(b) will move up in front and down at the back
(c) move up in back and move down in the front
(d) fluctuate

37. 'Product control' refers to the schemes for evaluating the quality of:
(a) incoming material
(b) outgoing product
(c) inprocess product
(d) purchased product

38. Value engineering determine:
(a) selling price
(b) depreciated value
(c) major function of an item and to accomplish the same at the least cost without change in quality
(d) resale value

39. In an assembly line, the cycle time is equal to the:
(a) minimum time of all stations
(b) average time of all stations
(c) time for total work content
(d) sum of all station times

40. Materials exhibiting time bound behavior are known as:
(a) inelastic (b) viscoelastic
(c) isentropic (d) resilient

41. Plasticisers are:
(a) low molecular weight polymer additives which increase flexibility
(b) high molecular weight polymers which decrease flexibility
(c) all polymers
(d) metals undergoing plastic deformation

42. A rubber ball is dropped from a height of 2 meters. To what height will it rise if there is no loss of velocity after rebounding?
(a) 4 meters (b) 3 meters
(c) 2 meters (d) 1 meter

43. Coriolis component of acceleration is always:

(a) parallel to link
(b) perpendicular to link
(c) radially outward along link
(d) coincident with the axis of link

44. The motion transmitted between the teeth of gears in mesh will be:
(a) sliding
(b) rolling
(c) rotational
(d) partly sliding and partly rolling

45. Advantage of laser beam machining is that:
(a) there is no contact between tool and work piece
(b) laser beam can be sent to longer distances without diffraction
(c) heat treated and magnetic particles can be welded without losing their properties
(d) all the above

46. Which of the following properties of a solid are dependent on crystal in imperfections?
(a) yield stress
(b) melting point
(c) semiconductivity
(d) ductility
Select the answer using the codes given below:
(a) (i) and (iii)
(b) (i), (iii) and (iv)
(c) (ii), (iii), and (iv)
(d) (ii) and (iv)

47. A stone is whirled in a vertical circle. The tension in the string is largest:
(a) When the string is horizontal
(b) When the stone is at the lowest position
(c) When the stone is at the lowest position
(d) At all positions

48. Which of the following constituents of steel is the most soft and the least strong?
(a) austenite (b) pearlite
(c) ferrite (d) cementite

49. In determining the stresses in frames by method of sections, the frame is divided into two parts by an imaginary section drawn in such a way so as not to cut more than:
(a) two members with unknown forces of the frame
(b) three members with unknown forces of the frame
(c) four members with unknown forces of the frame
(d) three members with known forces of the frame

50. Deformation in plastics occurs by:
(a) twin (b) slip
(c) yield (d) cross linking

51. For satisfactory transmission of motion between two mating gears, it is necessary that the two gears should have:
(a) same module
(b) same pitch circle diameter
(c) same number of teeth
(d) same face width

52. Which of the following forces is neglected in the equation of virtual work?
(a) reaction at a point or an axis, fixed in space, around which a body is constrained to turn
(b) reaction of any smooth surface with which the body is in contact
(c) reaction of a rough surface on a body which rolls on it without slipping
(d) all the above

53. Neutral plane of a beam:
(a) passes through its centre of gravity
(b) lies at the bottom most fibres
(c) lies at the top most fibres
(d) is one whose length remains unchanged during the deformation

54. In a Hartnell governor, if the spring of larger stiffness is used, the governor will:
(a) become less sensitive
(b) become more sensitive
(c) remain unaffected in respect of sensitivity
(d) become isochronous

55. In case of flywheel, the maximum fluctuation of energy is directly proportional to:
(a) coefficient of fluctuation of speed
(b) square of the angular velocity of flywheel
(c) moment of inertia of flywheel
(d) all the above

56. At room temperature iron is:
(a) paramagnetic (b) ferromagnetic
(c) ferroelectric (d) dielectric

57. Any point on a link connecting double slider crank chain will trace a:
(a) straight line (b) circle
(c) ellipse (d) parabola

58. In case of insulating materials the energy gap between valence band and conduction band is:
(a) very small (b) infinite
(c) very large(d) near to zero

59. Simplex table is the representation of a linear programming problem in:
(a) the tabular form
(b) the form of a list of products to be produced
(c) the form on alist of profits for individual products
(d) the form of a list of manufactures

60. Queuing theory is used to find:
(a) Optimum situation between length of queue and coat of providing service
(b) Minimum queue length
(c) Minimum service time
(d) None of the above

61. The following layout requires the line balancing:
(a) product layout
(b) process layout
(c) fixed position layout
(d) functional layout

62. Point of contraflexure occurs it:
(a) simply supported beam
(b) beams carrying load varying from zero at one end to maximum at the other
(c) cantilevers
(d) overhanging beams

63. The moment of inertia does not depend upon:
(a) angular velocity of body
(b) mass of body
(c) distribution of mass in the body
(d) axis of rotation of the body

64. The number of basic variables in a transportation problem is at the most:
(a) m (b) n
(c) m + n (d) m +n -1
where m = number of constraints
n = number of decision variables

65. The purpose of compounding the cylinders is to :
(a) increase the wall thickness
(b) increase the strength of the cylinder
(c) Increase its diameter
(d) make the stresss distribution uniform

66. A rope having a weight of 600 N and 15 m free length hangs from a drum. The work done in winding up the rope will be:
(a) 4500 joules (b) 9000 joules
(c) 40 joules (d) 13500 joules

67. A periodic motion in which body comes to static equilibrium positions, when released from a displaced position, in smallest possible time, is called:
(a) critically damped vibration
(b) under damped vibration
(c) undamped vibration
(d) none of the above

68. The size of abrasive grains in abrasive jet machining lies between:
(a) 1 to 10 microns
(b) 10 ro 50 microns
(c) 50 to 100 microns
(d) 100 to 500 microns

69. The torque produced due to friction for same shaft diameter in conical clutch as compared to plate clutch is:
(a) more than that for plate clutch
(b) less than that for plate clutch
(c) equal to that of plate clutch
(d) less or more depending on cone angle

70. Optimum rake angle of a tool is a function of:
(a) cutting speed
(b) cutting tool material
(c) properties of work material
(d) feed and depth of cut

71. Function of absorption type dynamoter is:
(a) to absorb the heat produced in braking action
(b) to measure the power of a prime mover by absorbing and transferring the available energy
(c) to act as a friction brake only
(d) to measure the power transmitted by a prime mover without causing any interruption

72. Masses rotating in different parallel planes can be balanced:
(a) only by several rotating masses in a single plane

(b)by atleast two rotating masses in different planes
(c) by a reciprocating mass
(d) by a reciprocating mass

73. Hardness of carbon tool steels is increased when alloyed with:
(a) chromium and vanadium
(b) tungsten
(c) silicon
(d) manganese

74. Best all purpose coolant for carbide tools is:
(a) soluble oil
(b) kerosene
(c) compressed air
(d) soap water

75. In case of a plate cam, operating a roller follower, the trace a point is located at:
(a) point of contact between cam and roller
(b) cam centre of rotation
(c) roller centre
(d) some point on the follower axis

76. When a circular shaft of length 'L', polar moment of inertia 'J' and shear modulus, 'G' is subjected to torque, 'T', its torsional stiffness is given by:
(a) GJ/L (b)TL/GJ
(c) TL/J (d) TL/G

77. Strain rosettes are used to determine:
(a) shear strain directly on the surface of a loaded component
(b) state of strain at a point on the surface of a component
(c) the stresses directly in a component
(d) the normal and shearing strains at any given point

78. Merchant's analysis in metal cutting assumes that:
(a) tool edge is blunt
(b) deformation is three dimensional
(c) deformation zone is shear zone
(d) rake angle is zero

79. The machining method which uses abrasive slurry is known as:
(a) electrodischarge machining
(b) laser machining
(c) plasma arc machining
(d) ultrasonic machining

80. Which of the following is not the characteristic of USM (Ultrasonic Machining)?
(a) high machining rate
(b) high accuracy
(c) good surface finish
(d) machining of brittle materials

81. Slow plastic deformation of metals under constant stress is known as:
(a) creep (b) fatigue
(c) hardenability (d) malleability

82. Which of the following tool materials has the highest cutting steel?
(a) carbon steel (b) tool steel
(c) high speed steel (d) carbide

83. Limits for the 'C' charts are based on the following distribution:
(a) Binomial (b) Normal
(c) Possion (d) Exponential

84. Shear angle is the angle between:
(a) shear plane and tool face
(b) shear plane and job surface
(c) shear plane and horizontal plane
(d) shear plane and vertical plane

85. In an involute pinion meshing with involute gear, the normal to the contacting involute curves is tangent to :
(a) base circles
(b) pitch circles
(c) addendum circles
(d) Dedendum circles

86. A car is moving with a speed V meters per second. It can be stopped in a minimum distance x meters when the brakes are applied. If the speed is nV meters per second, then the minimum distance over which the car can be stopped by braking would be:
(a) n^2x (b) x/n
(c) nx (d) $\frac{x}{n^2}$

87. A smooth plane is inclined at 30^0 with the horizontal. It is held there by a force P of magnitude 2121.64 N. If the inclination of P with the plane is θ, then value of θ will be:
(a) 30^0 (b) 75^0
(c) 45^0 (d) 120^0

88. On the principal planes:
(a) normal stress is maximum or minimum and the shear stress is zero
(b) normal stresses are zero
(c) normal stress is zero and the shear stress is maximum
(d) all the stresses are maximum

89. A cantilever beam is deflected by 'd' due to a load P. If the length of the beam is doubled, the deflection will be changed by a factor:
(a) 2 (b) $\frac{1}{2}$
(c) $\frac{1}{8}$ (d) 8

90. In belt drive system, the effect on velocity ratio due to slip as undernoted:
(a) unaffected
(b) increased
(c) decreased
(d) cannot be predicted

91. Two railway wagons of masses 12 and 10 tonnes, moving in the same direction at speeds 3 m/s and 5 m/s respectively, collide and then move together. Their common speed is given by:
(a) 3.91 m/s (b) 2.75 m/s
(c) 2.2 m/s (d) 4.5 m/s

92. The property of a material by a virtue of which it can be rolled into plates is called:
(a) malleability (b) ductility
(c) plasticity (d) elasticity

93. The following is not correct in gauging:
(a) go-end of the plug gauge is longer than no-go-end
(b) go gauges are given tolerance in the tolerance zone
(c) wear allowance is provided on the go end of the gauge
(d) go gauges check the minimum metal conditions

94. A sample is drawn in such a way that every unit or item of the population has an equal chance of selection. This is called:
(a) random sampling
(b) single sampling
(c) double sampling
(d) multiple sampling

95. Drill bushes are provided in jigs and fixtures:
(a) to guide the drill
(b) to provide marking for the hole
(c) to clamp the job
(d) none of the above

96. A lamp weighing 5 n is suspended from ceiling by a chain. It is pulled aside by a horizontal cord until the chain makes an angle 45^0 with the ceiling. The pulling force in the cord is:
(a) 5 N (b) $\sqrt{50}$ N
(c) $5\sqrt{2}$ N (d) $5/\sqrt{2}$ N

97. Calculation of metal cutting time depends on the correct selection of the values for:
(a) (b) cutting speed
(c) depth of cut (d) all the above

98. A very large cam is undesirable as:
(a) it is difficult to mount on cam shaft
(b) it is difficult to be manufactured
(c) it produces more unbalance at higher speeds
(d) it will have to be steeper

99. Metal removal in electrolytic grinding takes place:
(a) by electrochemical action
(b) by erosion
(c) by corrosion
(d) by mechanical friction

100. 18 – 8 stainless steel contains:
(a) 18 % nickel, 8% chromium
(b) 18% chromium, 8% nickel
(c) 18% tungsten, 8% nickel
(d) 18% tungsten, 8% chromium

1 (a)	21 (c)	41 (a)	61 (a)	81 (a)
2 (a)	22 (b)	42 (c)	62 (d)	82 (d)
3 (a)	23 (b)	43 (b)	63 (a)	83 (c)
4 (b)	24 (b)	44 (d)	64 (d)	84 (b)
5 (d)	25 (a)	45 (d)	65 (b)	85 (a)
6 (a)	26 a , d	46 (b)	66 (a)	86 (a)
7 (a)	27 (b)	47 (c)	67 (a)	87 (c)
8 (b)	28 (a)	48 (c)	68 (d)	88 (a)
9 (a)	29 (b)	49 (b)	69 (b)	89 (d)
10 (b)	30 (b)	50 (b)	70 (a)	90 (c)
11 (c)	31 (c)	51 (a)	71 (b)	91 (a)
12 (c)	32 (d)	52 (d)	72 (b)	92 (a)
13 (c)	33 (d)	53 (d)	73 (b)	93 (d)
14 (a)	34 (c)	54 (a)	74 (a)	94 (a)
15 (a)	35 (c)	55 (d)	75 (c)	95 (a)
16 (a)	36 (c)	56 (b)	76 (a)	96 (a)
17 (a)	37 (c)	57 (c)	77 (b)	97 (d)
18 (a)	38 (c)	58 (c)	78 (c)	98 (c)
19 (c)	39 (c)	59 (a)	79 (d)	99 (a)
20 (b)	40 (b)	60 (a)	80 (a)	100 (d)

8. P-Chart: It is used to record the proportion of defective units in a sample.

C-Chart: It is used to record the number of defects in a sample.

To find the number of missing rivets at aircraft final inspection, C-control chart is used.

9. $\frac{1}{2}m_1V_1^2 = \frac{1}{2}m_2V_2^2$

$$\frac{V_1}{V_2} = \sqrt{\frac{m_2}{m_1}}$$

$$\frac{P_1}{P_2} = \frac{m_1V_1}{m_2V_2} = \frac{m_1}{m_2}\sqrt{\frac{m_2}{m_1}} = \sqrt{\frac{m_1}{m_2}}$$

if $m_1 > m_2$ then $\frac{P_1}{P_2} > 1$

$P_1 > P_2$

Heavier mass have higher momentum

14. Slenderness ratio is ratio of the effective length of column divided by the least radius of gyration k.

(a) Pinned – Pinned end conditions

$$L_e = L$$

(b) Fixed –free end conditions

$$L_e = 2L$$

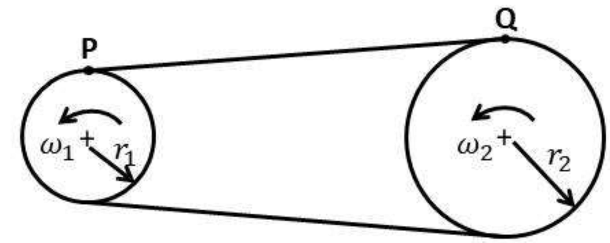
(c) Fixed – Fixed end conditions

$$L_e = 0.5L$$

(d) Fixed – pinned end conditions

$$L_e = 0.7L$$

23.



If slip doesn't occur between belt and pulley then velocity at point P and Q should be same.

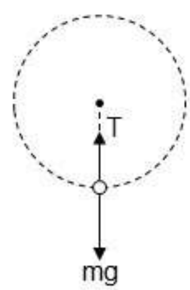
$V_P = \omega_1 r_1$ and $V_Q = \omega_2 r_2$

$$\omega_1 r_1 = \omega_2 r_2$$

$$\frac{\omega_1}{\omega_2} = \frac{r_2}{r_1}$$

The velocity ratio is inversely proportional to diameter.

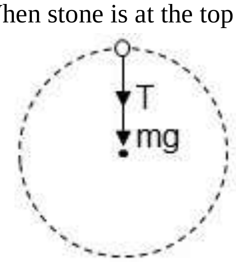
47. Case-1: When stone is at the bottom



$$\frac{mv^2}{r} = T - mg$$

$$T = mg + m\frac{v^2}{r}$$

Case-2: When stone is at the top



$$\frac{mv^2}{r} = T + mg$$

$$T = m\frac{v^2}{r} - mg$$

48. Austenite is stronger and has better creep resistance than BCC ferrite because of the better packing of atoms in the FCC structure.

Ferrite is soft and ductile while pearlite is hard and brittle.

64. Number of basic variables in transportation problem

= m + n -1

66. Work done is equal to change in potential energy

$$W = mgh_{cm} = 600 \times \frac{15}{2} = 4500 \text{ joules}$$

86. Initial velocity = V

Final velocity = 0

Distance travelled = x

Assume moves with constant retardation

$$V^2 = U^2 + 2aS$$

$$0^2 = V^2 + 2a\,x$$

$$a = -\frac{V^2}{2x}$$

Case - II

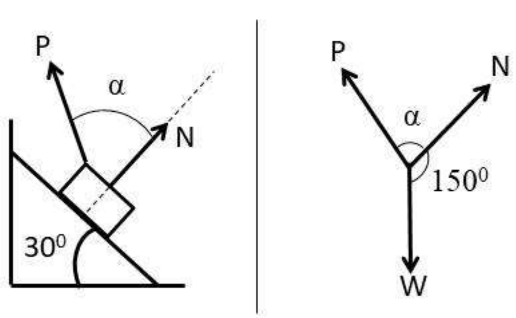
Initial velocity = nV

Final velocity = 0

$$0^2 = (nV)^2 - 2 \times \frac{V^2}{2x}\,x'$$

$$x' = n^2 x$$

87.



$$\frac{W}{\sin\alpha} = \frac{N}{\sin(360^0 - 150^0 - \alpha)} = \frac{P}{\sin 150^0}$$

$$\frac{3000\,N}{\sin\alpha} = \frac{2121.64\,N}{\sin 30^0}$$

$$\sin\alpha = \frac{3000 \times \frac{1}{2}}{2121.64} = \frac{1500}{2121.64}$$

$$\alpha = 45^0$$

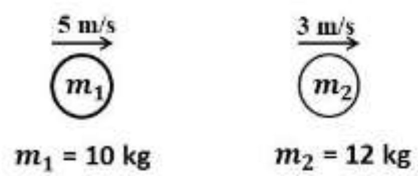
89. Deflection at free end in a cantilever beam

$$\delta = \frac{PL^3}{3EI}$$

$$\delta \;\alpha\; L^3$$

if length is double then deflection of the beam is increased by eight times.

91. Before collision,



After collision both masses move together with velocity V_{CM} .

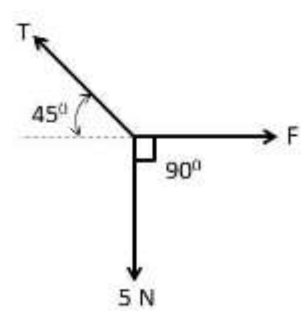
$$(m_1 + m_2)\,V_{cm} = m_1V_1 + m_2V_2$$

$$(10 + 12)V_{CM} = 10 \times 5 + 12 \times 3$$

$$V_{CM} = 3.91 \text{ m/s}$$

93. Go gauges are designed to check the maximum metal conditions. i.e. Minimum hole limit and Maximum shaft limit.

96.



$$\frac{F}{\sin 135^0} = \frac{5\ N}{\sin 135^0}$$

F = 5 N

1. The main function of refractories is
(a) Thermal radiation
(b) Reflection of heat
(c) Thermal Insulation
(d) Absorption of heat

2. Polyethylene is produced from ethylene by the process of
(a) addition polymerisation
(b) co-polymerisation
(c) condensation polymerization
(d) all the above

3. In high frequency applications, a ferrite is preferred to ferromagnetic materials because the ferrite has
(a) High permeability
(b) High resistivity
(c) High saturation magnetization
(d) Square hysteresis loop

4. Dielectric strength of a material is
(a) capacity to bear two stresses
(b) magnetic property
(c) capacity to withstand high voltage
(d) capacity to resist creep deformation

5. Silicon doped with phosphorous is an
(a) intrinsic semi-conductor
(b) super conductor
(c) p-type semi-conductor
(d) n-type semi-conductor

6. Fatigue strength of materials increases
(a) with rise in temperature
(b) by overstressing the specimen
(c) by making scratches on the surface
(d) by understressing

7. The property of a material by which it can be rolled into sheets is called
(a) Elasticity (b) Plasticity
(c) Malleability (d) Ductility

8. At higher temperatures all semiconductors are found to have
(a) less conductivity (b) less photosensitivity
(c) less resistance (d) none of the above

9. Ceramic crystals of A X type have coordination number
(a) 3, 8 and 12 (b) 3, 6 and 12
(c) 3, 4 and 8 (d) 4, 6 and 8

10. A material which undergoes no deformation upto yield point and at yield point, it continuously deforms at constant stress is known as
(a) elasto-plastic (b) rigid-plastic
(c) plasto-elastic (d) rigid-elastic

11. The direction of the line of intersection of the planes (111) and (112) is
(a) $[0\ \ \bar{1}\ \ 2]$ (b) $[1\ \ \bar{1}\ \ 0]$
(c) $[0\ \ 1\ \ \bar{1}]$ (d) $[0\ \ 2\ \ \bar{1}]$

12. Out of the following defects which one occurs during extrusion?
(a) Crocodile cracks (b) Cold shuts
(c) Centre burst (d) Corner fracture

13. Gauge number is related to
(a) length of sheet (b) diameter of rod
(c) thickness of sheet (d) none of the above

14. Ernst and Merchant obtained a relationship between shear angle φ, friction angle β and rake angle α. This relationship is
(a) $2\varphi + \beta - \alpha = \frac{\pi}{4}$
(b) $2\varphi + \beta - \alpha = C$
Where C is a constant
(c) $2\varphi + \beta - \alpha = \frac{\pi}{2}$
(d) $\varphi + \beta - \alpha = \frac{\pi}{4}$

15. Tandem drawing of wires and tubes is necessary because
(a) surface finish improves after every drawing stage
(b) annealing is needed between stages
(c) It is not possible to reduce in one stage.
(d) accuracy in dimensions is not possible otherwise

16. Which one is not an element of flexibile manufacturing system?
(a) Plant layout
(b) Work station
(c) Automated handling and transport of materials and parts
(d) Computer controlled system

17. Higher shear plane angle results in
(a) smaller shear plane area
(b) lower cutting energy
(c) lower cutting temperature
(d) all the above

18. In machining operation, the most significant force is
(a) Longitudinal (b) Tangential
(c) Radial (d) All of the above

19. In orthogonal cutting, the chip thickness is
(a) uniform throughout
(b) minimum at middle
(c) maximum at middle
(d) maximum at sides

20. Good machinability results in
(a) moderate cutting forces
(b) low component cost
(c) smaller chips
(d) good surface finish
Choose the wrong statement above.

21. A blunt tool is used in
(a) Spinning (b) Piercing
(c) Knurling (d) Gear shaving

22. The relationship between shear angle φ, rake angle α and chip thickness ratio t is expressed as
(a) $\tan\varphi = \frac{r\cos\alpha}{1-\sin\alpha}$ (b) $\tan\varphi = \frac{\cos\alpha}{1-r\sin\alpha}$
(c) $\tan\varphi = \frac{r\cos\alpha}{1-r^2\sin\alpha}$ (d) none of the above

23. In order to get uniform thickness of plate by rolling process, one provides
(a) offset on the rolls
(b) air bearing
(c) hardening of rolls
(c) camber on the rolls

24. In strip rolling process, the neutral point shifts towards the exit when
(a) front tension increases
(b) front tension decreases
(c) back tension increases
(d) back tension decreases

25. In the relation for cutting tool life $VT^n = C$, the numerical value of 'n' for high speed steel tools varies in the range of
(a) 0.8 to 0.9 (b) 0.6 to 0.7
(c) 0.2 to 0.4 (d) 0.1 to 0.15

26. Serrated chip are formed when machining
(a) Ductile metals
(b) Brittle metals
(c) Metal with low thermal conductivity
(d) With high depth of cut

27. Device used for holding the work piece in milling and planning operations is
(a) Jig (b) Fixture
(c) Template (d) Chuck

28. A graphite electrode with finer grains in electro-discharge machining results in
(a) lower tool wear rate
(b) higher material removal rate
(c) both (a) and (b)
(d) none of the above

29. Poor surface finish and fast wear of tool are the characteristics of
(a) continuous chips with built-up edges
(b) discontinuous chips
(c) continuous chips
(d) inhomogeneous chips

30. In spark erosion machining the instantaneous temperature may reach as high as
(a) 2000 ^{0}C (b) 5000 ^{0}C
(c) 10,000 ^{0}C (d) 15, 000 ^{0}C

31. The mode of deformation of the metal during spinning is
(a) drawing and stretching
(b) use cheaper and better materials
(c) modify and improve product design
(d) all the above

32. The aim of value analysis is to generate promising ideas to
(a) simplify the product
(b) use cheaper and better materials
(c) modify and improve product design
(d) all the above

33. The following is not the characteristic of linear programming problem:
(a) objective function is expressed as a linear function of variable
(b) resources are not limited
(c) some alternative course of actions are also available
(d) decision variables are interrelated

34. The following is not true for the C items in ABC analysis:
(a) low control
(b) keep the stock in large quantities
(c) rough estimate for planning
(d) rigorus value analysis

35. Which of the following is not the objective of 'Production Management'?
(a) Productivity improvement
(b) Employment generation
(c) Quality improvement
(d) Cost reduction

36. Graphical method, simplex method and transportation method are concerned with
(a) Break even analysis
(b) Value analysis
(c) Linear programming
(d) Queuing theory

37. Which of the following is not true for the work simplifications?
(a) It reduces inventories of materials.
(b) It simplifies inspection and control
(c) It simplifies planning methods
(d) It satisfies a wide range of demand

38. Work sampling observations are taken on the basis of
(a) Random number tables
(b) Past experience
(c) Fixed percentage of daily output
(d) Convenience

39. The following chart shows the consistency of the process:
(a) $\bar{X}$ – chart (b) R– chart
(c) P– chart (d) C– chart

40. The upper control limit for 'C' chart is.
(a) $\bar{C} - 3\sqrt{\bar{C}}$ (b) $\bar{C} + 3\sqrt{\bar{C}}$
(c) $3\bar{C} + \sqrt{\bar{C}}$ (d) $3\bar{C} - \sqrt{\bar{C}}$

41. The following is not the guideline of control of 'A' class items
(a) very strict control
(b) frequent ordering
(c) maximum efforts to reduce lead time
(d) high safety stock

42. Which of the following is not true in the value engineering?
(a) Product cost is reduced
(b) quality is not maintained at desired level.
(c) It creates cost consciousness among employees.
(d) there is constant search for improvement

43. Line balancing problems are associated with
(a) Job shop production
(b) Batch production
(c) Mass production
(d) Manual production

44. Therbligs are realted with
(a) sub division of labour
(b) sub-division of store space
(c) sub-division of work
(d) simulation of work cycle

45. The basic concept of motion economy includes proper
(a) use of the human body
(b) use of work place
(c) use of machines and tools
(d) all above

46. MIS stands for
(a) Military Inspection Scheme
(b) Management Information System
(c) Mangement Intelligence
(d) Management Information Service

47. Two equal forces act at a point. If the square of their resultant is equal to three times their product, then the angle between them is
(a) 30^0 (b) 45^0
(c) 60^0 (d) 90^0

48. A rope having a weigh of 600 N and 15 m free length from a drum. The work done in winding up the rope will be
(a) 40 joules (b) 4500 joules
(c) 9000 joules (d) 13,500 joules

49. The coefficient of friction depends on
(a) surface roughness
(b) Normal force
(c) surface material
(d) None of these

50. The term "virtual work" refers to
(a) actual work done by virtual forces
(b) virtual work done by virtual forces
(c) virtual work done by actual forces
(d) all the above

51. In truss analysis, method of joints involves
(a) non-concurrent forces
(b) concurrent forces
(c) collinear forces

(d) all the above

52. A car, going with V m/s can be stopped in a minimum distance x when brakes are applied. If the speed of the car is nV, then the minimum distance, over which the car can be stopped by brakes, will be
(a) $\frac{x}{n}$ (b) n x
(c) n^2x (d) $\frac{x}{n^2}$

53. If the kinetic energy of the body becomes four times its initial value, then the new momentum will be
(a) three times its initial value
(b) four times its initial value
(c) twice its initial value
(d) unchanged

54. On a horizontal ground if a projectile is fired at an angle α with the horizontal with an initial velocity u, then the duration of flight will be
(a) $\frac{u \sin\alpha}{g}$ (b) $\frac{u \cos\alpha}{g}$
(c) $\frac{2u \sin\alpha}{g}$ (d) $\frac{2u \cos\alpha}{g}$

55. The Young's modulus and Poisson's ratio of a material are 220 $\frac{GN}{m^2}$ and 0.3 respectively. The shear modulus of this material is
(a) 68.4 (b) 76
(c) 80 (d) 85

56. A cable having uniformly distributed load per horizontal meter run will take the following shape:
(a) Hyperbola (b) Parabola
(c) Elliptical (d) Straight line

57. Which of the following do not have identical dimensions?
(a) Torque and work
(b) Momentum and impulse
(c) Momentum of force and angular momentum
(d) Kinetic energy and potential energy

58. The effect of arching a beam is to
(a) increase the bending moment throughout
(b) decrease the bending moment throughout
(c) reduce the shear force
(d) none of the above

59. A frame in which the number of members is just sufficient to keep it in equilibrium is known as
(a) Ideal frame (b) Deficient frame
(c) Perfect frame (d) Redundant frame

60. A stone is thrown vertically up with a velocity of 19.6 m/s. The time taken to attain maximum height will be
(a) 1 second (b) 2 seconds
(c) 3 seconds (d) 9.8 seconds

61. Effect of a force on a body depends upon
(a) line of action
(b) direction
(c) magnitude
(d) all the three above

62. The instantaneous centre of rotation of a circular disc, rolling on a straight path, is
(a) at the centre of disc
(b) at the centre of gravity of disc
(c) at their point of contact
(d) at infinity

63. The creep in a belt drive is due to
(a) material of the pulleys
(b) material of belt
(c) unequal size of pulleys
(d) unequal tension on tight and the slack sides of the belt

64. In a four mechanism the sum of the shortest and longest links is less than the sum of the other two links. It will act as a crank rocker mechanism if
(a) any link adjacent to the shorter
(b) shortest link is fixed
(c) link opposite to shortest link is fixed
(d) none of the above

65. Static balancing involves balancing of
(a) forces
(b) couples
(c) forces as well as couples
(d) masses

66. The moment of inertia of an area is always least with respect to
(a) bottom most axis
(b) radius of gyration
(c) central axis
(d) vertical axis

67. For maximum power to be transmitted by belt drive, the ratio of centrifugal tension to permissible tension is
(a) $\frac{1}{2}$ (b) $\frac{2}{3}$

(c) $\frac{1}{3}$ (d) 3

68. Which one of the following is a transmission dynamometer?
(a) Belt dynamometer
(b) Torsion dynamometer
(c) Hydraulic dynamometer
(d) Prony brake dynamometer

69. The type of gears need to connect two intersecting coplanar shafts are
(a) spur gears (b) straight bevel gears
(c) helical gear (d) spiral gear

70. The most suitable follower motion program for high speed engine cam is
(a) uniform velocity
(b) cycloidal
(c) simple harmonic motion
(d) uniform acceleration and retardation

71. The partial balancing of reciprocating parts in locomotives produces
(a) hammer blow
(b) swaying couple
(c) variation in tractive effort
(d) all the above

72. In a Hartnell governor if a spring of greater stiffness is used, the governor will
(a) become less sensitive
(b) become more sensitive
(c) remain unaffected in respect of sensitivity
(d) become isochronous

73. The effect of the spring mass can be accounted for calculating the natural frequency of a spring mass system by adding n times the mass of spring to the main mass where 'n' is equal to
(a) $1/3$ (b) $1/2$
(c) $1/4$ (d) $3/4$

74. The factor which affects critical speed of shaft is
(a) eccentricity
(b) span of shaft
(c) diameter of shaft
(d) all the above

75. A simple spring mass vibrating system has a natural frequency 'N'. If the spring stiffness is halved and the mass is doubled, then the natural frequency will become
(a) $N/2$ (b) $2N$
(c) $4N$ (d) $8N$

76. In a forced vibration system for what value of frequency ratio (w_1/w_n), the transmissibility is same for all values of damping forces?
(a) 1 (b) 2
(c) $\sqrt{2}$ (d) $1/2$

77. For safe design, a friction clutch is designed asuming
(a) uniform pressure theory
(b) uniform wear theory
(c) both of the upper two
(d) self locking system

78. Which one of the following is an example of constant acceleration cam?
(a) Simple harmonic motion
(b) circular arc
(c) polynomial
(d) parabola

79. The number of natural frequencies for three rotor system will be
(a) one (b) two
(c) three (d) four

80. Strain rosettes are used to
(a) measure strain
(b) analyse the property of materials
(c) produce strain for testing purpose
(d) relieve strain in heavily loaded purpose

81. The maximum shear stress in Mohr circle is equal to
(a) Chord of circle
(b) Radius of circle
(c) Diameter of circle
(d) One fourth the diameter of circle

82. Rankine's theory of failure is
(a) strain energy theory
(b) maximum principal stress theory
(c) maximum principal strain theory
(d) maximum shear stress theory

83. Neutral axis of a beam is where
(a) stress due to bending is maximum tensile
(b) stress due to bending is maximum compressive
(c) fibres undergo maximum tensile strain
(d) fibres do not undergo any strain

84. A circular steel rod is separately subjected to a bending moment and a torque of equal magnitude. The ratio of maximum principal stresses in the two cases will be
(a) 2 : 1 (b) 1 : 2
(c) 1 : 1 (d) $\sqrt{2}:1$

85. The point of contraflexure in a loaded beam is the space where
(a) shear force is zero
(b) shear force is maximum
(c) unpredictable
(d) sign of bending moment changes

86. The relationship between stress and strain for a linearly elastic, isotropic and homogeneous material can be expressed with the help of following independent constants
(a) two (b) three
(c) six (d) nine

87. If the load passes through the shear centre of the section of the beam, then there will be
(a) bending accompanied by twisting
(b) only twisting in the beam
(c) only bending in the beam
(d) neither bending nor twisting

88. The most common way of keeping the beam of uniform strength is
(a) varying both width and depth
(b) keeping the depth uniform and varying the width
(c) keeping the width uniform and varying the depth
(d) none of the above

89. Torsional rigidity of a solid circular shaft of diameter d is proportional to
(a) d (b) d^2
(c) $1/d^2$ (d) d^4

90. In a thick cylinder subjected to internal pressure p, the radial stress at the outer stress is
(a) zero (b) p
(c) – p (d) 2p

91. If a load 'P' is suddenly applied in a bar to produce an extension 'δ' , then load will produce
(a) same effect as the load gradually applied
(b) twice the effect of the same load when gradually applied
(c) $\frac{\delta}{2}$ extension if gradually applied
(d) none of the above

92. The buckling load will be maximum for a column if
(a) one end is clamped and the other is free
(b) both ends are clamped
(c) both ends are hinged
(d) one end is clamped and the other is hinged

93. If the cross section of a member is subjected to uniform shear stress τ , then the strain energy stored per unit volume is equal to
(a) $\frac{\tau^2}{2G}$ (b) $\frac{\tau^2}{G}$
(c) $\frac{\tau}{G^2}$ (d) $\frac{\tau^2}{G^2}$

94. A column has its equivalent length equal to its length when
(a) both ends are fixed
(b) both ends are hinged
(c) both ends are free
(d) one end is fixed and the other end is free

95. Auto frottage is the method of
(a) joining thick cylinders
(b) increasing life of thick cylinders
(c) calculating stresses in thick cylinder
(d) prestressing thick cylinder

96. For an isotropic material, Poisson's ratio is given by $\boldsymbol{v}$ = $\left(\frac{\epsilon_y}{\epsilon_x}\right)$ where ϵ_x and ϵ_y are normal strain in two perpendicular directions x and y respectively. For this the loading will be universal in
(a) direction – x
(b) direction – y
(c) third perpendicular direction-z
(d) arbitrary direction in x-y plane

97. A cast iron test piece of circular cross section, when tested in pure tension, usually fails along a plane close to 45^0 to the axis of test piece. This indicates that the failure is due to the maximum value of
(a) shear stress (b) normal stress
(c) shear strain (d) shear strain energy

98. In a crystal, line imperfection is called
(a) Frenkel defect
(b) Schottky defect
(c) Edge dislocation
(d) Stacking fault

99. Elastomers show
(a) no deformation
(b) low deformation
(c) Edge dislocation
(d) Stacking fault

100. Yield strength of the material is the stress at which the material
(a) fractures
(b) develops cracks
(c) becomes plastic
(d) ruptures

Answer

1 (c)	21 (a)	41 (d)	61 (d)	81 (b)
2 (a)	22 (d)	42 (b)	62 (c)	82 (b)
3 (*)	23 (c)	43 (*)	63 (d)	83 (d)
4 (c)	24 (*)	44 (c)	64 (a)	84 (a)
5 (d)	25 (d)	45 (d)	65 (a)	85 (d)
6 (d)	26 (a)	46 (b)	66 (c)	86 (a)
7 (c)	27 (d)	47 (c)	67 (c)	87 (c)
8 (c)	28 (*)	48 (b)	68 (b)	88 (*)
9 (*)	29 (a)	49 (a)	69 (b)	89 (d)
10 (b)	30 (c)	50 (c)	70 (b)	90 (a)
11 (b)	31 (a)	51 (b)	71 (d)	91 (c)
12 (c)	32 (d)	52 (c)	72 (a)	92 (b)
13 (c)	33 (*)	53 (c)	73 (a)	93 (*)
14 (c)	34 (d)	54 (c)	74 (d)	94 (b)
15 (b)	35 (b)	55 (d)	75 (a)	95 (d)
16 (*)	36 (c)	56 (b)	76 (c)	96 (d)
17 (a)	37 (*)	57 (c)	77 (b)	97 (a)
18 (b)	38 (a)	58 (*)	78 (d)	98 (c)
19 (*)	39 (b)	59 (c)	79 (c)	99 (*)
20 (*)	40 (b)	60 (b)	80 (a)	100 (c)

47. $R = \sqrt{F_1^2 + F_2^2 + 2F_1F_2\cos\theta}$
Forces are equal
$F_1 = F_2$
$R^2 = 3F_1F_2 = 3F_1F_1 = 3F_1^2$
$R^2 = F_1^2 + F_1^2 + 2F_1F_1\cos\theta$
$3F_1^2 = 2F_1^2 + 2F_1^2\cos\theta$
$\theta = 60^0$

48. Work done is equal to change in potential energy of rope. Change in potential energy of rope is equal to weight of rope multiply by change in position of centre of mass of rope. If L is length of rope, then centre of mass of lie at distance L/2.
W = mgh = 600 N × $\frac{15}{2}$ m = 4500 N-m = 4500 J

49. The coefficient of friction depends on surface roughness.

52. If initial speed is V
$v^2 = u^2 + 2aS$
$0 = V^2 + 2ax$
$a = -\frac{V^2}{2x}$
If initial speed is nV
$v^2 = u^2 + 2aS$
$0 = n^2V^2 + 2\left(-\frac{V^2}{2x}\right)x'$
$x' = n^2x$

53. $K.E_1 = \frac{1}{2}mV^2$
$V' = 2V$
$K.E_2 = \frac{1}{2}m(4V^2) = 4K.E_1$

54. Time of flight T
$y = u_yt - \frac{1}{2}gt^2$
When projectile hit the ground, y = 0
$0 = u_yt - \frac{1}{2}gt^2$
$T = \frac{2u_y}{g} = \frac{2u\sin\theta}{g}$

55. $G = \frac{E}{2(1+\vartheta)} = \frac{220}{2(1+0.3)} \approx 85$ MPa

60. u = 19.6 m/s
$v = u - gt$
$0 = 19.6 - 9.8t$
t = 2 sec.

66. $I = I_{CM} + Ad^2$
if d = 0, I is least

67. In belt drive,
Maximum permissible tension is equal to three times centrifugal tension force for maximum power transmission.
$T = 3T_c$

73. If mass of spring is consider in spring mass system then natural frequency of spring mass system is equal to
$\boldsymbol{\omega} = \sqrt{\frac{\boldsymbol{k}}{\boldsymbol{m} + \frac{\boldsymbol{m_s}}{3}}}$
m_s = mass of spring.

75. $\omega = \sqrt{\frac{K}{M}}$
if stiffness of spring reduced by half.

If mass of spring is double.

$\omega' = \sqrt{\frac{K/2}{2M}} = \frac{\omega}{2}$

84. $\sigma_{max} = \frac{M}{I} \times y_{max}$

$I = \frac{\pi R^4}{R}$

$y_{max} = R$

$\sigma_{max} = \frac{4M}{\pi R^3}$

$\tau_{max} = \frac{T}{J} \times R = \frac{T}{\frac{\pi R^4}{2}} \times R = \frac{2T}{\pi R^3}$

M = T (given)

$\frac{\sigma_{max}}{\tau_{max}} = \frac{2}{1}$

1. 3-2-1 principle is related with
(a) design of locating devices
(b) tool design
(c) plant layout design
(d) work sampling

2. Which of the following non-conventional machining methods does not cause tool wear?
(a) Anode mechanical machining
(b) Ultrasonic machining
(c) Electro-discharge machining
(d) Electro-chemical machining

3. In a blanking operation, the clearance is provided
(a) 50% on punch and 50% on die
(b) only on die
(c) only on punch
(d) clearance not needed

4. The relationship between blank diameter D and cup diameter d during deep drawing process is given as
(a) $D = \sqrt{d^2 + 4dh}$
(b) $D = \sqrt{d^2 + 2dh}$
(c) $D = \sqrt{d^2 + \frac{dh}{2}}$
(d) $D = \sqrt{d^2 + dh}$
Where h = height of the cup.

5. The force F required to cut a sheet metal is given by
(a) $F = \tau_s p/t$ (b) $F = \tau_s p/t^2$
(c) $F = \tau_s pt$ (d) $F = \tau_s/pt$
Where τ_s = shear strength of sheet metal.
p = perimeter of the cut
t = thickness of the sheet metal

6. In a tool life test, doubling the cutting speed reduces the tool life to $1/8^{th}$ of the original value. The Taylor's tool life index is
(a) 1 (b) 1/2
(c) 1/3 (d) 1/4

7. The chip thickness ratio 'r' is given by
(a) $\frac{\cos\phi}{\sin(\phi-\alpha)}$ (b) $\frac{\sin(\phi-\alpha)}{\cos\phi}$
(c) $\frac{\cos(\phi-\alpha)}{\sin\alpha}$ (d) $\frac{\sin\phi}{\cos(\phi-\alpha)}$
Where ϕ = shear plane angle, and
α = rake angle

8. In Electro Discharge Machining better surface finish is obtained at
(a) low frequency and low discharge current.
(b) low frequency and high discharge current.
(c) high frequency and low discharge current.
(d) high frequency and high discharge current.

9. Which of the following statements is incorrect about the continuous chip?
(a) It is formed while machining ductile materials at high cutting speeds.
(b) It is formed when feed and depth of cut are low.
(c) It results in good surface finish.
(d) None of the above

10. Consider the following work piece materials:
(i) Carbides (ii) Glass
(iii) Copper and (iv) Ceramics
Which of the above material/s are best suited for ultrasonic Machining.
(a) (ii) only (b) (ii) and (iii)
(c) (i), (ii) and (iv) (d) (ii), (iii) and (iv)

11. To prolong the life of shaper tools, after they are ground they should be undergone through the following operation
(a) sand blasting (b) shot peening
(c) lapping (d) hardening

12. An Operating Characteristics curve (OC-curve) is a plot between
(a) consumer's risk and producer's risk.
(b) probability of acceptance and probability of rejection
(c) percentage of defective and probability of acceptance.
(d) average outgoing quality and probability of acceptance

13. An $\bar{X}$ chart uses the following data
(a) count data
(b) attribute measurement data
(c) variable measurement data
(d) None of the above

14. Which of these would not be a reason for using acceptance sampling?
(a) a very high inspection cost
(b) boredom and fatigue
(c) a process needing statistical control
(d) destructive testing

15. For a M/M/1/∞/∞/FCFS queue model, the mean arrival rate is equal to 10 per hour and the mean service rate is 15 per hour. The expected queue length is

(a) 1.33 (b) 1.53
(c) 2.75 (d) 3.20

16. ABC analysis, as an input, requires

(a) annual usage and cost of the items.
(b) cost and critically of the items.
(c) critically and availability of the items.
(d) availability and annual usage of items.

17. The finite production rate inventory model relaxes which of the following EOQ assumptions?

(a) instantaneous replenishment
(b) constant lead time
(c) fixed deterministic demand
(d) no variation in unit time

18. In a time study the observed time is 0.75 min, performance rating factor is 110% and allowances are 20% of the normal time. The standard time is

(a) 0.82 min (b) 0.975 min
(c) 0.99 min (d) 1.03 min

19. 'Value engineering' is used in

(a) understanding customer's requirements.
(b) designing products according to the customer's requirements.
(c) producing products according to the customer's requirements.
(d) providing products to customer with enhanced functionality at no additional cost.

20. Which type of control chart should be used to directly monitor the number of defectives in a process for making iron castings?

(a) $\bar{X}$ – chart (b) P – chart
(c) C – chart (d) R – chart

21. A production line is to be designed to make 2400 items/week for atleast the next 3 months. The line operates 40 hours/week. The standard time required to assemble each item is 244 second. What is the smallest number of work station required?

(a) 5 (b) 6
(c) 7 (d) 8

22. A basic feasible solution in a linear programming problem with m constraints and n variables will have

(a) at the most m variables with non zero values.
(b) atleast m variables with non zero values.
(c) at the most n variables with non zero values.
(d) atleast n variables with non zero values.

23. The maximum value of the average outgoing quality for all possible values of proportion defective is called

(a) Average Outgoing Quality (AOQ)
(b) Acceptable Quality Level (AQL)
(c) Average Outgoing Quality Limit (AOQL)
(d) Lot Tolerance Proportion Defective (LTPD)

24. 20 samples of size 100 are taken. The total number of defective items is 200. What is the upper control limit of 3 – sigma P-chart?

(a) 0.13 (b) 0.16
(c) 0.19 (d) None of the above

25. Which of the following is not an underlying assumption of the basic EOQ model?

(a) Stochastic demand
(b) Instant replenishment
(c) Fixed lead time
(d) No shortages

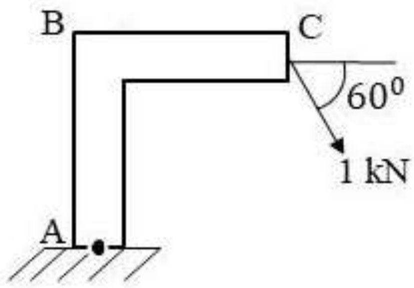
26. The error estimate (e) in work sampling varies with sample size (n) as

(a) $e \; \alpha \; \frac{1}{n}$ (b) $e \; \alpha \; \frac{1}{\sqrt{n}}$
(c) $e \; \alpha \; \sqrt{n}$ (d) $e \; \alpha \; \frac{1}{n^2}$

27. The producer's risk is the probability with which a consumer will

(a) reject a bad lot
(b) reject a good lot
(c) accept a good lot
(d) accept a bad lot

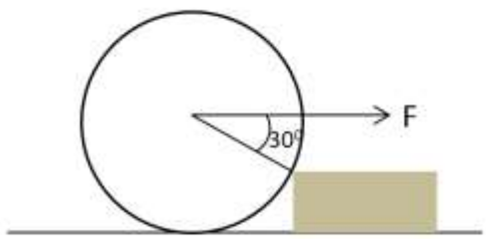
28. What is the thrust at the point 'A' in the post shown in the figure?



(a) 0.866 kN (b) 0.5 kN
(c) 1.388 kN (d) 1 kN

29. The possible loading in various members framed structure are
(a) buckling or shear
(b) compression or tension
(c) shear or tension
(d) bending

30. A roller of weight W is to be rolled over a wooden block as shown in the figure. The pull F required to just cause the said motion



(a) $\frac{W}{2}$ (b) W
(b) $\sqrt{3}W$ (d) 2W

31. In virtual work equation some forces are neglected. Select the most appropriate answer from the following:
(a) Reaction of a rough surface on a body which rolls on it without slipping.
(b) Reaction of any smooth surface with which the body is in contact.
(c) Reaction at a point or on an axis, fixed in space, around which a body is constrained to turn.
(d) All of the above

32. A circular disc rolls down without slipping on an inclined plane. The ratio of its rotational kinetic energy to the total kinetic energy is
(a) $\frac{1}{4}$ (b) $\frac{1}{2}$
(c) $\frac{1}{3}$ (d) $\frac{2}{3}$

33. Two masses 2 kg and 8 kg are moving with equal kinetic energy. The ratio of magnitude of their momentum is
(a) 0.25 (b) 0.50
(c) 0.625 (d) 1.00

34. The efficiency of a screw jack is maximum, when
(a) $\alpha = 45^0 + \frac{\emptyset}{2}$ (b) $\alpha = 45^0 - \frac{\emptyset}{2}$
(c) $\alpha = 90^0 + \emptyset$ (d) $\alpha = 90^0 - \emptyset$
Where α = Helix angle and ∅ = Angle of friction.

35. 'When two bodies collide without the presence of any other force or force fields?
(a) Their total kinetic energy must be conserved.
(b) Their total momentum must be conserved.
(c) Their collision must be direct.
(d) Both (a) and (b)

36. The tension in the cable supporting a lift is more when the lift is
(a) moving downwards with uniform velocity.
(b) moving upwards with uniform velocity.
(c) moving upwards with acceleration.
(d) moving downwards with acceleration.

37. The angle between two forces P and Q is α. The resultant of these forces is
(a) $\sqrt{P^2 + Q^2 + 2PQ\sin\alpha}$
(b) $\sqrt{P^2 + Q^2 + 2PQ\cos\alpha}$
(c) $\sqrt{P^2 + Q^2}$
(d) $\sqrt{P^2 + Q^2 - 2PQ\cos\alpha}$

38. A fixed gear having 200 teeth is in mesh with another gear having 50 teeth. The two gears are connected by an arm. The number of turns made by the smaller gear for one revolution of arm about the centre of the bigger gear is
(a) 2 (b) 3
(c) 4 (d) 5

39. For high speed engines, the cam follower should move with
(a) uniform velocity
(b) simple harmonic motion
(c) uniform acceleration and retardation
(d) cycloidal motion.

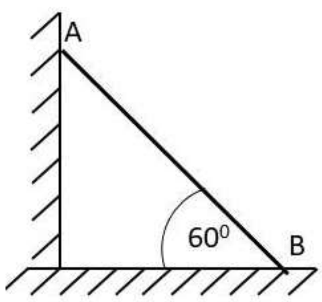
40. A flywheel is fitted to the crank shaft of an engine having W amount of indicated work per revolution. Permissible limits of coefficient of fluctuation of energy and speed are C_E and C_S respectively. The kinetic energy of the flywheel is given by

(a) $2\frac{WC_E}{C_S}$ (b) $\frac{WC_E}{2C_S}$
(c) $\frac{WC_E}{C_S}$ (d) $\frac{WC_S}{2C_E}$

41. If the ratio of length of connecting rod to crank radius increases, then
(a) primary unbalanced force increases.
(b) primary ubalanced force decreases.
(c) secondary unbalanced force increases
(d) secondary unbalanced force decreases

42. A system in dynamic balance implies that
(a) the system is critically damped
(b) the system is at its critical speed.
(c) the system, is also statically balanced
(d) there will be no wear of bearings

43. A rod AB of length 1 m is sliding as shown in the figure. At an instant when the rod makes 60^0 angle with the horizontal plane, the downwards velocity of point A is 1 m/s. What is the angular velocity of the rod at that instant?

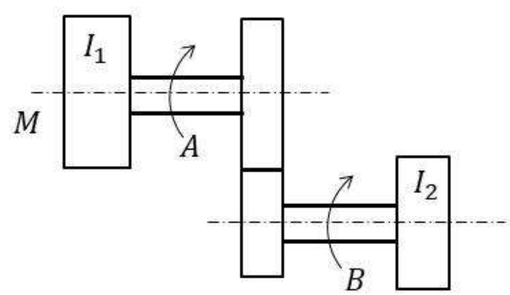


(a) 2.0 rad/s (b) 1.5 rad/s
(c) 0.5 rad/s (d) 0.75 rad/s

44. Isochronism in a governor is desirable when
(a) the engine operates at low speeds.
(b) the engine operates at high speeds.
(c) only one speed is desired to be kept at all loads.
(d) the engine operates at variable speeds.

45. A rigid body can be replaced by two masses placed at fixed distance apart. The two masses form an equivalent dynamic system, if (select the most appropriate answer).
(a) the sum of the two masses is equal to the total mass of the body.
(b) the centre of gravity of two masses coincide with that of the body.
(c) the sum of the mass moment of inertia of the masses about their centre of gravity is equal to the mass moment inertia of the body.
(d) All of the above.

46. A torsional system with discs of moment of inertia I_1 and I_2 shown in figure, which are gear driven. The ratio of speed of shaft B to shaft A is G. The equivalent moment of inertia of disc on shaft B at the speed of shaft 'A' is equal to



(a) GI_2 (b) G^2I_2
(c) I_2/G (d) I_2/G^2

47. Identify lower pair/s. Select the most appropriate answer.
(a) ball and socket
(b) cam and follower
(c) piston and cyclinder
(d) both (a) and (c)

48. In a spring dash pot, mass system if m = mass, k = spring stiffness and ω_n = natural frequency of vibration, then critical damping is equal to
(a) $2\sqrt{km}$
(b) $2m.\omega_n$
(c) both (a) and (b)
(d) neither (a) nor (b)

49. An imaginary circle which by pure rolling action gives the same motion as the actual gear is called
(a) addendum circle
(b) Dedendum circle
(c) pitch circle
(d) base circle

50. The pressure angle in a cam depends on
(a) the angle of ascent
(b) the lift of the follower
(c) offset between centre lines of cam and follower
(d) All of the above

51. The centrifugal tension in belt drive
(a) increases power transmitted.
(b) decreases power transmitted.
(c) has no effect on the power transmitted.
(d) increases power transmitted upto a certain speed and then decreases.

52. If there are several unbalanced masses in a rotor in different planes, the minimum number of balancing masses required is
(a) 1 (b) 2
(c) 3 (d) 4

53. The tractive force is maximum or minimum when the angle of inclination of the crank to the line of stroke is equal to
(a) 90^0 and 225^0 (b) 135^0 and 180^0
(c) 180^0 and 225^0 (d) 135^0 and 315^0

54. The number of instantaneous centre of rotation in a quick return motion mechanism are
(a) six (b) eight
(c) twelve (d) fifteen

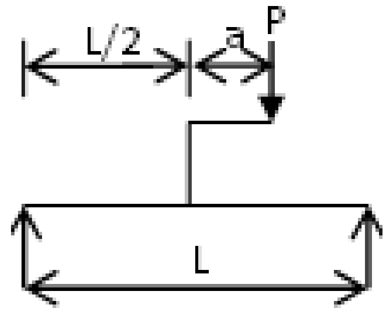
55. In a forced vibration system, for which value of frequency ratio $\left(\frac{\omega_f}{\omega_n}\right)$, the transmissibility is same for all the values of damping factors
(a) 1 (b) 2
(c) $\sqrt{2}$ (d) $\frac{1}{2}$
Where ω_f = forced frequency and
ω_n = natural frequency

56. Constant velocity ratio between two shafts can be obtained, if they are connected by
(a) V-belts and pulleys
(b) Sprocket and chains
(c) Gears
(d) Universal joint

57. Differential gear is used in an automobile to
(a)transmit power from the engine to driving wheels.
(b)multiply the available engine torque.
(c)enable the vehicle negotiate curves properly.
(d) serves all the three functions as mentioned in (a), (b) and (c) above.

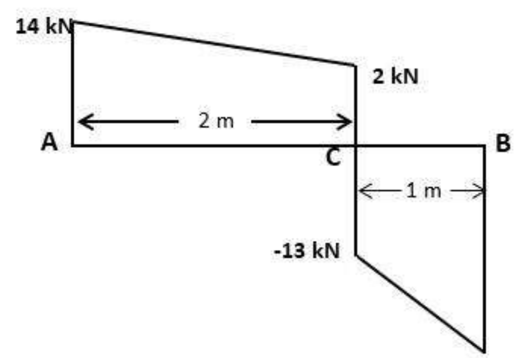
58. The point of contraflexure is a point where,
(a) shear force changes sign
(b) bending moment is zero or changes sign.
(c) shear force is maximum
(d) bending moment is maximum

59. A simply supported beam carries a load 'P' through a bracket as shown in figure. The maximum bending moment in the beam is



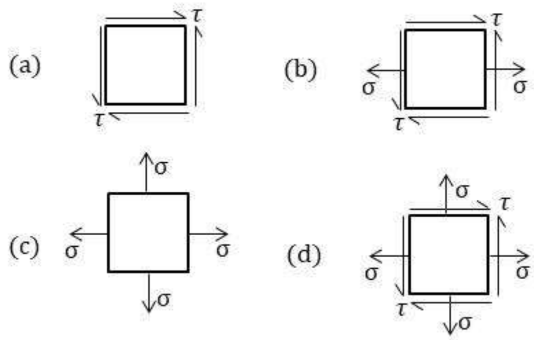
(a) $P\frac{L}{2}$ (b) $P\frac{L}{2}+\frac{a.P}{2}$
(c) $P\frac{L}{2}+a.P$ (d) $P\frac{L}{2}-a.P$

60. The shear force diagram of a loaded beam is shown in the following figure. The maximum bending moment in the beam is



(a) 16 kN-m (b) 11 kN-m
(c) 28 kN-m (d) 8 kN-m

61. In which of the following two dimensional state of stress, Mohr's stress circle takes the shape of a point.



62. If the shear force diagram for a beam is triangle with length of the beam as its base, the beam is
(a) a cantilever with a point load at its free end.
(b) a cantilever with uniformly distributed load over its whole span.
(c) a simply supported beam with a point load at its mid-point.
(d) a simply supported beam with uniformly distributed load over its whole span.

63. The torque transmitted by a solid shaft of diameter d and maximum allowable shear stress τ is
(a) $\frac{\pi}{4}\tau d^3$ (b) $\frac{\pi}{16}\tau d^3$
(c) $\frac{\pi}{32}\tau d^3$ (d) $\frac{\pi}{64}\tau d^3$

64. A thick cylinder, having r_0 and r_i as outer and inner radii, is subjected to an internal pressure P. The maximum tangential stress at the inner surface of the cylinder is
(a) $\frac{P(r_0^2+r_i^2)}{r_0^2-r_i^2}$ (b) $\frac{P(r_0^2-r_i^2)}{r_0^2+r_i^2}$
(c) $\frac{2Pr_i^2}{(r_0^2-r_i^2)}$ (d) $\frac{P(r_0^2-r_i^2)}{r_i^2}$

65. A thin cylindrical shell of diameter d and thickness t is subjected to an internal pressure P. The Poisson's ratio is $\boldsymbol{\upsilon}$. The ratio of longitudinal strain to volumetric strain in
(a) $\frac{1-\upsilon}{2-\upsilon}$ (b) $\frac{2-\upsilon}{1-\upsilon}$
(c) $\frac{1-2\upsilon}{3-4\upsilon}$ (d) $\frac{1-2\upsilon}{5-4\upsilon}$

66. In a compression test, the fracture in cast iron specimen would occur along
(a) the axis of the load
(b) an oblique plane
(c) at right angle to the axis of specimen
(d) None of the above

67. The Erichsen cupping number of a metal sheet indicates its
(a) ductility (b) hardenability
(c) toughness (d) drawing ability

68. In a I-section of a beam subjected to transverse shear force, the maximum shear stress is developed at
(a) the bottom edges of the top flange.
(b) the top edges of the top flange.
(c) the centre of the web.
(d) the upper edges of the bottom flange.

69. The equivalent length of a column supported firmly at both ends is (L = length of the column)
(a) 0.5 L (b) 0.707 L
(c) L (d) 2L

70. A circular shaft is subjected to a twisting moment T and a bending moment M. The ratio of maximum bending stress to maximum shear stress is given by
(a) $2M/T$ (b) M/T
(c) $2T/M$ (d) $M/2T$

71. The strain energy in a beam subjected to bending moment M is
(a) $\int \frac{M^2}{2EI}dx$ (b) $\int \frac{M^2}{4EI}dx$
(c) $\int \frac{M^2}{EI}dx$ (d) $\int \frac{2M^2}{EI}dx$
Where the terms have their usual meaning.

72. Maximum deflection in a cantilever due to pure bending moment M at its end is
(a) $\frac{ML^2}{2EI}$ (b) $\frac{ML^2}{3EI}$
(c) $\frac{ML^2}{4EI}$ (d) $\frac{ML^2}{8EI}$
The terms have their usual meaning.

73. The expression $EI\frac{d^3y}{dx^3}$ at a section of a beam represents
(a) shear force
(b) rate of loading
(c) bending moment
(d) slope

74. Compound tubes are used in internal pressure cases, for following reasons
(a) For increasing the thickness.
(b) For increasing the outer diameter of the tube.
(c) The strength is more.

(d) It evens out stresses.

75. Normal stress on a plane, the normal to which is inclined at an angle Θ with the line of action of applied uniaxial stress σ is given by
(a) $\sigma/\sin^2\theta$ (b) $\sigma/\cos^2\theta$
(c) $\sigma\cos^2\theta$ (d) $\sigma\sin^2\theta$

76. A shaft of 20 mm diameter and length 1 m is subjected to a twisting moment, due to which shear strain on the surface of the shaft is 0.001. The angular twist in the shaft is
(a) 0.1 radian (b) 0.01 radian
(c) 0.05 radian (d) 0.5 radian

77. A beam of uniform strength is one in which
(a) bending moment is same throughout the beam.
(b) deflection is the same throughout the length.
(c) bending stress is same in every section along the longitudinal axis.
(d) Shear stress is uniform throughout the beam.

78. Increase in ferrite phase in steel Increases
(a) strength (b) hardness
(c) ductility (d) brittleness

79. The co-ordination number for FCC crystal structure is
(a) 4 (b) 8
(c) 12 (d) 16

80. Which of the following elements determine maximum attainable hardness in the steel?
1. Chromium 2. Manganese
3. Carbon 4. Molydenum
Select the correct answer using codes given below:
(a) 1 only (b) 1 and 2
(c) 3 only (d) 2 and 4

81. How many space lattices does the Bravis lattices consists of?
(a) 3 (b) 7
(c) 9 (d) 14

82. Schottky imperfection is a
(a) Point imperfection
(b) Line imperfection
(c) Surface imperfection
(d) Volume imperfection

83. Match the List – I with the List-II and select the correct answer using the codes given below:

List-I (Crystal Structure)	List-II (Packing Efficiency)
A. Simple cubic	1. 34
B. Diamond cubic	2. 74
C. Body centered cubic	3. 52
D. Face centered cubic	4. 68

Select the correct answer using the codes given below:

Codes:

	A	B	C	D
(a)	4	3	1	2
(b)	3	1	4	2
(c)	1	2	4	3
(d)	3	2	1	4

84. Which of the following tests is also called Micro hardness Test?
(a) Brinell test (b) Rockwell test
(c) Knoop test (d) Vickers test

85. S-N curves are connected with
(a) toughness (b) hardness
(c) creep (d) fatigue

86. Which one of the following is a basic refractory material?
(a) Dolomite (b) Quartz
(c) Sand (d) Silicon carbide

87. Creep plays an important role in the design of which of the followings?
(a) boiler tublings
(b) I.C. Engine cyclinders
(c) Gas turbine blades
(d) Steam turbine blades

88. Babbit metal is an alloy of
(a) Sn and Cu
(b) Sn, Cu, Sb and Pb
(c) Sn, Cu and Pb
(d) Sn, Cu and Sb

89. Thermoplastic polymers are
(a) formed by addition polymerization
(b) formed by condensation polymerization.
(iii) softened on heating and hardened on cooling for any number of times.
(iv) moulded by heating and cooling.
Of these statement, select the correct answer from the options given below:
(a) (ii) and (iii) are true
(b) (ii) and (iv) are true
(c) (i) and (iv) are true
(d) (i) and (iii) are true

90. The true strain ϵ_t and the engineering strain ϵ relationship is
(a) $\epsilon_t = \log_n(1-\in)$
(b) $\epsilon_t = \log_n(1+\in)$
(c) $\epsilon_t = \log_n(1-2\in)$
(d) $\epsilon_t = \log_n \frac{1}{(1+\in)}$

91. The metal power used in a thermite welding of steel.
(a) Al (b) Cu
(c) Pb (d) W

92. Which of the following material is used for manufacturing of extrusion nozzles?
(a) Grey cast iron
(b) Malleable cast iron
(c) White cast iron
(d) Nodular cast iron

93. The main purpose of Chaplet is
(a) to support core
(b) to ensure directional solidification
(c) to provide efficient venting
(d) to align the mould box parts

94. Which is the main reason for poor surface finish?
(a) heavy depth of cut
(b) high cutting speed
(c) high feed
(d) low side rake angle

95. In a machining operation chip thickness ratio is 0.3 and tool back rake angle is 10^0. The value of shear strain is
(a) 0.86 (b) 2.24
(c) 3.10 (d) 3.34

96. Grinding of hard materials requires
(a) fine grit size and hard grades.
(b) fine grit size and soft grades.
(c) coarse grit size and harm grades.
(d) coarse grit size and soft grades.

97. Crater wear occurs mainly on the
(a) nose part, front and side relief faces of the cutting tool.
(b) face of the cutting tool at a short distance from the cutting edge only.
(c) cutting edge only.
(d) front face only.

98. High speed steel contains carbon
(a) 0.15 to 0.3% (b) 0.6 to 1.0%
(c) 4 to 6% (d) 6 to 10%

99. The rake angle required for machining brass by high speed steel tool is
(a) 0^0 (b) 10^0
(c) -5^0 (d) -10^0

100. Consider the following statements:
(i) Mechanical comparators are used for high accuracy.
(ii) Optical comparators use both optical and mechanical means to get magnification.
(iii) Pneumatic comparators are used for very high magnification.
(iv) Dial indicator is the most widely used mechanical comparator.
Of these statements:

(a) (ii), (iii) and (iv) are true.

(b) (iii) is true.

(c) (i) , (ii) and (iii) are true.

(d) (i) and (ii) are true.

1 (a)	21 (a)	41 (d)	61 (c)	81 (d)
2 (d)	22 (b)	42 (c)	62 (b)	82 (a)
3 (c)	23 (c)	43 (a)	63 (b)	83 (b)
4 (a)	24 (c)	44 (c)	64 (a)	84 (c)
5 (c)	25 (a)	45 (d)	65 (d)	85 (d)
6 (c)	26 (b)	46 (d)	66 (b)	86 (a), (c)
7 (d)	27 (b)	47 (d)	67 (d)	87 (d)
8 (c)	28 (a)	48 (c)	68 (c)	88 (b)
9 (c)	29 (b)	49 (c)	69 (a)	89 (d)
10 (c)	30 (c)	50 (d)	70 (a)	90 (b)
11 (c)	31 (d)	51 (c)	71 (a)	91 (a)
12 (c)	32 (c)	52 (b)	72 (a)	92 (c)
13 (c)	33 (b)	53 (c)	73 (a)	93 (a)
14 (c)	34 (b)	54 (d)	74 (d)	94 (c)
15 (a)	35 (d)	55 (c)	75 (c)	95 (d)
16 (a)	36 (c)	56 (c)	76 (a)	96 (b)
17 (a)	37 (b)	57 (c)	77 (c)	97 (b)
18 (c)	38 (d)	58 (b)	78 (c)	98 (b)
19 (d)	39 (d)	59 (c)	79 (c)	99 (a)
20 (c)	40 (b)	60 (a)	80 (d)	100 (a)

5. Shear force = Shear stress × Shear area

$F = \tau \times$ perimeter × thickness of plate.

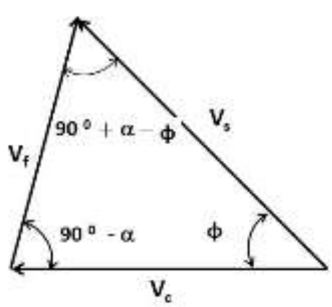
6. $VT^n = C$

$V_1T_1^n = V_2T_2^n$

$V_2 = 2V_1$ and $T_2 = \frac{T_1}{8}$

n = 1/3

7.



$$\frac{V_c}{\sin(90^0+\alpha-\varphi)} = \frac{V_s}{\sin(90^0-\alpha)} = \frac{V_f}{\sin(\varphi)}$$

Mass of chip is conserved

$t \times V_c \times b = t_c \times V_f \times b$

Chip thickness ratio = $\frac{Depth\ of\ cut}{Chip\ thickness} = \frac{t}{t_c} = \frac{V_f}{V_c}$

$$= \frac{\sin\varphi}{\sin(90^0+\alpha-\varphi)} = \frac{\sin\varphi}{\cos(\alpha-\varphi)}$$

15. Arrival rate λ = 10 persons per hour

Service rate μ = 5 persons per hour

Queue length $L_q = \frac{\rho^2}{1-\rho}$

ρ = utilization factor = $\frac{\lambda}{\mu} = \frac{10}{15}$

$L_q = \frac{(10/15)^2}{1-(10/15)} = 1.33$

18. Standard time = Normal time + allowances

Normal time = observed time × rating factor

= 0.75 × 1.1 = 0.825

Standard time = Normal time + allowances

= 0.825 + 0.2 × 0.825

= 0.99 min

21. Cycle time = $\frac{40 \times 3600}{2400}$ = 60 sec

Number work stations = $\frac{244}{60}$ = 4.1

Number of work stations = 5

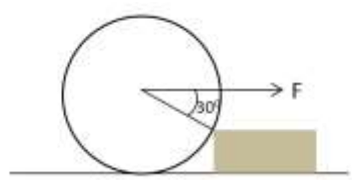
24. UCL = $\bar{p} + 3\sqrt{\frac{\bar{p}\bar{q}}{N}}$

$\bar{p} = \frac{20}{200} = \frac{1}{10}$

$\bar{q} = 1 - \bar{p} = 0.9$

UCL = 0.19

30.



Moment about a point of contact of cylinder and block.

Moment due to Force F = Moment due to gravity force mg

$F \times R\sin 30^0 = W \times R \times \cos 30^0$

F = $\sqrt{3}\,W$

32. Total Energy = $\frac{1}{2}I_P\omega^2$

I_p = Mass moment of inertia about point of contact.

ω = angular speed

Rotational kinetic energy = $\frac{1}{2}I_{CM}\omega^2$

I_{CM} = Mass moment of inertia about centre of mass.

$$\frac{K.E}{T.E.} = \frac{I_{C.M.}}{I_P} = \frac{\frac{MR^2}{2}}{\frac{MR^2}{2}+MR^2} = \frac{1}{3}$$

33. m_1 = 2 kg, m_2 = 8 kg

$\frac{1}{2}m_1v_1^2 = \frac{1}{2}m_2v_2^2$

$\frac{1}{2} \times 2 \times v_1^2 = \frac{1}{2} \times 8 \times v_2^2$

$v_1 = 2v_2$

$\frac{m_1v_1}{m_2v_2} = \frac{2}{8} \times \frac{2}{1} = \frac{1}{2}$

34. Efficiency of screw jack

$\eta = \frac{\tan\alpha}{\tan(\alpha+\emptyset)} = \frac{\sin(2\alpha+\emptyset)-\sin\emptyset}{\sin(2\alpha+\emptyset)+\sin\emptyset}$

Maximum efficiency η_{max} ,

when $2\alpha + \emptyset = \frac{\pi}{2}$

$\alpha = 45^0 - \frac{\emptyset}{2}$

α → Helix angle

$\emptyset$ → Friction angle

36.(a). When lift is moving downwards with uniform velocity.

Tension in cable is equal to weight of lift.

$T = mg$

(b) When the lift is moving upwards with uniform velocity in downwards direction. Tension in cable is equal to weight of lift.

$T = mg$

(c) When the lift is moving upwards acceleration

$ma = T - mg$

$T = m(a + g)$

(d) When the lift is moving downwards acceleration

$ma = mg - T$

$T = m(g - a)$

38. $\frac{\omega_B - \omega_{Arm}}{\omega_A - \omega_{Arm}} = -\frac{Z_A}{Z_B}$

Gear A is fixed,

Number of teeth on gear A = 200.

Number of teeth on gear B = 50.

Rotation of Arm $\Theta_{Arm} = +1$ rev.

$\frac{\Theta_B - 1}{0-1} = -\frac{200}{50} = -4$

$\Theta_B = +5$ rev.

40. K.E $= \frac{1}{2}I\,\omega_{mean}^2$

Coefficient of fluctuation of energy in flywheel:

$C_E = \frac{\text{Maximum fluctuation of energy}}{\text{Work done per cycle}}$

Maximum fluctuation of energy

$\Delta E = E_{max} - E_{min} = \frac{1}{2}I\,(\omega_{max}^2 - \omega_{min}^2)$

$\Delta E = \frac{1}{2}I\,(\omega_{max} + \omega_{min})(\omega_{max} - \omega_{min})$

$\Delta E = I \times \omega_{mean} \times \Delta\omega$

Coefficient of fluctuations of speed

$C_s = \frac{\text{Range of speed}}{\text{Mean speed}} = \frac{2(\omega_{max} - \omega_{min})}{(\omega_{max} + \omega_{min})}$

$C_s = \frac{\Delta\omega}{\omega_{mean}}$

$\Delta\omega = C_s \times \omega_{mean}$

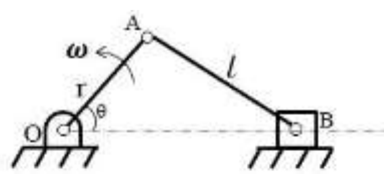
$C_E = \frac{I \times \omega_{mean} \times \Delta\omega}{W}$

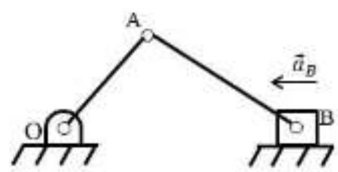
$C_E = \frac{I \times \omega_{mean} \times C_s \times \omega_{mean}}{W}$

$C_E = \frac{2 \times K.E \times C_s}{W}$

$K.E = \frac{WC_E}{2C_s}$

41. Balancing of reciprocating masses





Acceleration of slider B

$a_B = \omega^2 r\left(\cos\theta + \frac{\cos 2\theta}{n}\right)$

Inertia force act on slider

$ma_B = m\omega^2 r\cos\theta + m\omega^2 r\frac{\cos 2\theta}{n}$

$m\omega^2 r\cos\theta$ = Primary force

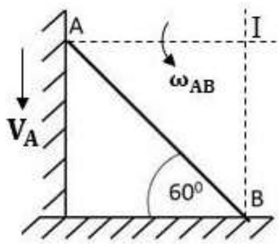
$m\omega^2 r\frac{\cos 2\theta}{n}$ = Secondary force

Maximum primary force is equal to $m\omega^2 r$

Maximum secondary force is equal to $\frac{m\omega^2 r}{n}$

As we increase the value of n, secondary force will decreases.

43.



I = Instantaneous centre of rotation

ω_{AB} = angular speed of rod AB

$V_A = \omega_{AB} \times AI$

V_A = 1 m/s , AI = AB cos (60^0) , AB = 1 m

ω_{AB} = 2 rad/s

47. Ball and socket joint, piston and cylinder are lower pairs.

Cam and follower is high pair.

48. Equation of motion of spring mass damper system

$m\ddot{x} + c\dot{x} + kx = 0$

Characteristic equation of above equation,

$ms^2 + cs + k = 0$

D = $c^2 - 4km$

For critically damped conditions:

D = 0

$c^2 - 4km = 0$

$c = \sqrt{4km} = 2\sqrt{km}$

Natural frequency

$\omega_n = \sqrt{\frac{k}{m}}$

Critically damping coefficient

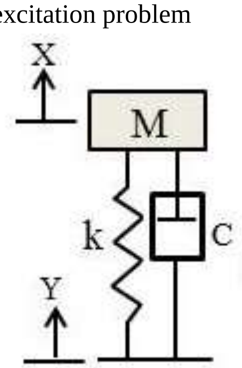
$c = 2m\omega_n$

54. Number of link for a quick return mechanism is equal to six.

n = 6

No. of I-centers = $\frac{n(n-1)}{2}$ = 15

55. Base excitation problem



EOM: $M\ddot{X} = -K(X - Y) - C(\dot{X} - \dot{Y})$

$M\ddot{X} + C\dot{X} + +KX = KY + C\dot{Y}$

For harmonic base excitation: Y = $Y_0 \sin \omega t$

$M\ddot{X} + C\dot{X} + +KX = KY_0 \sin \omega t + C\omega \cos \omega t$

Transmissibility ratio is defined as ratio of magnitude of maximum displacement of mass M and magnitude of maximum displacement of base.

TR = $\frac{X_0}{Y_0} = \frac{\sqrt{K^2+(C\omega)^2}}{\sqrt{(K-M\omega^2)^2+(C\omega)^2}}$

if $K - M\omega^2 = -K$ then TR is equal to one for all value of frequency ratio (ω/ω_n)

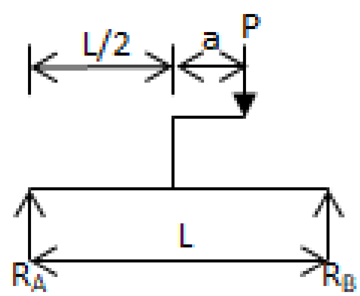
$2K = M\omega^2$

$\frac{\omega^2}{\frac{K}{M}} = \frac{\omega^2}{\omega_n^2} = 2$

$\frac{\omega}{\omega_n} = \sqrt{2}$

56. Gear drive is positive drive. Gear gives constant velocity ratio.

59.



$R_A + R_B = P$

Moment equilibrium about point A

$\sum M_A = R_B \times L - P \times \left(a + \frac{L}{2}\right)$

$R_B \times L - P \times \left(a + \frac{L}{2}\right) = 0$

$R_B = \frac{P\left(a + \frac{L}{2}\right)}{L} = P\left(\frac{1}{2} + \frac{a}{L}\right)$

$R_A = P - \frac{P\left(a + \frac{L}{2}\right)}{L}$

$R_A = P\left(\frac{1}{2} - \frac{a}{L}\right)$

Maximum bending moment at mid-point,

M = $R_B \frac{L}{2}$

M = $P\left(\frac{L}{4} + \frac{a}{2}\right)$

63. $\frac{T}{J} = \frac{\tau}{R}$

$J = \frac{\pi R^4}{2}$

$$T = \frac{\pi}{2}\tau R^3 = \frac{\pi}{16}\tau d^3$$

64. $\sigma_\theta = A + \frac{B}{r^2}$

$A = \frac{P_i r_i^2 - P_0 r_0^2}{r_0^2 - r_i^2}$

$B = \frac{(P_i - P_0) r_i^2 r_0^2}{r_0^2 - r_i^2}$

if $P_0 = 0$

$A = \frac{P_i r_i^2}{r_0^2 - r_i^2}$ and $B = \frac{P_i r_i^2 r_0^2}{r_0^2 - r_i^2}$

Maximum hoop stress at inner surface

$$\sigma_\theta = \frac{P_i r_i^2}{r_0^2 - r_i^2} + \frac{P_i r_i^2 r_0^2}{r_0^2 - r_i^2} \times \frac{1}{r_i^2} = P_i\left(\frac{r_0^2 + r_i^2}{r_0^2 - r_i^2}\right)$$

69. Critical load for both ends fixed.

$$P_{cr} = \frac{4\pi^2 EI}{L^2} = \frac{\pi^2 EI}{(L/2)^2}$$

Equivalent length: $L_e = L/2$

70. $\frac{M}{I} = \frac{\sigma}{y_{max}}$

$y_{max} = R$

$\sigma_b = \frac{M y_{max}}{I} = \frac{MR}{\frac{\pi R^4}{4}} = \frac{4M}{\pi R^3}$

$\frac{T}{J} = \frac{\tau_{max}}{r_{max}}$

$\tau_{max} = \frac{2T}{\pi R^3}$

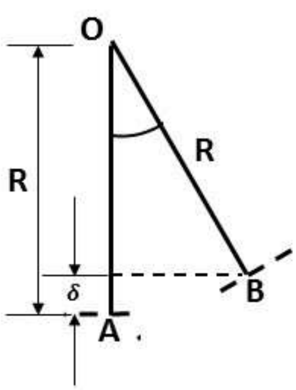
$\frac{\sigma_b}{\tau_{max}} = \frac{2M}{T}$

72. In pure bending case bending moment is constant throughout its length.

Using flexural formulae,

$$\frac{1}{R} = \frac{M}{EI} = \text{constant}$$

For cantilever beam subjected to end moment M maximum deflection occur at free end.



$\delta = R - R\cos(\theta)$

$\delta = R(1 - \cos\theta)$

$\delta = 2R\sin^2\frac{\theta}{2}$

if θ is small then $\sin\frac{\theta}{2} = \frac{\theta}{2}$

$\delta = 2R\frac{\theta^2}{4}$

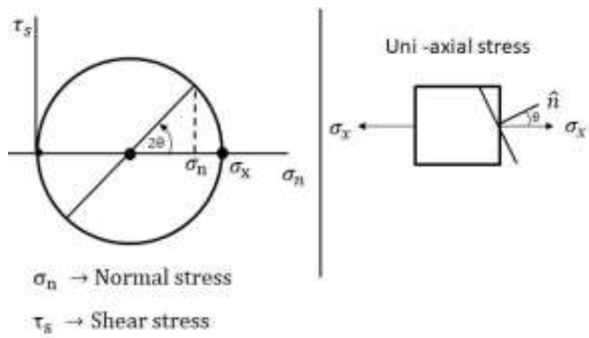
$\delta = \frac{R\theta^2}{2}$

Angle subtended by beam at centre of curvature

$\theta = \frac{L}{R}$

$\delta = \frac{L^2}{2R} = \frac{ML^2}{2EI}$

75.



Normal stress on a plane, on which normal to the plane make an angle θ from the x-axis.

$$\sigma_n = \frac{\sigma_x}{2} + \frac{\sigma_x}{2}\cos 2\theta = \sigma_x \cos^2\theta$$

76. D = 20 mm, L = 1m, γ = 0.001

$\gamma = \frac{\tau}{G} = \frac{R}{L}\theta = \frac{10 \times 10^{-3}}{1}\theta$

$0.001 = \frac{0.01}{1}\theta$

$\theta = 0.1$ radian

95. $\tan\beta = \frac{r\cos\alpha}{1 - r\sin\alpha}$

β → Shear angle

α → rake angle

r → Chip thickness ratio

Chip thickness ratio r = 0.3

rake angle $\alpha = 10^0$

. $\tan\beta = \frac{0.3 \times \cos 10^0}{1 - 0.3 \times \sin 10^0} = 0.31$

$\beta = 17.3^0$

Shear strain γ

$\gamma = \tan(\beta - \alpha) + \cot\beta$

$\gamma = \tan(17.3^0 - 10^0) + \cot 17.3^0$

$\gamma = 3.34^0$

1. Material handling and plant location is analysed by
(a) Gantt chart (b) Bin Chart
(c) Travel Chart (d) Emerson Chart

2. In PERT and CPM network the dummy activity
(a) Consumes time
(b) Consume resources
(c) Is used to preserve the logic
(d) Is a real activity

3. The following measurement are carried out by internal state sensors of the end effector
(a) Position
(b) Position and Velocity
(c) Velocity and Acceleration
(d) Position, Velocity and Acceleration

4. In a microprocessor, RISC stands for
(a) Restructured Instruction Set Computer
(b) Redefined Instruction Set Computer
(c) Reduced Instruction Set Computer
(d) Regional Instruction Set Computer

5. Which of the following provides anticlockwise and clockwise rotation about the vertical axis perpendicular to the arm?
(a) Shoulder swivel (b) Arm sweep
(c) Wrist bend (d) Elbow extension

6. PLC operates on following signals
(a) Digital (b) Impulse
(c) Analog (d) Frequency

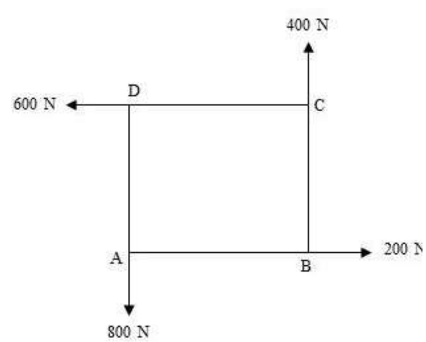
7. A disc of radius 30 cm is rolling without slip with angular velocity of 10 rad/s on a horizontal surface. Which of the following statements is NOT true?
(a) Linear velocity of all the points is different
(b) Speed of all the points is different
(c) Acceleration of all the points is different
(d) Linear velocity of the point touching the horizontal surface is zero.

8. The ratio of magnitude of linear momentum for two objects having mass 30 kg and 10 kg respectively with equal kinetic energy is
(a) $\sqrt{\frac{1}{3}}$ (b) $(3)^2$
(c) $\sqrt{3}$ (d) $\left(\frac{1}{\sqrt{3}}\right)^2$

9. Condition for stable equilibrium of a conservative force system in terms of potential energy U is
(a) $\delta U = 0$ and $\delta^2 U = 0$
(b) $\delta U = 0$ and $\delta^2 U > 0$
(c) $\delta U = 0$ and $\delta^2 U < 0$
(d) $\delta U > 0$ and $\delta^2 U = 0$

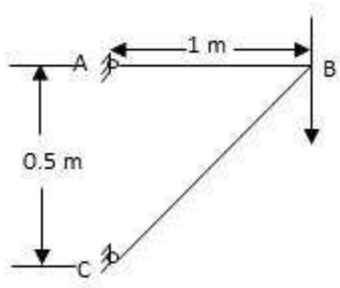
10. A simply supported beam of length l, carries a load $w(x) = w_0(x)$ over the entire span. Maximum bending moment in the beam at x will be
(a) $\frac{l}{3}$ (b) $\frac{l}{\sqrt{3}}$
(c) $\frac{l\sqrt{3}}{2}$ (d) $\frac{l}{\sqrt{2}}$

11. Four forces having magnitudes of 200 N, 400 N, 600 N and 800 N respectively acting along four sides (1 m each) of a square ABCD as shown in figure. Determine the magnitude of direction of the force from A along the line AB.



(a) $400\sqrt{3}$ N, 3.2 m from A
(b) $400\sqrt{2}$ N, 2.5 m form A
(c) $300\sqrt{2}$ N, 2 m form A
(d) $300\sqrt{3}$ N, 2.5 m from A

12. A two member truss ABC is shown in figure. The axial force (in kN) transmitted in member AB is



(a) 40 kN (b) 10 kN
(c) 20 kN (d) 30 kN

13. If the propeller of an aeroplane rotates clockwise when viewed from the rear and the aeroplane takes a right turn, the gyroscopic effect will
(a) Tend to raise the tail and depress the nose
(b) Tend to raise the nose and depress the tail
(c) Tilt the aeroplane about spin axis
(d) Have no effect

14. A man is climbing up a ladder which is resting against a vertical wall. When he was exactly half way up, the ladder started slippling. The path traced by the man is
(a) Parabola (b) Circle
(c) Ellipse (d) Hyperbola

15. When the primary direct crank of a reciprocating engine positioned at 30^0 clockwise, the secondary reverse crank for balancing will be at
(a) 30^0 anticlockwise
(b) 60^0 anticlockwise
(c) 30^0 clockwise
(d) 60^0 clockwise

16. A thin uniform rod of length L and mass M is free to rotate in vertical plane as shown in figure below. The time period of its oscillation in vertical plane is
(a) $T = 2\pi\sqrt{\frac{L}{2g}}$ (b) $T = 2\pi\sqrt{\frac{2L}{3g}}$
(c) $T = 2\pi\sqrt{\frac{L}{g}}$ (d) $T = 2\pi\sqrt{\frac{3L}{4g}}$

17. A 60 kg man is weighted by a balance as 54 kg in lift which is accelerated downwards. The acceleration of the lift is
(a) 1.26 m/s^2 (b) 1.98 m/s^2
(c) 0.98 m/s^2 (d) 1.76 m/s^2

18. Smallest and largest natural frequency of a 'n' degree freedom system are ω_1 and ω_n respectively. Approximate natural frequency estimated by Rayleigh's and Dankerley's methods are ω_1 and ω_d respectively. Which of the following statements is true?
(a) $\omega_r < \omega_1 \; and \; \omega_d < \omega_1$
(b) $\omega_r < \omega_1 \; and \; \omega_d > \omega_1$
(c) $\omega_r > \omega_1 \; and \; \omega_d > \omega_1$
(d) $\omega_r > \omega_1 \; and \; \omega_d < \omega_1$

19. A thin spherical shell is subjected to an external pressure P_0. The volumetric strain of the spherical shell is (where, d is the diameter of shell, t is the thickness of the shel,l E is Young's modulus of elasticity of shell material, μ is Poisson's ratio of shell material)
(a) $\frac{p_0 d}{4tE}(5-4\mu)$ (b) $\frac{3p_0 d}{4tE}(1-\mu)$
(c) $\frac{3p_0 d}{4tE}(1-2\mu)$ (d) $-\frac{3p_0 d}{4tE}(1-\mu)$

20. When there is a sudden increase or decrease in shear force diagram between any two points, it indicates that there is
(a) No loading between the two points
(b) Point load at the two points
(c) Uniformly varying load between the two points
(d) Uniformly distributed load between the two points

21. Maximum shear stress in a solid shaft of diameter D and length L twisted through an angle Θ is τ. A hollow shaft of the same material and length having outside and inside diameters of D and $\frac{D}{2}$ respectively is also twisted through the same angle of twist θ. The value of maximum shear stress in the hollow shaft will be
(a) $\frac{16}{15}\tau$ (b) $\frac{8}{7}\tau$
(c) $\frac{4}{3}\tau$ (d) τ

22. A spring used to absorb shocks and vibration is
(a) Torsion spring (b) Conical spring

(c) Leaf spring (d) Disc spring

23. Two shafts of equal length and similar material in which one is hollow and other is solid are transmitting same level of torque. If the inside diameter is $\frac{2}{3}$ of the outside diameter of the hollow shaft, the ratio of weight of hollow shaft to weight of solid shaft is

(a) 0.642 (b) 0.358
(c) 0.732 (d) 1.444

24. For the state of stress of pure shear τ, the strain energy stored per unit volume in the elastic, homogeneous, isotropic material having elastic constants-Young's modulus, E and Poisson's ratio will be

(a) $\frac{\tau^2}{E}(1+\upsilon)$ (b) $\frac{\tau^2}{2E}(1+\upsilon)$
(c) $\frac{2\tau^2}{E}(1+\upsilon)$ (d) $\frac{\tau^2}{2E}(2+\upsilon)$

25. A circular solid rod of diameter 'd' welded to a rigid flat plate by a circular fillet weld of throat thickness 't' is subjected to a twisting moment 'T'. The maximum shear stress induced in the weld is

(a) $\frac{T}{\pi t d^2}$ (b) $\frac{2T}{\pi t d^2}$
(c) $\frac{4T}{\pi t d^2}$ (d) $\frac{8T}{\pi t d^2}$

26. The notch sensitivity q is expressed in terms of fatigue stress concentration factor K_f and theoretical stress concentration factor K_t as

(a) $\frac{K_f+1}{K_t+1}$ (b) $\frac{K_f-1}{K_t-1}$
(c) $\frac{K_t+1}{K_f+1}$ (d) $\frac{K_t-1}{K_f-1}$

27. A shaft has dimension φ 35(- 0.009 to – 0.025). The respective values of fundamental deviation and tolerance are

(a) – 0.025, ± 0.008 (b) – 0.025, 0.016
(c) – 0.009, ± 0.008 (d) – 0.009, 0.016

28. A thin walled spherical shell is subjected to an internal pressure. If the radius of the shell is increased by 1% and the thickness is reduced by 1% with the internal pressure remaining the same, the % change in circumferential (hoop) stress is

(a) 0 (b) 1
(c) 1.08 (d) 2.02

29. If there are n_1 discs on the driving shaft and n_2 discs on the driven shaft in a multi-plate clutch, then the number of pairs of contact surface is

(a) $n_1 + n_2$ (b) $n_1 + n_2 - 1$
(c) $n_1 + n_2 + 1$ (d) $n_1 + n_2 + 2$

30. When a helical compression spring is cut into halves, the stiffness of the resulting spring will be

(a) One half (b) One fourth
(c) Double (d) Same

31. Chromium as an alloying element in alloy steel is used principally to

(a) Improve harden ability
(b) Improve mechanical properties at low temperature
(c) Improve mechanical properties at elevated temperature
(d) Improve the corrosion and oxidation resistance

32. The composition of some of the alloy steels are as under

1. 18W4Cr1V
2. $12M_01W4Cr1V$
3. $5M_06W4Cr2V$
4. 18W8Cr1V

The composition of commonly used high speed steels would include

(a) 1 and 2 (b) 2 and 3
(c) 1 and 4 (d) 1 and 3

33. The materials which slow direction dependent properties are called

(a) Homogenous materials
(b) Viscoelastic materials
(c) Isotropic materials
(d) Anisotropic materials

34. Atomic radius of Face Centred Cubic (FCC) crystal is a = lattice parameter

(a) $\frac{a\sqrt{2}}{4}$ (b) $\frac{a\sqrt{3}}{2}$
(c) $\frac{a\sqrt{3}}{4}$ (d) $\frac{a\sqrt{2}}{3}$

35. Which of the following phase of steels is NOT present in iron-carbon phase diagram
(a) Ferrite (b) Cementite
(c) Austenite (d) Martensite

36. The machine tool guide ways are usually hardened by
(a) Induction hardening
(b) Flame hardening
(c) Vacuum hardening
(d) Martempering

37. Twin boundaries are which type of crystal defect?
(a) Line defect (b) Point defect
(c) Surface defect (d) None of the above

38. The function of interpolator in a CNC machine controller is to
(a) Control spindle speed
(b) Control feed rate of axes
(c) Control tool rapid speed
(d) Control tool rapid speed

39. During calculation of material removal rate in electro-discharge machining, supply voltage was used 60 V in plane of the actual supply voltage 40 V. Condition for maximum power delivery to the discharge circuit is satisfied. The ratio of actual to calculated material removal rate will be
(a) $\frac{3}{2}$ (b) $\frac{4}{9}$
(c) $\frac{9}{4}$ (d) $\frac{2}{3}$

40. Straight polarity in arc welding is obtained with
(a) Alternating current electrode with electrode being positive
(b) Direct current electrode with electrode being positive
(c) Direct current electrode with electrode being negative
(d) Alternating current electrode with electrode being negative

41. A good machinability rating would indicate
(a)Long tool life, high power requirement and less machining time
(b)Long tool life, low power requirement and a good surface finish
(c) Short tool life and a good surface finish
(d)Long tool life, high power requirement and a good surface finish

42. Find the blanking force required to punch 10 mm diameter holes in a steel sheet of 3 mm thickness. Given shear strength of material = 400 MPa, penetration = 40% and shear provided on the punch = 2mm.
(a) 22.6 kN (b) 37.7 kN
(c) 61.6 kN (d) 94.3 kN

43. If the speed of machining combined cemented carbide and steel tools is halved, then the tool life changes by (assume Taylor's exponent = 0.25 for single point turning operation)
(a) 2 times (b) 4 times
(c) 8 times (d) 16 times

44. In which of the following welding process flux is fed separately?
(a) Electric arc welding
(b) Plasma arc welding
(c) Tungsten inert gas arc welding
(d) Submerged arc welding

45. Which of the following operation does NOT use a jig?
(a) Tapping (b) Reaming
(c) Turning (d) Drilling

46. In machining operation if path of generatrix and directrix are circular and straight line respectively, the surface obtained will be
(a) Cylindrical (b) Helical
(c) Plain (d) Surface of revolution

47. Critical path method is good for
(a) Small projects only
(b) Large projects only
(c) Both small and large projects equally
(d) Neither small nor large projects

48. Term "Value" in value engineering refers to
(a) Total cost of the product
(b) Selling price of the product
(c) Utility of the product
(d) Manufacturing cost of the product

49. Classifying items in A, B and C categories for selective control in inventory management is done by arranging items in the decreasing order of
(a) Total inventory cost
(b) Item value
(c) Annual usage value
(d) Item demand

50. An industry produces 300 spark plugs in one shift of 8 hours. If standard time per piece is 1.5 minute, the productivity would be
(a) $\frac{3}{4}$ (b) $\frac{5}{8}$
(c) $\frac{7}{16}$ (d) $\frac{15}{16}$

51. In sampling inspection the maximum % defective that can be treated satisfactory as a process average is
(a) Rejectable Quality level (RQL)
(b) Acceptable Quality level (AQL)
(c) Average Outgoing Quality level (AOQL)
(d) Lot Tolerance Percent Defective (LTPD)

52. A technology for application of mechanical, electronics and computer based systems to control and operate the systems is called
(a) PLC
(b) Sequential controller
(c) Microprocessor based system
(d) Automation

53. Which of the following devices produces incremental motion through equal pulses?
(a) AC servo motor
(b) DC servo motor
(c) Stepper motor
(d) Series motor

54. The degree of freedom of a SCARA robot are
(a) Six (b) Five
(c) Four (d) Three

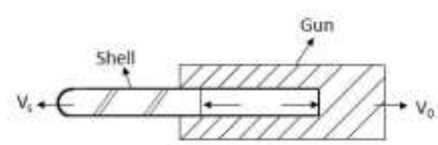
55. Hall sensor is used to a measure the
(a) Position of shaft
(b) Angular velocity
(c) Strength of magnetic field
(d) All the above

56. Work done by non-conservative forces on a particle is equal to
(a) Change in kinetic energy
(b) Change in mechanical energy
(c) Change in potential energy
(d) Change in internal energy

57. If a distributed force system on a beam is replaced, which of the following is same for both the beams?
(a) Support reactions
(b) Shear force diagram
(c) Bending moment diagram
(d) Maximum bending moment

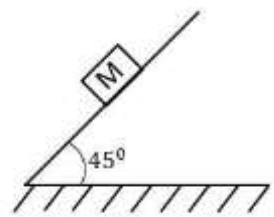
58. A simply supported beam of span L is subjected to a moment M_0 at a distance of $\frac{L}{4}$ from the left end. Magnitude of the maximum bending moment in the beam is
(a) M_0 (b) $\frac{M_0}{2}$
(c) $\frac{M_0}{4}$ (d) $\frac{3M_0}{4}$

59. A gun of mass 3000 kg fires horizontally a shell of mass 50 kg with a velocity of 300 m/s. What is the velocity with which the gun will recoil?



(a) – 5 m/s (b) 10 m/s
(c) 50 m/s (d) 30 m/s

60. A body of mass (M) 10 kg is initially stationary on a 45^0 inclined plane as shown in figure below. The coefficient of dynamic friction between the body and inclined plane is 0.5. The body slides down the inclined plane and attains a velocity of 20 m/s. The distance travelled (in meter) by the body along the inclined plane is

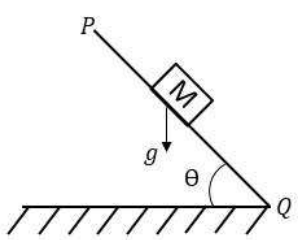


(a) 5.78 m (b) 57.8 m
(c) 34.6 m (d) 3.46 m

61. A simply supported beam of span **l** carries a uniformly variable load of intensity w_0x over its entire span. Maximum bending moment in the beam is

(a) $\frac{w_0 l^3}{27}$ (b) $\frac{w_0 l^3}{27}\sqrt{3}$
(c) $\frac{w_0 l^3}{9}\sqrt{2}$ (d) $\frac{w_0 l^3}{9}$

62. A block of mass M is released from point P on a rough inclined plane with angle of inclination θ as shown in figure below. The coefficient of friction is μ. If $\mu < \tan\theta$, then the time taken by the block to reach point Q on the inclined plane, where PQ = s is



(a) $\sqrt{\frac{2S}{g\cos\theta(\tan\theta-\mu)}}$
(b) $\sqrt{\frac{2S}{g\cos\theta(\tan\theta+\mu)}}$
(c) $\sqrt{\frac{2S}{g\sin\theta(\tan\theta-\mu)}}$
(d) $\sqrt{\frac{2S}{g\sin\theta(\tan\theta+\mu)}}$

63. Moment of inertia of a thin spherical shell of mass M and radius R, about its diameter is

(a) MR^2 (b) $\frac{MR^2}{2}$
(c) $\frac{2}{5}MR^2$ (d) $\frac{2}{3}MR^2$

64. Which one of the following can completely balance several masses revolving in different planes on a shaft?

(a) A single mass in different planes
(b) A single mass in one of the planes of the revolving masses
(c) Two masses in any two planes
(d) Two equal masses in any two planes

65. Linear acceleration of slider in slider crank mechanism may be expressed as: (r= radius of the crank, **l** = length of the connecting rod and n = $\frac{l}{r}$)

(a) $\omega^2 r[\cos\theta + \sin 2\theta/n]$
(b) $\omega^2 r[\cos\theta + \cos 2\theta/n]$
(c) $\omega^2 r[\sin\theta + \sin 2\theta/n]$
(d) $\omega r[\cos\theta + \cos 2\theta/n]$

66. The effect of the mass of spring can be considered for calculating natural frequency of a spring mass system by adding ' n' times the mass of spring to the main mass. The value of 'n' is

(a) $\frac{1}{2}$ (b) $\frac{1}{3}$
(c) $\frac{1}{4}$ (d) $\frac{2}{3}$

67. In a radial cam translating follower mechanism, the offset is provided to

(a) Decrease the pressure angle during descent of the follower
(b) Decrease the pressure angle during ascent of the follower
(c) Increase the pressure angle during ascent of the follower
(d) Avoid any obstruction due to other machine parts

68. 20^0 full depth involute profile 19 tooth pinion and 37 teeth gear are in mesh. If the module is 5 mm, then the centre distance between the gear pair is

(a) 140 mm (b) 150 mm
(c) 280 mm (d) 300 mm

69. Initial tension in the belt of a belt drive is T_0. At the point of maximum power transmission, the belt speed is given by (where m is mass of unit length of the belt)

(a) $\sqrt{\frac{T_0}{m}}$ (b) $\sqrt{\frac{3T_0}{m}}$

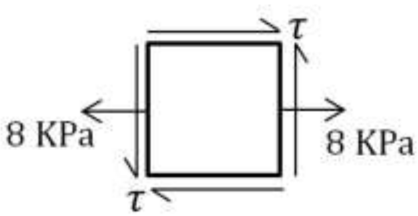
(c) $\frac{T_0}{3m}$ (d) $\sqrt{\frac{T_0}{3m}}$

70. A cantilever beam, 2m in length is subjected to a uniformly distributed load of 10 kN/m. If E = 200 GPa and I = 1000 cm^4, the strain energy stored in the beam will be

(a) 7 Nm (b) 12 Nm

(c) 8 Nm (d) 40 Nm

71. For the plane stress state shown below if the largest stress is 10 kPa, find the magnitude of unknown shear stress (τ).



(a) 3.47 KPa (b) 4.47 KPa

(c) 5.47 KPa (d) 6.47 KPa

72. Consider a two dimensional state of stress for an element

Where, σ_x = 200 MPa

$\sigma_y = -100$ MPa

The co-ordinates of the centre of Mohr's circle are

(a) (0,0) (b) (100, 200)

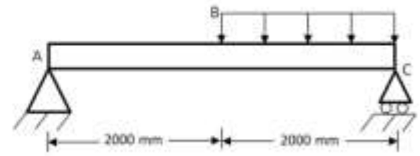
(c) (200, 100) (d) (50 , 0)

73. What is the maximum torque transmitted by a hollow shaft of external radius 'R', internal radius 'r' and maximum allowable shear stress τ?

(a) $\frac{\pi}{16}(R^3 - r^3)\tau$ (b) $\frac{\pi}{2R}(R^4 - r^4)\tau$

(c) $\frac{\pi}{8R}(R^4 - r^4)\tau$ (d) $\frac{\pi}{32}(R^4 - r^4)\tau$

74. A massless beam has a loading pattern as shown in the Figure. The maximum bending moment occurs at



(a) Location B

(b) 2675 mm to the right of A

(c) 2500 mm to the right of A

(d) 3225 mm to the right of A

75. Internal and external radii of a thick cylinder are a and b. It is subjected to an internal pressure of p_i. The radial stress at a radius r in the cylinder is

(a) $\frac{a^2p_i}{(b^2-a^2)}\left(1 - \frac{a^2}{r^2}\right)$

(b) $\frac{a^2p_i}{(b^2-a^2)}\left(1 - \frac{b^2}{r^2}\right)$

(c) $\frac{b^2p_i}{(b^2-a^2)}\left(1 - \frac{a^2}{r^2}\right)$

(d) $\frac{b^2p_i}{(b^2-a^2)}\left(1 - \frac{b^2}{r^2}\right)$

76. A shaft is subjected to a bending moment M = 0.75 kNm and a twisting moment T = 1 kNm. The magnitude of equivalent bending moment in shaft is

(a) 1.25 kNm(b) 1.125 kNm

(c) 1.0 kNm (d) 0.75 kNm

77. If the size of a standard specimen for a fatigue testing machine is increased, the endurance limit for the material will

(a) Have same value as that of standard specimen

(b) Increase

(c) Decrease

(d) None of the above

78. If the load on a ball bearing is halved, its life

(a) Remains unchanged

(b) Increases two times

(c) Increases four times

(d) Increases eight times

79. The deflection of a close coiled helical spring with 20 active turns under a load of 1000 N is 10 mm. The spring is divided into two pieces each of 10 active turns and placed in parallel under the same load. The deflection of this system is

(a) 20 mm (b) 10 mm
(c) 5 mm (d) 2.5 mm

80. Find the dynamic load carrying capacity of a roller bearing if the shaft rotates at 1500 rpm, radial load acting on the bearing is 6 kN and the expected life for 90% life of the bearing is 8100 hours.
(a) 6 kN (b) 54 kN
(c) 54000 kN(d) 60000 kN

81. If ‘w’ is the load on a cylindrical journal of diameter (d) and length (l) , then bearing pressure is
(a) $\frac{2w}{\pi d^2}$ (b) $\frac{4w}{\pi d^2 l}$
(c) $\frac{w}{\pi d l}$ (d) $\frac{w}{dl}$

82. δ-iron occurs in the temperature range of
(a) Between 400 ^{0}C to 600 ^{0}C
(b) Between 600 ^{0}C to 900 ^{0}C
(c) Between 900 ^{0}C to 1400 ^{0}C
(d) Between 1400 ^{0}C to 1539 ^{0}C

83. Tensile test performed on Universal testing
(a) True stress and True strain
(b) Young’s Modulus and Poisson’s ratio
(c) Engineering Stress and Engineering Strain
(d) Load and Elongation

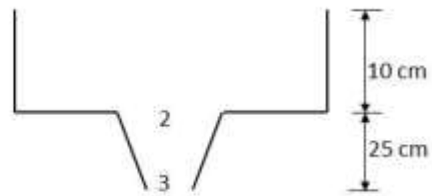
84. The process which does not improve the fatigue strength of a material is
(a) Shot peening of the surface
(b) Electroplating of the surface
(c) Polishing of the surface
(d) Cold rolling of the surface

85. Which of the following are the advantages of polymer composite materials?
1. Higher Specific Strength
2. Higher Specific Modulus
3. Higher Corrosion Resistance
4. Higher Residual Stresses
(a) 1, 2, 3 (b) 1, 2, 4
(c) 1, 3, 4 (d) 1, 2, 3, 4

86. Stainless steels are highly corrosion resistance due to the presence of
(a) Chromium (b) Manganese
(c) Molybdenum (d) Nickel

87. Packing efficiency of Body Centred Cubic (BCC) crystal is
(a) 0.68 (b) 0.74
(c) 0.50 (d) 0.65

88. For the sprue shown below what should be the area of point 3 in order to avoid aspiration effect? Given area at point 2 = 125 cm^2.



(a) 79.05 cm^2 (b) 105.84 cm^2
(c) 66.81 cm^2 (d) 96.82 cm^2

89. Spring back during the sheet metal operation is caused because of the
(a) Release of the stored energy during the elastic and plastic deformation
(b) Release of the stored energy during the plastic deformation
(c) Release of the stored energy during the elastic deformation
(d) Excess energy that was utilized during the forming process

90. In computer aided part programming by Automatically Program Tool (APT), ‘ COOLNT/ON’ is a
(a) Geometry Statement
(b) Motion Statement
(c) Post processor Statement
(d) Set up Statement

91. An orthogonal cutting operation is being carried out under the following conditions: Cutting speed = 2 m/sec, Depth of cut = 0.5 mm, Chip thickness = 0.6 mm. What is the chip velocity?
(a) 2 m/sec (b) 2.4 m/sec
(c) 1 m/sec (d) 1.66 m/sec

92. Low helix angle drills are used for drilling holes in

(a) Plastics (b) Copper
(c) Cast steel (d) Carbon steel

93. In Ultrasonic Machining (USM) process the material removal rate will be higher for materials with
(a) Higher ductility
(b) Higher fracture strain
(c) Lower toughness
(d) Higher toughness

94. Which of the following represents the type of fit for a hole and shaft pair? Given that hole = $50^{+0.04}_{+0.00}$ mm and shaft $50^{+0.060}_{+0.041}$ mm
(a) Clearance fit (b) Loose fit
(c) Transition fit (d) Interference fit

95. For machining ceramics, glasses and plastics, which method is NOT applicable?
(a) LBM (b) AJM
(c) EDM (d) USM

96. A comparator for its working depends on
(a) Accurately calibrated scale
(b) Comparison with standard such as slip gauges
(c) Optical device
(d) Limit gauges

97. In machining processes, the percentage of total heat generated in shear action is carried away by the chips to the extent of
(a) 10% (b) 25%
(c) 50% (d) 80%

98. Group Technology brings together and organizes
(a) Parts and simulation analysis
(b) Documentation and analysis
(c) Automation and tool production
(d) Common parts, problems and tasks

99. Which of the following layout is used for the manufacturing of large aircrafts?
(a) Product layout
(b) Process layout
(c) Fixed position layout
(d) Combination layout

100. The leaving basic variable in simplex method is the basic variable that
(a) has the lowest value
(b) has the smallest coefficient in the key row
(c) has the largest coefficient in the key row
(d) goes to zero first, as the entering basic variable is increased

1 (c)	21 (d)	41 (b)	61 (b)	81 (d)
2 (c)	22 (c)	42 (a)	62 (a)	82 (d)
3 (d)	23 (a)	43 (d)	63 (d)	83 (d)
4 (c)	24 (a)	44 (d)	64 (c)	84 (b)
5 (b)	25 (b)	45 (c)	65 (b)	85 (d)
6 (a)	26 (b)	46 (a)	66 (b)	86 (a)
7 (b)	27 (d)	47 (c)	67 (b)	87 (a)
8 (c)	28 (d)	48 (c)	68 (a)	88 (c)
9 (b)	29 (b)	49 (c)	69 (d)	89 (a)
10 (b)	30 (c)	50 (d)	70 (d)	90 (c)
11 (b)	31 (d)	51 (c)	71 (b)	91 (d)
12 (c)	32 (d)	52 (d)	72 (d)	92 (d)
13 (a)	33 (d)	53 (c)	73 (b)	93 (c)
14 (b)	34 (a)	54 (c)	74 (c)	94 (d)
15 (b)	35 (d)	55 (d)	75 (b)	95 (c)
16 (b)	36 (b)	56 (b)	76 (c)	96 (d)
17 (c)	37 (c)	57 (a)	77 (c)	97 (d)
18 (d)	38 (b)	58 (d)	78 (d)	98 (a)
19 (d)	39 (b)	59 (a)	79 (d)	99 (c)
20 (b)	40 (c)	60 (b)	80 (*)	100 (b)

8. $m_1 = 30$ kg, $m_2 = 10$ kg

$$\frac{1}{2}\, m_1 v_1^2 = \frac{1}{2}\, m_2 v_2^2$$

$$\left(\frac{v_1}{v_2}\right)^2 = \frac{m_2}{m_1} = \frac{10}{30}$$

$$\frac{v_1}{v_2} = \frac{1}{\sqrt{3}}$$

$$\frac{m_1 v_1}{m_2 v_2} = \frac{30}{10} \times \frac{1}{\sqrt{3}} = \sqrt{3}$$

9. For stable equilibrium,

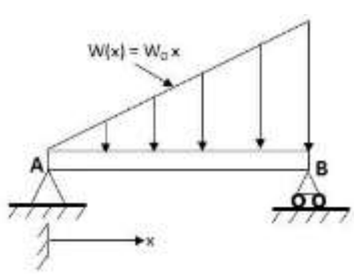
Potential energy should be minimum.

Variation of P.E (U) = 0

$$\delta U = 0$$

Also, $\delta^2 U = 0$

10.



Force equilibrium in vertical direction

$$R_A + R_B = \int_{x=0}^{x=L} w(x)dx = \int_{x=0}^{x=L} w_0\, x\, dx$$

$$R_A + R_B = \frac{w_0 L^2}{2}$$

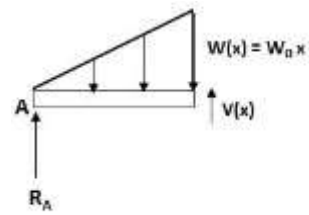
Moment equilibrium about point B,

$$\sum M_B = 0$$

$$R_A \times L - \frac{w_0 L^2}{2} \times \frac{L}{3} = 0$$

$$R_A = \frac{w_0 L^2}{6} \quad \text{and} \quad R_B = \frac{w_0 L^2}{3}$$

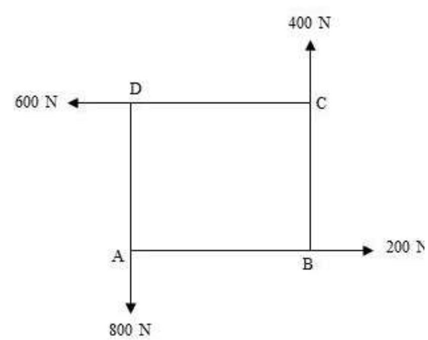
At maximum Bending moment, shear force is equal to zero.



$$V(x) = \frac{w_0 x^2}{2} - \frac{w_0 L^2}{6} = 0$$

$$x = \frac{L}{\sqrt{3}}$$

11.

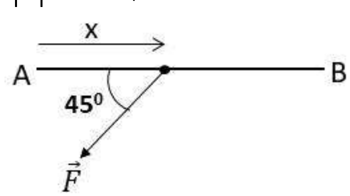


$$\sum \vec{F} = (200\,N - 600\,N)\hat{\imath} + (400\,N - 800\,N)\hat{\jmath}$$

$$= -400\,N\,\hat{\imath} - 400\,N\hat{\jmath}$$

$$\sum M_A = 400 \times 1 + 600 \times 1 = 1000 \text{ N-m}$$

$$|\vec{F}| = 400\sqrt{2}\text{ N}$$

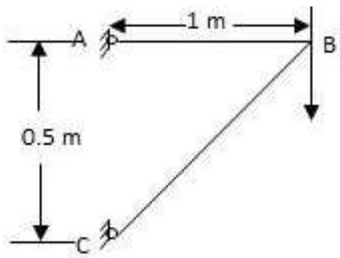


Moment due to resultant force F about point A

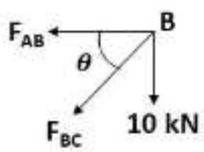
$$|\vec{F}| \times x \times \frac{1}{\sqrt{2}} = 1000$$

$$x = 2.5 \text{ m}$$

12.

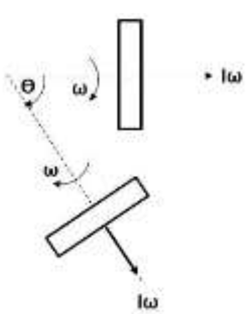


Method of joint at B,



$$\sum F_x = 0$$
$$F_{AB} + F_{BC}\cos\theta = 0 \quad ----(1)$$
$$\sum F_y = 0$$
$$10 + F_{BC}\sin\theta = 0 \quad ----(2)$$
$$F_{BC} = -\frac{10}{\sin\theta}$$
By (1),
$$F_{AB} - \frac{10}{\sin\theta}\cos\theta = 0$$
$$F_{AB} = 10\,\cot\theta$$
$$\cot\theta = \frac{b}{p} = \frac{1}{0.5} = 2$$
$$F_{AB} = 20\text{ N}$$

13.



Initial angular momentum

$$\vec{L}_i = I\omega\,\hat{\imath}$$

Final angular momentum,

$$\vec{L}_f = I\omega\cos d\theta\ \hat{\imath} + I\omega\sin d\theta\ \hat{\jmath}$$

$$\vec{L}_f - \vec{L}_i = I\omega(\cos d\theta - 1)\hat{\imath} + I\omega\sin d\theta\ \hat{\jmath}$$

$d\Theta \approx$ small

$\cos d\theta\ \approx 1$ and $\sin d\theta\ \approx d\theta$

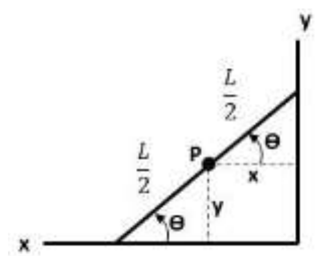
$$\vec{L}_f - \vec{L}_i = I\omega\ d\theta\,\hat{\jmath}$$

Torque T $= \frac{d\vec{L}}{dt} = I\omega\frac{d\theta}{dt}\,\hat{\jmath} = I\omega\omega_p\,\hat{\jmath}$

Reactive gyroscopic couple $\vec{C} = -T = -I\omega\omega_p\,\hat{\jmath}$

Reactive couple tend to raise tail and depress nose.

14.



$x = \frac{L}{2}\cos\theta$ and $y = \frac{L}{2}\sin\theta$

$$x^2 + y^2 = \frac{L^2}{4} = R^2$$

R = L/2

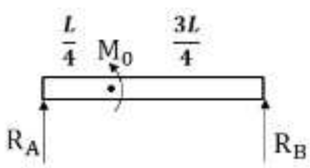
Locus of mid point of rod is a circle with centre is origin and radius is L/2.

17. $Ma = Mg - N$
M = 60 kg, N = 54g
Ma = 60g – 54g = 6g
60a = 6 × 9.8
a = 0.98 m/s^2

43. Tool life: $VT^n = C$
$\boldsymbol{V_2 = \frac{V_1}{2}}$ and n = 0.25
$V_1T_1^n = V_2T_2^n$

$T_2 = T_1 \left(\frac{V_1}{V_2}\right)^{\frac{1}{0.25}} = 16\, T_1$

58.



$R_A + R_B = 0$

Moment equilibrium about point A

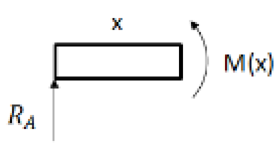
$R_B L + M_0 = 0$

$R_B = -\frac{M_0}{L}$

$R_A = +\frac{M_0}{L}$

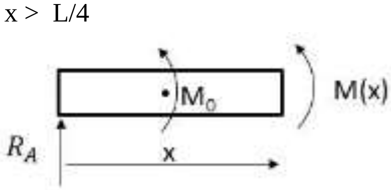
Let at a distance x from point A

0 < x < L/4



M(x) = $R_A \times x = \frac{M_0}{L} \times x = \frac{M_0}{L}\, x$

x > L/4



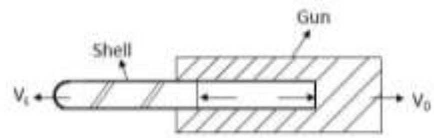
M(x) = $-M_0 + \frac{M_0}{L}\, x$

x = L/4

M($\frac{L}{4}$) = $-\frac{3}{4}\, M_0$

Maximum bending moment = $\frac{3}{4}\, M_0$

59.



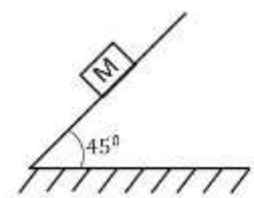
Apply conservation of linear momentum,

$M_s V_s + M_{Gun} V_0 = 0$

$50 \times 300 + 3000 \times V_0 = 0$

$V_0 = -5$ m/s

60.

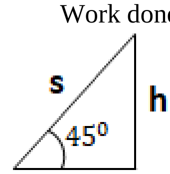


Initial velocity of mass M is 0 m/s.

Final velocity of mass M is 20 m/s.

Let distance covered is s metres.

Work done by gravity force = mg h



h = s sin 45^0 = 0.707 s

Work done by friction force = - μN × s

Normal force N = mg sin 45^0

Work done by friction force = - μmg sin 45^0 × s

From work – kinetic energy theorem,

Sum of work done by conservative force and non-conservative force is equal to change in kinetic energy.

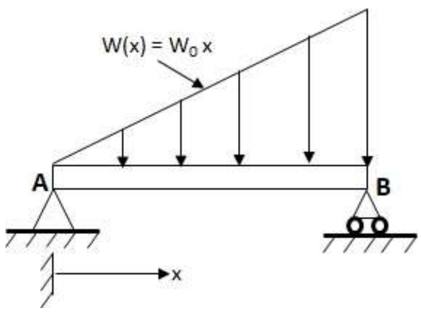
$W_{C.F} + W_{N.C.F} = \Delta K.E$

$mgh - \mu mg \sin 45^0 \times s = \frac{1}{2} m(v^2 - u^2)$

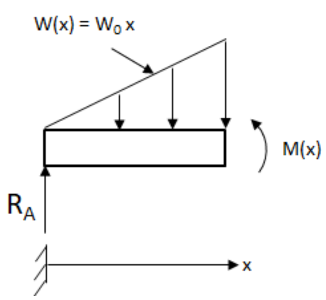
$g \times 0.707\, s - 0.5 \times g \times 0.707 \times s = \frac{1}{2} \times 20^2$

$s = \frac{200}{0.707 \times 9.81 - 0.5 \times 9.81 \times 0.707} = 57.7$ m

61.



Location of maximum Bending MomentTake a section at a distance x from point A.



Reaction at A, $R_A = \frac{w_0 L^2}{6}$

Location of maximum bending moment occur at $x = \frac{L}{\sqrt{3}}$

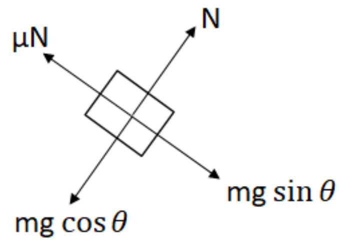
$$M\left(x = \frac{L}{\sqrt{3}}\right) = \frac{w_0 L^2}{6} \times \frac{L}{\sqrt{3}} - \frac{w_0 x^2}{6} \times \frac{x}{3}$$

$$= \frac{w_0 L^3}{6\sqrt{3}} - \frac{w_0}{18} \times \left(\frac{l}{\sqrt{3}}\right)^3 = \frac{w_0 L^3 \sqrt{3}}{27}$$

62. $S = \frac{1}{2} a t^2$

$t = \sqrt{\frac{2S}{a}}$

Free body diagram of mass M



$N = mg\ \cos\theta$

$ma = mg \sin\theta - \mu N$

$ma = mg \sin\theta - \mu mg\ \cos\theta$

$a = g\cos\theta\,(\tan\theta - \mu)$

66. Kinetic energy of the system

$T = \frac{1}{2} m\dot{x}^2 + \int_0^L \frac{1}{2} dm\dot{y}^2$

$dm = \frac{m_s}{L}$dy

m_s = mass of spring

$\dot{y} = \dot{x}\frac{y}{L}$

$\int_0^L \frac{1}{2} dm\dot{y}^2 = \int_0^L \frac{1}{2} \times \frac{m_s}{L} \text{dy} \times \dot{x}^2 \times \frac{y}{L} = \frac{m_s}{2L^2}\dot{x}^2 \left.\frac{y^3}{3}\right|_0^L$

$= \frac{1}{2} m_s \frac{\dot{x}^2}{3}$

$T = \frac{1}{2} m\dot{x}^2 + \frac{1}{2} m_s \frac{\dot{x}^2}{3}$

Potential energy V

$V = \frac{1}{2} kx^2$

By energy method

Maximum kinetic energy = maximum potential energy

Maximum velocity = Aω

Maximum kinetic energy = $\frac{1}{2} mA^2\omega^2 + \frac{1}{6} m_s A^2\omega^2$

Maximum potential energy = $\frac{1}{2} kA^2$

$\frac{1}{2} mA^2\omega^2 + \frac{1}{6} m_s A^2\omega^2 = \frac{1}{2} kA^2$

$\omega = \sqrt{\frac{k}{m + \frac{m_s}{3}}}$

68. Centre distance = $r_1 + r_2$

$C_1 C_2 = \frac{m\,(z_P + z_G)}{2} = \frac{5(19+37)}{2} = 140\ mm$

70. The strain energy in the beam

$U = \int_0^L \frac{1}{2} M(x) d\theta$

$\frac{d\theta}{dx} = \frac{1}{R}$ and $\frac{M(x)}{I(x)} = \frac{E}{R}$

$U = \int_0^L \frac{1}{2} M(x) \frac{M(x)}{E\,I(x)} dx = \int_0^L \frac{1}{2} \frac{M^2}{E\,I} dx$

$M(x) = \frac{w \times x^2}{2}$

$U = \int_0^L \frac{1}{8}\frac{w^2x^4}{EI}dx = \frac{w^2L^5}{40EI}$

Given w = 10 kN/m, E = 200 GPa,

I = 1000 cm^4, L = 2m

$U = \frac{w^2L^5}{40EI} = \frac{(10\times10^3)^2\times2^5}{10\times200\times10^9\times1000\times10^{-8}}$

U = 40 Nm

71. $\sigma_x = 8$ kPa, $\tau = \tau$, $\sigma_y = 0$ kPa

Maximum principal stress $\sigma_{max} = 10$ kPa

$$\sigma_{max} = \frac{\sigma_x+\sigma_y}{2} + \sqrt{\left(\frac{\sigma_x-\sigma_y}{2}\right)^2 + \tau^2}$$

$$10 = \frac{8+0}{2} + \sqrt{\left(\frac{8-0}{2}\right)^2 + \tau^2}$$

$$10 = 4 + \sqrt{16+\tau^2}$$

τ = 4.47 kPa

72. $\sigma_x = 200$ MPa, $\sigma_y =$ -100 MPa

Co-ordinate of centre of Mohr's circle

$C = \left(\frac{\sigma_x+\sigma_y}{2}, 0\right) = \left(\frac{200-100}{2}, 0\right) = (50, 0)$

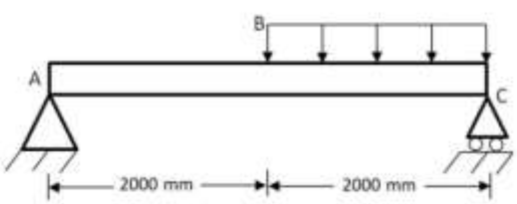
73. Polar modulus of inertia of hollow shaft

$$J = \frac{\pi R^4 - \pi r^4}{2}$$

$$\frac{T}{J} = \frac{\tau_{max}}{R}$$

$$T = \frac{\tau_{max}}{R}\times J_H = \frac{\tau}{R}\times\frac{\pi R^4 - \pi r^4}{2}$$

74.



When shear force is equal to zero, then bending moment is equal to zero.

Let R_{Ay} is reaction at joint A in vertical direction.

R_{cy} is reaction at joint C in vertical direction.

w is uniformly distributed load.

Force equilibrium in vertical direction:

$R_{Ay} + R_{cy} = w \times 2$

Moment equilibrium about point C:

$R_{Ay}\times 4 = w \times 2 \times 1$

$R_{Ay} = \frac{w}{2}$ and $R_{cy} = \frac{3}{2}w$

Shear force at a distance of x from end A:

$V(x) = -R_{Ay}$ $\quad 0 < x < 2$ m

$= -R_{Ay} + w(x-2)$ $\quad 2$ m $< x < 4$ m

$V(x) = 0$

$-R_{Ay} + w(x-2) = 0$

$-\frac{w}{2} + w(x-2) = 0$

$x = 2 + \frac{1}{2} = \frac{5}{2} = 2.5$ m from A

Maximum bending moment occur at point 2.5 m away from joint A.

75. Radial stress in thick cylinder:

$$\sigma_r = A - \frac{B}{r^2}$$

$$A = \frac{p_ir_i^2 - p_0r_0^2}{r_0^2 - r_i^2}$$

$$B = \frac{(p_i - p_0)r_i^2r_0^2}{r_0^2 - r_i^2}$$

$P_i \rightarrow$ Internal pressure

$P_0 \rightarrow$ outer pressure

$r_0 \rightarrow$ outer radius

$r_i \rightarrow$ inner radius

$p_i = p_i$ and $p_0 = 0$

$r_0 = b$, $r_i = a$

$A = \frac{pa^2}{b^2-a^2}$ and $B = \frac{pa^2b^2}{b^2-a^2}$

$$\sigma_r = \frac{p_ia^2}{b^2-a^2} - \frac{p_ia^2b^2}{b^2-a^2}\times\frac{1}{r^2}$$

$$\sigma_r = \frac{p_ia^2}{b^2-a^2}\left(1 - \frac{b^2}{r^2}\right)$$

76. Maximum bending stress due to bending moment M:

$$\sigma_b = \frac{4M}{\pi R^3}$$

Maximum shear stress due to twisting moment T:

$$\tau_{max} = \frac{2T}{\pi R^3}$$

Maximum principal stress

$$\sigma_p = \frac{\sigma_x}{2} + \sqrt{\left(\frac{\sigma_x}{2}\right)^2 + \tau^2}$$

$$\sigma_p = \frac{\frac{4M}{\pi R^3}}{2} + \sqrt{\left(\frac{\frac{4M}{\pi R^3}}{2}\right)^2 + \left(\frac{2T}{\pi R^3}\right)^2}$$

$$\sigma_p = \frac{2}{\pi R^3}\left(M + \sqrt{M^2+T^2}\right)$$

$\sigma_p = \frac{4}{\pi R^3}\frac{\left(M + \sqrt{M^2 + T^2}\right)}{2} = \frac{4}{\pi R^3} M_e$

M_e → Equivalent bending moment

$M_e = \frac{\left(M + \sqrt{M^2 + T^2}\right)}{2}$

$M_e = \frac{0.75 + \sqrt{0.75^2 + 1^2}}{2}$

$M_e = 1\ kNm$

79. $k\,\Delta = mg$

$k = \frac{mg}{\Delta} = \frac{1000}{0.01} = 100$ kN/m

if spring is cut into two equal pieces then stiffness of spring is doubled.

$k' = 200$ kN/m

If spring is connected in parallel then equivalent stiffness of spring

$k_e = k_1 + k_2 = k' + k' = 2k' = 400$ kN/m

$\Delta' = \frac{mg}{k_e} = \frac{1000}{400 \times 1000}$ m = 2.5 mm

87. Number of effective atoms in BCC = 2

$$\sqrt{3}a = 4R$$

Volume occupied by two atoms = $2 \times \frac{4}{3}\pi R^3$

Volume of unit cell = a^3

Packing fraction = $\frac{\text{Volume occupied by two atoms}}{\text{Volume of unit cell}}$

Packing fraction = $\frac{2\times\frac{4}{3}\pi R^3}{a^3} = \frac{8\pi}{2}\left(\frac{R}{a}\right)^3$

$= 0.68$

91. Cutting velocity V_c = 2 m/sec

Depth of cut = 0.5 mm

Chip thickness = 0.6 mm

$V_c \times t = V_{chip} \times t_c$

$2 \times 0.5 = V_{chip} \times 0.6$

$V_{chip} = 1.66$ m/sec

94. Hole dimension: $50^{+0.04}_{+0.00}\ mm$

Shaft dimension: $50^{+0.060}_{+0.041}\ mm$

Minimum shaft dimension is maximum hole dimension. So interference fit occurs.

1. In a polytropic expansion process ratio of work to heat transfer is :
(a) $\frac{n-1}{\gamma-1}$ (b) $\frac{n}{\gamma}$
(c) $\frac{\gamma-1}{n-1}$ (d) $\frac{n}{\gamma-1}$
Where n , γ and r have their usual meanings.

2. Maximum amount of work that can be converted into heat in any process
(a) depends upon how much work is lost in friction
(b) is 50%
(c) depends upon initial and final temperatures
(d) is 100%

3. Equation $TdS = du + pdv$ can be applied to processes which are
(a) only reversible
(b) only irreversible
(c) reversible or irreversible both
(d) quasi-static

4. The more effective way to increase the efficiency of a Carnot engine is to
(a) increase T_1 keeping T_2 constant.
(b) decrease T_1 keeping T_2 constant.
(c) decrease T_2 keeping T_1 constant.
(d) increase T_2 keeping T_1 constant.
Where T_1 and T_2 are the temperatures of source and sink respectively.

5. Internal energy of an ideal gas is a function of
(a) entropy only (b) temperature only
(c) pressure only (d) volume only

6. Rankine cycle efficiency of a steam power plant
(a) improves in summer as compared to in winter.
(b) improves in winter as compared to in summer.
(c) is unaffected by climatic conditions.
(d) none of the above

7. In a Rankine cycle with an increase in the degree of super heat of steam, the efficiency of the cycle
(a) remains unchanged
(b) decreases
(c) increases
(d) can not be predicated

8. If a real gas obeys Clausius equation of state $p(v-b) = RT$ then
(a) $\left(\frac{\partial u}{\partial v}\right)_P = 0$ (b) $\left(\frac{\partial u}{\partial v}\right)_T = 0$
(c) $\left(\frac{\partial u}{\partial v}\right)_T = 1$ (d) $\left(\frac{\partial u}{\partial v}\right)_T = \frac{1}{p}$

9. A control volume refers to
(a) specified mass
(b) a closed system
(c) an isolated system
(d) a fixed region in space

10. For a constant volume process, v = constant, the value of $\left(\frac{\partial T}{\partial S}\right)_{v=constant}$ on T-P chart is given by
(a) $\frac{V}{C_v}$ (b) $\frac{P}{C_v}$
(c) $\frac{T}{C_v}$ (d) $\frac{C_v}{T}$

11. During frictionless throttling process
(a) entropy remains constant.
(b) internal energy remains constant.
(c) enthalpy remains constant.
(d) temperature remains constant.

12. For a Brayton cycle the air standard efficiency is given by
(a) $1 - \frac{1}{r^{(\gamma/\gamma-1)}}$ (b) $1 - \frac{1}{r^{(\gamma-1)}}$
(c) $1 - \frac{1}{r^{(\gamma-1/\gamma)}}$ (d) $1 - \frac{1}{r^{(1/\gamma-1)}}$

13. Rankine cycle efficiency of good steam power plant may in the range of
(a) 15 – 20 % (b) 35 – 45 %
(c) 55 – 65 % (d) 70 – 80 %

14. A ballon initially flat is inflated by means of compressed air to a volume of 0.3 m^3. Considering ballon as a system as a system the work for the process would be
(a) 16.5 kJ (b) 20.5 kJ
(c) 30.4 kJ (d) can not be found

15. Which law of thermodynamics defines entropy?
(a) First (b) Second
(c) Third (d) Zeroth

16. A heat engine is supplied with 2780 kJ/sec of heat at constant fixed temperature of 283 ^{0}C and the engine rejects 700 kJ/sec of heat at 5 ^{0}C. The engine is
(a) irreversible (b) reversible
(c) impossible (d) unique

17. A reversible process requires that
(a) there should no heat transfer
(b) Newton's law of viscosity be satisfied.
(c) temperature of system and surrounding be equal.
(c) there should be no viscous or columb friction in the system.

18. A refrigerator consumes 4000 kJ of energy and the internal energy of the system drops by 6000 kJ during a specified period of time. The net heat transfer for the system will be
(a) zero (b) positive
(c) negative (d) none of the above

19. For any reversible process the change in entropy of the system and surrounding is
(a) unity (b) positive
(c) negative (d) zero

20. During a polytropic expansion work obtained is 1.8 times the heat transferred. If $\gamma = 1.4$, n will be
(a) 1.178 (b) 1.19
(c) 1.2 (d) 1.15

21. Mechanical efficiency is not expressed by
(a) $\frac{B.P.}{I.P.}$ (b) $\frac{b.m.e.p}{i.m.e.p}$
(c) $\frac{B.P.}{I.P.+F.P.}$ (d) $\frac{I.P.-F.P}{I.P.}$

22. Theoretically correct air-fuel ratio for gasoline in S.I. engine is
(a) 9 : 1 (b) 12 : 1
(c) 15 : 1 (d) 18 : 1

23. In a C.I. engine, swirl is the
(a) radial motion imparted to air fuel mixture
(b) circular motion imparted to air
(c) circular motion imparted to burned gases.
(d) raidial motion to fuel supply

24. The effect of closing the throttle is to
(a) reduce the indicated power
(b) increase the indicated power
(c) keep the indicated power constant
(d) none of the above

25. The thickness of laminar boundary layer at a distance 'x' from the leading edge over a flat plate varies as
(a) $x^{4/5}$ (b) $x^{1/2}$
(c) $x^{1/5}$ (d) $x^{3/5}$

26. The velocity of pressure wave (c) in terms of bulk modulus (k) and density (ρ) is given by
(a) $c = \sqrt{\frac{\rho}{k}}$ (b) $c = \sqrt{\rho k}$
(c) $c = \sqrt{\frac{k}{\rho}}$ (d) none of the above

27. Boundary layer on a flat plate is called laminar boundary layer if
(a) Re < 2000
(b) Re <4000
(c) 4000 < Re < 5 x 10^5
(d) None of the above
Where: Re = Reynolds's number.

28. The ratio of inertia force to surface tension is known as
(a) Mach number
(b) Froude number
(c) Reynolds's number
(d) Weber number

29. Froude's number is defined as the ratio of
(a) Inertia force to viscous force
(b) inertia force to gravity force
(c) inertia force to elastic force
(d) inertia force to pressure force

30. Bernoulli's theorem deals with the law of conservation of
(a) mass
(b) momnetum
(c) energy
(d) none of the above

31. The velocity gradient at the wall in the case of ideal fluid is
(a) negative (b) zero
(c) positive (d) infinity

32. The centre of pressure for a plane vertical surface lies at a depth of
(a) half of the height of the immersed surface
(b) one third of the height of the immersed surface
(c) two third of the height of the immersed surface
(d) none of the above

33. The drag force exerted by the fluid on a body immersed in a fluid its due to
(a) pressure and viscous forces.
(b) pressure and gravity forces.
(c) pressure and turbulence forces.
(d) noine of the above

34. Irrotational flow means
(a) the fluid particle does not rotate while moving
(b) the fluid particle moves in straight line.
(c) the net rotation of the fluid particles about their mass centre is zero
(d) none of the above

35. For the resistance to a ship's motion model through water the basic similitude criteria is
(a) Reynold's law
(b) Froude's law
(c) Weber's law
(d) Both (a) and (b) above

36. A turbine is called reaction turbine if at the inlet of the turbine is
(a) kinematic energy only
(b) kinematic and pressure energy only
(c) pressure energy only
(d) none of the above

37. A submerged body will be stable if
(a) centre of buoyancy is below centre of gravity
(b) centre of gravity coincide with centre of gravity.
(c) centre of buoyancy is above the metacenter
(d) centre of buoyancy is above the centre of gravity.

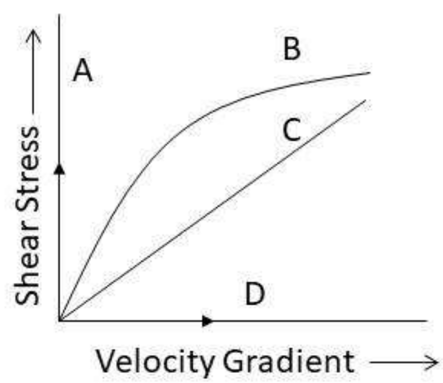
38. Pressure drag as per boundary layer theory is a function of
(a)shape of body
(b) flow of direction
(c) separation of flow
(d) both shape of body and separation of flow

39. The coefficient of friction for laminar flow through pipe of a circular cross section is given by
(a) $\frac{0.0791}{(Re)^{1/4}}$ (b) $\frac{16}{Re}$
(c) $\frac{64}{Re}$ (d) None of the above

40. In laminar flow through a circular pipe, the discharge varies
(a) linearly as the viscosity
(b) inversely as the pressure drop
(c) as the cube of the diameter
(d) inversely as the viscosity

41. Blasius equation is used for
(a) laminar flow
(b) turbulent flow in rough pipes
(c) turbulent flow in smoother pipes for any Reynolds number.
(d) turbulent flow in smother pipe for Re < 10^5

42. Curve 'D' in the following figure corresponds to



(a) Ideal fluid
(b) Newtonian fluid
(c) Non- Newtonian fluid

(d) Ideal solid

43. Across a normal shock
(a) the velocity and pressure increases.
(b) the velocity and pressure decreases
(c) the density and temperature decreases
(d) the pressure and temperature increases

44. The differential equation for energy in isentropic flow may take the form
(a) $dp + d(\rho V^2) = 0$
(b) $\frac{dV}{V} + \frac{d\rho}{\rho} + \frac{dA}{A} = 0$
(c) $2VdV + \frac{d\rho}{\rho} = 0$
(d) $VdV + \frac{d\rho}{\rho} = 0$

45. Van Karman momentum integral equation for a flat plate $\left(\frac{\tau_0}{\rho V^2} = \frac{\partial\theta}{\partial x}\right)$ is applicable to
(a) laminar boundary layer flow only.
(b) turbulent boundary layer flow only.
(c) transition boundary layer flow only.
(d) laminar, transition and turbulent boundary layer flows

46. Dynamic similarity between the model and prototype is the
(a) similarity of motion
(b) similarity of length
(c) similarity of forces
(d) none of the above

47. In an Electrolux refrigeration system no. of pumps used to handle the refrigerant are
(a) 1 (b) 3
(c) 2 (d) 0

48. The COP of a refrigerator working on a reversed carnot cycle is 4. The ratio of the highest absolute temperature to the lowest absolute temperature is
(a) 1.2 (b) 1.25
(c) 3.33 (d) 4.00

49. Which of the following refrigerant has the maximum ozone depletion in the staratosphere?
(a) Ammonia(b) CO_2
(c) SO_2 (d) Fluorine

50. A good refrigerant should have
(a) large latent heat of vapourisation and low operating pressures
(b) small latent heat and high operating pressures
(c) large latent heat and large operating pressures
(d) small latent heat of vapourisation and low operating pressures.

51. Specific humidity is equal to
(a) $0.622\frac{p_w}{p-p_w}$ (b) $0.622\frac{p-p_w}{p_w}$
(c) $0.622\frac{p}{p_s}$ (d) $0.622\frac{p_s}{p_w}$

52. Desert coolers work on the principle of
(a) evaporative cooling
(b) constant dew point cooling process
(c) moisture content remaining constant
(d) none of the above

53. The most suitable refrigerant for a commercial ice plant is
(a) CO_2 (b) NH_3
(c) R – 12 (d) NaCl

54. In Parson's reaction turbine, where 'α' is the angle with the direction of motion of the blade at which steam enters the blade, then the maximum efficiency of turbine is given by
(a) $\frac{2cos^2\alpha}{1+cos^2\alpha}$ (b) $\frac{2cos^2\alpha}{1-cos^2\alpha}$
(c) $\frac{2cot\alpha}{1+cos\,\alpha}$ (d) $\frac{2cot\alpha}{1-cos\,\alpha}$

55. Stefan's – Boltzman law is applicable to
(a) black body (b) grey body
(c) white body (d) all of above

56. Free convection flow depends on all the following except
(a) velocity (b) density
(c) coefficient of viscosity (d) gravitational force

57. A satellite in space exchanges heat with the surrounding objects essentially by
(a) radiation
(b) convection
(c) condution
(d) conduction and convection

58. The temperature gradient of a fluid flowing over a heated plate will be
(a) zero at the plate surface.
(b) positive at the surface.
(c) very steep at the surface
(d) zero at the top of thermal boundary layer

59. Addition of fin to the surface increases the heat transfer if $\sqrt{\frac{hA}{kP}}$is
(a) equal to 1
(b) greater than 1
(c) less than 1
(d) greater than 1 but less than 2

60. The Logarithmic Mean Temperature Difference (LMTD) for a counter flow heat exchanger as compared to parallel flow heat exchanger is
(a) greater (b) same
(c) less (d) none of the above

61. The fouling factor
(a) increases the overall heat transfer coefficient.
(b) decreases the overall heat transfer coefficient.
(c) is equal to the overall heat transfer coefficient.
(d) none of the above

62. Upto the critical insulation of radius
(a) added insulation will decrease heat loss.
(b) added insulation will increase heat loss.
(c) convection heat loss will be less than conduction heat loss.
(d) heat flux will decrease.

63. The velocity and temperature distribution in a pipe flow are given by u(r) and T(r). If u_m is the mean velocity at any section of the pipe, the bulk mean temperature at the section is
(a) $\int_0^{r_0} u(r).T(r).r^2 dr$
(b) $\int_0^{r_0} \frac{u(r).T(r)}{3r.2r} dr$
(c) $4\int_0^{r_0} \frac{u(r).T(r)}{2\pi r_0^3} dr$
(d) $\frac{2}{u_m r_0^2}\int_0^{r_0} u(r).T(r).rdr$

64. The ratio of energy transferred by convection to that of conduction is called by
(a) Stanton number
(b) Nusselt number
(c) Biot number
(d) Preclet number

65. Caviation is caused by
(a) low pressure (b) high pressure
(c) low velocity (d) none of the above

66. For two infinite parallel plates with emissivities, ϵ_1 and ϵ_2, the interchange factor for radiation from surface 1 to 2 is given by
(a) $\frac{\epsilon_1\epsilon_2}{\epsilon_1+\epsilon_2-\epsilon_1\epsilon_2}$
(b) $\frac{1}{\epsilon_1}+\frac{1}{\epsilon_2}$
(c) $\epsilon_1 + \epsilon_2$
(d) $\epsilon_1\epsilon_2$

67. The shape factor F_{12} in case of a conical cavity having semi vertex angle = α and height = h, is given by
(a) $F_{12} = (1-\sin\alpha)$
(b) $F_{12} = \sin\alpha$
(c) $F_{12} = \sin\frac{\alpha}{2}$
(d) $F_{12} = (1-\sin\alpha)/2$

68. In a lumped parameter model the temperature variation with time is
(a) cubic (b) linear
(c) exponential (d) sinusoidal

69. In a counter flow heat exchanger, cold fluid enters at 30 ^{0}C and leaves at 50 ^{0}C, where as the hot fluid enters at 150 ^{0}C and leaves at 130 ^{0}C. The mean temperature difference for this case is
(a) intermediate (b) 20 ^{0}C
(c) 80 ^{0}C (d) 100 ^{0}C

70. A composite slab has two layers of different materials with thermal conductivity $k_1$and k_2. If each layer has the same thickness, the equivalent thermal conductivity of the slab will be
(a) $K_1 + K_2$ (b) $\frac{2K_1K_2}{K_1+K_2}$

(c) $\frac{K_1+K_2}{K_1K_2}$ (d) K_1K_2

71. In the case of laminar boundary layer on a flat plate. the local skin friction coefficient given by
(a) $C_f = \frac{4.91x}{\sqrt{Re_x}}$ (b) $C_f = \frac{0.664}{\sqrt{Re_x}}$
(c) $C_f = \frac{1.328}{\sqrt{Re_x}}$ (d) $C_f = 0.332\sqrt{Re_x}$

72. A cross-flow type air-heated has an area of 50 m^2. The overall heat transfer coefficient 100 W/m^2-K and heat capacity of both hot and cold streams is 1000 W/K. The value of NTU is
(a) 1000 (b) 500
(c) 5 (d0 0.2

73. The wave length of radiation emitted by a body depends upon
(a) the nature of its surface
(b) the area of its surface
(c) the temperature of its surface
(d) all the above factors

74. Match List-I with List-II and select the correct answer using the codes given below the lists:

List-I	List –II
A. Non- isotropic thermal conductivity is exhibited by	1. molecular
B. Conduction is transmission of heat by ______ collision	2. four
C. The thermal conductivity of ice is nearly _______times the thermal conductivity of water	3. porous
D. Cork is a good insulator because it is _______.	4. wood

Code:

	A	B	C	D
(a)	4	2	3	1
(b)	4	1	2	3
(c)	1	2	3	4
(d)	3	4	2	1

75. Higher the Cetane number, the delay period is
(a) longer (b) medium
(c) shorter (d) none of the above

76. Mixture formation in a carburetor is based on the principle of
(a) Pascal's law
(b) Venturi principle
(b) Buoyancy principle
(d) Pitot tube principle

77. For minimizing knocking tendency in S.I. engines, the spark plug should be located
(a) near the inlet valve.
(b) away from the inlet valve.
(c) near the exhaust valve.
(d) midway between inlet and exhaust valve.

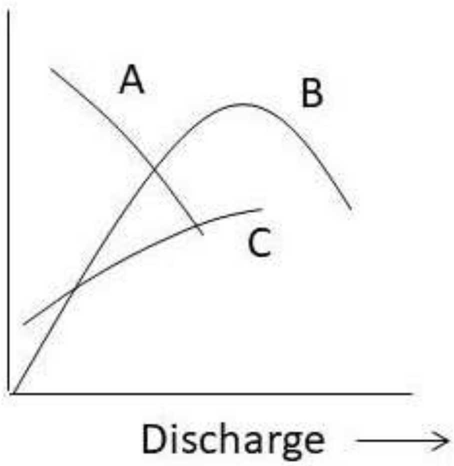
78. The critical pressure at which latent heat of vapourisation becomes zero for water is (nearst value)
(a) 273 bar (b) 221 bar
(c) 215 bar (d) 210 bar

79. If steam is throttled, its
(a) pressure and enthalpy remains unchanged.
(b) temperature and entropy remains unchanged.
(c) enthalpy remains unchanged but other properties change.
(d) enthalpy remains unchanged but pressure may or may not change.

80. A fuel has higher and lower calorific values because the fuel contains
(a) ash which does not burn and thus does not release any energy
(b) O_2 (Oxygen) which helps in combustion
(c) Sulphur which burns to SO_2.
(d) H_2 which burns to H_2O which absorbs some heat as latent heat of vapourisation.

81. With equal compression ratio and equal heat input, Diesel cycle is
(a) less efficient than Otto cycle.
(b) more efficient than Otto cycle.
(c) equally efficient as Otto cycle.
(d) can not say

82. The operating characteristic curves of a centrifugal pump are shown in figure given below:



Curve 'B' in the figure is for
(a) Head (b) Efficiency
(b) Power (d) None of the above

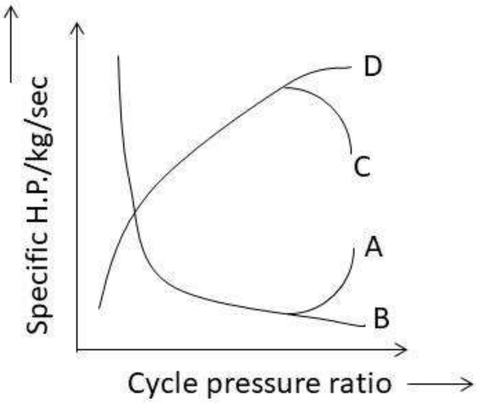
83. In a four-stroke I.C. engine, the inlet valve remains open for approximately
(a) 135^0 (b) 180^0
(c) 230^0 (d) 270^0

84. In a four-stroke I.C. engine the ratio of actual air capacity to ideal air capacity is commonly called
(a) scavenging efficiency
(b) volumetric efficiency
(c) trapping efficiency
(d) indicated thermal efficiency

85. The fineness of atomisation in case of C.I. engines
(a) increase the delay period
(b) reduce the delay period
(c) keep the delay period constant
(d) none of the above

86. Morse test can be used on
(a) low power engines only
(b) single cylinder engines only
(c) multi-cyclinder engines only
(d) water cooled engines only

87. The curve that shows the graph of the variation of thermal efficiency versus cycle pressure ratio in the following figure is



(a) A (b) B
(c) C (d) D

88. Hydrogen is used in Electrolux refrigeration system so that vapour pressure of ammonia in the evaporator should
(a) equalise (b) reduce
(c) increase (d0 can't be predicated

89. In I.C. engines, the approximate percentage of the combustion heat that passes to the cylinder wall is
(a) 5 – 10 % (b) 10 – 15 %
(c) 25 -30 % (d) 50 – 60%

90. The regenerator in a gas turbine plant is a heat exchanger of
(a) parallel flow type
(b) counter flow type
(c) mixed flow type
(d) cross flow type

91. Temperature recorded by a thermometer which is not affected by moisture is
(a) dry bulb temperature
(b) wet bulb temperature
(c) dew point temperature
(d) adiabatic saturation temperature

92. Thermoelectric refrigerator is based upon the phenomenon producing following effect/effects
(a) Peltier effect
(b) Seeback effect

(c) Thomson effect
(d) All the above

93. The compression ratio in diesel engine is generally in the range of
(a) 22 – 25 (b) 14- 22
(c) 25 – 30 (d) more than 30

94. Thermal efficiency of diesel engine is close to
(a) 20% (b) 25%
(c) 30 % (d) 35 %

95. The OTEC (Ocean Thermal Energy conversion) efficiency
(a) 0 - 5% (b) 8 – 13 %
(c) 15 – 20 % (d) 25 – 30%

96. Environmental protection agencies advice against the use of chloro fluoro carbon refrigeration since
(a) these react with water vapour and cause acid rain.
(b) these react with plants and cause greenhouse effect
(c) these react with O_2 and cause its depletion.
(d) these react with ozone layer and cause its depletion

97. For practical purpose one ton of refrigeration means
(a) 3.51 kW (b) 35.1 kW
(c) 351 kW (d0 none of the above

98. The unit in the refrigeration cycle in which heat is rejected
(a) Condenser (b) Coil
(b) Compressor (d) Evaporator

99. Which of the following is not the basic component of an absorption system?
(a) Evaporator (b) absorbant
(c) Generator (d) Compressor

100. A reversible engine performing as refrigerator has COP = 1/3, machine operates as engine, its efficiency will be
(a) 33 % (b) 75%
(c) 67% (d)37.5%

1 (c)	21 (c)	41 (a)	61 (b)	81 (a)
2 (d)	22 (c)	42 (a)	62 (b)	82 (b)
3 (b)	23 (c)	43 (d)	63 (d)	83 (c)
4 (a)	24 (*)	44 (d)	64 (b)	84 (b)
5 (a)	25 (b)	45 (a)	65 (a)	85 (b)
6 (b)	26 (c)	46 (c)	66 (a)	86 (c)
7 (c)	27 (d)	47 (d)	67 (b)	87 (d)
8 (b)	28 (d)	48 (b)	68 (c)	88 (c)
9 (d)	29 (b)	49 (d)	69 (d)	89 (c)
10 (c)	30 (c)	50 (c)	70 (b)	90 (b)
11 (c)	31 (b)	51 (a)	71 (b)	91 (a)
12 (c)	32 (c)	52 (a)	72 (c)	92 (a)
13 (b)	33 (a)	53 (b)	73 (c)	93 (b)
14 (c)	34 (c)	54 (a)	74 (b)	94 (d)
15 (b)	35 (a)	55 (a)	75 (c)	95 (a)
16 (c)	36 (b)	56 (a)	76 (b)	96 (d)
17 (d)	37 (d)	57 (a)	77 (d)	97 (a)
18 (c)	38 (d)	58 (d)	78 (b)	98 (a)
19 (d)	39 (b)	59 (c)	79 (c)	99 (d)
20 (a)	40 (d)	60 (c)	80 (*)	100 (b)

8. $P(v-b) = RT$

$$u = C_vT = \frac{R}{\gamma-1}T = \frac{P(v-b)}{\gamma-1}$$

$$\left(\frac{\partial u}{\partial v}\right)_P = \frac{1}{\gamma-1}P(1-0) = \frac{P}{\gamma-1}$$

$$\left(\frac{\partial u}{\partial v}\right)_T = 0$$

10. $dS = \frac{dQ}{T}$

$TdS = dQ = dU + dW$

(For constant volume process dW = 0)

$TdS = dU = C_v dT$

$$\frac{dT}{dS} = \frac{T}{C_v}$$

14. $W = P\Delta V = 10^5 \times 0.3 = 30$ kJ

20. Given $\Delta W = 1.8\Delta Q$

$$\Delta Q = \frac{\gamma-n}{\gamma-1}\Delta W$$

$$\frac{\gamma-n}{\gamma-1} = \frac{1}{1.8}$$

n = 1.178

25. $\delta = \frac{4.93\,x}{\sqrt{Re_x}}$

$Re_x = \frac{\rho V x}{\mu}$

$\delta \; \alpha \; \sqrt{x}$

26. $T_H = 283\ ^0\text{C} = 283 + 273 = 556\ \text{K}$

$T_L = 5\ ^0\text{C} = 5 + 273 = 278\ \text{K}$

$Q_H = 2780\ \text{kW}$

$Q_L = 700\ \text{kW}$

$\eta = \frac{W}{Q_H} = \frac{Q_H - Q_L}{Q_H} = \frac{2780-700}{2780}$

$= 0.75$

$\eta_{carnot} = 1 - \frac{T_L}{T_H} = 1 - \frac{278}{556} = 0.5$

$\eta > \eta_{carnot}$ (impossible)

29. Froude's number = $\frac{Inertia \;\; Force}{Gravitational \;\; Force}$

$Fr = \frac{v}{\sqrt{gD}}$

D = Hydraulic depth

v = water velocity

32. $y_p = y_c + \frac{I_{x'x'}}{A y_c}$

$= \frac{h}{2} + \frac{b\frac{h^3}{12}}{bh\;\frac{h}{2}}$

$= \frac{h}{2} + \frac{h}{6}$

$y_p = \frac{2}{3}h$

Position of centre of pressure from base

$= h - \frac{2}{3}h = \frac{h}{3}$

40. Discharge through circular pipe

$Q = \frac{\pi D^4 \Delta P}{128\,\mu L}$

Discharge is inversely proportional to viscosity of fluid.

48. Reversed Carnot Cycle

$COP = \frac{Q_L}{Q_H - Q_L} = 4$

$= \frac{T_L}{T_H - T_L} = 4$

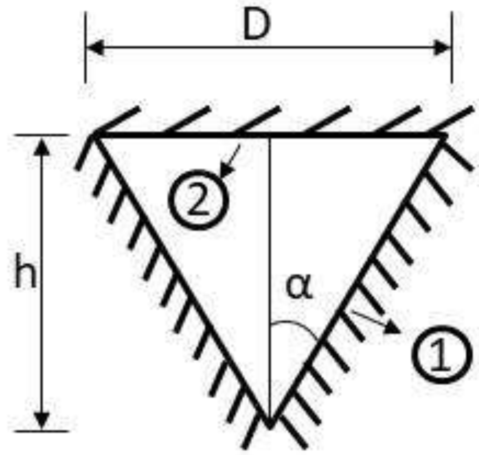
$= \frac{T_L}{T_H} = 1.25$

59. Effectiveness $\varepsilon_{long,fin} = \frac{\dot{Q}_{fin}}{\dot{Q}_{no,fin}} = \sqrt{\frac{kP}{hA_C}}$

Effectiveness greater than one , it means fins increase the rate of heat transfer.

If $\frac{hA_c}{kP} < 1$, then addition of fin to the surface increases the heat transfer.

67.



$A_1 F_{12} = F_{21} A_2$

$F_{12} = F_{21}\frac{A_2}{A_1}$ $\qquad$ ($F_{21} = 1$)

$F_{12} = \frac{A_2}{A_1}$

$F_{22} = 0$

$F_{22} + F_{21} = 1$

69. Counter flow heat exchanger

$T_{c,in} = 30\ ^0\text{C}, \quad T_{c,0} = 50\ ^0\text{C}$

$T_{h,in} = 150\ ^0\text{C}, \quad T_{h,0} = 130\ ^0\text{C}$

$\Delta T_1 = T_{h,in} - T_{c,0} = 150 - 50 = 100\ ^0\text{C}$

$\Delta T_2 = T_{h,o} - T_{c,in} = 130 - 30 = 100\ ^0\text{C}$

if $\Delta T_1 = \Delta T_2$ then $\Delta T_{LMTD} = \Delta T_1 = 100\ ^0\text{C}$

72. NTU = $\frac{UA}{C_{min}} = \frac{100 \times 50}{1000} = 5$

100. COP = $\frac{\dot{Q}_L}{W} = \frac{\dot{Q}_L}{\dot{Q}_H - \dot{Q}_L} = \frac{T_L}{T_H - T_L} = \frac{1}{3}$

$\frac{T_L}{T_H} = \frac{1}{4}$

$\eta = 1 - \frac{T_L}{T_H} = 1 - \frac{1}{4} = 0.75$

1. In a simple gas turbine cycle the temperature at exhaust in comparsion to compressor exit temperature is
(a) greater (b) equal
(c) less (d) not related

2. The maximum temperature in the gas turbine is of the order of
(a) 800 ^{0}C (b) 1500 ^{0}C
(c) 400 ^{0}C (d) 1800 ^{0}C

3. The regenerator in a gas turbine plant is a heat exchanger of
(a) parallel flow type
(b) mixed flow type
(c) cross-flow type
(d) counter-flow type

4. The water tubes in Babcock and Wilcox boiler are inclined to
(a) improve convective heat transfer
(b) improve radiative heat transfer
(c) promote natural circulation of water
(d) accommodate the furnace

5. Which of the following are classified as high pressure steam boilers ?
(a) Loeffler (b) Benson
(c) La Mont (d) All of the above

6. The O.T.E.C (Ocean Thermal Energy Conversion) efficiency is of the order of
(a) 0 – 5% (b) 10 – 15%
(c) 20 – 25% (d) 30 – 35%

7. The efficiency of bio-mass production through photosynthesis is of the order of
(a) 30 – 35% (b) 20 – 25%
(c) 10 – 15% (d) 0 – 5%

8. Wind energy is
(a) an indirect form of solar energy
(b) a direct form of solar energy
(c) having no relation with solar energy
(d) None of the above

9. The solar energy falling on the earth's surface is called
(a) beam radiation
(b) diffuse radiation
(c) terrestrial radiation
(d) extraterrestrial radiation

10. The speed material generally used in Magneto Hydro Dynamic (MHD) power generation is
(a) Calcium Carbonate
(b) Magnesium Carbonate
(c) Aluminium Carbonate
(d) Potassium Carbonate

11. For practical purposes one ton of refrigeration means
(a) 38.7 kW (b) 387 kW
(c) 3.87 kW (d) None of the above

12. In refrigeration system refrigerant gains heat at
(a) compressor (b) evaporator
(c) condenser (d) expansion valve

13. In a vapour compression refrigeration system, the effect of superheating the vapour before suction to the compressor
(a) increases the work of compression
(b) increases the heat rejection in the condenser
(c) decreases the C.O.P
(d) All of the above

14. The C.O.P of a refrigerator working on a reversed Carnot Cycle is 4. The ratio of highest absolute temperature to the lowest temperature is
(a) 1.25 (b) 1.20
(c) 3.33 (d) 4

15. With which refrigerant steel piping, fittings and joints are to be used?
(a) CO_2 (b) SO_2
(c) R – 12 (d) NH_3

16. Hydrogen is used in Electrolux refrigeration system so that vapour pressure of ammonia in the evaporator should be
(a) equalized (b) reduced
(c) increased (d) cannot be predicated

17. Which of the following refrigerants has the maximum ozone depletion in the stratosphere?
(a) Ammonia (b) CO_2
(c) Fluorine (d) SO_2

18. The effect of subcooling in vapour compression system will increase
(a) refrigeration effect and increases.
(b) refrigeration effect but reduces coefficient of performance.
(c) compressor work and reduces coefficient of performance.

(d) None of the above.

19. In a domestic refrigerator, a capillary tube controls the flow of refrigerant from the
(a) expansion valve to the evaporator
(b) evaporator to the thermostat.
(c) condesor to the expansion valve.
(d) condenser to the evaporator

20. The performance of an evaporative condenser largely depends on
(a) dry bulb temperature
(b) wet bulb temperature
(c) hot water temperature
(d) air-conditioned room temperature

21. During adiabatic saturation process of air, wet bulb temperature
(a) increases and dry bulb temperature remains constant.
(b) remains constant and dry bulb temperature increases.
(c) remains constant and dry bulb temperature decreases.
(d) decreases and dry bulb temperature remains constant.

22. The deposition of frost on evaporator tubes of air conditioner will result in
(a) increase in heat transfer
(b) no change in heat transfer
(c) decrease in heat treansfer
(d) increase in capacity of evaporator

23. Temperature recorded by a thermometer which is not affected by moisture is
(a) dry bulb temperature
(b) wet bulb temperature
(c) dew point temperature
(d) adiabatic saturation temperature

24. Sensitive heating or cooling of air is done at
(a) same dry bulb temperature
(b) same ambient temperature
(c) varying humidity ratio
(d) same humidity ratio

25. On Psychrometric chart, dry bulb temperature lines are
(a) horizontal
(b) Vertical
(c) straight inclined sloping upto the left
(d) curved

26. For completely dry air total heat is
(a) total latent heat
(b) sum of latent heat and sensible heat
(c) total sensible heat
(d) difference of sensible heat and latent heat

27. In spray humidification process, the dry bulb temperature
(a) decreases
(b) increases
(c) remains constant
(d) equals the temperature of environment (surroundings)

28. In the process of heating and humidification
(a) relative humidity is higher than initial value.
(b) dry bulb temperature is higher.
(c) specific humidity and dry bulb temperature are increased.
(d) specific humidity is reduced

29. In heating and dehumidification process, the relative humidity
(a) increases
(b) may increases or decreases
(c) decreases
(d) remains unchanged

30. In chilled water spray pond, the temperature of water is lower than dew point temperature of entering air. The air passing through the spray undergoes
(a) cooling and humidification
(b) sensible cooling
(c) dehumidification
(d) cooling and dehumidification

31. The first law of thermodynamics was developed by
(a) Carnot (b) Kelvin
(c) Plank (d) Joule

32. Reversible process requires that
(a) there is no heat transfer.
(b) there is no viscous or columb friction in the system.
(c) temperature of system and surrounding be equal.
(d) heat transfer occurs from surrounding to the system only.

33. When a gas is to be stored, the type of compression that would be ideal is
(a) polytropic (b) isothermal
(c) adiabatic (d) None of the above

34. The heat absorbed or rejected during a polytropic process is
(a) $\left(\frac{\gamma-n}{n-1}\right)\times$ work done
(b) $\left(\frac{\gamma-n}{n-1}\right)^2\times$ work done
(c) $\left(\frac{\gamma-n}{\gamma-1}\right)\times$ work done
(d) $\left(\frac{n-\gamma}{n+1}\right)\times$ work done

35. Kelvin-Plank's law deals with
(a) conversion of heat into work
(b) conservation of heat
(c) conversion of work into heat
(d) conservation of energy

36. Equation $TdS = dU + pdV$ can be applied to processes which are
(a) reversible only
(b) irreversible only
(c) reversible and irreversible both
(d) quasi static

37. Change in entropy for polytropic process is expessed as
(a) $\Delta S = C_v\left(\frac{\gamma-n}{1-n}\right)\ln\left(\frac{T_2}{T_1}\right)$
(b) $\Delta S = C_p\left(\frac{\gamma-n}{1-n}\right)\ln\left(\frac{T_2}{T_1}\right)$
(c) $\Delta S = \left(\frac{\gamma-n}{\gamma-1}\right)R\ln\left(\frac{T_2}{T_1}\right)$
(d) $\Delta S = C_v\left(\frac{\gamma-n}{\gamma-1}\right)\ln\left(\frac{V_2}{V_1}\right)$

38. If a fluid flows through a turbine the entropy of the inlet fluid (S_i) is related to the entropy of the fluid leaving the turbine (S_e) as
(a) $S_i = S_e$ (b) $S_i > S_e$
(c) $S_i \leq S_e$ (d) $S_i < S_e$

39. The C.O.P. of a heat pump can be increased either by decreasing T_H by ΔT or by increasing T_L by ΔT. The new C.O.P. of the heat pump is
(a) same in both the cases
(b) highest if T_H is decreased
(c) highest if T_L is increased
(d) independent of change in T_H and T_L

40. The Carnot engine with 50% efficiency is used to drive a refrigerator having C.O.P. of 5. The ratio of energy absorbed by the engine to the energy absorbed from the cold space by the refrigerator is
(a) 0.4 (b) 2.5
(c) 0.1 (d) 10

41. At a fixed compression ratio and fixed value of adiabatic index (γ) in a Diesel cycle
(a) η_{th} increases with increase in cut-off ratio.
(b) η_{th} decreases with increase in cut-off ratio.
(c) η_{th} remains same with increase in cut-off ratio.
(d) None of the above
(η_{th} = Thermal efficiency)

42. The following graph shown in fig- shows variation of work output versus pressure ratio for Otto cycle with fixed compression ratio and fixed value of adiabatic index (γ)
Figure missing
(a) A (b) B
(c) C (d) D

43. In a Rankine cycle if the exhaust pressure of the turbine is increased the quality of steam leaving the turbine
(a) does not get affected
(b) increases
(c) decreases
(d) cannot be predicated

44. Constant volume regenerator is used in
(a) Ericsson cycle
(b) Brayton cycle
(c) Stirling cycle
(d) Otto cycle

45. Rankine cycle efficiency of a good steam power plant may be in the range of
(a) 15 to 20% (b) 55 to 65%
(c) 70 to 80% (d) 35 to 45%

46. The following expression is given for the relationship between Rankine cycle efficiency and optimum fraction of the bled steam for regeneration (m) :
(a) $m_{opt} = \frac{2-\eta_R}{2\eta_R}$ (b) $m_{opt} = \frac{1-\eta_R}{\eta_R}$
(c) $m_{opt} = \frac{1-\eta_R}{2\eta_R}$ (d) $m_{opt} = \frac{\eta_R}{2-\eta_R}$

47. Which of the following processes is essentially reversible?
(a) Throttling (b) Isothermal
(c) Adiabatic (d) Isentropic

48. During a polytropic expansion work obtained is 1.8 times the heat transferred. If γ = 1.4, 'n' will be
(a) 1.178 (b) 1.190
(c) 1.200 (d) 1.155

49. For a constant volume process, the slope of $\left(\frac{\partial T}{\partial S}\right)_{V=const.}$ on T-S chart is given by
(a) p/C_v (b) $\frac{T}{C_v}$
(c) V/C_v (d) $\frac{C_v}{T}$

50. The thermal efficiency of the air standard Brayton cycle expressed in terms of pressure ratio r_p is
(a) $1-\frac{1}{r_P^{\gamma}}$ (b) $1-r_p^{\frac{\gamma-1}{\gamma}}$
(c) $1-r_p^{\gamma-1}$ (d) $1-\frac{1}{r_p^{\frac{\gamma-1}{\gamma}}}$

51. In case of laminar flow, the loss of pressure head is proportional to
(a) velocity (b) $(\text{velocity})^2$
(c) $(\text{velocity})^3$ (d) None of the above

52. The most commonly used equation for the velocity distribution for laminar flow through pipes is
(a) $u=u_{max}\left[1-\frac{r}{R}\right]$
(b) $u=u_{max}\left[1-\left(\frac{r}{R}\right)^2\right]$
(c) $u=u_{max}\left[1-\left(\frac{r}{R}\right)^3\right]$
(d) $u=u_{max}^2\left[1-\left(\frac{r}{R}\right)^2\right]$

53. The kinetic energy correction factor (α) for a circular pipe is equal to
(a) 6 (b) 4
(c) 3 (d) 2

54. The shear stress distribution in pipe flow is give as
(a) $\tau=r\left(\frac{\partial P}{\partial x}\right)$
(b) $\tau=-2r\left(\frac{\partial P}{\partial x}\right)$
(c) $\tau=-\left(\frac{\partial P}{\partial x}\right)\frac{r}{2}$
(d) None of the above

55. The shear in turbulent flow is mainly due to
(a) momentum transfer
(b) mass transfer
(c) heat transfer
(d) All of the above

56. The flow in town water supply pipes is generally
(a) laminar (b) turbulent]
(c) transition (d) None of the above

57. A streamline is a line
(a) which is along the path of a fluid particle
(b) which is always parallel to the main direction of flow
(c) across which there is no flow
(d) on which normal drawn at any point gives the direction of velocity

58. Bernoull's theorem deals with the law of conservation of
(a) mass (b) momentum
(c) energy (d) None of the above

59. The pressure variation along the radial direction for vortex flow on a horiziontal plane is given by
(a) $\frac{\partial P}{\partial r}=-\rho\frac{v^2}{r}$ (b) $\frac{\partial P}{\partial r}=-\rho\frac{v}{r^2}$
(c) $\frac{\partial P}{\partial r}=\rho\frac{v}{r^2}$ (d) None of the above

60. For viscous flow in a pipe the coefficient of friction is given by
(a) $f=\frac{8}{Re}$ (b) $f=\frac{64}{Re}$
(c) $f=\frac{32}{Re}$ (d) $f=\frac{16}{Re}$

61. Dynamic similarity between the model and prototype is the
(a) similarity of motion
(b) similarity of forces
(c) similarity of length
(d) None of the above

62. Flow over a 27 m high dam is to be studied in a laboratory with a 3 m high model. If the river discharge is at the rate of 80 m^3/s, the model discharge rate should be
(a) 30 m^3/s (b) 9 m^3/s
(c) 3 m^3/s (d) 0.33 m^3/s

63. Mach number is defined as the square root of the ratio of
(a) inertia force to the elastic force
(b) inertia force to the surface tension force
(c) inertia force to the pressure force
(d) None of the above

64. Which of the following is the condition for detached flow?

(a) $\left(\frac{\partial u}{\partial y}\right)_{y=0} = 0$

(b) $\left(\frac{\partial u}{\partial y}\right)_{y=0} > 0$ but less than 1

(c) $\left(\frac{\partial u}{\partial y}\right)_{y=0} = 1$

(d) $\left(\frac{\partial u}{\partial y}\right)_{y=0} < 0$

65. Von Karman momentum integral equation for flat plate $\left(\frac{\tau_0}{\rho v^2} = \frac{\partial \theta}{\partial x}\right)$ is applicable to

(a) laminar boundary layer flow only

(b) turbulent boundary layer flow only

(c) transition boundary layer flow only

(d) laminar, transition and turbulent boundary layer flows

66. The thickness of laminar boundary layer at a distance x from the leading edge over a flat plat varies as

(a) $x^{1/2}$ (b) $x^{4/5}$

(c) $x^{1/5}$ (d) $x^{3/5}$

67. The differential equation for energy in isentropic flow may take the form

(a) $\mathrm{dp} + \mathrm{d}(\rho \mathrm{v}^2) = 0$

(b) $\mathrm{vdv} + \frac{\mathrm{dp}}{\rho} = 0$

(c) $\frac{\mathrm{dv}}{\mathrm{v}} + \frac{\mathrm{d}\rho}{\rho} + \frac{\mathrm{dA}}{\mathrm{A}} = 0$

(d) $2\mathrm{vdv} + \frac{\mathrm{dp}}{\rho} = 0$

68. The velocity of pressure wave in terms of Bulk Modulus (K) and density (ρ) is given by the following expression :

(a) $C = \sqrt{\frac{K}{\rho}}$

(b) $C = \sqrt{\frac{\rho}{K}}$

(c) $C = \sqrt{K\rho}$

(d) None of the above

69. The area-velocity relationship for compressible fluids in a varying cross-section pipe is

(a) $\frac{dA}{A} = \frac{dV}{V}(1 - M^2)$

(b) $\frac{dA}{A} = \frac{dV}{V}(M^2 - 1)$

(c) $\frac{dA}{A} = \frac{dV}{V}(1 - V^2)$

(d) $\frac{dA}{A} = \frac{dV}{V}(C^2 - 1)$

70. Across a normal shock

(a) the velocity and pressure increase

(b) the velocity and pressure decrease

(c) the pressure and temperature

(d) the density and temperature

71. Which of the following forms of water has the highest value of thermal conductivity?

(a) Boiling water (b) Solid ice

(c) Steam (d) Melting ice

72. In case of hollow cylinder as the ratio of outer radius to inner radius increases the rate of heat transfer

(a) decreases

(b) increases

(c) remains constant

(d) may increase or decrease depending on cylinder material

73. A critical radius of insulated pipe leads to

(a) minimum rate of heat transfer

(b) no effect on heat transfer

(c) no heat transfer at all

(d) maximum rate of heat transfer

74. Heat conduction in gases is due to

(a) electromagnetic waves

(b) motion of electrodes

(c) mixing motion of different layers of gas

(d) elastic impact of molecules

75. Provision of fins on a given heat transfer surface will be more effective if there are

(a) fewer number of thick fins

(b) larger number of thick fins

(c) large number of thin fins

(d) fewer number of thin fins

76. Addition of fins to the surface increases the heat transfer if $\sqrt{hA/KP}$ is

(a) equal to 1

(b) greater than 1

(c) less than 1

(d) greater than 1 but less than 2

77. The logarithmic mean temperature difference (L.M.T.D) for a counter flow heat exchanger as compared to that for parallel flow is

(a) greater (b) same

(c) lesser (d) None of these

78. For a free convection system, Nusselt number is a function of

(a) Prandtl and Grasshoff numbers
(b) Reynold's and Grashoff numbers
(c) Reynold's number only
(d) Reynold's and Prandtl numbers

79. In case of electric transmission lines, the cooling depends largely on the following mode of heat transfer:
(a) free convection
(b) conduction
(c) forced convection
(d) radiation

80. Rate of heat transfer in case of forced convection as compared with natural convection is
(a) lower (b) almost equal
(c) higher (d) None of the above

81. Free convection flow depends on all of the following except
(a) density
(b) coefficient of viscosity
(c) gravitational force
(d) velocity

82. In the case of laminar boundary layer on a flat plate, the local skin friction coefficient is given by
(a) $C_f = \frac{4.91\,x}{\sqrt{Re_x}}$
(b) $C_f = \frac{0.664}{\sqrt{Re_x}}$
(c) $C_f = \frac{1.328}{\sqrt{Re_x}}$
(d) $C_f = 0.332\sqrt{Re_x}$

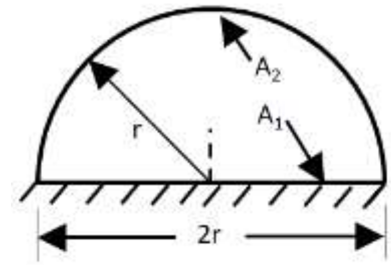
83. Stefan-Boltzmann law is applicable to
(a) black body
(b) grey body
(c) white body
(d) all the above

84. A satellite in space exchanges heat with the surrounding essentially by
(a) convection
(b) conduction
(c) radiation
(d) conduction and convection together

85. If the temperature of a black body is increased, the wavelength corresponding to maximum monochromatic emissive power becomes
(a) larger
(b) smaller
(c) no change
(d) cannot be predicted

86. The wave length of radiation emitted by a body depends upon
(a) the nature of its surface
(b) the area of its surface
(c) the temperature of its surface
(d) all the above factors

87. A long semi-circular duct is shown in fig. below. What is the value of shape factor F_{2-1}?



(a) 1.36 (b) 0.73
(c) 0.50 (d) 0.36

88. For two infinite parallel planes with emissivity's, ϵ_1 and ϵ_2, the interchange factor for radiation from surface 1 to 2 is given by
(a) $\frac{1}{\epsilon_1} + \frac{1}{\epsilon_2}$ (b) $\epsilon_1 + \epsilon_2$
(c) $\epsilon_1\epsilon_2$ (d) $\frac{\epsilon_1\epsilon_2}{\epsilon_1 + \epsilon_2 - \epsilon_1\epsilon_2}$

89. The shape factor F_{1-2} in case of a conical cavity having a semi-vertex angle, α and height h, is given by
(a) $F_{12} = (1 - \sin\alpha)$
(b) $F_{12} = \sin\alpha$
(c) $F_{12} = \sin\frac{\alpha}{2}$
(d) $F_{12} = (1 - \sin\alpha)/2$

90. The fouling factor's effect on overall heat transfer coefficient is
(a) it increases (b) it decreases
(c) both are same (d) None of the above

91. The fineness of atomization in case of diesel engines
(a) increases the dealy period
(b) reduces the delay period
(c) keep the dealy period constant
(d) None of the above

92. Higher the Cetane number, the delay period is
(a) longer (b) medium
(c) shorter (d) None of the above

93. Theoretically correct air-fuel ratio for gasoline in S.I. Engine is

(a) 9 : 1 (b) 12 : 1

(c) 15 : 1 (d) 18 : 1

94. Anti-knock additive for Diesel engine is

(a) hexadecane (b) aromatics

(c) amylnitrate (d) tetramethyl lead

95. The engine, which can work on very lean mixture of fuel, is

(a) S.I. Engine (b) C.I. Engine

(c) both (a) and (b) (d) None of the above

96. Iso-Octane content in a fuel for S.I. engines

(a) accelerates auto-ignition

(b) retards auto-iginition

(c) does not affect auto-ignition

(d) None of the above

97. In a 4-cylinder petrol engine, the standard firing order is

(a) 1-3-2-4 (b) 1-3-4-2

(c) 1-4-3-2 (d) 1-2-3-4

98. The spark advance in S.I. engine is adjusted to obtain maximum pressure

(a) at T.D.C. (b) 10 – 12^0 before T.D.C

(c) more than 12^0 after T.D.C

(d) 10 – 12^0 after T.D.C.

99. The maximum attainable delivery pressure in a reciprocating compressor is limited by

(a) swept volume

(b) clearance volume

(c) (swept volume + clearance volume)

(d) (swept volume – clearance volume)

100. Higher dryness fraction of steam at turbine exit in Rankine cycle will

(a) reduce cycle efficiency

(b) reduce pump work

(c) protect turbine blading

(d) increase turbine work

ANSWER

1 (c)	21 (b)	41 (b)	61 (b)	81 (d)
2 (a)	22 (c)	42 (d)	62 (b)	82 (b)
3 (c)	23 (a)	43 (b)	63 (a)	83 (a)
4 (c)	24 (d)	44 (c)	64 (a)	84 (c)
5 (d)	25 (a)	45 (d)	65 (a)	85 (b)
6 (a)	26 (c)	46 (b)	66 (a)	86 (c)
7 (c)	27 (b)	47 (d)	67 (b)	87 (c)
8 (a)	28 (c)	48 (a)	68 (a)	88 (d)
9 (c)	29 (c)	49 (b)	69 (b)	89 (b)
10 (b)	30 (d)	50 (d)	70 (c)	90 (b)
11 (c)	31 (b)	51 (a)	71 (b)	91 (b)
12 (b)	32 (b)	52 (b)	72 (a)	92 (c)
13 (b)	33 (b)	53 (d)	73 (d)	93 (c)
14 (a)	34 (c)	54 (c)	74 (d)	94 (c)
15 (d)	35 (a)	55 (a)	75 (c)	95 (b)
16 (c)	36 (a)	56 (b)	76 (c)	96 (b)
17 (c)	37 (c)	57 (a)	77 (a)	97 (b)
18 (a)	38 (d)	58 (c)	78 (a)	98 (d)
19 (d)	39 (c)	59 (c)	79 (c)	99 (c)
20 (b)	40 (a)	60 (d)	80 (c)	100 (c)

11. One tone of refrigeration means heat required to convert 1 tons of water at 0 ^{0}C is 0 ^{0}C ice in 24 hrs.

$Q = mL_f$ = 334 kJ/kg × 1000 kg

$\frac{Q}{t} = \frac{334 \times 1000}{24 \times 3600}$ 3.87 kW

14. COP = $\frac{\dot{Q}_L}{\dot{W}_{in}} = \frac{T_L}{T_H - T_L} = 4$

$T_H = 1.25\, T_L$

34. $\Delta W = \int PdV$

For polytrophic process, $PV^n = c$

$\Delta W = \int \frac{C}{V^n} dV = \frac{P_2V_2 - P_1V_1}{1-n}$

$\Delta U = nC_v\Delta T = n\frac{R}{\gamma-1}(T_2 - T_1)$

$= \frac{P_2V_2 - P_1V_1}{\gamma-1}$

$\frac{\Delta W}{\Delta U} = \frac{\gamma-1}{1-n}$

$\Delta Q = \Delta U + \Delta W$

$$\Delta Q = \frac{\gamma - n}{\gamma - 1}\Delta W$$

37. $\Delta Q = \Delta U + \Delta W$

$T\Delta S = nC_v\Delta T + P\Delta V$

$\Delta S = nC_v\frac{\Delta T}{T} + P\frac{\Delta V}{T}$ (PV = n RT)

$\Delta S = nC_v\frac{\Delta T}{T} + \frac{nR}{V}\Delta V$

$\Delta S = nC_v \ln\frac{T_2}{T_1} + nR\ln\frac{V_2}{V_1}$

(For polytropic process $\frac{V_2}{V_1} = \left(\frac{T_1}{T_2}\right)^{\frac{1}{n-1}}$)

$\Delta S = nC_v \ln\frac{T_2}{T_1} + \frac{nR}{n-1}\ln\frac{T_1}{T_2}$ $\left(C_v = \frac{R}{\gamma-1}\right)$

$\Delta S = n\frac{R}{\gamma-1}\ln\frac{T_2}{T_1} + \frac{nR}{n-1}\ln\frac{T_1}{T_2}$

$\Delta S = n\frac{R}{\gamma-1}\left(1 - \frac{\gamma-1}{n-1}\right)\ln\frac{T_2}{T_1}$

$$= n\frac{R}{\gamma-1}\left(\frac{\gamma-n}{1-n}\right)\ln\frac{T_2}{T_1} = nC_v\left(\frac{\gamma-n}{1-n}\right)\ln\frac{T_2}{T_1}$$

39. C.O.P $= \frac{\dot{Q}_H}{\dot{W}_N} = \frac{T_H}{T_H - T_L}$

If T_H is decreased by ΔT

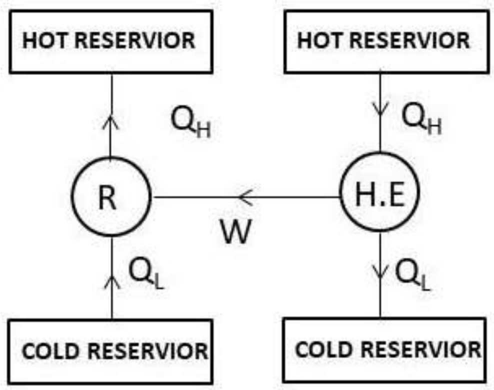
$C.O.P_1 = \frac{\dot{Q}_H}{\dot{W}_N} = \frac{T_H - \Delta T}{T_H - T_L - \Delta T}$

If T_H is increased by ΔT

$C.O.P_2 = \frac{\dot{Q}_H}{\dot{W}_N} = \frac{T_H}{T_H - T_L - \Delta T}$

$C.O.P_2 > C.O.P_1$

40.



η = 50% , C.O.P = 5

Efficiency of Heat engine,

$\eta = \frac{W}{Q_H} = \frac{1}{2}$

C.O.P. $= \frac{Q_L}{W} = 5$

$\frac{Q_H}{Q_L} = \frac{2W}{5W} = 0.4$

48. W = 1.8 Q

$\Delta Q = \Delta U + \Delta W$

For polytrophic process **,**

$\Delta W = \frac{R}{1-n}\Delta T$

$\Delta Q = C_v\Delta T + \frac{R}{1-n}\Delta T$

$$= \frac{R}{\gamma - 1}\Delta T + \frac{R}{1-n}\Delta T = \frac{1}{1.8}\frac{R}{1-n}\Delta T$$

$n = 1.178$

49. $dS = \frac{dQ}{T}$

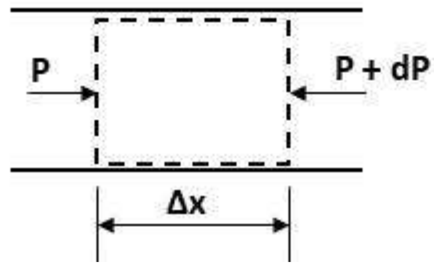
$TdS = dQ = dU + dW$

(For constant volume process dW = 0)

$TdS = dU = C_v dT$

$\frac{dT}{dS} = \frac{T}{C_v}$

54.



Force equilibrium in horizontal direction

$P \times A = (P + dP)A + \tau \times p \times \Delta x$

$\tau = -\frac{A}{p}\frac{dP}{dx} = -\frac{\pi r^2}{2\pi r}\frac{dP}{dx}$

$\tau = -\frac{r}{2}\frac{dP}{dx}$

85. Wein's displacement law

$$\lambda T = c$$

As temperature increases, λ decreases

87. $F_{21}A_1 = F_{21}A_2$ [$F_{21} = 1$]

$1 \times \pi R^2 = F_{21} \times 2\pi R^2$

$F_{21} = 0.5$

1. Intercooling in multi stage reciprocating compressor helps the process of compression to come nearer to :
(a) Isothermal (b) Polytropic
(c) Adiabatic (d) Constant volume

2. The device which changes the mixture from maximum power to maximum economy power to maximum economy when maximum power is no longer required is called:
(a) Idling system
(b) Accelerating pump system
(c) Choke valve system
(d) Economizer system

3. If the ratio of emission from a body to that of a black body for a given temperature is constant for all wave lengths, the body is called:
(a) Grey body (b) Black body
(c) White body (d) Opaque body

4. A heat exchanger with heat transfer surface area 'A' and overall heat transfer coefficient U handles two fluids of heat capacities C_{max} and C_{min}. The parameter NTU (Number of transfer units) used in the analysis of heat exchanger is defined as:
(a) $\frac{AC_{min}}{U}$ (b) $\frac{U}{AC_{min}}$
(b) AUC_{min} (d) $\frac{AU}{C_{min}}$

5. Provision of fins on a given heat transfer surface will be more effective if there are :
(a) fewer number of thick fins
(b) large number of thick fins
(c) large number of thin fins
(d) fewer number of thin fins

6. In case of hollow cylinder, as the ratio of outer radius to inner radius increases, the rate of heat transfer:
(a) Decreases
(b) Increases
(c) remains constant
(d) May increase or decrease depending on cylinder material.

7. Cam-type of combustion chambers are more suitable for:
(a) Industrial gas turbine
(b) Closed cycle gas turbine
(c) Aircraft gas turbine
(d) None of the above

8. Normal heptane in fuel will:
(a) accelerate autoignition
(b) decelerate autoignition
(c) will not effect autoignition
(d) None of the above

9. In a heat exchanger with one liquid evaporating or condensing, the surface area required is least in:
(a) Parallel flow (b) Counter flow
(c) Cross flow (d) Same in all the above

10. For completely dry air total heat is:
(a) Total latent heat
(b) Total sensible heat
(c) Sum of latent heat and sensible heat
(d) Difference of sensible heat and latent heat

11. A solid sphere and a hollow sphere of the same size and material are heated to the same temperature and allowed to cool in the same surroundings. If the temperature difference between the body and surroundings is T, then:
(a) Both spheres will cool at the same rate for small values of T
(b) Same rate for only large value of T
(c) Hollow sphere will cool at a faster rate
(d) Solid sphere will cool at faster rate

12. The Heat addition process in the Rankine cycle takes place at:
(a) Constant temperature
(b) Constant pressure
(c) Constant entropy
(d) Constant enthalpy

13. For two infinite parallel planes with emissivities ϵ_1 and ϵ_2 , the interchange factor for radiation form surface 1 to surface 2 is given by :
(a) $\frac{\epsilon_1\epsilon_2}{\epsilon_1+\epsilon_2-\epsilon_1\epsilon_2}$
(b) $\frac{1}{\epsilon_1}+\frac{1}{\epsilon_2}$
(c) $\epsilon_1+\epsilon_2$
(d) $\epsilon_1\epsilon_2$

14. In a domestic refrigerator, a capillary tube controls the flow of refrigerant from the:
(a) Expansion valve to the evaporator
(b) Evaporator value to the thermostat
(c) Condenser to the expansion valve
(d) Condenser to the evaporator

15. Two walls of same thickness and cross sectional area have thermal conductivities in the ratio of 1 : 2 if the same temperature difference is maintained across the wall faces, the ratio of heat flow $\frac{\partial_1}{\partial_2}$ will be:
(a) $\frac{1}{2}$ (b) 1
(c) 2 (d) 4

16. The door of a running refrigerator inside a room was left open. Which of the following statements is correct?
(a) The room will be cooled to the temperature inside the refrigerator
(b) The room will be cooled very slightly
(c) The room will be gradually warmed up
(d) The temperature of the air in the room will be unaffected

17. In a vapour compression refrigeration system, the effect of super heating the vapour before suction to the compressor:
(a) Increases the work of compression
(b) Increases the heat rejection in the condenser
(c) Decreases C.O.P.
(d) All of the above

18. The reheat Rankine cycle is used so that the exhaust steam is:
(a) Superheated (b) Saturated
(c) Subcooled (d) Not of very poor quality

19. Inside surface temperature of a furnace wall having wall thickness of 0.6 m is maintained at 1000^0 C while the outside wall surface temperature is 200^0C. The wall is 1 m wide and 1.5 m long. It is made up of a material having thermal conductivity of 0.4 W/m-K. The thermal resistance of the wall is:
(a) 1 K/W (b) 2 K/W
(c) 1.5 K/W (d) 1.8 K/W

20. Higher dryness fraction of steam at exit of turbine in Rankine cycle:
(a) will refer the cycle efficiency
(b) will reduce pump work
(c) will protect turbine blading
(d) will increase tubine work

21. In the case of laminar boundary layer on a flat plate, the local skin friction coefficient is given by:
(a) $C_f = \frac{4.91\,x}{\sqrt{Re_x}}$
(b) $C_f = \frac{0.664}{\sqrt{Re_x}}$
(c) $C_f = \frac{1.328}{\sqrt{Re_x}}$
(d) $C_f = 0.332\sqrt{Re_x}$

22. The maximum amount of mechanical energy that can be converted into heat in any process:
(a) Depends on source and sink temperature
(b) Depend on friction present
(c) Depends on natural of mechanical energy
(d) Is 100%

23. An empty cylinder is connected to a pipe carrying air at 20 bar, 320 K and 100 m/s. A valve between the pipe and cyclinder is opened and closed just after the pressure inside the cylinder becomes 20 bar. The temperature inside the cylinder would be:
(a) 488 K (b) 455 K
(c) 462 K (d) 469 K
The cylinder is perfectly by insulated.

24. The shape factor F_{12} in case of a conical cavity having a semi vertex angle α and height h is given by:
(a) $F_{12} = 1 - \sin\alpha$
(b) $F_{12} = \sin\alpha$
(c) $F_{12} = \sin{}^{\alpha}/_{2}$
(d) $F_{12} = {}^{(1-\sin\alpha)}/_{2}$

25. A cold liquid is preferably stored in a spherical vessel in order to:
(a) Reduce the heat transfer rate through the vessel

(b) Increase the heat transfer rate through the vessel
(c) Prevent the liquid from freezing
(d) None of the above

26. The Energy thickness for a laminar boundary layer flow depends on local and free stream velocities within and outside the boundary layer δ. The expression for the energy thickness is given by:
(a) $\int_0^\delta \left(1 - \frac{u}{u_\infty}\right) dy$
(b) $\int_0^\delta \frac{u}{u_\infty}\left(1 - \frac{u}{u_\infty}\right) dy$
(c) $\int_0^\delta \frac{u}{u_\infty}\left(1 - \frac{u^2}{u_\infty^2}\right) dy$
(d) $\int_0^\delta \frac{u}{u_\infty}\left(1 - \frac{u^2}{u_\infty}\right)^2 dy$

27. The energy associated with the molecular motion is called:
(a) Kinetic energy of the gas
(b) Internal energy
(c) Entropy
(d) Enthalpy

28. A heat engine operates between 1200 K and 300 K. It takes 1000 kJ of thermal energy and rejects 200 KJ giving work output of 800 kJ. The engine violates:
(a) First law of thermodynamics
(b) second law of thermodynamics
(c) Both (a) and (b)
(d) None of the above

29. The ratio of energy transferred by convection to that by conduction is called:
(a) Stanton No.
(b) Nussult No.
(c) Biot No.
(d) Preclet No.

30. The efficiency of Biomass production through photosynthesis is of the order of:
(a) 30 – 35%
(b) 20 – 25%
(c) 10 – 15%
(d) 0 – 5%

31. A two stage air compressor operating for condition of maximum efficiency receives air at 1 bar and compresses is to 4 bar in the first stage. The overall compression ratio is:
(a) 12 (b) 8
(c) 16 (d) 20

32. From commercial point of view, the following refrigeration system is often used in practice:
(a) Vapour compression system
(b) Electroux system
(c) Bell- coleman system
(d) Lithium Bromide system

33. Bernoulli's equation can be derived from:
(a) First law of thermodynamics
(b) Second law of thermodynamics
(c) Boyle's law
(d) Zeroth law of thermodynamics

34. Which of the following forms of energy may properly be called as heat?
(a) The energy in a hot plate
(b) The energy in the exhaust gases of an automobile engine
(c) The energy in a warm radiator
(d) The energy which passes from the hot gases to the water in the cylinder jacket of an automobile engine

35. Subcooling in vapour –compression refrigeration system will:
(a) Increase the power but reduce the flow of refrigerant.
(b) Reduce the power but increase the flow of refrigerant.
(c) Reduce the power and size of compressor.
(d) Increase the power but reduce the size of compressor.

36. Which form of the following forms of water has the highest value of thermal conductivity?
(a) Boiling water (b) Solid ice
(c) Steam (d) Melting ice

37. Effective temperature includes the effect of some of the following:
(i) Dry bulb temperature

(ii) Air humidity
(iii) Clothings
(iv) Activity level
(v) Air movement
Choose the answer using following codes:
(a) (i) and (ii)
(b) (i), (ii) and (iii)
(c) (i), (iii) and (iv)
(d) (i), (ii) and (v)

38. A composite slab has two layers of two different materials, with thermal conductivities K_1 and K_2. If each layer has the same thickness, the equivalent thermal conductivity of the slab will be:
(a) $K_1 + K_2$ (b) $\frac{2K_1K_2}{K_1+K_2}$
(c) $\frac{K_1+K_2}{K_1K_2}$ (d) K_1K_2

39. The convective heat transfer coefficient in laminar flow over a flat plate:
(a) Increases with distance
(b) Increases if a denser fluid is used
(c) Increases if a fluid of higher viscosity is used
(d) Decreases with increase in free stream velocity

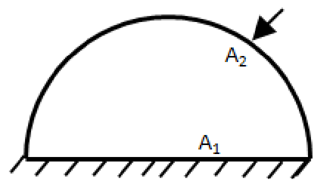
40. In a CI Engine, swirl is the:
(a) Radial motion imparted to the air fuel mixture
(b) Circular motion imparted to the air
(C) Circular motion imparted to the burnt gases
(d) Radial motion to fuel supply

41. P_1 and P_2 are pressures before and after a normal shock respectively. For the same initial conditions and for isentropic flow, the final pressure $P_{2,}$ will be:
(a) $P_{2i} > P_2$
(b) $P_{2i} < P_2$
(c) $P_{2i} \leq P_2$
(d) None of the above i.e. provided density change
in both the processes are same

42. Which of the following are classified as high pressure steam boilers?
(a) Loeffler Boiler
(b) Benson Boiler
(c) La Mont Boiler
(d) All of the above

43. If steam is throttled, its:
(a) Pressure and enthalpy remain unchanged
(b) Temperature and entropy remain unchanged
(c) Enthalpy remains unchanged but the other properties change
(d) Enthalpy remains unchanged but pressure may or may not change

44. A long semi circular duct is shown above. What is the value of shape factor F_{2-1} ?



(a) 1.36 (b) 0.73
(c) 0.5 (d) 0.36

45. Hot and cold water are mixed together. The entropy of the system will :
(a) Increase
(b) Decrease
(c) Remain same
(d) May increase or decrease depending on initial temperature of hot and cold water

46. Halide torch is used to detect leakage of refrigerant in system using:
(a) NH_3 (b) CO_2
(c) SO_2 (d) Freons

47. Friction loss in pipes is due to:
(a) Change in momentum
(b) Fluctuation in flow rate
(c) Change in total energy
(d) Surface roughness

48. The continuity equation is true for:
(a) Steady flow only
(b) Unsteady flow only
(c) Incompressible flow only
(d) All the above types of flow

49. According to the Kirchoff's Law the ratio of the total emissive power to the absorptivity of the body is dependent on:
(a) The temperature of the body
(b) Nature of the body
(c) Wave length of radiation
(d) None of the above

50. A carnot heat pump works between temperature limits of 300 K and 400 K. Its coefficient of performance is:
(a) 0.25 (b) 1.33
(c) 3 (d) 4

51. The two other cycles which have the same efficiency as the carnot cycle are:
(a) Joule cycle and Stirling cycle
(b) Ericsson cycle and Joule cycle
(c) Ericsson cycle and Stirling cycle
(d) None of the above

52. In a laminar flow, the thermal boundary layer is a region where:
(a) Inertia terms are of the same order of magnitude as convection terms
(b) Convection terms are of the same order of magnitude as dissipation terms
(c) Convection terms are of the same order of magnitude as conduction terms
(d) Dissipation is negligible

53. The water tubes in Babcock and Wilcox boiler are inclined to
(a) Improve convective heat transfer
(b) Improve radiative heat transfer
(c) Promote natural circulation of water
(d) Accommodate the furnace

54. Which of the following is an intensive thermodynamic property?
(a) Pressure (b) Volume
(c) Entropy (d) Internal energy

55. Sensible heating or cooling of air is done at:
(a) Same humidity ratio
(b) Same dry bulb temperature
(c) Same ambient temperature
(d) Varying humidity ratio

56. In the process of heating and humidification:
(a) R.H. is higher than the initial value
(b) D B T is higher
(c) Specific humidity and DBT (Dry Bulb temp) are increased
(d) Specific humidity is reduced

57. An isolated system is one which:
(a) Permits the passage of energy and matter across the boundaries
(b) Permits the passage of energy only
(c) Does not permit the passage of energy and matter across it.
(d) Permits the passage of matter only

58. The effect of subcooling in vapour refrigeration compression system will increase:
(a) Refrigeration effect and the C.O.P.
(b) Refrigeration effect but reduce C.O.P.
(c) Compressor work and reduce C.O.P.
(d) None of the above

59. In a uniform flow, the fluid particle velocities are:
(a) Unequal at all the sections
(b) Equal at all the sections
(c) Radially outward
(d) None of the above

60. For a steady laminar flow through a pipe, the velocity distribution at any section is:
(a) Elliptic (b) Parabolic
(c) Hyperbolic (d) None of the above

61. The terminal velocity of a small sphere when a falling in a very viscous liquid is proportional to:
(a) Liquid Viscosity
(b) Diameter of the sphere
(c) Inverse of the viscosity
(d) Liquid density

62. The maximum temperature in a gas turbine is of the order of:
(a) 400 ^{0}C (b) 800 ^{0}C
(c) 1500 ^{0}C (d) 2000 ^{0}C

63. A reversible engine receives heat from a reservoir at 700 ^{0}C and rejects heat temperature T_2. A second reversible temperature T_2. A second reversible engine receives heat rejected by the first engine and rejects to a sink at 37 ^{0}C. T_2 for equal work output by both the engine will be:
(a) 350 K (b) 500 K
(c) 641 K (d) 581 K

64. During a thermodynamic process,84 kJ of heat flows into the system and the work done by the system is 32 kJ. The increase in internal energy of the system is:
(a) 52 kJ (b) – 52 kJ
(c) + 116 kJ (d) – 116 kJ

65. A critical radius of insulated pipe leads to:
(a) Minimum rate of heat transfer
(b) No effect on Heat Transfer
(c) No Heat transfer at all
(d) Maximum rate of Heat transfer

66. A thermodynamic cycle comprises of isothermal compression from state 1 to state 2 and then isentropic compression from 2 to 3 upto maximum temperature T_3 for the cycle. Thereafter isothermal expansion occurs upto state 4. Finally isentropic expansion completes the cycle. The pressure at 4 state points are related as:
(a) $P_2P_4 = P_3P_1$
(b) $P_1P_2 = P_3P_4$
(c) $P_2 = \sqrt{P_1P_3}$ and $P_4 = \sqrt{P_1P_2}$
(d) $P_4 = \sqrt{P_2P_3}$ and $P_3 = \sqrt{P_1P_4}$

67. After adiabatic expansion, the temperature of a gas:
(a) Remains unchanged
(b) Increases
(c) Decreases
(d) Uncertain

68. A greater ignition advance will:
(a) keep the delay period constant
(b) Increase the delay period
(c) Decrease the delay period
(d) Unpredictable

69. The Regenerator in a gas turbine plant is a heat exchanger of:
(a) Parallel flow type
(b) Counter flow type
(c) Mixed flow type
(d) Bleed type

70. The Degree of freedom of a diatomic gas is in general:
(a) 3 (b) 4
(c) 5 (d) 6

71. The centre of pressure of an immersed surface is:
(a) Same as centroid of surface
(b) Always above the centroid of surface
(c) The point through which the resultant pressure acts on the surface
(d) None of the above

72. In heating and Dehumidification process the R.H. (Relative Humidity):
(a) Increases
(b) Reduces
(c) May increases or decreases
(d) Remains unchanged

73. The Stanton Number is given by:
(a) $\frac{Re\ Pr}{Nu}$ (b) $\frac{Re}{Nu\ Pr}$
(c) $\frac{Pr}{Nu\ Re}$ (d) $\frac{Nu}{Re\ Pr}$

74. Which of the following statements is correct?
(a) All the isentropic processes are adiabatic
(b) All the adiabatic processes are isentropic
(c) Both (a) and (b) are true
(d) None of the above

75. Wind Energy is:
(a) A direct form of solar energy
(b) An indirect form of solar energy
(c) Has no relation with solar energy
(d) None of the above

76. The velocity and temperature distribution in a pipe flow are given by u(r) and T(r). If u_m is the mean velocity at any section of the pipe, the bulk mean temperature at that section is:
(a) $\int_0^{r_0} u(r)T(r)r^2 dr$
(b) $\int_0^{r_0} \frac{u(r)}{3r}\frac{T(r)}{2r} dr$
(c) $\frac{4\int_0^{r_0} u(r)T(r)dr}{2\pi r_0^3}$
(d) $\frac{2}{u_m r_0^2}\int_0^{r_0} u(r)T(r)dr$

77. For cooling load to be minimum at a particular place for air conditioning, the glass windows should be towards:
(a) North (b) South
(c) East (d) West

78. The maximum attainable delivery pressure in a reciprocating compressor is limited by:
(a) Swept volume
(b) clearance volume
(c) (swept volume + clearance volume)^2
(d) (swept volume − clearance volume)^2

79. In Psychrometric chart, dry bulb temperature lines are:
(a) Vertical
(b) Horizontal
(c) Straight, inclined sloping upto the left
(d) Curved

80. Octane number of gasoline is a measure of its:
(a) Ignition delay
(b) Ignition temperature
(c) Smoke point
(d) Knocking tendency

81. In a normal shock wave in one dimensional flow:
(a) The velocity, pressure and density increase
(b) Pressure, density and temperature
(c) Velocity temperature and density increase
(d) Entropy remains constant

82. The Heat transfer rate from an insulated pipe:
(a) Always decreases with the addition of insulation
(b) Always increases with the addition of insulation
(c) Is minimum with certain thickness of insulation
(d) None of the above

83. The OTEC(Ocean Thermal Energy Conversion) efficiency is of the order of:
(a) 0 – 5% (b) 10 – 15%
(c) 20 – 15% (d) 30 – 35%

84. Which one of the following properties of moist air depends upon barometric pressure?
(a) Dew point temperature
(b) Specific humidity
(c) Relative humidity
(d) None of the above

85. The more effective way to increase the efficiency of a carnot engine is to:
(a) Increase T_1 keeping T_2 constant
(b) Decrease T_1 keeping T_2 constant
(c) Decrease T_2 keeping T_1 constant
(d) Increase T_2 keeping T_1 constant

86. At any section in a pipe the air flows with velocity 150 m/s at 310 K. If the potential energy is negligible, the stagnation temperature would be:
(a) 316.2 K (b) 312.2 K
(c) 326.2 K (d) 331.2 K
Take C_P of air = 1004 J/kg K.

87. A Rayeligh line is derived from the following equations.
(a) Momentum and Continuity
(b) Energy and continuity
(c) Momentum and Energy
(d) Momentum, countinuity and energy

88. Water pipe line in cold countries is layed beyond certain depth from the earth's surface in order to:
(a) Supply warm water
(b) Prevent water from freezing
(c) Reduce frictional losses.
(d) None of the above

89. Which of the following refrigerants has the maximum ozone depletion in the Stratosphere?
(a) Ammonia (b) CO_2
(c) SO_2 (d) Fluorine

90. Temperature recorded by a thermometer which is not affected by moisture is :
(a) Dry bulb temperature
(b) Wet bulb temperature
(c) Dew point temperature
(d) Adiabatic saturation temperature

91. The highest temperature in the core of the sun is about _______K.
(a) 10 million K (b) 20 million K
(c) 40 million K (d) 60 million K

92. A carburetor properly adjusted to sea level will supply:
(a) too rich mixture at high altitude
(b) too lean mixture at high altitude
(c) Stoichiometric mixture at high altitude
(d) None of the above

93. Compressed air coming out from a punctured football:
(a) becomes hotter
(b) becomes cooler
(c) Remains at the same temperature
(d) Becomes hotter or cooler depending upon the humidity of the surrounding air

94. In a temperature entropy diagram for a vapourisation process, isobars are:
(a) Parallel to T-axis
(b) Parallel to S-axis
(c) Both (a) and (b) are true
(d) Neither (a) nor (b) are true

95. In a lumped parameter model, the temperature variation with time is:
(a) Cubic (b) Linear
(c) Exponential (d) Sinusoidal

96. In a simple gas turbine cycle, the temperature at the exhaust in comparison to the compressor exit temperature is:
(a) equal (b) greater
(c) less (d) not related

97. Heat conduction in gases is due to:
(a) Electromagnetic waves
(b) Motion of electrons
(c) Mixing motion of different layers of gas
(d) Elastic impact of molecules

98. The deposition of frost on evaporator tubes of an air-conditioner will result in:
(a) Decrease in heat transfer
(b) Increase in heat transfer
(c) No change in heat transfer
(d) Increase in capacity of evaporator

99. In spray humidification process, the dry bulb temperature:
(a) decreases
(b) increases
(c) remains constant
(d) equals ambient temperature

100. The stagnation pressure across a Mach wave:
(a) Remain constant
(b) Decreases
(c) Increases
(d) May increase or decrease

Answer

1 (a)	21 (b)	41 (b)	61 (c)	81 (b)
2 (c)	22 (d)	42 (d)	62 (b)	82 (d)
3 (a)	23 (*)	43 (c)	63 (c)	83 (a)
4 (d)	24 (b)	44 (c)	64 (a)	84 (b)
5 (c)	25 (a)	45 (a)	65 (d)	85 (c)
6 (a)	26 (c)	46 (d)	66 (a)	86 (d)
7 (c)	27 (b)	47 (*)	67 (c)	87 (a)
8 (a)	28 (c)	48 (d)	68 (c)	88 (b)
9 (d)	29 (b)	49 (a)	69 (b)	89 (d)
10 (b)	30 (d)	50 (d)	70 (c)	90 (a)
11 (c)	31 (c)	51 (c)	71 (c)	91 (b)
12 (b)	32 (a)	52 (c)	72 (b)	92 (a)
13 (a)	33 (a)	53 (c)	73 (d)	93 (b)
14 (c)	34 (d)	54 (a)	74 (a)	94 (b)
15 (a)	35 (c)	55 (a)	75 (c)	95 (c)
16 (c)	36 (b)	56 (c)	76 (d)	96 (c)
17 (d)	37 (d)	57 (c)	77 (a)	97 (d)
18 (d)	38 (b)	58 (a)	78 (a)	98 (a)
19 (a)	39 (a)	59 (b)	79 (b)	99 (b)
20 (c)	40 (a)	60 (b)	80 (d)	100 (b)

15. $L_2 = L_1$

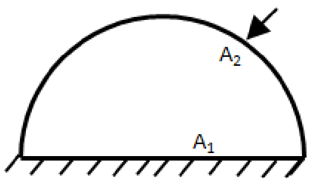
$\frac{\partial_1}{\partial_2} = \frac{R_2}{R_1} = \frac{\frac{L_2}{k_2 A}}{\frac{L_1}{k_1 A}} = \frac{k_1}{k_2} = \frac{1}{2}$

19. k = 0.4 W/m-K, L = 0.6 m,

A = 1 m × 1.5 m = 1.5 m^2

$\frac{L}{kA} = \frac{0.6}{1.5 \times 0.4} = 1$ K /W

44.



$F_{21}A_2 = F_{12}A_1$

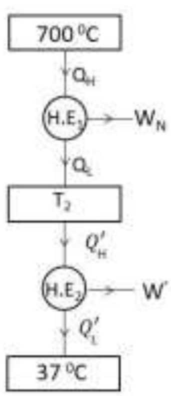
$F_{21} = \frac{F_{12}}{A_2}A_1 = \frac{1 \times \pi R^2}{2\pi R^2} = 0.5$

50. COP = $\frac{Q_H}{W_N} = \frac{Q_H}{Q_H - Q_L} = \frac{T_H}{T_H - T_L} = \frac{400}{400-300} = 4$

61. Terminal Velocity $V_c = \frac{2V^2(\rho - \rho_0)g}{9\eta}$

Terminal velocity is inversely proportional to viscosity of fluid.

63.



Work output for both engine are same.

$W_N = W'$

$Q_H - Q_L = Q'_H - Q'_L \quad (Q_L = Q'_H)$

$Q_H + Q'_L = 2Q_L$

$\frac{Q_H}{T_H} = \frac{Q_L}{T_L}$

$\frac{Q_H}{700+273} = \frac{Q_L}{T_2}$

$Q_H = \frac{973}{T_2} Q_L$

$\frac{Q'_H}{T_2} = \frac{Q'_L}{273+37}$

$Q'_L = \frac{310}{T_2} Q'_H = \frac{310}{T_2} Q_L$

$Q_H + Q'_L = 2Q_L$

$\frac{973}{T_2} Q_L + \frac{310}{T_2} Q_L = 2Q_L$

$T_2 = 641.5$ K

64. Q = 84 kJ, W = 32 kJ

Q = U + W

U = 52 kJ

76. Bulk mean temperature

$T_b = \frac{2}{u_m r_0^2}\int_0^{r_0} u(r)T(r)rdr$

81. Across a shock wave, the static pressure, temperature and density increases almost instantaneously.

85. $\eta = 1 - \frac{T_2}{T_1}$

The efficiency of a carnot engine is to increase T_1 keeping T_2 constant.

The efficiency of a carnot engine is to decrease T_2 keeping T_1 constant.

86. $h + \frac{1}{2}v^2 = h_0$

$c_p T + \frac{1}{2}v^2 = c_p T_0$

$T_0 = T + \frac{1}{2}\frac{v^2}{c_p} = 310 + \frac{1}{2} \times \frac{150^2}{1004} = 321.2$ K

1. Euler Number is defined as the ratio of inertia force to
(a) viscous force (b) elastic force
(c) pressure force (d) gravity force

2. The ratio of thermal conductivity to electrical conductivity is
(a) Prandtl Number
(b) Schmidt Number
(c) Lorentz Number
(d) Lewis Number

3. An electric cable of 22 mm diameter is insulated with rubber of thermal conductivity 0.18 W/mK. Heat transfer coefficient from outer surface to atmosphere is 9 W/m^2K. The insulation thickness which will give maximum heat dissipation from the surface of electric cable is
(a) 9 mm (b) 10 mm
(c) 20 mm (d) 22 mm

4. Absorptivity of a body will be equal to its emissivity
(a) at all temperatures
(b) at a particular temperature
(c) when system is in thermal equilibrium
(d) for a polished body

5. The thickness of thermal and hydrodynamic boundary layers are equal if
(a) Pr = 1 (b) Pr > 1
(c) Pr < 1 (d) Pr = Nu
Where Pr → Prandtl Number and
Nu → Nusselt Number

6. If the capacity rates of hot and cold fluids are equal and NTU =2, for a parallel flow heat exchanger, its effectiveness is
(a) $\frac{1}{2}(1 - e^{-4})$
(b) $1 - e^{-4}$
(c) $1 - e^{-4}/2$
(d) $\frac{1}{2}(1 - 2e^{-4})$

7. If Nusselt Number is 400, Stanton Number is 0.5 and Reynold's Number is 40, Prandtl Number will be
(a) 200 (b) 80
(c) 4 (d) 20

8. If Pr < 1, the thickness ratio of thermal boundary layer and hydrodynamic boundary layer is
(a) 0 (b) 1.0
(c) less than 1 (d) greater than 1

9. For evaporators and condensors, the logarithimic mean temperature difference for parallel flow, in given conditions, is
(a) Equal to that for counter flow
(b) Greater than that for counter flow
(c) Smaller than that for counter flow
(d) Very much smaller than that for counter flow

10. For evaporators and condensers, the logarithmic mean temperature difference for parallel flow, in given condition, is
(a) Equal to that for counter flow
(b) Greater than that for counter flow
(c) Smaller than that for counter flow
(d) Very much smaller than that for counter flow

11. If petrol is used in a diesel engine,
(a) knocking will increase
(b) efficiency will be low
(c) black smoke will be produced
(d) power produced will be less

12. Multistage turbines are
(a) Reaction type
(b) Velocity compounded
(c) Pressure compounded
(d) All of the above

13. A single stage impulse turbine with a diameter of 120 cm runs at 3000 rpm. If the blade speed ratio is 0.42, the inlet velocity of the steam will be
(a) 79 m/s (b) 188 m/s
(c) 450 m/s (d) 900 m/s

14. Exhaust pipes of I.C. engines are covered with insulating material in order to
(a) keep the exhaust pipes warm
(b) reduce formation of condensate
(c) reduce heat transfer to engine room
(d) increase engine efficiency

15. Euler's equation for water turbine derived on the basis of
(a) conservation of mass
(b) rate of change of linear
(c) rate of change of angular momentum
(d) rate of change of velocity

16. To reduce the possibility of knocking, in CI engine, the fuel air mixture should have
(a) low temperature
(b) low density

(c) short delay period
(d) non reactive mixture

17. A regenerative steam cycles renders
(a) increased work output per unit mass of steam
(b) decreased work output per unit mass of steam
(c) decreased work output per unit mass of steam as well as increased thermal efficiency
(d) increased thermal efficiency

18. In a reciprocating air compressor, the compression work per kg of air
(a) increases as clearance volume increases
(b) decreases as clearance volume increases
(c) increases with clearance volume only in multistage compression
(d) is independent of clearance volume

19. In aircraft gas turbine the axial flow compressor is preferred because
(a) it gives high pressure ratio
(b) it is stall free
(c) it has low frontal area
(d) it give high thrust

20. Water is directly converted from the liquid form to superheated steam in
(a) Benson boiler
(b) La Mont boiler
(c) Velox boiler
(d) Leoffler boiler

21. For constant maximum pressure and heat input, the air standard efficiency of a gas power cycle is in the decreasing order
(a) Diesel cycle, dual cycle, Otto cycle
(b) Otto cycle, Dual cycle, Diesel cycle
(c) Dual cycle, Diesel cycle, Otto cycle
(d) Diesel cycle, Otto cycle, Dual cycle

22. Solid injection in C.I. Engines refers to injection of
(a) liquid fuel only
(b) liquid fuel and air
(c) solid fuel
(d) solid fuel and air

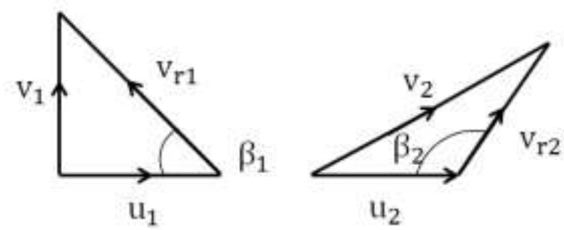
23. Magnetic field strength in the MHD is of the order of
(a) 1 to 3 Tesla
(b) 4 to 6 Tesla
(c) 10 to 12 Tesla
(d) 14 to 16 Tesla

24. Curtis steam turbine is a
(a) simple impulse turbine
(b) simple reaction type turbine
(c) velocity compounded turbine
(d) pressure compounded turbine

25. High specific speed of a pump implies that it is a
(a) Centrifugal pump
(b) Mixed flow pump
(c) Axial flow pump
(d) None of the above

26. The function of control rods in nuclear plants is to
(a) control temperature
(b) control radioactive pollution
(c) control absorption of neutrons
(d) control fuel consumption

27. The inlet and exit velocity triangles of turbo machine rotor are shown in the figure. The turbo machine is



(a) An axial compressor with backward curved blades.
(b) A radial compressor with backward curved blades.
(c) A radial compressor with forward curved blades.
(d) An axial compressor with forward curved blades.

28. Plasma is called
(a) First state of mater
(b) Second state of matter
(c) Third state of matter
(d) Fourth state of matter

29. Which of the following factors increase detonation in S.I. engines?
1. Increased spark advance
2. Increase speed
3. Increased air fuel ratio beyond stoichiometric strength
4. Increased compression ratio
Select the correct answer from codes given below:

(a) 1 and 3 (b) 2 and 4
(c) 1, 2 and 4 (d) 1 and 4

30. Low specific speed of water turbine implies that it is
(a) Propeller turbine (b) Francis turbine
(c) Impluse turbine (d) All of the above

31. For a given evaporator temperature and given condenser temperature the work input to compressor having two stages as compared to that having single stage for the same refrigeration capacity is
(a) Less (b) More
(c) Same (d) Not predictable

32. For the same clearance factor and same evaporator and condenser temperatures, single stage compressor as compared to two stage compressor gives
(a) lower volumetric efficiency
(b) higher volumetric efficiency
(c) same volumetric efficiency

33. The condition of refrigeration, before entering the expansion or throttle valve, in vapour compression system is
(a) Dry vapour
(b) Wet vapour
(c) Very wet vapour
(d) High pressure saturated liquid

34. By-pass factor of cooling coil decreases with
(a) increase in fin spacing and increase in number of rows
(b) increase in fin spacing and decrease in number of rows
(c) decrease in fin spacing and decrease in number of rows
(d) decrease in fin spacing and increase in number of rows

35. The desirable combination of properties for refrigerant include
(a) High specific heat and high specific volume
(b) High Heat transfer coefficient and and low latent heat
(c) High thermal conducitvity and and low freezing point
(d) High specific heat and high latent heat

36. The maximum COP for the absorption cycle is given by
(a) $\frac{T_E(T_G-T_C)}{T_G(T_C-T_E)}$ (b) $\frac{T_G(T_C-T_E)}{T_C(T_G-T_E)}$
(c) $\frac{T_C(T_G-T_E)}{T_G(T_C-T_E)}$ (d) $\frac{T_C(T_C-T_E)}{T_G(T_G-T_E)}$
Where
$T_G \rightarrow$ Generator Temperature
$T_C \rightarrow$ Environment Temperature
$T_E \rightarrow$ Refrigerated space Temperature

37. It desired to condition the outside air from 70% RH and 45 ^{0}C dry bulb temperature to 50% RH and 25 ^{0}C dry bulb room condition. The practical arrangement would be
(a) Cooling and dehumidification
(b) Dehumidification and pure sensible heating
(c) Cooling and humidification
(d) Dehumidification

38. Both cooling and dehumidification can be achieved by passing air over a cooling coil whose effective surface temperature, as compared to dew point temperature for the entering air, is
(a) Lower (b) Equal
(c) Higher (d) None of the above

39. Regarding dehumidification process which of the following is incorrect?
(a) Enthalpy of saturation increases
(b) Moisture is removed
(c) Dry bulb temperature remains unchanged
(d) Specific humidity and relative humidity decrease

40. During adiabatic saturation process on insaturated air, which of the following remains constant?
(a) relative humidity
(b) Dry bulb temperature
(c) wet bulb temperature
(d) Dew point temperature

41. In Vapour compression refrigeration cycle for ice making, the condensing temperature for better COP is (desired) to be
(a) Near critical temp. of the refrigerant
(b) Above critical temperature of the refrigerant
(c) Much below the critical temperature of the refrigerant
(d) Any value as it is not affected by condensing temperature

42. In a simple saturated vapour compression refrigeration cycle, the following results were obtained:
Heat rejected in

condenser = 160 kJ/kg
Compression work = 32 kJ/kg
The COP of the refrigerator is
(a) 5 (b) 4
(c) 6 (d) Date is insufficient

43. In a lithium Bromide absorption refrigeration system
(a) Lithium bromide is used as a refrigerant and water as an absorbent
(b) Water is used as a refrigerant and Lithium Bromide as an absorbent
(c) Ammonia is used as refrigerant and lithium bromide as an absorbent
(d) None of the above

44. In Electrolux refrigerator
(a) Ammonia is absorbed in hydrogen
(b) Ammonia is absorbed in water
(c) Ammonia evaporates in hydrogen
(d) Hydrogen evaporates in Ammonia

45. A vapour compression refrigeration installation has 40 ^{0}C condensing temperature and – 10 ^{0}C evaporator temperature. Its capacity is 10 tons. If the evaporator is now changed to + 10 ^{0}C,
(a) its capacity increases
(b) Its capacity decreases
(c) Its capacity remains unchanged
(d) None of the above

46. In reversed Carnot cycle working on perfect gas
(a) Isothermal work of compression is equal to Isothermal work of expansion
(b) Isentropic work of compression is equal to Isentropic work of expansion
(c) Net work of the cycle is zero
(d) Net heat transfer of the cycle is zero

47. That refrigerant is desirable which gives evaporator pressure
(a) As high as possible
(b) As low as possible
(c) Close to atmospheric pressure
(d) Close to atmospheric pressure but above it

48. When a stream of moist air is passed over a cold and dry cooling coil such that no condensation takes place, the air stream will get cooled along the line of
(a) constant wet bulb temperature
(b) constant dew point temperature
(c) constant relative humidity
(d) constant enthalpy

49. For minimum work of a reciprocating compressor, the compression process should be
(a) Isentropic (b) Polytropic
(c) Isothermal (d) Adiabatic

50. In heating and dehumidification process, the RH
(a) increases
(b) decreases
(c) remains unchanged
(d) may increases or decrease

51. A heat engine is supplied with 2500 kJ/s of heat at constant temperature of 227 ^{0}C.The heat is rejected at 27 ^{0}C. The cycle is reversible if the amount of heat rejected is
(a) 1500 kJ/s (b) 2000 kJ/s
(c) 1000 kJ/s (d) 180 kJ/s

52. A gas is compressed adiabatically in a steady flow process with negligible change in potential and kinetic energy. The work done in the process is given by
(a) $-\int pdV$ (b) $+\int pdV$
(c) $-\int vdp$ (d) $+\int vdp$

53. Carnot, Stirling and Ericsson cycles are
(a) Reversible cycles
(b) Irreversible cycles
(c) Semi-irreversible cycles
(d) Irreversible adiabatic cycles

54. The pressure of 10 kg of a gas is increased two times that of its initial value while being heated in a reversible non-flow, constant volume process. The initial temp. of the gas is 27 ^{0}C and specific heat at constant volume is 0.6 kJ/kgK. The heat transferred to gas is
(a) 1600 kJ (b) 1800 kJ
(c) 2000 kJ (d) 2100 kJ

55. The triple point temperature of water is
(a) 100 ^{0}C (b) 273 K
(c) 273.15 K (d) 273.16 K

56. The efficiency of a Carnot cycle is given as 0.75. If a Carnot refrigerator is run on the same cycle, the C.O.P. will be
(a) 0.33 (b) 1.33
(c) 2.33 (d) 0.25

57. At critical pressure 221.2 bar, latent heat of vapourisation of water is
(a) Maximum (b) Minimum
(c) Zero (d) None of the above

58. One reversible heat engine operates between 1600 K and T_2 K. Another reversible heat engine operates between T_2 K and 400 K. If the both heat engines have the same heat input and work output, the temperature T_2 must be equal to
(a) 800 K (b) 1000 K
(c) 1200 K (d) 1400 K

59. A throttling process is represented on Molliers Chart by
(a) Vertical line (b) Horizontal line
(c) Point (d) A curve

60. Which of the following is an air standard cycle for gas turbine power plant?
(a) Brayton (b) Bell-Coleman
(c) Dual (d) Carnot

61. The Ericsson cycle is made up of
(a) two reversible isotherms and two reversible isobars
(b) two reversible isotherms and two reversible isochoric
(c) two reversible isotherms and two reversible adiabatic
(d) None of these

62. The desirable characteristic of the working fluid in a vapour power cycle are
(a) Low critical temperature
(b) Large enthalpy of evaporation
(c) High specific heat
(d) All of the above

63. Rankine cycle efficiency can be increased by
(a) Lowering exhaust temperature
(b) Increasing pressure during heat addition
(c) Super heating steam
(d) All of the above

64. Two finite bodies at temperature T_1 and T_2 are brought in contact. If maximum work is delivered by the system, the final temperature of the bodies is
(a) $\frac{T_1+T_2}{2}$ (b) $\sqrt{T_1T_2}$
(c) $\sqrt{T_1 + T_2}$ (d) None

65. For an irreversible thermodynamic cycle
(a) $\oint \frac{dQ}{T} > 0$ but $<\infty$
(b) $\oint \frac{dQ}{T} = 0$
(c) $\oint \frac{dQ}{T} = \infty$
(d) $\oint \frac{dQ}{T} < 0$

66. For a heat engine operating on Carnot cycle, the work output is $\frac{1}{4}$ of the Heat rejected to the sink. The thermal efficiency of the engine would be
(a) 10% (b) 20%
(c) 30% (d) 50%

67. Stroke of an IC engine equals
(a) Half of crank radius
(b) Crank radius
(c) Twice the crank radius
(d) Four times crank radius

68. The process of carburation is directly affected by
(a) temperature of exhaust
(b) temperature of jacket water
(c) temperature of spark plug
(d) temperature of atmosphere

69. The internal energy of a perfect gas is a function of
(a) temperature change and specific heat
(b) pressure change and specific heat
(c) temperature
(d) pressure

70. Which of the following cycles may have the same efficiency as Carnot cycle if the temperature limits are same?
(a) Rankine cycle
(b) Stirling cycle
(c) Brayton cycle
(d) Otto cycle

71. The expression $\left(p + rz + \frac{\rho v^2}{2}\right)$ commonly used to express Bernoulli's equation has units of total energy per unit
(a) mass
(b) volume
(c) weight
(d) cross-sectional area of flow

72. Continuity equation is connected with
(a) viscosity
(b) compressibility of fluid
(c) conservation of mass
(d) steady/unsteady flow

73. In a floating body, the metacenter is below the centre of gravity of the body. The body is in
(a) stable equilibrium
(b) neutral equilibrium
(c) unstable equilibrium
(d) None of the above

74. The velocity distribution in a turbulent boundary layer follows
(a) Logarithmic law
(b) Parabolic law
(c) Linear law
(d) Cubic law

75. A two-dimensional vortex has
(a) radial stream lines
(b) constant circulation around any closed path including the origin
(c) zero circulation around it
(d) vorticity about any circular stream line including or excluding the origin

76. Friction factor for pipes depends upon
(a) Rate of flow
(b) Fluid density and viscosity
(c) Pipe roughness
(d) All of the above

77. For a fully developed laminar flow in a pipe of circular section, the average velocity is found to be 20 m/s. The maximum velocity of flow is
(a) 25 m/s (b) 30 m/s
(c) 40 m/s (d) 50 m/s

78. A dimensionless group formed with the variable ρ(density), ω(angular velocity), μ(dynamic viscosity) and D(characteristic diameter) is
(a) $\rho\omega\mu/D^2$ (b) $\rho\omega D^2/\mu$
(c) $\mu D^2\rho\omega$ (d) $\rho\omega\mu D$

79. An isentropic flow process is always
(a) Adiabatic
(b) Reversible
(c) Adiabatic and Reversible
(d) None of the above

80. Weber number is the ratio of inertia force to
(a) Gravitational force
(b) Surface Tension
(c) Elasticity
(d) Viscosity

81. The continuity equation $\frac{\partial(\rho u)}{\partial x}+\frac{\partial(\rho v)}{\partial y}+\frac{\partial(\rho w)}{\partial z}=0$ is valid for
(a) Steady flow
(b) unsteady flow
(c) Incompressible and steady flow
(d) None of the above

82. Blasius suggested the following relation for the approximate boundary layer thickness for laminar flow.
(a) $5x(Re)^{-1/2}$
(b) $4.64x(Re)^{-1/2}$
(c) $0.73x(Re)^{-1/2}$
(d) $1.86(Re)^{-1/2}$
where x is distance from the leading flow.

83. In which of the following cases the separation of a boundary layer occurs?
(a) change in kinetic energy
(b) change in pressure
(c) change in internal energy
(d) None of the above

84. In which of the following cases the separation of a boundary layer occurs?
(a) $\frac{dP}{dx}<0$
(b) $\frac{dP}{dx}=0$
(c) $\frac{dP}{dx}>0$
(d) $\frac{dP}{dx}>0$ and the velocity profile has a point of inflexion

85. A stream function for a two dimensional flow is represented by $\Psi = y^2 - x^2$. The corresponding velocity potential function of the flow field would be
(a) $\oint = 2xy + c$
(b) $\oint = 2(x^2 - y^2)$
(c) $\oint = 2xy + f(y)$
(d) $\oint = 2xy + f(x) + g(y)$

86. The flow past a Rankine body is obtained by the superposition of following elementary flows.
(a) Source, sink and uniform flow
(b) Source and uniform flow
(c) Vortex and uniform flow
(d) None of the above

87. As per boundary layer theory, pressure drag is a function of
(a) shape and dimension of body

(b) flow direction
(c) separation of flow
(d) shape of body and separation of flow

88. Displacement thickness for a boundary layer
(a) may be greater than the boundary layer thickness
(b) must be less than the momentum thickness
(c) represents the momentum deficit in a flow
(d) represents the mass deficit in a flow

89. Chances of occurrence of cavitation are height if the
(a) local pressure becomes very high
(b) local temperature becomes low
(c) Thoma cavitation parameter exceeds a certain limit
(d) Local pressure falls below the vapour pressure

90. Realization of velocity potential in a fluid flow indicates that
(a) circulation along any close curve must have a finite value
(b) flow is rotational and satisfies the continuity equation
(c) flow must be irrotational
(d) vorticity must be non zero

91. The Nusselt Number for a tube whose wall temperature is kept constant is less than that of a similar tube receiving a constant wall heat by
(a) 10 % (b) 12%
(c) 16% (d) 18%

92. A composite slab has two layers of different materials with thermal conductivity k_1& k_2. If each layer has the same thickness, the equivalent thermal conductivity of the salb would be
(a) $k_1 + k_2$ (b) $\frac{k_1 k_2}{k_1+k_2}$
(c) $\frac{2k_1 k_2}{k_1+k_2}$ (d) $k_1 k_2$

93. The shape factor of a cylindrical cavity of length L and diameter D covered with a flat surface with respect to itself is
(a) $\frac{2L}{4L+D}$ (b) $\frac{4L}{4L+D}$
(c) $\frac{4L}{L+4D}$ (d) $\frac{2L}{L+4D}$

94. Total emissivity of polished silver compared to black body is
(a) same (b) higher
(c) almost same (d) very much lower

95. The shape factor of a hemispherical body placed on surface with respect to itself is
(a) 0 (b) 0.25
(c) 0.50 (d) 1.0

96. The equation of effectiveness for a boiler in parallel flow arrangement is
(a) $1 - e^{-NTU}$ (b) $1 - e^{-2NTU}$
(c) $\frac{NTU}{1+NTU}$ (d) 1

97. The Fourier heat conduction equation $Q = -kA\frac{dT}{dx}$, presumes
1. Steady state conduction
2. Constant thermal conmductivity
3. Uniform temperature at wall surface
4. One dimensional heat flow.
The correct assumptions are

(a) 1, 2 and 3 (b) 1, 2 and 4
(c) 2, 3 and 4 (d) 1, 3 and 4

98. Free convection heat flow depends upon all except
(a) density
(b) coefficient of viscosity
(c) gravity
(d) velocity

99. In lumped parameter model, the temperature variation with time is
(a) linear (b) cubic
(c) exponential (d) sinusoidal

100. For two infinite parallel plates with emissivities, ϵ_1 and ϵ_2, the interchange factor for radiation from surface 1 to 2 is given by
(a) $\epsilon_1\epsilon_2$ (b) $\epsilon_1 + \epsilon_2$
(c) $\frac{1}{\epsilon_1} + \frac{1}{\epsilon_2}$ (d) $\frac{\epsilon_1\epsilon_2}{\epsilon_1+\epsilon_2-\epsilon_1\epsilon_2}$

Answer

1 (c)	21 (a)	41 (c)	61 (a)	81 (a)
2 (c)	22 (*)	42 (b)	62 (*)	82 (a)
3 (a)	23 (*)	43 (b)	63 (d)	83 (*)
4 (c)	24 (c)	44 (b)	64 (*)	84 (*)
5 (a)	25 (c)	45 (*)	65 (a)	85 (a)
6 (a)	26 (*)	46 (b)	66 (b)	86 (*)
7 (d)	27 (*)	47 (*)	67 (c)	87 (d)
8 (d)	28 (d)	48 (b)	68 (*)	88 (d)

9 (a)	29 (*)	49 (c)	69 (c)	89 (d)
10 (a)	30 (c)	50 (b)	70 (b)	90 (c)
11 (a)	31 (*)	51 (a)	71 (b)	91 (*)
12 (d)	32 (*)	52 (c)	72 (c)	92 (c)
13 (c)	33 (d)	53 (a)	73 (c)	93 (b)
14 (c)	34 (*)	54 (b)	74 (*)	94 (c)
15 (b)	35 (*)	55 (d)	75 (*)	95 (c)
16 (c)	36 (a)	56 (a)	76 (d)	96 (a)
17 (c)	37 (a)	57 (c)	77 (b)	97 (d)
18 (d)	38 (a)	58 (a)	78 (b)	98 (d)
19 (c)	39 (a)	59 (b)	79 (a)	99 (c)
20 (*)	40 (c)	60 (a)	80 (b)	100 (d)

1. Euler number = $\frac{Pressure\ force}{Inertia\ force} = \frac{\Delta P}{\rho v^2}$

3. h = 9 W/m^{2}K, k = 0.18 W/mK

$r = \frac{k}{h} = \frac{0.18}{9}$ = 0.02 m

r = 20 mm

t = r – r_0 = 20 – 11 = 9 mm

6. Parallel flow HEX,

Given $C_c = C_h$

heat capacity ratio = $\frac{C_{max}}{C_{min}} = 1$

$\varepsilon = \frac{1-e[-NTU(1+c)]}{1+c} = \frac{1-e[-2\times2]}{2} = \frac{1-e^{-4}}{2}$

7. Nu = 400 , St = 0.5, Re = 40

$St = \frac{Nu}{Re\ Pr}$

$0.5 = \frac{400}{40\ Pr}$

Pr = 20

8. $\delta_t = \frac{\delta}{(Pr)^{1/3}}$

if Pr < 1, $\frac{\delta_t}{\delta} > 1$

$\delta_t \rightarrow$ Thermal boundary layer thickness

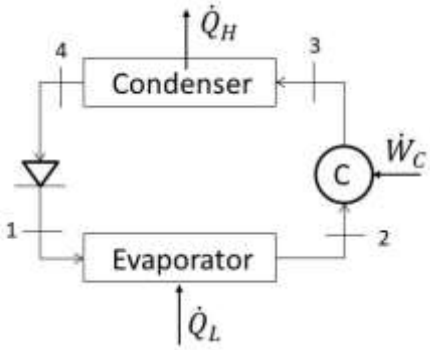
$\delta \rightarrow$ Velocity boundary layer thickness

13. $u = \frac{2\pi D}{60} \times R = \frac{\pi DN}{60} = \frac{\pi \times 1.2 \times 3000}{60}$ = 188.4 m/s

$\frac{u}{V} = 0.42$

$V = 0.42/u$ = 450 m/s

42.



$\dot{Q}_H$ = 160 kJ/kg, W_c = - 32 kJ/kg

$Q_H = h_3 - h_4$

$160 = h_3 - h_4$

$|W_c| = h_3 - h_2$

$32 = h_3 - h_2$

$h_2 - h_4 = 128$

Process 1 – 4 is constant enthalpy process,

$h_4 = h_1$, $h_2 - h_1 = Q_L$

$COP = \frac{Q_L}{W_c} = \frac{128}{32} = 4$

51. $\dot{Q}_H$ = 2500 kW, T_H = 227 ^{0}C = 500 K ,

T_L = 27 ^{0}C = 300 K

$\frac{\dot{Q}_H}{T_H} = \frac{\dot{Q}_L}{T_L}$

$\frac{2500}{500} = \frac{\dot{Q}_L}{300}$

$\dot{Q}_L$ = 1500 kW

54. m = 10 kg, $P_2 = 2P_1$, T_1 = 27 ^{0}C = 300 K

C_v = 0.6 kJ/kgK

$\Delta Q = \Delta U + \Delta W$

$\Delta Q = mC_v\Delta T + P\Delta V$

For constant volume, ΔV = 0.

$\Delta Q = mC_v\Delta T = 10\text{ kg} \times 0.6\frac{\text{kJ}}{\text{kgK}} \times (T_2 - T_1)$

For constant volume process,

$\frac{P_2}{P_1} = \frac{T_2}{T_1} = 2$, $T_2 = 2T_1$.

$\Delta Q = 10\text{ kg} \times 0.6\frac{\text{kJ}}{\text{kgK}} \times (2T_1 - T_1) = 1800$ KJ

56. η = 0.75

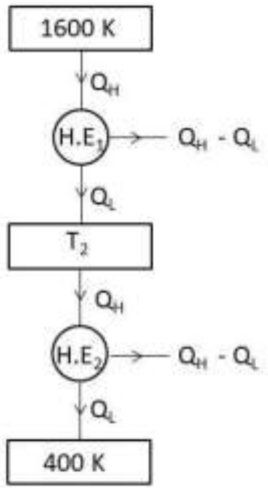
$\eta = 1 - \frac{T_L}{T_H}$

$0.75 = 1 - \frac{T_L}{T_H}$

$\frac{T_L}{T_H} = 0.25$

COP = $\frac{T_L}{T_H - T_L} = \frac{1}{\frac{T_H}{T_L} - 1}$ = 0.33

58.



$\eta_1 = 1 - \frac{T_2}{1600}$

$\eta_2 = 1 - \frac{400}{T_2}$

When work done and heat input are same for both heat engine then thermal efficiency are also same.

$1 - \frac{T_2}{1600} = 1 - \frac{400}{T_2}$

$T_2 = 800$ K

66. $\eta_{th} = \frac{w_{net}}{Q_H}$

$w_{net} = \frac{1}{4}Q_L$

$\eta_{th} = \frac{Q_L}{4Q_H}$

$Q_H - Q_L = W_{net}$

$Q_H - Q_L = \frac{1}{4}Q_L$

$\frac{Q_H}{Q_L} = \frac{5}{4}$

$\eta_{th} = 0.2$

67. $\Delta Q = \Delta U + \Delta W$

For adiabatic process, heat transfer is equal to zero.

$\Delta U + \Delta W = 0$

In expansion process, work transfer is positive.

Therefore change in internal energy is negative. It means temperature should decrease.

77. $u_{avg} = 20$ m/s

$u_{max} = \frac{3}{2}u_{avg} = \frac{3}{2} \times 20 = 30$ m/s

78. $\rho = \frac{kg}{m^3} = [ML^{-3}]$

$\mu = \frac{kg}{m.s} = [ML^{-1}T^{-1}]$

$\omega = \frac{rad}{s} = [T^{-1}]$

$D = [L]$

$\frac{\rho\omega D^2}{\mu} = \frac{ML^{-3} \times T^{-1} \times L^2}{ML^{-1}T^{-1}} = [M^0L^0T^0]$

$\frac{\rho\omega D^2}{\mu}$ → Dimension less terms

85. $\Psi = y^2 - x^2$

$u = \frac{\partial\Psi}{\partial y} = 2y$

$v = -\frac{\partial\Psi}{\partial x} = 2x$

$u = \frac{\partial\varphi}{\partial x} = 2y$

$\varphi = 2xy + f(y)$

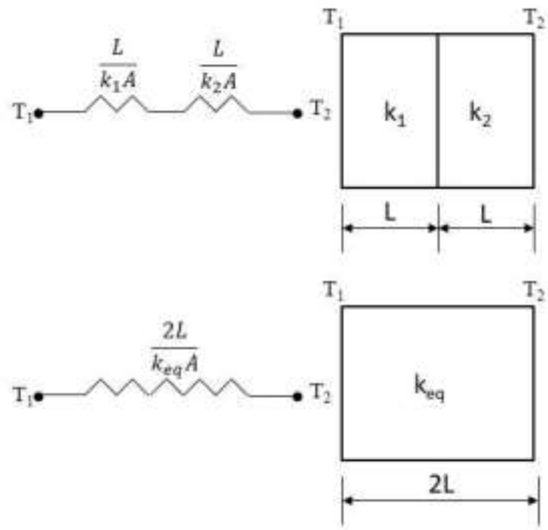
$v = \frac{\partial\varphi}{\partial y} = 2x$

$\varphi = 2xy + f(x)$

$f(x) = f(y) = constant\ (C)$

$\varphi = 2xy + C$

92.



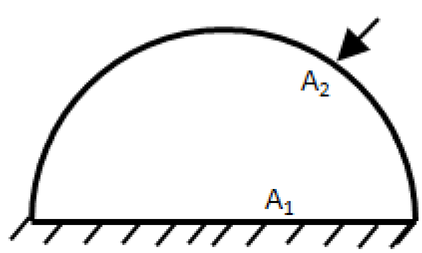
$\dot{Q} = \frac{T_1 - T_2}{\frac{L}{k_1A} + \frac{L}{k_2A}}$

$\dot{Q} = \frac{T_1 - T_2}{\frac{2L}{k_{eq}A}}$

$\frac{L}{k_1A} + \frac{L}{k_2A} = \frac{2L}{k_{eq}A}$

$k_{eq} = \frac{2k_1k_2}{k_1 + k_2}$

95.



$F_{12} = 1$

$F_{21}A_2 = F_{12}A_1$

$F_{21} \times 2\pi R^2 = F_{12} \times \pi R^2$
$F_{21} = 0.5$
$F_{21} + F_{22} = 1$
$F_{22} = 0.5$

1. Water at 42 ^{0}C is sprayed into a steam of air at atmospheric pressure, dry bulb temperature of 40 ^{0}C and a wet bulb temperature of 20 ^{0}C. The air leaving the spray humidifier is not saturated, Which of the following statements is true?
(a) Air gets cooled and humidified.
(b) Air gets heated and humidified.
(c) Air gets heated and dehumidified.
(d) Air gets cooled and dehumidified.

2. In an ideal vapour compression refrigeration cycle, the specific enthalpy of refrigerant (kJ/kg) at the following stages is given as
Inlet of condenser = 283
Outlet of condenser = 116
Exit of evaporator = 232
The COP is
(a) 2.27 (b) 2.75
(c) 3.27 (d) 3.75

3. During the chemical dehumidification process of air
(a) dry bulb temperature and specific humidity decreases.
(b) dry bulb temperature increases and specific humidity decreases.
(c) dry bulb temperature decreases and specific humidity increases.
(d) dry bulb temperature and specific humidity humidity increases.

4. Dew point temperature is the temperature at which condensation begins when the air is cooled at constant
(a) volume (b) entropy
(c) pressure (d) enthalpy

5. For air with a relative humidity of 80%
(a) the dry bulb temperature is less than the wet bulb temperature.
(b) the dew point temperature is less than the wet bulb temperature.
(c) the dew point and wet bulb temperatures are equal.
(d) the dry bulb and dew point temperatures are equal.

6. In window air-conditioner the expansion device used is
(a) capillary tube
(b) thermostatic expansion valve
(c) automatic expansion valve
(d) float valve

7. One ton of refrigeration is equivalent to SI unit of
(a) 1 kW (b) 2.5 kW
(c) 3.5 kW (d) 5 kW

8. Efficiency of a Carnot engine is 75%. If the cycle direction is reversed, COP of the reversed Carnot cycle is
(a) 1.33 (b) 0.75
(c) 0.33 (d) 1.75

9. As an Index of comfort, the temperature of saturated air at which a person would experience the same feeling of Comfort as experienced in the actual unsaturated environment is called
(a) Comfort temperature
(b) Effective temperature
(c) Wet bulb temperature
(d) Soothing temperature

10. If the specific humidity of moist air remains the same but its DBT increases, its DPT
(a) remains the same
(b) Increases
(c) decreases
(d) may increase or decrease depending on its relative humidity.

11. In a vapour compression cycle, a good refrigerator should have a
(a)large latent heat of vaporization at condenser pressure.
(b)large latent heat at evaporator pressure.
(c)condenser pressure close to critical pressure.
(d)large latent heat of vaporization at condenser pressure.

12. R-12 is preferred over R-22 in deep freezer, because
(a) It has lower operating pressure.
(b) It gives higher COP.
(c) It is miscible with oil over a large range of temperature.
(d) All of the above.

13. Low grade fuels have
(a) low moisture content
(b) low ash content
(c) low calorific value
(d) high carbon content

14. Which of the following does not use ambient air for propulsion?

(a) Turbo jet (b) Pulse jet
(c) Turbo-prop (d) Rocket

15. Humidity ratio can be given in terms of partial pressures of dry air (P_a) and water vapour (P_v) as
(a) $0.622\left(\frac{P_a}{P_v}\right)$
(b) $0.622\left(\frac{P_v}{P_a}\right)$
(c) $0.622\left(\frac{P_v}{P_v-P_a}\right)$
(d) None of the above

16. If the air is passed over the cooling coils then this process is termed as
(a) sensible heating
(b) cooling with humidification
(c) cooling with dehumidification
(d) None of the above

17. COP of air refrigerator is related with COP of vapour compression refrigerator as
(a) $(COP)_{air} > (COP)_{vap.c.}$
(b) $(COP)_{air} < (COP)_{vap.c.}$
(c) $(COP)_{air} = (COP)_{vap.c.}$
(d) None of the above

18. In an air craft refrigeration system the pressure at the cooling turbine outlet is equal to
(a) ambient pressure
(b) cabin pressure
(c) pressure at inlet to compressor
(d) None of the above

19. The relative humidity, during sensible heating
(a) can increase or decrease
(b) increases
(c) decreases
(d) remains constant

20. Kelvin Plank law deals with
(a) conversion of work into heat
(b) conversion of heat into work
(c) conservation of work
(d) conservation of heat

21. Thermodynamic work is the product of
(a) Two intensive properties
(b) Two extensive properties
(c) An intensive property and change in an extensive property
(d) An extensive property and change in an intensive property

22. Air is compressed adiabatically in a steady flow process with negligible change in potential and kinetic energy. The work done in the process in given by
(a) $-\int pdv$ (b) $+\int pdv$
(c) $-\int vdp$ (d) $+\int vdp$

23. A heat engine is supplied with 250 kJ/s of heat at constant fluid temperature of 227 ^{0}C. The heat is rejected at 27 ^{0}C. The cycle is reversible, if the amount of heat rejected is
(a) 273 kJ/s (b) 200 kJ/s
(c) 180 kJ/s (d) 150 kJ/s

24. The sequence of processes that eventually returns the working substance to its original state is known as
(a) Event
(b) Process
(c) Thermodynamic property
(d) Thermodynamic cycle

25. If the dryness fraction of a sample by throttling calorimeter is 0.8 and that by separating calorimeter is also 0.8, then the actual dryness fraction of sample will be taken as
(a) 0.8 (b) $\sqrt{0.8}$
(c) 0.64 (d) 0.5

26. Thermodynamic equilibrium is completely defined by the specifications of
(a) internal energy
(b) Enthalpy
(c) Generalized displacements
(d) All of the above

27. Gas expands for a definite volume in a closed vessel. The maximum work will be done when the process is at constant
(a) Volume (b) Temperature
(c) Pressure (d) Enthalpy

28. Which conversion is incorrect?
(a) 1 kWh = 3.6 $\times 10^6$ Nm
(b) 1 Nm = 0.238 $\times 10^{-3}$ kcal
(c) 1 HP hr = 0.746 kWh
(d) 1 kcal = 4.1868 Nm

29. In an air standard Diesel cycle at fixed compression ratio and fixed value of adiabatic index (v)
(a) Thermal efficiency increases with increase in heat addition cut-off ratio.

(b) Thermal efficiency decreases with increase in heat addition cut-off ratio.
(c) Thermal efficiency remains same with increase in heat addition cut-off ratio.
(d) None of the above.

30. In Rankine cycle, the work output from the turbine is given by
(a) change in internal energy between inlet and outlet.
(b) change in enthalpy between inlet and outlet.
(c) change in entropy between inlet and outlet.
(d) change in temperature between inlet and outlet.

31. For a closed system, undergoing an expansion process according to the law PV^n = constant, the work output.
(a) increases with increase in 'n'
(b) increases with decrease in 'n'
(c) is maximum when n = 0
(d) is independent of 'n'

32. Law of degradation of energy says that unavailable energy is gradually decreasing due to
(a) increase in reversible processes.
(b) increase in irreversible processes.
(c) increase in unavailable energy.
(d) None of these

33. For the same compression ratio, the efficiency of Brayton cycle is
(a) equal to that of Diesel cycle
(b) equal to that of Otto cycle
(c) equal to that of Dual cycle
(d) greater than that of Diesel cycle

34. If the temperature at the turbine inlet is keep constant, the net output of a simple gas turbine plant would
(a) increase with increasing pressure ratio.
(b) decrease with increasing pressure ratio.
(c) first increase and then decrease with increasing pressure ratio.
(d) remains unaffected with changes in pressure ratio.

35. When the relationship between Reynolds number and the friction factor is represented by a straight line, the flow is said to be
(a) isentropic (b) laminar
(c) turbulent (d) vortex

36. At the point of separation
(a) velocity is maximum.
(b) shear stress is zero.
(c) shear stress is maximum.
(d) pressure gradient is zero.

37. A potential function exists for
(a) steady flow only
(b) two dimensional irrotational flow only.
(c) irrotational flow of fluid whether compressible or incompressible.
(d) irrotational flow of incompressible fluids only.

38. Which property of mercury is the main reason for use in barometers?
(a) High density
(b) Negligible capillary effect
(c) Very low vapour pressure
(d) Low compressibility

39. In case of fluid flow through pipes, cavitation is caused by
(a) high pressure
(b) high velocity
(c) low pressure below a limit
(d) weak material of pipe

40. A stream function
(a) is a mathematical function which has no physical equivalence.
(b) is defined only for steady and incompressible flow.
(c) satisfies Laplace equation for rotational motion.
(d) may not remain constant for a streamline.

41. For the flow to occur between two points in a pipeline, the differential pressure between these points should be more than
(a) surface friction (b) viscosity force
(c) frictional force (d) All of the above

42. Fluid is flowing in a curved path without any external impressed contact force. This flow is known as
(a) free vortex flow
(b) forced vortex flow
(c) radial flow
(d) spiral flow

43. In fluid flow through pipes, transition from laminar to turbulent flow, does not depend on

(a)length of pipe
(b) density of fluid
(c) diameter of pipe
(d) velocity of flow

44. In the region of boundary layer on a flat plat surface where velocity is not zero, the viscous force is
(a) less than inertial force
(b) more than inertial force
(c) equal in magnitude
(d) not predictable

45. The magnitude of water hammer in the flow of a liquid through a pipe does not depend upon
(a) length of pipe
(b) elastic properties of pipe material
(c) temperature of liquid
(d) time of valve closure

46. Compressibility effect can be treated as negligible when Mach number is
(a) upto 0.2 (b) upto 0.5
(c) less than 1 (d) 1

47. A body is called streamline body when
(a) it is symmetrical about the axis along the free stream.
(b) surface of the body coincides with the stream lines
(c) flow is laminar around it.
(d) it produce no drag for flow around it.

48. Mach number is the ratio of
(a) elastic force to gravity force
(b) viscous force to elastic force
(c) inertial force to surface tension
(d) inertial force to elastic force

49. For a linear distribution of velocity in the boundary layer on a flat plate, the ratio of displacement thickness to nominal thickness is
(a) $\frac{1}{4}$ (b) $\frac{1}{3}$
(c) $\frac{1}{2}$ (d) $\frac{2}{3}$

50. In case of laminar flow through pipe, the ratio of total kinetic energy of fluid passing per second to the energy value obtained on the basis of average velocity is
(a) 1.2 (b) 1.54
(c) 2.0 (d) 2.37

51. Sonic velocity will have a low value in the medium having
(a) low value of coefficient of compressibility.
(b) high value of coefficient of compressibility.
(c) high bulk modulus of elasticity.
(d) homogenous composition.

52. An isentropic flow is one which is
(a) adiabatic and reversible
(b) isothermal only
(c) adiabatic only
(d) adiabatic and irreversible

53. The size of a venturimeter is specified by
(a) fluid pressure
(b) discharge
(c) pipe diameter and throat diameter
(d) length of ventrimeter

54. In a flow field at the stagnation point
(a) pressure is zero.
(b) total energy is zero.
(c) pressure head is equal to velocity head.
(d) All the velocity head is converted into pressure head.

55. Which two forces are most important in laminar flow between parallel plates?
(a) Inertial and viscous
(b) Viscous and pressure
(c) Gravity and pressure
(d) Pressure and inertial

56. A high value of thermal diffusivity represents
(a) high storage, less conduction of heat.
(b) less strorage, more conduction of heat.
(c) There is always equal amount of conduction and storage since it is a property.
(d) It has no relevance

57. What happens when the thickness of insulation on a pipe exceeds the critical value?
(a) Heat transfer rate increases
(b) Heat transfer rate decreases
(c) Heat transfer rate remains constant
(d) None of these

58. For flow of fluid over a heated plate, the following fluid properties are known:
Viscosity = 0.001 Pa.s,
sp. heat at constant pressure = 1 kJ/kg-K,
thermal conductivity = 1 W/mK

The hydrodynamic boundary layer thickness at a specified location on the plate if 1 mm, then thermal boundary layer thickness at the same location is

(a) 0.001 mm (b) 0.01 mm
(c) 1 mm (d) 10 mm

59. Which one of the following configuration has the highest fin effectiveness?
(a) thin, close spaced
(b) thin, widely spaced
(c) thick, widely spaced
(d) thick, close spaced

60. In a condenser at a power plant, the steam condenses at a temperature of 60 ^{0}C. The cooling water enters at 30 ^{0}C and leaves at 45 ^{0}C. Logarithmic Mean Temperature Difference (LMTD) of the condenser is
(a) 16.2 ^{0}C (b) 21.6 ^{0}C
(c) 30 ^{0}C (d) 37.5 ^{0}C

61. In a heat exchanger, the temperature of the hot fluid decreases while the temperature of the cold fluid increases. The increase and decrease following:
(a) A quadratic law
(b) A linear law
(c) A cubic law
(d) An exponential law

62. Which substance has the minimum value of thermal conductivity?
(a) Air (b) Water
(c) Plastic (d) Rubber

63. Lumped parameter analysis for transient heat conduction is essentially valid of
(a) Bi < 0.1 (b) 0.1< Bi < 0.5
(c) 1< Bi < 10 (d) Bi $\rightarrow \infty$

64. Cork is a gold thermal insulator because
(a) Its density is low.
(b) It is porous.
(c) It can be powdered.
(d) It is flexible.

65. Unsteady state of heat flow occurs in
(a) Flow of heat through furnace walls.
(b) Flow of heat through insulated pipe with constant surface temperature.
(c) Annealing of castings.
(d) Flow of heat through refrigerator walls.

66. The temperature inside a furnace is generally measured by
(a) Mercury thermometer
(b) Alcohol thermometer
(c) Gas thermometer
(d) Optical pyrometer

67. Heat is transferred by conduction, convection and radiation in
(a) Insulated pipes carrying hot water
(b) Refrigerator freezer coils
(c) Melting of ice
(d) Boiler furnaces

68. The density of water is maximum at
(a) 20 ^{0}C (b) 4 ^{0}C
(c) 0 ^{0}C (d) – 4^{0}C

69. Which non-metallic body is expected to have highest value of emissivity?
(a) Iron oxide (b) Carbon
(c) Ice (d) Paper

70. The rate of heat transfer by conduction in pipes at critical radius is
(a) equal to the rate of heat transfer by convection and is maximum.
(b) equal to the rate of heat transfer by convection and is minimum.
(c) greaterthan the rate of heat transfer by convection.
(d) less than the rate of heat transfer by convection.

71. The heat transfer coefficient over the surface of a pin fin decreases, then
(a) Its effectiveness will decrease.
(b) Its effectiveness will increase.
(c) Its effectiveness will remain unchanged.
(d) Its effectiveness will first increase and then decrease.

72. The critical radius of insulation for a sphere is equal to
(a) 2 kh (b) $\frac{h}{2k}$
(c) $\frac{2k}{h}$ (d) $\sqrt{2kh}$
Where symbols have usual meanings.

73. In a cylinder under steady state conduction with uniform heat generation, the temperature gradient at half the radius location will be

(a) one half of that at surface
(b) one fourth of that at surface
(c) twice that at surface
(d) four times that at surface

74. For the quick response of a thermocouple
(a) Its wire diameter should be large.
(b) the convective heat transfer coefficient should be high.
(c) the specific heat should be high.
(d) the density should not be very small.

75. If Nusselt number is 390, Reynolds number is 39 and prandtl number is 20, then Stanton number will be
(a) 780 (b) 200
(c) 2 (d) 0.5

76. The temperature of a solid surface is raised from 227 ^{0}C to 727 ^{0}C. The emissive power of the body will change from E_1 to E_2 such that E_2/E_1
(a) 400 (b) 16
(c) 4000 (d) 1600

77. For an opaque body sum of absorptivity and reflectivity is
(a) 0 (b) 1.0
(c) less than 1.0 (d) greater than 1.0

78. Efficiency of a Diesel cycle will approach to Otto cycle when
(a) diesel engine will operate at high speed.
(b) cut-off period of diesel cycle is reduced to zero.
(c) diesel fuel is balanced with petrol.
(d) None of these.

79. A gas turbine cycle with heat exchanger and reheating improves
(a) only the thermal efficiency.
(b) only the specific power output.
(c) both thermal efficiency and specific power output.
(d) neither thermal efficiency nor specific power output

80. The ideal efficiency of simple gas turbine cycle depends upon
(a) pressure ratio
(b) cut-off ratio
(c) both (a) and (b)
(d) None of the above

81. The area of a p-v diagram for a Carnot cycle represents
(a) heat supplied
(b) heat rejected
(c) work done
(d) temperature drop

82. For a given set of operating pressure limits of a Rankine cycle the highest efficiency occurs
(a) Saturated cycle
(b) Superheated cycle
(c) Reheat cycle
(d) Regenerative cycle

83. Which process is responsible for production of energy in the Sun?
(a) Nuclear fission reaction
(b) Nuclear fusion reaction
(c) Exothermal chemical reaction
(d) All of the above

84. Terrestrial radiation has a wavelength in the range of
(a) 0.2 µm to 4 µm
(b) 0.2 µm to 0.5 µm
(c) 0.380 µm to 0.760 µm
(d) 0.29 µm to 2.3 µm

85. A solar thermal collector
(a) collects the solar energy and reflects it back.
(b) absorbs the solar radiation and dissipates it to the ambient.
(c) collects and converts the solar energy into electrical energy.
(d) collects and converts the solar energy into thermal energy and delivers it to the next stage of the system

86. A solar cell is basically
(a) a voltage source, controlled by flux of radiation.
(b) a current source, controlled by flux of radiation.
(c) a uncontrolled current source.
(a) an uncontrolled voltage source.

87. The working fluid used in an MHD system coupled to a fast breeder reactor is
(a) hot flue gases
(b) seeded inert gas
(c) liquid metal inert gas
(d) liquid metal only

88. For the same maximum pressure and temperature
(a) Otto cycle is more efficient than diesel cycle.
(b) Diesel cycle is more efficient than Otto cycle.
(c) Dual cycle is more efficient than Otto and Diesel cycle.
(d) Dual cycle is less efficient than Otto and Diesel cycle.

89. Consider the following emissions of I.C. engine.
1. CO_2 2. HC
3. NO_x 4. Paticulate
Which of these emissions causes photochemical smog?
(a) 1 and 4 (b) 1 and 2
(c) 2 and 3 (d) 3 and 4

90. Consider the following statements:
Knock in the S.I. engine can be reduced by
1. Supercharging
2. Retarding the spark
3. Using a fuel of long straight chain structure.
4. Increasing the engine speed.
Of these correct statements are
(a) 1 and 2 (b) 2 and 3
(c) 1, 3 and 4 (d) 2 and 4

91. Which of the following is considered to be superior quality coal for power plants?
(a) Bituminous coal
(b) Peat
(c) Coke
(d) Lignite

92. A curve showing the variation of load on a power station with respect to time is known as
(a)Load curve
(b) Load duration curve
(c) Diversity factor
(d) Performance curve

93. The capacity of generators being installed in super thermal power plant is
(a) 100 MW (b) 200 MW
(c) 400 MW (d) 500 MW

94. Fuel injection pressure in solid injection system is approximately in the range of
(a) < 10.5 bar (b) 10.5 – 21 bar
(c) 30 – 50 bar (d) 200 – 246 bar

95. The thermal efficiency of a gas turbine cycle with ideal regenerative heat exchanger is
(a) equal to work ratio
(b) less than work ratio
(c) more than work ratio
(d) unpredictable

96. The ratio of work done to the energy supplied to rotor in a turbine stage is called
(a) blade efficiency
(b) stage efficiency
(c) nozzle efficiency
(d) None of these

97. The diagram efficiency is highest for simple impulse turbine stage having smooth and symmetrical blade when blade steam speed ratio can be given as
(a) $\cos\alpha_1$ (b) $\frac{\cos\alpha_1}{4}$
(c) $\frac{\cos\alpha_1}{2}$ (d) None of these
Where α_1 is the angle of absolute velocity at inlet.

98. What will happen to the volumetric efficiency with increasing pressure ratio in case of single stage compression in compressions?
(a) Decreases
(b) Increases
(c) Remains unaffected
(d) None of these

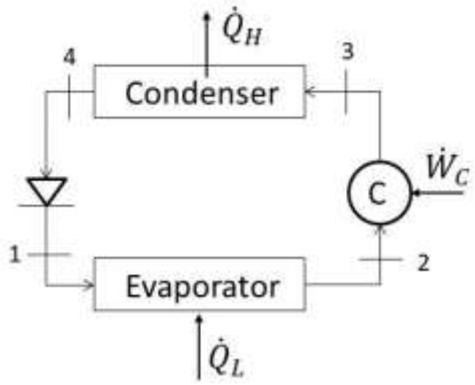
99. The compression work requirement is minimum in case of compression process being
(a) Adiabatic (b) Isochoric
(c) Isothermal (d) Hyperbolic

100. If a mass of moist air in an air tight vessel is heated to a higher temperature, then
(a) specific humidity of the air increases.
(b) specific humidity of the air decreases.
(c) relative humidity of the air increases.
(d) relative humidity of the air decreases.

1 (b)	21 (c)	41 (d)	61 (d)	81 (c)
2 (a)	22 (c)	42 (a)	62 (a)	82 (d)
3 (b)	23 (d)	43 (a)	63 (a)	83 (b)
4 (c)	24 (d)	44 (b)	64 (b)	84 (a)
5 (b)	25 (c)	45 (c)	65 (c)	85 (d)
6 (a)	26 (d)	46 (a)	66 (d)	86 (b)
7 (c)	27 (c)	47 (b)	67 (a)	87 (d)
8 (a)	28 (d)	48 (d)	68 (b)	88 (b)
9 (b)	29 (b)	49 (c)	69 (c)	89 (*)
10 (a)	30 (b)	50 (c)	70 (a)	90 (d)

11 (b)	31 (c)	51 (a)	71 (b)	91 (a)
12 (c)	32 (a)	52 (c)	72 (c)	92 (a)
13 (c)	33 (b)	53 (c)	73 (a)	93 (d)
14 (d)	34 (c)	54 (d)	74 (b)	94 (d)
15 (b)	35 (b)	55 (a)	75 (d)	95 (a)
16 (c)	36 (d)	56 (b)	76 (b)	96 (a)
17 (b)	37 (c)	57 (b)	77 (b)	97 (c)
18 (b)	38 (a)	58 (c)	78 (d)	98 (a)
19 (c)	39 (c)	59 (a)	79 (c)	99 (b)
20 (b)	40 (b)	60 (b)	80 (a)	100 (d)

2. COP = $\frac{Q_L}{W_{in}} = \frac{116}{50}$ = 2.27



Given h_3 = 283 kJ/kg, h_4 = 116 kJ/kg

$\dot{Q}_H = h_3 - h_4 = 167$ kJ/kg

h_2 = 232 kJ/kg

$h_1 = h_4$

$\dot{Q}_L = h_2 - h_1$ = 232 – 116 = 116 kJ/kg

$\dot{W}_{in} = h_3 - h_2$ = 283 – 232 = 51 kJ/kg

7. $\eta = 0.75 = 1 - \frac{T_L}{T_H}$

$\frac{T_L}{T_H} = 0.25$

$COP = \frac{Q_L}{Q_H - Q_L} = \frac{T_L}{T_H - T_L} = \frac{1}{3} = 0.33$

8. $\eta_{\text{carnot engine}} = 0.75 = 1 - \frac{T_L}{T_H}$

$\frac{T_L}{T_H} = 0.25$

Coefficient of Heat pump

COP = $\frac{T_H}{T_H - T_L} = \frac{1}{1-0.25} = \frac{1}{0.75} = 1.33$

23. $Q_H = 250$ kJ/s, $T_H = 227\,^0C = 500$ K

$T_L = 27\,^0C = 300$ K

$\frac{Q_H}{T_H} = \frac{Q_L}{T_L}$

$Q_L = 150$ kJ/s

25. Dryness fraction = 0.8 × 0.8 = 0.64

37. Velocity potential (Φ)

(1) Flow is irrotational $\vec{\nabla} \times \vec{V} = 0$

(2) Flow may be 2-D, 3-D.

48. Mach number = $\frac{Inertia\ Force}{Elastic\ Force} = \frac{\rho V^2}{E_S} = \frac{V^2}{\frac{E_S}{\rho}}$

$\frac{E_S}{\rho} = a^2$ (a = speed of sound)

49. Displacement thickness

$\boldsymbol{\delta^* = \int_0^\delta 1 - \frac{u}{u_\infty}\, dy}$

Velocity profile

$u = \frac{y}{\delta} u_\infty$

$\boldsymbol{\delta^* = \frac{\delta}{2}}$

50. Velocity profile in circular pipe flow

$u = u_{max}(1 - \frac{r^2}{R^2})$

$\frac{dK.E.}{dt} = \int_0^R \frac{1}{2}(\rho A u)u^2 = \int_0^R \frac{1}{2}\rho u^3 2\pi r dr$

$\frac{dK.E.}{dt} = \frac{\pi}{8}\rho u_{max}^3 R^2$

Average kinetic energy per unit time

$\frac{d(K.E.)_{Avg}}{dt} = \frac{1}{2}(\rho V_{av} A)V_{av}^2 = \frac{\pi}{16}\rho u_{max}^3 R^2$

$V_{av} = \frac{u_{max}}{2}$

56. $\alpha = \frac{\text{Heat conduction}}{\text{Heat storage}} = \frac{k}{\rho C_P}$

58. μ = 0.001 Pa.s

$Pr = \frac{\mu C_P}{k} = \frac{0.001 \times 1000}{1} = 1$

$C_P = 1$ kJ/kg-K

$k = 1$ W/mK

$\frac{\delta_t}{\delta_v} = (Pr)^{\frac{1}{3}} = 1$

$\delta_t = \delta_v$ = 1 mm

60. $T_{h,\,in} = 60\,^0C$, $T_{h,\,0} = 60\,^0C$

$T_{c,\,in} = 30\,^0C$, $T_{c,\,0} = 45\,^0C$

$\Delta T_1 = T_{h,\,in} - T_{c,\,in} = 30\,^0C$

$\Delta T_2 = T_{h,\,0} - T_{c,\,0} = 15\,^0C$

$\Delta T_{LMTD} = \frac{30-15}{\ln 2} = \frac{15}{\ln 2} = 21.6\,^0C$

73. Temperature profile

$T(r) = T_s + \frac{\dot{e}_{gen}}{4k}(r_0^2 - r^2)$

$\frac{dT}{dr} = \frac{\dot{e}_{gen}}{4k}(-2r)$

$\frac{\left(\frac{dT}{dr}\right)_{r = r_0/2}}{\left(\frac{dT}{dr}\right)_{r = r_0}} = \frac{1}{2}$

74. In lumped model, temperature variation is exponential in nature

response time of thermocouple depend on parameter b = $\frac{hA_S}{\rho V C_p}$

For spherical surface,

$\frac{Volume\ (V)}{Area\ (A_S)} = \frac{R}{3}$

$b \propto \frac{1}{R}$

Increasing the thermocouple diameter , parameter b will decrease. So response will also reduce.

75. $St = \frac{Nu}{Re\ Pr} = \frac{390}{39 \times 20} = \frac{1}{2} = 0.5$

76. $T_1 = 227\ ^0C = 273 + 227 = 500$ K

$T_2 = 727\ ^0C = 273 + 727 = 1000$ K

$\frac{E_2}{E_1} = \frac{\sigma A T_2^4}{\sigma A T_1^4} = \left(\frac{1000}{500}\right)^4 = 2^4 = 16$

99. For isochoric process , change in volume is equal to zero. Therefore work done is equal to zero.

1. A tank containing air is stirred by a paddle wheel. The work input to the paddle wheel is 6000 kJ. The heat transferred to the surroundings from the tank is 3000 kJ. The external work done by the system is
(a) Zero (b) 3000 kJ
(c) 6000 kJ (d) 9000 kJ

2. If specific heat ratio for a gas is γ, the change in internal energy of a mass of gas at constant pressure P, when volume changes from V to 2V is
(a) $\frac{PV}{\gamma - 1}$ (b) $\frac{R}{\gamma - 1}$
(c) PV (d) $\frac{\gamma PV}{\gamma - 1}$

3. When the depth of immersion of a plane surface is increased the centre of pressure will
(a) come closer to centroid
(b) move farther away from the centroid
(c) will remain unchanged
(d) depends on the specific weight of the liquid

4. If a pure substance is below the triple point temperature, the solid on being heated will only
(a) temperature remain constant
(b) liquify
(c) vaporize or sublimate
(d) have its temperature increased

5. Velocity at a point in a pipe flow may be measured by installing
(a) a Pitot probe at that point
(b) a wall trap
(c) a stagnation pressure probe at that point
(d) A prandtl probe at that point

6. A 2 kW electric resistance heater submerged in 5 kg water is turned on and kept on for 10 minutes. During the process, 300 kJ of heat is lost from the water, the temperature rise of water is
(a) 0.4 ^{0}C (b) 43.1 ^{0}C
(c) 57.4 ^{0}C (d) 71.8 ^{0}C

7. If the stream function is given by Ψ=3xy, then the velocity at point (2, 3) will be
(a) 7.21 unit (b) 10.82 unit
(c) 18 unit (d) 54 unit

8. The pressure and temperature of mixture of 4 kg O_2 and 6 kg N_2 are 4 bar and 27 ^{0}C. What will be the value of molecular weight of mixture?
(a) 40.67 (b) 39.87
(c) 29.47 (d) None of the above

9. The shear stress between two fixed parallel plates with a laminar flow between them
(a) a constant across the gap
(b) varies parabolically as the distance from the mid plane
(c) varies inversely as the distance from the mid plane
(d) varies directly as the distance from the mid plane

10. A vapour while condensing at 420 ^{0}C, transfers heat to water evaporating at 250 ^{0}C. If ambient is at 35 ^{0}C, what fraction of available energy a lost in the process?
(a) 0.18 (b) 0.22
(c) 0.26 (d) 0.30

11. Given power 'P' of a pump, the head 'H', the discharge 'Q' and specific weight 'w' of the liquid, dimensional analysis would lead to the result that 'P' is proportional to
(a) $H^{1/2}Q^2w$ (b) $H^{1/2}Qw$
(c) $HQ^{1/2}w$ (d) $H\ Q\ w$

12. In which of the following situations, the entropy change is negative?
(a) Air expands isothermally from 6 bar to 3 bar
(b) Air is compressed to half of its volume at constant pressure
(c) Air is supplied with heat at constant volume till its pressure is doubled
(d) Air expands adiabatically from 6 bar to 3 bar

13. A dimensionless group formed with the variables ρ, ω, μ and D is
(a) $\rho\omega\mu/D^2$ (b) $\rho\omega D^2/\mu$
(c) $\mu D^2\rho\omega$ (d) $\mu D^2\rho\omega$

14. Biot number signifies
(a) the ratio of heat conducted to heat convected
(b) the ratio of heat convected to heat conducted
(c) the ratio of external convective resistance to internal convective resistance
(d) the ratio of internal convective resistance to external convective resistance

15. The centre of pressure of a vertical rectangular plate with height of h m from its base is at
(a) $^h/_2$ from base

(b) $h/3$ from base
(c) $2h/3$ from base
(d) $3h/4$ from base

16. For a glass plate, transmittivity and reflectively, the absorptivity of the plate is
(a) 0.86 (b) 0.08
(c) 1.00 (d) 0.06

17. Turbulence in a flow implies
(a) random component of velocity superimposed on the mean flow.
(b) unsteadiness of flow
(c) non-uniformly of flow
(d) unsteadiness and non-uniformity of flow

18. In certain heat exchanger, both the fluids have identical mass flow rate-specific heat product. The hot fluid enters at 76 ^{0}C and leaves at 47 ^{0}C and the cold fluid entering at 28 ^{0}C leaves at 57 ^{0}C. The effectiveness of the heat exchanger is
(a) 0.16 (b) 0.60
(c) 0.72 (d) 1.00

19. An object weighs 50 N is water. Its volume is 15.3 liter. Its weight when fully immersed in an oil by specific gravity 0.8 will be
(a) 40 N (b) 62.5 N
(c) 80 N (d) 65 N

20. Uniform heat generation takes place in a symmetric slab so that heat flows towards both side in contact with fluid. The zero gradient boundary condition $\frac{\partial T}{\partial x} = 0$ occurs at
(a) centre line of slab (b) left wall of slab
(c) right wall of slab (d) nowhere in slab

21. Flow in a pipe takes place from
(a) higher level to lower level
(b) higher velocity to lower velocity
(c) higher pressure to lower pressure
(d) higher energy to lower energy

22. The shape factor of a hemispherical body palced on a flat surface with respect to itself is
(a) zero (b) 0.25
(c) 0.5 (d) 1.0

23. A potential function
(a) is constant along a streamline
(b) is defiend, if streamline function is available for the flow
(c) describe the flow, if it is rotational
(d) describe the flow, if it is irrotational

24. The average diameter of water drops from the water spray in a cooling tower is 1.5 mm. The relative velocity between the water drops and the air current may be taken as 0.9 m/s. The air and water temperatures are 15 ^{0}C and 80 ^{0}C respectively. Compute the connective coefficient of heat transfer.
(a) 165 W/m^{2}K (b) 60 W/m^{2}K
(c) 100 W/m^{2}K (d) 14.5 W/m^{2}K

25. Shear strain rate in a fluid is given by
(a) $\frac{1}{2}\left(\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y}\right)$ (b) $\frac{1}{2}\left(\frac{\partial v}{\partial x} + \frac{\partial u}{\partial y}\right)$
(c) $\left(\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y}\right)$ (d) $\left(\frac{\partial v}{\partial x} + \frac{\partial u}{\partial y}\right)$

26. In a counter flow heat exchanger, hot fluid enters at 60 ^{0}C and cold fluid leaves at 30 ^{0}C. Mass flow rate of the hot fluid is 1 kg/s and that of the cold fluid is 2 kg/s. Specific heat of the hot fluid is 10 kJ/kgK and that of cold fluid is 5 kJ/kgK. The Log Mean Temperature Diffrence (LMTD) for the heat exchanger in ^{0}C is
(a) 15 (b) 30
(c) 35 (d) 45

27. An object weighing 100 N in air was found to weight 75 N when fully submerged in water. The relative density of the object is
(a) 4.0 (b) 4.5
(c) 2.5 (d) 1.125

28. For a flow over a flat plate, the hydrodynamic boundary layer thickness is 0.5 mm. The fluid viscosity is 25 $\times 10^{-6}$ Pa.s, specific heat is 2.0 kJ/kgK and thermal conductivity is 0.05 W/m-K. The thermal boundary layer thickness would be
(a) 0.1 mm (b) 0.5 mm
(c) 1 mm (d) 1.5 mm

29. A vacuum gauge fixed on a steam condenser reads 80 kPa. The barometer indicates 1.013 bar. The absolute pressure in terms of mercury head
(a) 160 mm of Hg
(b) 190 mm of Hg
(c) 380 mm of Hg
(d) 760 mm of Hg

30. A wall thickness of 0.6 m has a nominal area 1.5 m^2 and is made up of material of thermal conductively 0.4 W/mK. The temperature on the

two sides are 800 ^{0}C and 100 ^{0}C. What is the thermal resistance of the wall?
(a) 1 W/K (b) 1.8 W/K
(c) 1 K/W (d) 1.8 K/W

31. If the surface tension of water-air interface is 0.073 N/m, the guage pressure inside a rain drop of 1 mm diameter will be
(a) 0.146 N/mm^2 (b) 73 N/m^2
(c) 146 N/m^2 (d) 292 N/m^2

32. In a counter flow heat exchanger, the product of specific heat and mass flow rate is the same for hot and cold fluids. If NTU is equal to 0.5, the effectiveness of the heat exchanger is
(a) 1.0 (b) 0.5
(c) 0.33 (d) 0.2

33. A piece of wood of volume V and specific gravity 0.87 floats on the surface of a liquid of specific gravity 1.31. The portion of the wood which is submerged in the liquid will be
(a) 0.335 V (b) 0.665 V
(c) 0.87 V (d) 0.13 V

34. The average Nusselt number in laminar natural convection from a vertical wall at 180 ^{0}C with still air at 20 ^{0}C is found to be 48. If the wall temperature becomes 30 ^{0}C, all other parameter remaining the same, average Nusselt number will be
(a) 8 (b) 16
(c) 24 (d) 32

35. Which one of the following is an irrotational flow?
(a) Free vortex flow
(b) Forced vortex flow
(c) Coutte flow
(d) Wake flow

36. The efficiency of a pin fin with insulated tip is
(a) $\frac{\tanh mL}{mL}$ (b) $\frac{\tanh mL}{\sqrt{hA/kP}}$
(c) $\frac{mL}{\tanh mL}$ (d) $\frac{\sqrt{hA/kP}}{\tanh mL}$

37. For the same pressure the saturation
(a) higher than saturation temperature of water
(b) lower than saturation temperature of water
(c) same as the saturation temperature of water
(d) depends on concentration of ammonia in water

38. In case of turbulent flow through a horizontal isothermal cylinder of diameter 'D', free convection heat transfer coefficient for the cylinder will
(a) be independent of diameter
(b) vary as $D^{3/4}$
(c) vary as $D^{1/4}$
(d) vary as $D^{1/2}$

39. In a vapour absorption refrigerator, the temperatures of evaporator and ambient are 10^0 C and 30^0 C respectively. If the COP of the system is 2, estimate the generator temperature.
(a) 90^0 C (b) 85^0 C
(c) 80^0 C (d) 75^0 C

40. A flat plate has thickness 5 cm, thermal conductivity 1 W/mK, convective heat transfer coefficients on its two flat faces are 10 W/m^{2}K and 20 W/m^{2}K. The overall heat transfer coefficient for such a plate is
(a) 5 W/m^{2}K (b) 6.33 W/m^{2}K
(c) 20 W/m^{2}K (d) 30 W/m^{2}K

41. In an air condition unit air enters the cooling coil at temperature 30 ^{0}C. The coil surface temperature is – 10 ^{0}C. If the cooling coil bypass factor is 0.45, then the temperature at the exit will be
(a) 6^0 C (b) 8^0 C
(c) 10^0 C (d) 12^0 C

42. A solid copper ball of mass 500 gm when quenched in a water bath at 30^0 C, cools from 530^0 C to 430^0 C in 10 sec. what will be the temperature of the ball after the next 10 seconds?
(a) 300^0 C (b) 320^0 C
(c) 350^0 C (d) Cannot be determine

43. During an adiabatic saturation process of an unsaturated air, the parameters which remains constant is
(a) Dry bulb temperature
(b) Dew point temperature
(c) Thermodyanmic wet bulb temperature
(d) Relative humidity

44. Critical radius of insulation of a hollow cyclinder is
(a) $^{2k}/_h$ (b) $^k/_{2h}$
(c) $^k/_h$ (d) $\sqrt{^k/_h}$

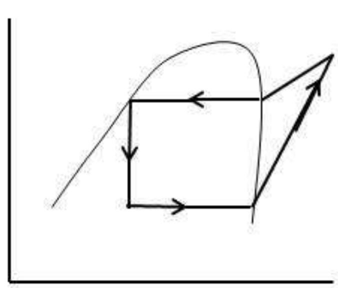
45. If the volume of moist air with 50% RH is isothermally reduced to half its original volume, then relative humidity of mosit air becomes
(a) 25% (b) 60%
(c) 70% (d) 100%

46. In a long cylinder rod of radius R and a surface heat flux of q_0, the uniform internal heat generation rate is
(a) $2q_0/R$ (b) $2q_0$
(c) q_0/R (d) $2q_0/R^2$

47. Moist air at 35^0 C and 100% relative huimidity is entering a psychrometric device and leaving at 25 ^{0}C and 100% relative humidity.
The name of the device is
(a) Humidifier
(b) Dehumidifier
(c) Sensible heater
(d) Sensible cooler

48. A 40 cm diameter disk with emissivity of 0.65 is placed in large enclosure at 30^0C and is effectively a black body. If the disc has a temperature of 55^0 C, calculate the radiosity of its upper surface.
(a) 604 W/m^{2}K (b) 594 W/m^{2}K
(c) 560 W/m^{2}K (d) 749 W/m^{2}K

49. The vapour compression refrigeration cycle is represented as shown in the figure below. With state '1' being the exit of the evaporator. The co-ordinate system used in this figure is



(a) p - h (b) T – s
(c) p – s (d) T – h

50. Which of the following configuration has the highest fin effectiveness?
(a) thin, closely spaced fins
(b) thin, widely spaced fins
(c) thick, widely spaced fins
(d) thick, closely spaced fins

51. If the specific humidity of moist air remain same but its dry bulb temperature increases
(a) its dew point temperature increases
(b) its dew point temperature decreases
(c) Its dew point temperature remains same
(d) its dew point temperature may increase or decrease depending upon increase or decrease of relative humidity

52. The radioactive heat transfer per unit area (W/m^2) between two plane parallel gray surfaces (emissivity = 0.9) maintained at 400 K and 300 K is
(a) 992 (b) 812
(c) 464 (d) 567

53. Refrigerant R-717 is
(a) Air (b) Ammonia
(c) Carbon dioxide (d) Freon – 12

54. Which one of the following is the effect of suction vapour superheat?
(a) Decreases the refrigeration effect
(b) Decreases the specific volume
(c) Decreases the energy for compression
(d) Increases the refrigeration effect

55. The room sensible heat loss is 30,000 kJ/hr and the latent heat loss is 20,000 kJ/hr. Then the sensible heat factor is
(a) 0.667 (b) 0.60
(c) 0.30 (b) 3.00

56. During the adiabatic cooling of mosit air
(a) dew point temperature constant
(b) specific humidity remains constant
(c) relative humidity remains constant
(d) wet bulb temperature remains constant

57. Environment friendly refrigerant R 134a is used in the new generation domestic refrigerators. Its chemical formula is
(a) $CHClF_2$ (b) $C_2Cl_3F_3$
(c) $C_2Cl_3F_4$ (d) $C_2H_2F_4$

58. The ratio of partial pressure of water vapour (p_v) to the saturation pressure of water (p_s) at same temperature is
(a) relative humidity
(b) degree of saturation
(c) specific humidity
(d) absolute humidity

59. A refrigerator working on a reversed Carnot cycle has a COP of 4. If it works as a heat pump and consumes 1 kW, the heating effect will be
(a) 1 kW (b) 4 kW
(c) 5 kW (d) 6 kW

60. An engine operating on Otto cycle has clearance volume. if γ = 1.4, the air standard cycle efficiency is
(a) 38.3% (b) 39.8%
(c) 60.2% (d) 61.7%

61. The primary factors responsible for human comfort are
(a) dry bulb temperature, relative humidity and air motion.
(b) dry bulb temperature, dew point temperature and air motion.
(c) dry bulb temperature, relative humidity and latitude of the place.
(d) dry bulb temperature, relative humidity, air motion and elevation of the place

62. Knocking tendency in a SI engine reduces with increasing
(a) engine speed (b) compression ratio
(c) wall temperature (d) supercharging

63. Choose undesirable properties of secondary refrigerants.
(a) low freezing point
(b) high viscosity
(c) good stability
(d) low vapour pressure

64. Chances of occurrence of cavitation are high if the
(a) local pressure becomes very high
(b) local temperature becomes low
(c) thoma cavitation parameter exceeds a certain limit
(d) local pressure falls below the vapour pressure

65. Partial pressure of water vapour at dew point temperature of moist air is 1.5×10^{-3} MPa. The barometric pressure is 0.1 MPa. The specific humidity of air is
(a) 15.225 gm/kg da (b) 9.47 gm / kg da
(c) 15.00 gm/kg da (d) 9.33 gm / kg da

66. If methane undergoes combustion with the stoichimoteric quantity of air, the fuel air ratio on molar basis would be
(a) 15.22:1 (b) 12.30 : 1
(c) 14.56 : 1 (d) 9.52 : 1

67. For an air-conditioned space, RTH = 100 kW, RSHF = 0.75, volume flow rate of air is 100 m^3/minute and room specific humidity is 0.01 kg/kg of dry air. The specific humidity of supply air in kg/kg of dry air is
(a) 0.0100 (b) 0.0075
(c) 0.0050 (d) 0.0025

68. In a Rankine cycle, with the maximum steam temperature being fixed from metallurgical considerations, as the boiler pressure increases
(a) the condenser load will increases
(b) the quality of turbine exhaust will decrease
(c) the quality of turbine exhaust will increase
(d) the quality of turbine exhaust will remain unchanged

69. If air at dry bulb temperature of 35^0 C and dew point temperature of 20^0 C passes through air washer in which water is sprayed at 25^0 C, then the process would be
(a) sensible cooling
(b) cooling and dehumidification
(c) cooling and himidification
(d) cooling at constant dew point temperature

70. The work ratio in a gas turbine plant is equal to

Where

r_p = pressure ratio

T_1 = compressor inlet temperature

T_3 = compressor inlet temperature

(a) $1 - r_p^{\frac{\gamma-1}{\gamma}}$ (b) $1 - \frac{T_1}{T_3} r_p^{\frac{\gamma-1}{\gamma}}$

(c) $1 + \frac{T_1}{T_2} r_p^{\frac{\gamma-1}{\gamma}}$ (d) $1 + r_p^{\frac{\gamma-1}{\gamma}}$

71. The velocity distribution in the boundary layer is given by $\frac{u}{U} = \frac{y}{\delta}$, where u is the velocity at a distance y from the plate and u = U at y = δ, δ being boundary layer thickness. The displacement thickness is given by
(a) δ (b) $\frac{\delta}{2}$
(c) $\frac{\delta}{3}$ (d) $\frac{2\delta}{3}$

72. A four stroke engine having a brake power of 105 kW is supplied with a fuel at a rate of 4.4 kg per

10 minutes. The brake specific fuel consumption of the engine

(a) 0.18 kg/kW – hr
(b) 0.25 kg/kW – hr
(c) 0.36 kg/kW – hr
(d) 0.42 kg/kW – hr

73. A circular plate of diameter 1.6 m is placed vertically in water in such a way that the centre of the plate is 2.5 m below the free surface of the water. The location of the centre of pressure is

(a) 2.564 m (b) 2.5 m
(c) 2.864 m (d) 2.654 m

74. Which of the following are effects of nozzle friction?

1. Enthalpy drop decreases
2. Exit velocity reduces
3. Decrease in specific volume
4. Decrease in mass flow rate

Select correct code.

(a) (1), (2) and (3) (b) (2), (3) and (4)
(c) (1), (3) and (4) (d) (1), (2) and (4)

75. For a heat engine operating on a Carnot cycle, the work output is $1/_{4th}$ of the heat rejected to the sink. The thermal efficiency of the engine would be

(a) 10% (b) 20%
(c) 30% (d) 50%

76. The quality of vapour at the exit of nozzle ______ due to nozzle friction.

(a) increases (b) decreases
(b) does not change (d) unpredictable

77. An ideal gas of mass m and temperature T_1 undergoes a reversible isothermal process from an initial pressure P_1 to final pressure P_2. The heat loss during the process is Q. The entropy change ΔS of the gas is

(a) $mRT_1 \ln\left(\frac{P_2}{P_1}\right)$ (b) $mRT_1 \ln\left(\frac{P_1}{P_2}\right)$
(c) $mRT_1 \ln\left(\frac{P_2}{P_1}\right) - \frac{Q}{T_1}$ (d) Zero

78. Which one is NOT a reason behind the fact that the ideal regenerative cycle is practically not possible?

(a) The reversible heat transfer takes infinite time

(b) It is mechanically impossible to exchange heat in the turbine

(c) The moisture content in the turbine will be high

(d) The steam specific volume will be too high

79. What will be the loss of available energy associated with the transfer of 1000 kJ of heat from constant temperature system at 600 K to another system at temperature 400 K, when the environment is 300 K?

(a) 150 kJ (b) 250 kJ
(c) 500 kJ (d) 700 kJ

80. An ideal closed cycle gas turbine plant working between temperatures 927 ^{0}C and 27 ^{0}C using as working fluid. The pressure ratio for maximum work output is

(a) 11.3 (b) 13.3
(c) 15.3 (d) 17.3

81. Consider the following properties:

1. Energy 2. Entropy
3. Gibbs energy 4. Volume
5. Pressure 6. Temperature
7. Viscosity 8. Elasticity

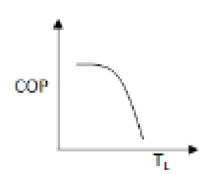
Which of the above are intensive properties?

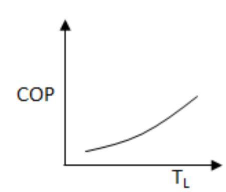
(a) 1, 3, 5, 6 (b) 5, 6, 7, 8
(c) 1, 3, 5, 6, 7, 8 (d) 4, 5, 6, 8

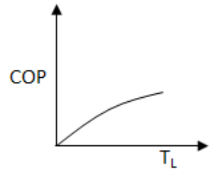
82. Air is drawn in a compressor at the rate of 0.8 kg/s at a pressure of 1 bar and temperature of 20^0 C. Delivering temperature is 90^0 C and pressure is 10 bar. The air is delivered through an area of 2×10^{-3} m^2. If R = 287 J/kgK, the air exit velocity is

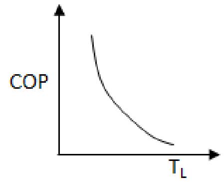
(a) 41.7 m/s (b) 35.8 m/s
(c) 29.7 m/s (d) 27.3 m/s

83. For a given value of T_H(source temperature) for a reversed Carnot cycle, the variation of T_L (sink temperature) for different values of COP is represented by which one of the following graphs?









84. Mach angle α and Mach number M are related as
(a) $M = \sin^{-1}\left(\frac{1}{\alpha}\right)$
(b) $\alpha = \cos^{-1}\sqrt{\frac{M^2-1}{M^2}}$
(c) $\tan\alpha = \left(\sqrt{M^2-1}\right)$
(d) $\alpha = \text{cosec}^{-1}\left(\frac{1}{M}\right)$

85. In the polytropic process, equation $PV^n =$ constant, if n is infinitely large, the process is termed as
(a) Constant pressure process
(b) Constant volume process
(c) Adiabatic process
(d) Isothermal process

86. Biogas is predominantly
(a) Hydrogen (b) Carbon monoxide
(c) Carbon dioxide (d) Methane

87. Change in enthalpy in a closed system is equal to heat transferred if the reversible process takes place at constant
(a) temperature (b) internal energy
(c) pressure (d) entropy

88. In a Rankine cycle, regeneration results in higher efficiency because
(a) pressure inside the boiler increases
(b) heat is added before steam enters the low pressure turbine
(c) average temperature of heat addition in the boiler increases
(d) total work delivered by the turbine increases

89. The value of compressibility factor, Z at the critical state of a Van der Waal's gas is
(a) 3.735 (b) 0.735
(c) 3.375 (d) 0.375

90. A diesel engine is usually more efficient than a spark ignition engine because
(a) diesel being a heavier hydrocarbon, releases more heat per kg than gasoline
(b) the air standard efficiency of diesel cycle is higher than the Otto cycle, at a fixed compression ratio
(c) the compression ratio of a diesel engine is higher than that of an spark ignition engine
(d) self ignition temperature of diesel is higher than that of gasoline

91. A perfect gas having P_1 = 0.1 N/mm^2, V_1 = 0.18 m^3, T_1 = 20 ^{0}C is compressed to $\frac{1}{10}$ of its volume in an isothermal process. The change in entropy is
(a) – 141.45 J/K (b) 141.45 J/K
(c) – 4144.23 J/K (d) Zero

92. If η_1 and η_2 are the thermal efficiencies of two individual power plants. When they are coupled in series, the overall thermal efficiency η_0 of the combined plant is given by
(a) $\eta_0 = \eta_1\eta_2$
(b) $\eta_0 = \eta_1 + \eta_2$
(c) $\eta_0 = \eta_1 + \eta_2 - \eta_1\eta_2$
(d) $\eta_0 = \frac{\eta_1+\eta_2}{\eta_1\eta_2}$

93. A substance whose Joule-Thomson coefficient is negative, is throttled to a lower pressure. During the process
(a) the entropy of the substance will decrease
(b) the entropy of the substance will remain constant
(c) the temperature of the substance will decrease
(d) the temperature of the substance will increase

94. Decrease of air-fuel ratio in spark ignition engines results in
(a) increase of NO_x
(b) a decrease of CO and unburnt hydrocarbon
(c) an increase of CO and unburnt hydrocarbon
(d) none of the above

95. A mass of 5 kg of water at 293 K is turned completely to ice at 273 K. The entropy change in the process is
(a) 6.13479 kJ/K (b) – 1.4847 kJ/K
(c) – 7.6195 kJ/K (d) 8.3195 kJ/K

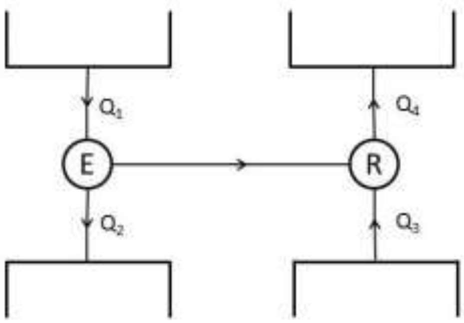
96. A centrifugal pump driven by a directly coupled 3 kW motor of 1450 rpm speed, is proposed to be connected to a motor of 2900 rpm speed. The power of the motor should be
(a) 6 kW (b) 12 kW
(c) 18 kW (d) 24 kW

97. One reversible heat engine operates between 1000 K and T K and another reversible heat operates between T K and 400 K. If both heat engines have same heat input and output, the value of T is

(a) 582.7 K (b) 632.5 K
(c) 682.8 K (d) 732.5 K

98. The pressure at a point is equal in all directions
(a) only when the fluid is inviscid
(b) when the fluid is incompressible
(c) when the fluid is at rest
(d) in a laminar flow

99. In the figure shown below, 'E' is the heat engine with efficiency of 0.4 and 'R' is the refrigerator , if $Q_2 + Q_4 = 3Q_1$, the COP of the refrigerator will be



(a) 3.0 (b) 4.5

(c) 5.0 (d) 5.5

100. An automobile moving at a velocity of 40 km/hr is experiencing a wind resistance of 2 kN. If the automobile is moving at a velocity of 50 km/hr, the power required to overcome the wind resistance is
(a) 43.4 kW (b) 3.125 kW
(c) 2.5 kW (d) 27.776 kW

Answer

1 (a)	21 (d)	41 (b)	61 (a)	81 (b)
2 (a)	22 (c)	42 (c)	62 (a)	82 (a)
3 (a)	23 (d)	43 (c)	63 (b)	83 (b)
4 (d)	24 (c)	44 (c)	64 (d)	84 (b)
5 (a)	25 (d)	45 (d)	65 (b)	85 (b)
6 (b)	26 (b)	46 (a)	66 (d)	86 (d)
7 (b)	27 (a)	47 (b)	67 (c)	87 (c)
8 (c)	28 (b)	48 (b)	68 (b)	88 (c)
9 (d)	29 (a)	49 (d)	69 (c)	89 (d)
10 (c)	30 (c)	50 (a)	70 (b)	90 (c)
11 (d)	31 (d)	51 (c)	71 (b)	91 (a)
12 (b)	32 (c)	52 (b)	72 (b)	92 (c)
13 (b)	33 (b)	53 (b)	73 (a)	93 (d)
14 (b)	34 (c)	54 (d)	74 (d)	94 (c)
15 (b)	35 (a)	55 (b)	75 (b)	95 (c)
16 (d)	36 (a)	56 (d)	76 (a)	96 (d)
17 (a)	37 (b)	57 (d)	77 (b)	97 (b)
18 (b)	38 (a)	58 (a)	78 (d)	98 (c)
19 (c)	39 (c)	59 (c)	79 (b)	99 (c)
20 (a)	40 (a)	60 (d)	80 (a)	100 (a)

1. The work input to the paddle wheel = - 6000 kJ
The heat transfer to the surrounding from the tank = - 3000 kJ
The external work done by the system is equal to zero.

2. Process 1 – 2 is constant pressure process.
Volume changes from V to 2V.
Change in internal energy $\Delta U = nC_v\Delta T$

$$= n\frac{R}{\gamma - 1}\Delta T$$

$$\Delta U = \frac{P(V_2-V_1)}{\gamma-1} = \frac{P(2V-V)}{\gamma-1} = \frac{PV}{\gamma-1}$$

3. $y_p = y_c + \frac{I_{x'x'}}{Ay_c}$

When the depth of immersion of a plane surface is increased then y_c is increased then y_p shifted towards y_c

6 . Power of electric resistance heater
P= 2 kW
Heat lost in 10 minutes
Q = Power × time
Q = 2000 × 10 × 60 = 1200 kJ
Heat lost by water
$Q_1 = -\ 300$ kJ
Change in internal energy
= 1200 kJ – 300 kJ = 900 kJ
$\Delta U = mC\Delta T = 900 \times 1000$
m = 5 kg, C =4180 J/kg^{0}C
$\Delta T = 43.1\ ^0$C

7. Stream function (Ψ) = 3xy

$u = \frac{d\Psi}{dy} = 3x$

$v = -\frac{d\Psi}{dx} = -3y$

Velocity at point P(2,3)
x = 2, and y = 3

u = 6 and v = −9

Resultant velocity V = $\sqrt{u^2 + v^2}$

$V = 10.81$ units

8. M = $\frac{n_1 M_1 + n_2 M_2}{n_1 + n_2}$

n_1 = number of mole of oxygen

n_2 = number of mole of nitrogen

M_1 = Molecular weight of oxygen

M_2 = Molecular weight of nitrogen

Mass of oxygen = 4 kg

Mass of nitrogen = 6 kg

$n_1 = \frac{4}{32} = \frac{1}{8}$ and $n_1 = \frac{6}{28} = \frac{3}{14}$

M = $\frac{\frac{1}{8}\times 32 + \frac{3}{14}\times 28}{\frac{1}{8}+\frac{3}{14}} = 29.47$

11. $P = H^a Q^b w^c$

[P] = $M L^2 T^{-3}$

[H] = L

[Q] = $[L^3 T^{-1}]$

[w] = $[M L^{-2} T^{-3}]$

a = 1 , b =1, c =1

P = H Q w

12. If air is compressed to half of its volume at constant pressure.

$\Delta W = P(V - 2V) = -PV$

Change in internal energy

$\Delta U = mR\Delta T = PV_2 - PV_1 = -PV$

$\Delta Q = \Delta U + \Delta W = -2PV$

$\Delta Q = \int TdS = -2PV$

$dS < 0$

14. Biot number = $\frac{hL}{K} = \frac{h(T-T_\infty)}{\frac{k}{L}(T-T_\infty)} = \frac{\dot{Q}_{conv}}{\dot{Q}_{cond}}$

15. $y_p = y_c + \frac{I_{x'x'}}{Ay_c}$

$$= \frac{h}{2} + \frac{b\frac{h^3}{12}}{bh\,\frac{h}{2}}$$

$$= \frac{h}{2} + \frac{h}{6}$$

$$y_p = \frac{2}{3}h$$

Position of centre of pressure from base

$= h - \frac{2}{3}h = \frac{h}{3}$

18. $\varepsilon = \frac{\dot{Q}_{actual}}{\dot{Q}_{max}} = \frac{C_h(T_{h,in}-T_{h,o})}{C_{min}(T_{h,in}-T_{h,o})} = \frac{76-47}{76-28} = 0.60$

19. When object is placed in water

50 N = mg – F_B

50 N = mg – $\rho_w Vg$

mg = 50 + $\rho_w Vg$

When object is placed in oil

Weight of object

= mg − F_B'

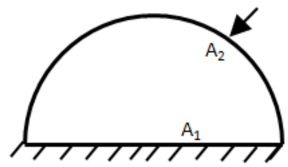
= 50 + $\rho_w Vg - \rho_{oil} Vg$

= 50 + $(\rho_w - \rho_{oil})Vg$

= 50 + (1000 – 800) × 15.3 × 10^{-3} × 9.81

= 80 N

22.



$F_{12} = 1$

$F_{21}A_2 = F_{12}A_1$

$F_{21} \times 2\pi R^2 = F_{12} \times \pi R^2$

$F_{21} = 0.5$

$F_{21} + F_{22} = 1$

$F_{22} = 0.5$

23. For potential flow,

$\vec{\nabla} \times \vec{V} = 0$

Flow is irrotational flow.

26. Counter flow heat exchanger,

$T_{h,in} = 60\,^0C$, $\dot{m}_h = 1$ kg/s, $c_h = 10$ kJ/kgK

$T_{c,o} = 30\,^0C$, $\dot{m}_c = 2$ kg/s, $c_c = 5$ kJ/kgK

Heat lost by hot fluid $= \dot{m}_h c_h (T_{h,in} - T_{h,o})$

$= 10(T_{h,in} - T_{h,o})$ kJ

Heat gained by cold fluid $= \dot{m}_c c_c (T_{c,o} - T_{c,in})$

$= 10(T_{c,o} - T_{c,in})$ kJ

Heat lost by hot fluid is equal to heat gained by cold fluid.

$10(T_{h,in} - T_{h,o}) = 10(T_{c,o} - T_{c,in})$

$T_{h,in} - T_{h,o} = T_{c,o} - T_{c,in}$

$T_{h,in} - T_{c,o} = T_{h,o} - T_{c,in}$

$T_{h,in} - T_{c,o} = \Delta T_1$, $T_{h,o} - T_{c,in} = \Delta T_2$

Log mean temperature difference = $\Delta T_1 = 30\,^0C$

27. mg = 100 N,

mass of object = density of object × volume of object

$\rho_{object} Vg = 100$ N

mg – F_B = 75 N

F_B = 25 N

$F_B = \rho_w Vg = \frac{\rho_w}{\rho_{object}} \times 100$

$25 = \frac{\rho_w}{\rho_{object}} \times 100$

$\frac{\rho_{object}}{\rho_w} = 4$

28. Pr = $\frac{\mu c_p}{k} = \frac{25 \times 10^{-6} \times 2 \times 10^3}{0.05} = 1$

For Pr = 1, thermal boundary layer thickness is equal to velocity boundary layer thickness.

$\delta_t = \delta_v = 0.5$ mm

30. Thermal resistance $R_{th} = \frac{L}{kA} = \frac{0.6}{0.4 \times 1.5} = 1$ K/W

31. $\sigma \times \pi D = P \times \frac{\pi}{4} \times D^2$

$P = \frac{4\sigma}{D} = \frac{4 \times 0.073}{0.001} = 293$ N/m^2

32. if heat capacity ratio is equal to 1.

c = 1

$\varepsilon = \frac{\text{NTU}}{1+\text{NTU}} = \frac{0.5}{1+0.5} = \frac{1}{3} = 0.33$

33. Buoyancy force = Gravity force

$\rho_L \times A \times x \times L = \rho_0 \times A \times h \times g$

$\rho_L x = \rho_0 h$

$x = \frac{0.87}{1.31}$ h

$Ax = \frac{0.87}{1.31}$ Ah = 0.664 V

34. $Nu_1 = 48 = C\,(Gr\,Pr)^n$ (n = 0.25)

Pr x Gr = $\frac{g\beta(T_s - T_\infty)L_c^3}{\vartheta\alpha}$

$\frac{Nu_1}{Nu_2} = \frac{(T_{s,1} - T_\infty)^n}{(T_{s,2} - T_\infty)^n} = \left[\frac{180-20}{30-20}\right]^n = 12^n$

$\frac{Nu_1}{Nu_2} = \frac{48}{Nu_2} = 12^{0.25}$

$Nu_2 = 25.78$

36. $\eta_{Long\,,fin} = \frac{Q_{fin}}{Q_{fin,\ max}} = \frac{\sqrt{hpkA_c}(T_b - T_\infty)}{hA_{fin}(T_b - T_\infty)}$

$$= \frac{1}{L}\sqrt{\frac{kA_c}{hp}} = \frac{1}{mL}$$

$\eta_{adiabatic\,,fin} = \frac{Q_{fin}}{Q_{fin,\ max}} = \frac{\sqrt{hpkA_c}(T_b - T_\infty)\tanh mL}{hA_{fin}(T_b - T_\infty)}$

$$= \frac{\tanh mL}{mL}$$

39. Evaporator temperature $T_E = 10\,^0$C = 283 K

Ambient temperature $T_C = 30\,^0$C = 303 K

COP = 2

Maximum C.O.P of vapour refrigeration system,

$(\text{C.O.P})_{\max} = \frac{T_G - T_C}{T_G} \times \frac{T_E}{T_C - T_E}$

$2 = \frac{T_G - 303}{T_G} \times \frac{283}{30-10}$

$T_G = 353\,K = 80\,^0$C

40. Heat flux $\dot{q} = \frac{T_{\infty,1} - T_{\infty,2}}{\frac{1}{h_i} + \frac{L}{k} + \frac{1}{h_0}}$

$\dot{q} = U(T_{\infty,1} - T_{\infty,2})$

U = Overall heat transfer coefficient

$\frac{1}{U} = \frac{1}{h_i} + \frac{L}{k} + \frac{1}{h_0} = \frac{1}{10} + \frac{5 \times 10^{-2}}{1} + \frac{1}{20}$

U = 5 W/m^{2}K

41. By pass factor = 0.45

Dry bulb temperature of inlet of moist air

$T_1 = 30\,^0$C

Temperature of cooling coil $T_3 = -10\,^0$ C

Let dry bulb temperature of leaving moist air T_2

By pass – factor = $\frac{T_2 - T_3}{T_1 - T_3} = 0.45$

$\frac{T_2 - (-10)}{30 - (-10)} = 0.45$

$T_2 = 8\,^0$C

42. $\frac{T - T_s}{T_i - T_s} = e^{-bt}$

$T_i = 530\,^0$C, $T = 430\,^0$C

$\ln\frac{T - T_s}{T_i - T_s} = -b\,t$

$\ln\frac{430 - 30}{530 - 30} = -b \times 10$

$b = \frac{1}{10}\ln\frac{5}{4}$

Let temperature at time t = 20 sec is T

$\frac{T - 30}{530 - 30} = e^{-\frac{1}{10}\ln\frac{5}{4}\times 20}$

T = 350 ^{0} C

45. Relative humidity $RH_1 = \frac{P_v}{P_{vs}}$

If volume is reduced isothermally then vapour pressure is increased twice. Since temperature remains constant therefore saturation pressure remains unchanged.

$RH_2 = \frac{2P_v}{P_{vs}} = 2 \times 0.50 = 1$

Relative humidity is equal to 100%.

46. $\dot{\varepsilon}_{gen} \times \frac{\pi}{4}D^2 \times L = q_0 \times \pi DL$

$\dot{\varepsilon}_{gen} = \frac{4q_0}{D} = \frac{2q_0}{R}$

52. $\dot{Q} = \frac{\sigma A(T_1^4 - T_2^4)}{\frac{1}{\varepsilon_1} + \frac{1}{\varepsilon_2} - 1} = \frac{5.6 \times 10^{-8} \times (400^4 - 300^4)}{\frac{1}{0.9} + \frac{1}{0.9} - 1}$

= 812 W/m^2

55. SHF = $\frac{SH}{LH + SH} = \frac{30{,}000}{50{,}000} = 0.6$

59. COP = $\frac{T_L}{T_H - T_L} = 4$

$5T_L = 4\,T_H$

$(\text{C.O.P})_{\text{H.P}} = \frac{T_H}{T_H - T_L} = 5$

$(\text{C.O.P})_{\text{H.P}} = \frac{Q_H}{W}$

$Q_H = 5W = 5 \times 1$ kW = 5 kW

65. Relative RH = $\frac{P_v}{P_{vs}}$

At dew point, Relative humidity = 100 %

$P_v = P_{vs} = 1.5 \times 10^{-3}$

Specific humidity (SH) = $0.622\ \frac{P_v}{P_t - P_v}$

$= 0.622\ \frac{1.5 \times 10^{-3}}{0.1 - 1.5 \times 10^{-3}}$

= 9.47 gm / kg of dry air

71. Displacement thickness

$\delta^* = \int_0^{\delta} 1 - \frac{u}{u_\infty}\, dy = \int_0^{\delta} 1 - \frac{y}{\delta}\, dy = \frac{\delta}{2}$

72. Brake power B.P. = 105 kW

Mass m = 44 kg

time t = 10 minutes

Mass flow rate of fuel $\dot{m}_f = \frac{44\ kg}{10 \times 60\ sec}$ = 0.073 kg/s

Brake specific fuel consumption

$= \frac{Mass\ flow\ rate\ of\ fuel}{Brake\ power} = \frac{0.073}{105} \times 3600$

= 0.25 kg/kW-hr

73. $y_p = y_c + \frac{I_{x'x'}}{Ay_c} = 2.5 + \frac{\frac{\pi}{4} \times 0.8^4}{\frac{\pi}{4} \times 1.6^2 \times 2.5}$ = 2.564 m

75. W = $\frac{1}{4} Q_L$

$Q_H - Q_L = \frac{1}{4} Q_L$

$Q_H = \frac{5}{4} Q_L$

$\eta = \frac{W}{Q_H} = \frac{(1/4)Q_L}{(5/4)Q_L}$ = 20 %

77. $\Delta S = \frac{dQ_{rev}}{T} = -\frac{Q}{T}$

For isothermal process , change in internal energy is equal to zero.

Q = W = $P_1 V_1 \ln\frac{P_1}{P_2} = mRT_1 \ln\frac{P_1}{P_2}$

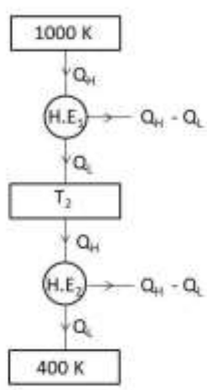
97.

$\eta_I = \eta_{II}$

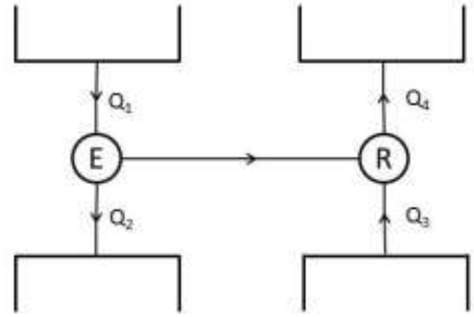
$1 + \frac{T}{1000}$

$= 1 + \frac{400}{T}$

T = 632. 5 K



99.



$\eta_{H.E} = 0.4 = \frac{Q_1 - Q_2}{Q_1}$

$Q_2 = 0.6Q_1$

COP = $\frac{Q_3}{Q_1 - Q_2} = \frac{Q_3}{Q_1 - 0.6Q_1} = \frac{Q_3}{0.4Q_1}$

$Q_2 + Q_4 = 3Q_1$

$Q_4 = 3Q_1 - Q_2$ ------ (1)

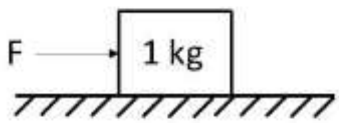
and $Q_4 = Q_3 + Q_1 - Q_2$ --- (2)

Compare equation (1) and (2) we get,

$Q_3 = 2Q_1$

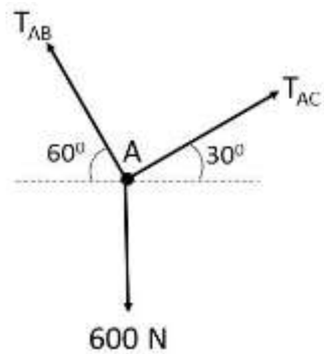
COP $= \frac{Q_3}{0.4Q_1} = \frac{2Q_1}{0.4Q_1}$ = 5

1. 1 kg block is resting on a surface with coefficient of friction μ = 0.1. How much force (F) is required to be applied on block to move.



(a) 0 (b) 0.1 N
(c) 0.981 N (d) 9.81 N

2. If point A is in equilibrium under the action of the applied forces, the values of tension T_{AB} and T_{AC} are respectively



(a) 520 N and 300 N
(b) 300 N and 520 N
(c) 450 N and 150 N
(d) 150 N and 450 N

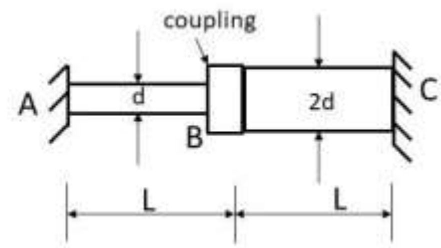
3. The time variation of the position of a particle in rectilinear motion is given by $x = 2t^3 + t^2 + 3t$. If V is the velocity and A is the acceleration of the particle in consistent units, the motion started with (where, t is time)
(a) V = 0, A = 0 (b) V = 0, A = 2
(c) V = 2, A = 3 (d) V = 3, A = 2

4. The second moment of a circular area the diameter is given by (D is the diameter).
(a) $\frac{\pi D^4}{4}$ (b) $\frac{\pi D^4}{16}$
(c) $\frac{\pi D^4}{64}$ (d) $\frac{\pi D^4}{32}$

5. A concentrated load of P acts on a simply supported beam of span L at a distance L/3 from the left support. The bending moment at the point of application of the load is given by
(a) $\frac{2PL}{9}$ (b) $\frac{PL}{9}$
(c) $\frac{2PL}{3}$ (d) $\frac{PL}{3}$

6. Maximum shear stress developed on the surface of a solid circular shaft under pure torsion is 80 MPa. If the shaft diameter is doubled then the maximum shear stress developed corresponding to the same torque will be
(a) 12 MPa (b) 6 MPa
(c) 5 MPa (d) 10 MPa

7. The two shafts AB and BC, of equal length and diameters d and 2d, are made of the same material. They are joined at B through a shaft coupling, while the ends A and C are built-in (cantilevered). A twisting moment T is applied to the coupling. If T_A and T_C represent the twisting moments at the ends A and C, respectively, then



(a) $T_C = T_A$ (b) $T_A = 16T_C$
(c) $T_C = 8T_A$ (d) $T_C = 16T_A$

8. A pin-ended column of length L, modulus of elasticity E and second moment of the cross-sectional area is I loaded eccentrically by a compressive load P. The critical buckling (P_{cr}) is given by
(a) $\frac{\pi^2 IE}{L^2}$ (b) $\frac{\pi IE}{L^2}$
(c) $\frac{\pi^2 IE}{L}$ (d) $\frac{\pi IE}{L}$

9. A steel rod of length L and diameter D, fixed at both ends, is uniformly heated to a temperature rise of ΔT. The Young's modulus is E and the co-efficient of linear expansion is α. The thermal stress in the rod is
(a) 0 (b) α ΔT
(c) α E (d) α E ΔT

10. If the Poisson's ratio of an elastic material is 0.4, the ratio of Young's modulus to modulus of rigidity is
(a) 0.25 (b) 2.5
(c) 1.25 (d) 1.5

11. A cantilever beam of length L is subjected to a point load W at the free end. The moment of inertia of the beam cross section about the neutral axis is I and the Young's modulus is E. The magnitude of the maximum deflection is

(a) $\frac{wL^3}{8IE}$ (b) $\frac{wL^2}{3IE}$

(c) $\frac{wL^3}{3IE}$ (d) $\frac{wL^2}{8IE}$

12. The state of stress at a point under plane stress condition is $\sigma_{xx} = 20$ MPa, $\sigma_{yy} = 50$ MPa and $\tau_{xy} = 20$ MPa. The radius of the Mohr's circle representing the given state of stress in MPa is

(a) 30 (b) 50

(c) 20 (d) 25

13. A column has a rectangular cross-section of 10 mm × 20 mm and a length of 200 mm. The slenderness ratio of the column is close to

(a) 1000 (b) 200

(c) 693 (d) 396

14. A thin cylinder of inner radius 1000 mm and thickness 20 mm is subjected to an internal pressure of 10 MPa. The average circumferential (hoop) stress in MPa is

(a) 500 (b) 250

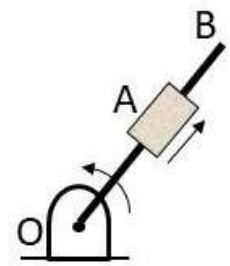
(c) 2000 (d) 1000

15. If the principal stresses in a plane stress problem are $\sigma_1 = 200$ MPa, $\sigma_2 = 80$ MPa, the magnitude of the maximum shear stress (in MPa) will be

(a) 20 (b) 30

(c) 140 (d) 6

16. A link OB is rotating with a constant angular velocity of 1 rad/s in counter clockwise direction and a block is sliding radially outward on it with an uniform velocity of 2 m/s with respect to the rod as shown in the figure. If OA = 3 m, the magnitude of the absolute acceleration of the block at location A in m/s^2 is



(a) 5 (b) 4

(c) 3 (d) 6

17. A circular solid disc of uniform thickness 20 mm, radius 100 mm and mass 20 kg, is used as a flywheel. If it rotates at 600 rpm, the kinetic energy of the flywheel, in Joules is

(a) 790 (b) 1576

(c) 197 (d) 394

18. The natural frequency of a spring-mass system on earth is ω_n. The natural frequency of this system on the moon($g_{moon} = 1/6\ g_{earth}$) is

(a) ω_n (b) $0.408\omega_n$

(c) $0.204\omega_n$ (d) $0.167\ \omega_n$

19. A vehicle suspension system has a spring. The stiffness of the spring is 3.6 kN/m. If the mass of vehicle is 500 kg, then natural frequency of vehicle is

(a) 7.2 (b) 2.7

(c) 0.4 (d) 4.0

20. A system consists of a spring and a damper. The stiffness of the spring is 1 kN/m and the damping constant of the damper is 100 Ns/m. If the mass is 10 kg, then the damping factor is

(a) 0.2 (b) 2.0

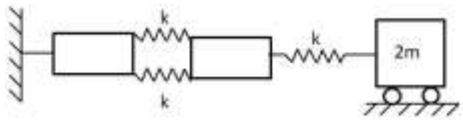
(c) 0.5 (d) 5.0

21. A planar mechanism has 8 links and 10 rotary joints. The number of degrees of freedom of the mechanism,using Gruebler's criterion, is

(a) 1 (b) 0

(c) 2 (d) 3

22. The natural frequency of the system shown below is



(a) A$\sqrt{\frac{k}{3m}}$ (b) $\sqrt{\frac{3m}{k}}$

(c) $\sqrt{\frac{k}{m}}$ (d) $\sqrt{\frac{m}{3k}}$

23. Relation between un-damped Natural frequency (ω_n) and damped natural frequency (ω_d) is (where, e = damping factor)
(a) $\omega_n = \omega_d\sqrt{1-e^2}$

(b) $\omega_n = \sqrt{\omega_d(1-e^2)}$

(c) $\omega_d = \omega_n\sqrt{1-e^2}$

(d) $\omega_d = \sqrt{\omega_n(1-e^2)}$

24. There are four samples A, B, C and D, with natural frequencies 60, 90, 120 and 300 Hz, respectively. They are mounted on test setups for conducting vibration experiments. If ground vibration transmitted to the setup is of frequency 122 Hz, which of the samples will show the most perceptible induced vibration?
(a) A (b) B

(c) C (d) D

25. A vibrating machine is isolated from the floor using springs. If the ratio of excitation frequency of vibration of machine to the natural frequency of the isolation system is equal to 0.7, then transmissibility ratio of isolation is close to (consider damping factor = 0)
(a) 2 (b) 0.5

(c) 1 (d) 0.2

26. The mechanism used in a shaping machine is
(a) a closed 4-bar chain having 4 revolute pairs

(b) a closed 6-bar chain having 6 revolute pairs

(c) a closed 4-bar chain having 2 revolute pairs

(d) an inversion of the slider-crank chain

27. When a cylinder is located in a Vee-block, the number of degrees of freedom which are free are
(a) 2 (b) 4

(c) 7 (d) 8

28. If the length of the cantilever beam is doubled, the natural frequency of the mass M at the end of this cantilever beam of negligible mass is increased be a factor of
(a) $\sqrt{8}$ (b) 2

(c) $\sqrt{\frac{1}{8}}$ (d) 0.5

29. Which of the following test is a destructive test?
(a) Radiography
(b) Compression test
(c) Annealing
(d) Normalizing

30. Following stress relieving process is used after cold working of materials
(a) Tempering (b) Cynading

(c) Annealing (d) Normalizing

31. A hole is of dimension $\emptyset 10^{+0.015}_{+0.010}$ mm. The corresponding shaft is of dimension $\emptyset 10^{+0.010}_{+0.001}$ mm, The resulting assembly has
(a) Loose running fit

(b) Close running fit

(c) Transition fit

(d) Interference fit

32. Which one among the following welding processes uses non-consumable electrode?
(a) Gas metal arc welding

(b) Submerged arc welding

(c) Gas tungsten arc welding

(d) Flux coated arc welding

33. The crystal structure of austenite is
(a) Body centred cubic

(b) Face centred cubic

(c) Hexagonal closed packed

(d) Body centred tetragonal

34. In A CNC program block, N002 G02 G91 X40 Z40 ……, G02 and G91 refer to
(a) Circular interpolation in counter clockwise direction and incremental dimension

(b) Circular interpolation in counter clockwise direction and absolute dimension

(c) Circular interpolation in clockwise direction and incremental dimension

(d) Circular interpolation in clockwise direction and absolute dimension

35. Which of the following is the correct data structure for solid models?
(a) Solid parts → faces → edges → vertices

(b) Solid parts → edges → faces → vertices

(c) vertices → edges → faces → solid parts

(d) vertices → faces → edges → solid parts

36. Which one of the following is a solid-state joining process?
(a) Gas tungsten arc welding

(b) Resistance spot welding

(c) Friction welding

(d) Submerged arc welding

37. When the temperature of a solid metal increases,
(a) Strength of the metal decreases but ductility increases

(b) Both strength and ductility of the metal decreases

(c) Both strength and ductility of the metal increases

(d) Strength of the metal increases but ductility decreases

38. In a 2-D CAD package, clockwise circular arc of radius to $P_2(10, 15)$ will have its centre at
(a) (10, 10) (b) (15, 10)

(c) (15, 15) (d) (10, 15)

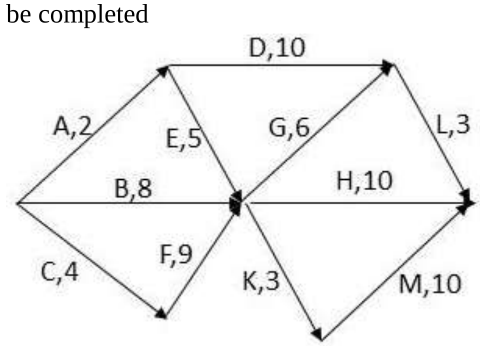
39. As tool and work are not in contact in EDM process
(a) No relative motion occurs between them

(b) No wear of tool occurs

(c) No power is consumed during metal cutting

(d) No force between tool and work occurs

40. A project consists of activities A to M shown in the net in the following figure with the duration of the activities marked in days, the project can be completed



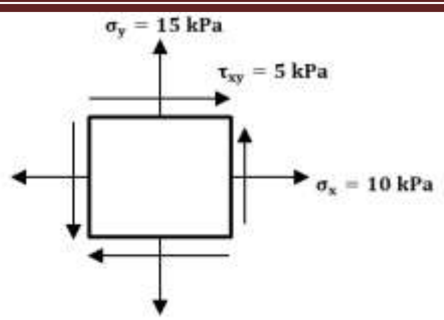
(a) Between 18, 19 days

(b) Between 25, 28 days

(c) Between 20, 22 days

(d) Between 60, 70 days

41. The state of stress at a point, for a body in plane stress, are shown in the figure below. What is value of maximum principal stress?



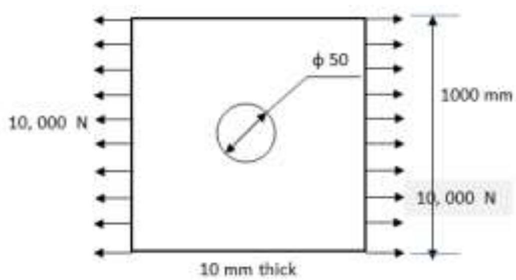
(a) 18 kPa (b) 20 kPa

(c) 81 kPa (d) 30 kPa

42. FE model consists of solid elements, total number of nodes in models are 50, how many degree of freedom this model will have?
(a) 50 (b) 100

(c) 150 (d) 300

43. A plate of width 1000 mm and thickness 10 mm having 50 mm hole in centre subjected to load of 10000 N as shown below, Maximum stress concentrated near hole is



(a) 1 MPa (b) 2 MPa
(c) 3 MPa (d) 4 MPa

44. In two-dimensional finite elements, Maximum length side of an element divided by the minimum length side of the element is known as
(a) Jacobian (b) Warpage

(c) Skew (d) Aspect ratio

45. Principal stress acting on solid body are 80 MPa, 30 MPa and 50 MPa, what is value of respective von Mises stress and Octahedral stress
(a) 43.6 MPa and 53.3 MPa

(b) 61.6 MPa and 53.3 MPa

(c) 46.3 MPa and 35.3 MPa

(d) 66.1 MPa and 53.3 MPa

46. In FEM, stiffness matrix for rod element shown below is represented by

A = Area of cross-section
E = Young's modulus
L = length of beam

(a) $\frac{L}{AE}\begin{vmatrix} 1 & -1 \\ -1 & 1 \end{vmatrix}$

(b) $\frac{AE}{L}\begin{vmatrix} 1 & -1 \\ -1 & 1 \end{vmatrix}$

(c) $\frac{L}{AE}\begin{vmatrix} -1 & -1 \\ -1 & -1 \end{vmatrix}$

(d) $\frac{AE}{L}\begin{vmatrix} 1 & 1 \\ 1 & 1 \end{vmatrix}$

47. Which of following is not standard 3D CAD format for exchange of CAD model among different CAD software
(a) SAT (b) EDF

(c) IGES (d) STEP

48. In CAD, what does WCS stand for
(a) Western CAD system

(b) Worldwide Coordinate System

(c) World Coordinate System

(d) Wrong CAD setting

49. Which of following material is having highest Poisson's ratio?
(a) Rubber (b) Aluminium

(c) Titanium (d) Steel

50. What is inverse of following matrix A?

$$A = \begin{vmatrix} 1 & 2 & 3 \\ 0 & 1 & 4 \\ 5 & 6 & 0 \end{vmatrix}$$

(a) $\begin{vmatrix} 24 & -18 & -5 \\ -20 & 15 & 4 \\ 5 & -4 & -1 \end{vmatrix}$

(b) $\begin{vmatrix} -24 & 18 & 5 \\ 20 & -15 & -4 \\ -5 & 4 & 1 \end{vmatrix}$

(c) $\begin{vmatrix} 24 & -20 & 5 \\ -18 & 15 & -4 \\ -5 & 4 & -1 \end{vmatrix}$

(d) $\begin{vmatrix} -24 & 20 & -5 \\ 18 & -15 & 4 \\ 5 & -4 & 1 \end{vmatrix}$

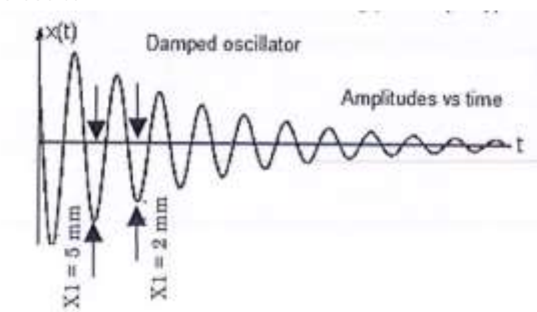
51. What is rank of following matrix B?

$$B = \begin{vmatrix} 1 & 2 & 1 \\ -2 & -3 & 1 \\ 3 & 5 & 0 \end{vmatrix}$$

(a) 0 (b) 1

(c) 2 (d) 3

52. In damped spring mass system, damped oscillation over time is shown below, amplitude of subsequent oscillation is 5 mm and 2 mm respectively, damping factor of this system is close to



(a) 0.05 (b) 0.2
(c) 0.15 (d) 0.70

53. Which of following material is having non zero co-efficient of moisture expansion?
Steel, Copper, Brass, Carbon Fibre Reinforce Plastic

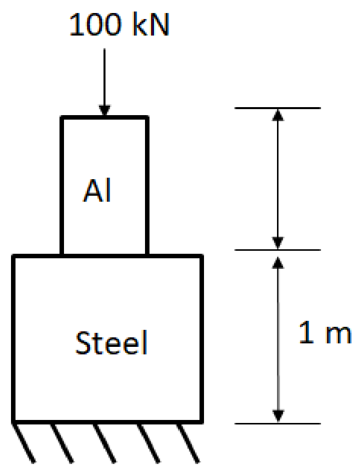
(a) Copper

(b) Steel

(c) Brass

(d) Carbon Fibre Reinforce Plastic

54. A 1 meter aluminum bar of 20×10^{-4} m^2 in cross sectional area is attached to a 1 meter steel bar 40×10^{-4} in cross sectional area, as shown in figure. Young's modulus of aluminium and steel are 70 GPa and 200 GPa respectively. Total Shorening due to an axial compressive force of 100 kN is



(a) 4.8 mm (b) 8.4 mm

(c) 0.48 mm (d) 0.84 mm

55. Strain energy in axially loaded bar is expressed as.
(Where, P is axial load, L is bar length, A is cross-sectional area of bar, E is Young's modulus of the bar)

(a) $\frac{PL^2}{2AE}$ (b) $\frac{PL^2}{AE}$

(c) $\frac{P^2L}{2AE}$ (d) $\frac{P^2L}{AE}$

56. A Rotor having definite mass mounted midway on horizontal shaft, simply supported at the ends by two bearings. Natural frequency of this rotor shaft system is 628 rad/sec. because of manufacturing inaccuracy, centre of gravity of rotor is 0.06 mm away from geometric centre of rotor. If the system rotates at 3000 rpm, what is maximum amplitude of vibration?
(a) 0.01 mm (b) 0.02 mm

(c) 0.03 mm (d) 0.04 mm

57. Hook's law holds good up to,
(a) Limit of proportionality

(b) Yield Point

(c) Plastic limit

(d) Breaking point

58. The ratio of direct stress to volumetric strain in case of a body subjected to three mutually perpendicular stress of equal intensity is equal to,
(a) Young's modulus

(b) Bulk modulus

(c) Modulus of rigidity

(d) Poission's ratio

59. A spur gear with 20^0 full depth teeth is transmitting 30 KW at 300 rad/sec. the pitch circle diameter of gear is 200 mm, the magnitude of force applied on the gear in the radial direction is
(a) 1.39 KN (b) 0.73 KN

(c) 0.36 KN (d) 2.78 KN

60. Cold working of steel is defined as working
(a) At its re-crystallisation temperature

(b) Above its re-crystallisation temperature

(c) Below its re-crystallisation temperature

(d) At two thirds of the melting temperature of the metal

61. Arrange following material with their increasing Young's modulus value Titanium, Aluminium, Steel, Rubber
(a) Rubber, Aluminium, Steel, Titanium

(b) Rubber, Aluminium, Titanium, Steel

(c) Rubber, Titanium, Aluminium, Steel

(d) Steel, Titanium, Aluminium, Rubber

62. Which is not applicable for a preloaded joint?
(a) To improve joint stiffness

(b) Increased fastener fatigue life

(c) Decreased fastener fatigue life

(d) Leak tightness

63. If d is the wire diameter, D the mean diameter, G is Modulus of rigidity and N the number of coils of a helical compression spring, then the spring rate is given by
(a) $d^4G/8D^3N$ (b) $8DN/\pi d^3$

(c) $d^3G/8D^4N$ (d) $Gd^2/(8D^3N)$

64. Two solid spheres of diameters d_1 and d_2 pressed together by a force F and a is the radius of the circular contact area, then, maximum pressure is given by
(a) $F/\left((\pi/4)\times(2a^2)\right)$

(b) $F/(2a)$

(c) $3F/(2\pi a^2)$

(d) $F/\left(2a\times(\pi/4d_1^2\ \times\ \pi/4d_2^2\ )\right)$

65. Resilience of a material is important, when it is subjected to
(a) Thermal stresses

(b) Shock loading

(c) Fatigue

(d) Wear and tear

66. If an application calls stresses on screw threads in one direction only, then the following type of thread would be best suited
(a) Square (b) Acme

(c) Buttress (d) Metric

67. The solid solution formed when carbon atoms are absorbed into face centred cubic structure of iron is called
(a) Austenite (b) Ferrite

(c) Cementite (d) Martensite

68. For wrought Aluminium alloys, AA 2XXX series, the predominant alloying element is
(a) Copper (b) Manganese
(b) Magnesium (d) Zinc and Manganese

69. In vibration isolation if $\frac{\omega}{\omega_n}$ is less than $\sqrt{2}$ then the transmissibility will be

(a) Less than one

(b) Equal to one

(c) Greater than one

(d) Zero

70. In coulomb damping the damping force is

(a) Proportional to velocity

(b) Related to the coefficient of friction

(c) Proportional to stiffness

(d) None of the above

71. A driver of mass 100 kg is standing at the tip of a spring board of negligible natural frequency of the spring board with the driver is 1.6 Hz. What is the static deflection at the tip of the spring board when the driver is standing at the tip?

(a) 0.1 mm (b) 981 mm

(c) 98.1 mm (d) 9.81 mm

72. Shear center in case of channel section will be

(a) Within cross section

(b) On the outer edge of channel section

(c) Outside the cross section

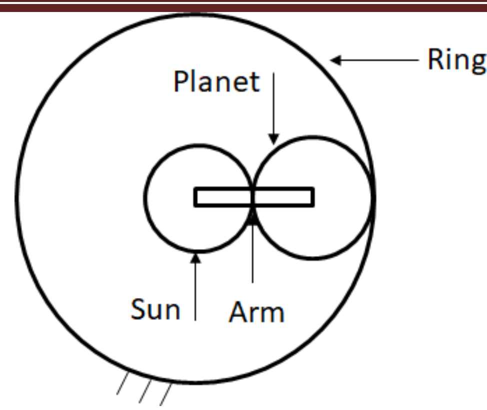
(d) None of the above

73. A cast iron block is experiencing biaxial stress field with normal stress components of 100 and 200 MPa. Its ultimate strength in tensile and compressive stress state are 250 MPa and 750 MPa respectively. Find its factor of safety.

(a) 7.5 (b) 1.25

(c) 2.5 (d) 1.44

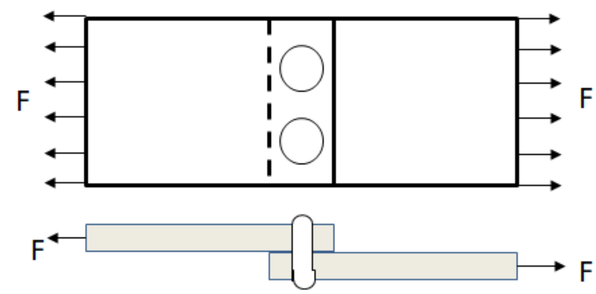
74. In the gear system shown in the figure, the sun gear is driven in the clockwise direction at 100 rpm. The ring gear is held stationary. The number of teeth for sun, planet, and ring gears are 20, 30 and 80 respectively. Find the rotation of arm.



(a) 15 rpm (b) 20 rpm

(c) 25 rpm (d) 10 rpm

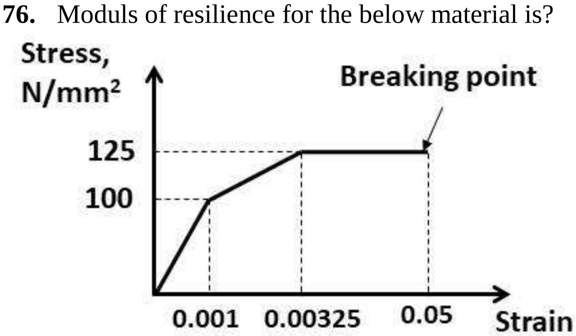
75. A single row riveted lap joint of two similar plates are shown in figure. Width and thickness of the plate are 150 mm and 5 mm respectively. Number of rivets 2, diameter of the rivet d = 8 mm, hole diameter = 9 mm, allowable stress is 200 MPa, allowable bearing stress of the rivet is 150 MPa, if the plates are to be designed to avoid tearing failure, Maximum permissible load in kN is



(a) 96 (b) 134

(c) 132 (d) 141

76. Moduls of resilience for the below material is?



(a) 50 kPa (b) 100 kPa

(c) 303.125 kPa (d) 6.15 MPa

77. The most applicable failure theory for metals like aluminium is

(a) Maximum principal stress theory

(b) Maximum principal strain theory

(c) Total strain energy theory

(d) Maximum distortion energy theory

78. In FEM, Individual elements are subdivided without altering their original position in

(a) r – adaptation

(b) p – adaptation

(c) h – adaptation

(d) hp – adaptation

79. ABCD is a four mechanism in which AB = 310 mm and CD = 450 mm. AB and CD are both perpendicular to the fixed link AD. If the velocity of B at this condition is v. Then the velocity C is,

(a) v (b) 2/3 v

(c) 3/2 v (d) 9/4 v

80. According to Nyquist theorem, the sampling rate should be ______ as fast as the highest frequency of the signal being measured or sampled

(a) Twice

(b) Thrice

(c) Ten times

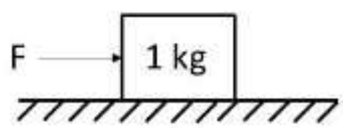
(d) Hundred Times

Answer

1 (c)	21 (a)	41 (a)	61 (*)
2 (a)	22 (a)	42 (c)	62 (*)
3 (d)	23 (c)	43 (c)	63 (a)
4 (c)	24 (c)	44 (*)	64 (*)
5 (a)	25 (d)	45 (b)	65 (*)
6 (d)	26 (d)	46 (b)	66 (c)
7 (d)	27 (a)	47 (*)	67 (*)
8 (a)	28 (c)	48 (*)	68 (*)
9 (d)	29 (b)	49 (a)	69 (*)
10 (*)	30 (*)	50 (b)	70 (*)
11 (c)	31 (b)	51 (c)	71 (c)
12 (d)	32 (c)	52 (c)	72 (c)
13 (c)	33 (b)	53 (*)	73 (b)
14 (b)	34 (*)	54 (*)	74 (b)
15 (d)	35 (c)	55 (c)	75 (*)
16 (a)	36 (a)	56 (b)	76 (a)
17 (c)	37 (a)	57 (a)	77 (d)
18 (a)	38 (*)	58 (b)	78 (*)
19 (b)	39 (*)	59 (c)	79 (a)
20 (c)	40 (b)	60 (c)	80 (*)

Solutions

1.



N = mg = 1 × 9.81 = 9.81 N

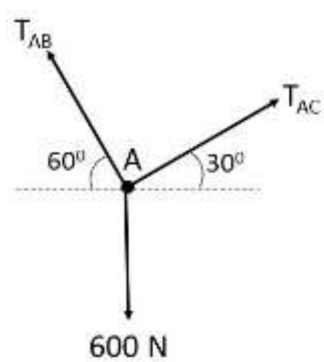
μ = 0.1

Maximum static friction force

$f_{s,max} = \mu N = 0.1 \times 9.81 = 0.981$ N

Minimum force F required to move the block is equal to maximum static friction force.

2.



Apply Lami's theorem,

$$\frac{T_{AB}}{\sin 120^0} = \frac{T_{AC}}{\sin 150^0} = \frac{600\ N}{\sin 90^0}$$

$T_{AB} = 600\ \sin 120^0 = 520$ N

$T_{AC} = 600\ \sin 150^0 = 300$ N

3. Position of a particle with respect to time

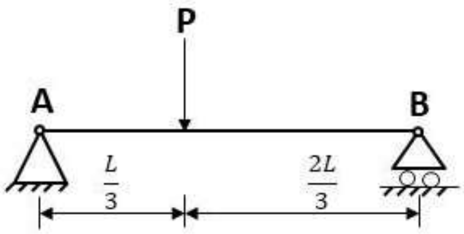
x (t) = $2t^3 + t^2 + 3t$

v (t) = $6t^2 + 2t + 3$
a (t) = 12t + 2
At time t = 0 sec, v (0) = 3, a(0) = 2

4. Second moment of a circular area

$I_{xx} = \frac{AR^2}{4} = \frac{\pi R^4}{4} = \frac{\pi D^4}{64}$

5.



Vertical equilibrium of beam AB

$R_A + R_B = P$

Moment equilibrium about point A

$R_B L = P \times \frac{L}{3}$

$R_B = \frac{P}{3}$

Bending moment at point of application of load

$B.M = \frac{P}{3} \times \frac{2L}{3} = \frac{2PL}{9}$

6. Maximum shear stress $\tau_{max} = 80$ MPa

If diameter of shaft is doubled and Torque remains constant.

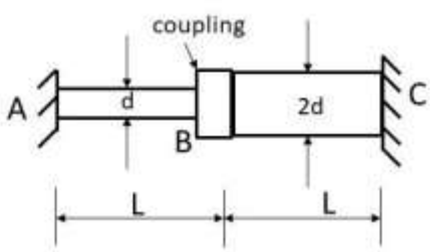
$\frac{T}{J} = \frac{\tau_{max}}{R}$

$\tau_{max} = \frac{2T}{\pi R^3}$

$\frac{\tau_2}{\tau_1} = \frac{R_1^3}{R_2^3} = \frac{1}{8}$

$\tau_2 = \frac{\tau_1}{8} = \frac{80}{8}$ = 10 MPa

7.



Let T is torque applied at section B.

Angle of twist at point B in shaft AB and BC are same.

Let torque transmitted in shaft AB is T_A and torque transmitted in shaft BC is T_C

$T_A = \frac{GJ_{AB}\theta_B}{L}$ and $T_C = \frac{GJ_{BC}\theta_B}{L}$

$\frac{T_A}{T_C} = \frac{J_{AB}}{J_{BC}} = \frac{d^4}{(2d)^4} = \frac{1}{16}$

$T_C = 16T_A$

8. Critical bucking load for hinge – hinge conditions.

$$P_{cr} = \frac{\pi^2 EI}{L^2}$$

9. Thermal stress = Young's modulus × Strain

If rod is fixed at both ends and temperature is rise ΔT.

Stain produced in rod = $\alpha\Delta T$

Thermal stress = $E\alpha\Delta T$

10. $E = 2G(1 + \vartheta)$

$\vartheta = 0.4$

$\frac{E}{G} = 2(1 + 0.4) = 2.8$

11. Maximum deflection of cantilever beam subjected to point load W at free end

$$\delta_{max} = \frac{WL^3}{3EI}$$

12. The state of stress at a point

$\sigma_{xx} = 20$ MPa

$\sigma_{yy} = 50$ MPa

$\tau_{xy} = 20$ MPa

Radius of Mohr's circle

$R = \sqrt{\left(\frac{\sigma_{xx} - \sigma_{yy}}{2}\right)^2 + \tau_{xy}^2}$

$R = \sqrt{\left(\frac{20 - 50}{2}\right)^2 + 20^2}$ = 25 MPa

13. Slenderness ratio = $\frac{L_e}{k}$

L_e = effective length of column

I = least area moment of inertia

k = radius of gyration

I = $\frac{20 \times 10^3}{12}$ = 1666.67 mm^4

k = $\sqrt{\frac{I}{A}} = \sqrt{\frac{1666.67}{200}}$ = 8.3 mm

Slenderness ratio = $\frac{2000}{8.3}$ = 240

14. Thin cylinder

inner radius = 1000 mm

thickness = 20 mm

internal pressure P = 10 MPa

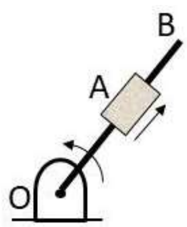
Hoop stress $\sigma_\theta = \frac{PD}{2t} = \frac{10 \times 1000}{2 \times 20}$ = 250 MPa

15. Principal stress at a point

σ_1 = 200 MPa, σ_2 = 80 MPa

$\tau_{max} = \frac{\sigma_1 - \sigma_2}{2} = \frac{200-80}{2}$ = 60 MPa

16.



Coriolis acceleration

$a_c = 2\,v\omega = 2\ \times 2\ \times 1$ = 4 m/s^2

Tangential acceleration

$a_t = \ \omega^2 \times OA$ = 3 m/s^2

Absolute acceleration

= $\sqrt{a_c^2 + \ a_t^2} = \ \sqrt{4^2 + \ 3^2}$ = 5 m/s^2

17. Kinetic energy of the flywheel

$\text{K.E} = \frac{1}{2}\text{I}\omega^2$

Mass moment of inertia of thin circular disc

I = $\frac{MR^2}{2} = \frac{20 \times 0.1^2}{2}$ = 0.1 kg-m^2

$\omega = \frac{2\,\pi\,N}{60} = \frac{2 \times 3.14 \times 600}{60}$ = 62.8 rad/sec

$\text{K.E} = \frac{1}{2} \times 0.1\ \times 62.8^2$ = 197.4 Joule

18. Natural frequency of a spring –mass system is depend only stiffness of spring and mass of an object. So natural frequency is same on earth as well as on moon.

19. Stiffness of the spring k = 3.6 kN/m

Mass of vehicle M = 500 kg

$\omega = \sqrt{\frac{k}{M}} = \sqrt{\frac{3600}{500}}$ = 2.68 rad/s

20. Stiffness of the spring k = 1 kN/m

Damping constant c = 100 Ns/m

Mass = 10 kg

Damping factor $\xi = \frac{c}{2\sqrt{km}} = \frac{100}{2\sqrt{1000 \times 10}}$ = 0.5

21. Number of links N = 8

Number of binary joint j = 10

F = 3(N-1) -2j = 3(8-1) -2×10 = 1

22. Equivalent stiffness of spring

$\frac{1}{k_e} = \frac{1}{2k} + \frac{1}{k} = \frac{3}{2k}$

$k_e = \frac{2k}{3}$

$$\omega = \sqrt{\frac{k_e}{M_e}} = \sqrt{\frac{\frac{2k}{3}}{2m}} = \sqrt{\frac{k}{3m}}$$

23. Undamped natural frequency

$\omega_\text{d} = \left(\sqrt{1 - \xi^2}\right)\omega_\text{n}$

25. $TR = \frac{\sqrt{k^2 + (c\omega)^2}}{\sqrt{(k - m\,\omega^2)^2 + (c\omega)^2}}$

$TR = \frac{\sqrt{1 + (2\xi r)^2}}{\sqrt{(1 - r^2)^2 + (2\xi r)^2}}$

$r = 0.7$

$\xi = 0$

$$TR = \frac{1}{(1 - \ r^2)} = \frac{1}{1 - \ 0.7^2} = 2$$

28. Natural frequency of cantilever beam

$\omega = \sqrt{\frac{\text{k}}{\text{m}}} = \sqrt{\frac{3\text{EI}}{\text{ML}^3}}$

$\frac{\omega_1}{\omega_2} = \sqrt{\frac{3\text{EI}}{\text{ML}^3}} = \sqrt{\frac{L_2^3}{L_1^3}} = \sqrt{\frac{8L_1^3}{L_1^3}} = \sqrt{8}$

$\frac{\omega_2}{\omega_1} = \frac{1}{\sqrt{8}}$

$\omega_2 = \frac{\omega_1}{\sqrt{8}}$

31. Maximum dimension of a hole = 10.015 mm

Minimum dimension of a hole = 10.010 mm

Maximum dimension of a shaft = 10.010 mm

Minimum dimension of a shaft = 10.001 mm

Maximum dimension of a shaft is equal to minimum dimension of hole

Close running fit

40.

Activity	EST	EFT	LST	LFT	Slack
A	0	2			
B	0	8			
C	0	4			
D	2	12			
E	2	7			
F	4	13			
G	13	19			

H	13	23			
K	13	16			
L	19	22			
M	16	26			

41. $\sigma_x = 10$ kPa, $\sigma_y = 15$ kPa , $\tau_{xy} = 5$ kPa

$$\sigma_{max} = \frac{\sigma_x + \sigma_y}{2} + \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2}$$

$$\sigma_{max} = \frac{10 + 15}{2} + \sqrt{\left(\frac{10 - 15}{2}\right)^2 + 5^2}$$

$= 18$ kPa

43. Nominal stress $\sigma_0 = \frac{P}{A} = \frac{10000}{1000 \times 10} = 1$ MPa

Stress concentration factor $K_t = 3$

Maximum stress $\sigma_{max} = K_t \sigma_0$

$= 3 \times 1$ MPa

$= 3$MPa

45. Principal stress are

$\sigma_1 = 80$ MPa, $\sigma_2 = 30$ MPa and

$\sigma_3 = 50$ MPa

$$\sigma_{VM} = \sqrt{(\sigma_1 - \sigma_2)^2 + (\sigma_2 - \sigma_3)^2 + (\sigma_3 - \sigma_1)^2}$$

$$\sigma_{VM} = \sqrt{(80 - 30)^2 + (30 - 50)^2 + (50 - 80)^2}$$

$\sigma_{VM} = 61.64$ MPa

$\sigma_{oct} = \frac{\sigma_1 + \sigma_2 + \sigma_3}{3} = \frac{80+30+50}{3} = 53.3$ MPa

50. $A = \begin{vmatrix} 1 & 2 & 3 \\ 0 & 1 & 4 \\ 5 & 6 & 0 \end{vmatrix}$

Det(A) = $1(1 \times 0 - 4 \times 6) + 5(2 \times 4 - 3 \times 1) = 1$

Co-factor of matrix A = $\begin{vmatrix} -24 & 20 & -5 \\ 18 & -15 & 4 \\ 5 & -4 & 1 \end{vmatrix}$

Transpose of co-factor of matrix A

$= \begin{vmatrix} -24 & 18 & 5 \\ 20 & -15 & -4 \\ -5 & 4 & 1 \end{vmatrix}$

51. $B = \begin{vmatrix} 1 & 2 & 1 \\ -2 & -3 & 1 \\ 3 & 5 & 0 \end{vmatrix}$

det (B) = $1(-2 \times 5 + 9) - (5 - 6) = -1 + 1 = 0$

Rank of matrix B is 2.

52. $\ln \frac{A_n}{A_{n+1}} = \frac{2\pi\xi}{\sqrt{1-\xi^2}}$

$\ln \frac{5}{2} = \frac{2\pi\xi}{\sqrt{1-\xi^2}}$

$$\frac{\xi}{\sqrt{1-\xi^2}} = 0.146$$

$\xi \approx 0.15$

56. Steady state amplitude

$$X_0 = \frac{F_0}{\sqrt{(k - m\omega^2)^2}} = \frac{me\omega^2}{\sqrt{(k - m\omega^2)^2}}$$

$$X_0 = \frac{e\omega^2}{\sqrt{(\omega_n^2 - \omega^2)^2}} = \frac{0.06 \times (2\pi N/60)^2}{\sqrt{((628)^2 - 314.1^2)^2}} = 0.02 \text{ mm}$$

59. Power P = 30 kW

pitch circle diameter of gear d = 200 mm

Angular speed $\omega = 300$ rad/sec

Pressure angle $\alpha = 20^0$

Torque T = $\frac{P}{\omega} = \frac{30000}{300}$ =100 N-m

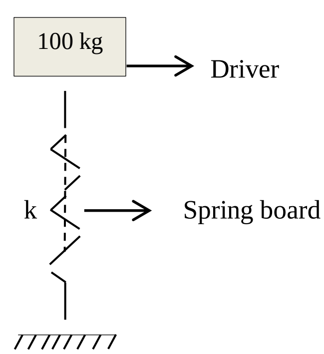
T = $F_t \times r$

$F_t = 1000$ N

$\tan\alpha = \frac{F_r}{F_t}$

$F_r = 1000 \times \tan 20^0 = 364$ N

71.



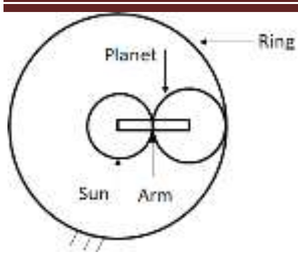
Natural frequency, $f_n = 1.6$ Hz

Angular frequency, $\omega_n = 2\pi f_n = 10.05$ rad/s

Static deflection,

$\Delta_s = \frac{mg}{k} = \frac{g}{\omega_n^2} = 9.81 / 10.05^2 = 98.1$ mm

74.



Speed of the sun gear $N_S = 100$ rpm

Speed of ring gear = 0 rpm

$$\frac{N_s - N_{arm}}{N_r - N_{arm}} = -\frac{Z_r}{Z_S}$$

$$\frac{100 - N_{arm}}{0 - N_{arm}} = -\frac{80}{20}$$

$N_{arm} = 20$ rpm

1. For an ideal gas, enthalpy is represented by

(a) $H = U - RT$
(b) $H = U + RT$
(c) $H = RT - U$
(d) $H = -(U + RT)$

2. In a steady flow process, across the control volume mass and energy flow

(a) Varies continuously
(b) Remain constant
(c) Depends on control surface
(d) Depends on type of process

3. A polytropic process with n = -1, initiates with P = V = 0 and ends with P = 600 kPa and V = 0.01 m^3. The work done is

(a) 2 kJ (b) 3 kJ
(c) 4 kJ (d) 6 kJ

4. A thermal reservoir is a body of

(a) Small heat capacity
(b) Large heat capacity
(c) Infinite heat capacity
(d) Large work capacity

5. Gas turbines are preferred in aircraft propulsion, due to

(a) They are heavy.
(b) They have low power to weight ratio.
(c) They have high power to weight ratio.
(d) They are efficient.

6. Ammonia has a boiling point of

(a) – 33.3 ^{0}C (b) – 43.3 ^{0}C
(c) – 53.3 ^{0}C (d) – 63.3 ^{0}C

7. If the pressure range of compressor is low, then the COP will be

(a) low
(b) high
(c) remains unchanged
(d) Cannot be determined.

8. The convective heat transfer coefficient does not depend on

(a) Surface type
(b) Surface orientation
(c) Surface material
(d) Surface area

9. Among the following, the best insulator is

(a) Air (b) Water
(c) Ash (d) Aluminium

10. During steady state heat transport in a thin plate with uniform temperature, the nature of temperature distribution is

(a) Parabolic (b) Logarithmic
(c) Linear (d) Exponential

11. A long conduit of 4 cm outer diameter is carrying steam. Currently it is insulated with 20 mm thick insulation. Additional insulation required to reduce the heat loss by two-third is

(a) 90 mm (b) 110 mm
(c) 120 mm (d) 140 mm

12. For an infinitely long fin, efficiency is given by

(a) $\frac{1}{mL}$ (b) $\frac{2}{mL}$
(c) $\frac{1}{2mL}$ (d) $\frac{3}{mL}$

13. In lumped capacity heat transfer model, the variation of temperature with time is

(a) Linear (b) Parabolic
(c) Exponential (d) Hyperbolic

14. The ratio between emissive power and intensity of normal radiation is

(a) π (b) $\frac{\pi}{2}$
(c) $2/\pi$ (d) $\frac{\pi}{3}$

15. In what form solar energy is radiated from the Sun?

(a) Ultraviolet radiation
(b) Infrared radiation
(c) Electro-magnetic waves
(d) Transverse waves

16. Two infinite parallel plates are kept at a distance, Y. The value of shape factor is

(a) zero (b) one
(c) Y (d) Infinity

17. A solar thermal operated vapour absorption system is capable of

(a) Continuous operation.
(b) both continuous and intermittent operation.
(c) No operation.
(d) Intermittent operation

18. For an incompressible fluid, the density

(a) Varies with temperature only.
(b) Varies with pressure only.
(c) Varies with both pressure and temperature.
(d) Remain constant.

19. In a flow field, streamlines and equipotential lines are
(a) Parallel to each other.
(b) Perpendicular to each other.
(c) Intersect each other at acute angle.
(d) Intersect at obtuse angle.

20. Newtonian fluids are the one which
(a) Obeys Newton's law of viscosity.
(b) Obeys Hook's law.
(c) Obeys Williamson's law.
(d) Obeys Power law.

21. Which fluid does not experience stress during flow?
(a) Dilatant (b) Bingham
(c) Viscoplastic (d) Inviscid

22. A beaker contains water upto h height. The location of centre of pressure is
(a) h/3 from top (b) h/2 from top
(c) 2h/3 from top (d) 3h/4 from top

23. Which one of the following is not a case of ideal fluid flow?
(a) Inviscid
(b) Incompressible
(c) Forced vortex flow
(d) Super critical flow

24. For an inclined plane for which position, maximum total pressure acts on it?
(a) Horizontal (b) Vertical
(c) Skewed (d) Inclined

25. Which one of the following is an example of magneto fluids?
(a) Alcohol (b) Water
(c) Liquid metal (d) Ethylene Glycol

26. Which one of the following needs maximum head?
(a) Kaplan turbine
(b) Pelton turbine
(c) Francis turbine
(d) Reaction turbine

27. Power delivered in Pelton turbine is given by
(a) $W(V_{w1} + V_{w2})\frac{u}{g}$
(b) $W(V_{w1} - V_{w2})\frac{u}{g}$
(c) $(V_{w1} - V_{w2})\frac{u}{g}$
(d) $(V_{w1} + V_{w2})\frac{u}{g}$

28. Generally runner blades are made of
(a) Cast Iron
(b) Cast Steel
(c) Mild Steel
(d) High Carbon steel

29. The inlet passage of water entry in a hydraulic turbine is controlled by
(a) Gate (b) Head race
(c) Tail race (d) Pump

30. Which one is a major advantage of centrifugal pump?
(a) Cost is low
(b) Efficiency is high
(c) Construction is simple.
(d) Ease in use.

31. Hydraulic gradient line represents the sum of
(a) Datum head and Pressure head
(b) Datum head and Kinetic head
(c) Pressure head and Kinetic head
(d) Pressure, Datum and Kinetic head

32. In a locomotive boiler, the shell length is
(a) 2 m (b) 3m
(c) 4 m (d) 5 m

34. What should be pH value of water used in boilers?
(a) 0 (b) 7
(c) less than 7 (d) more than 7

35. Which of the following is an example of externally fired boiler?
(a) Lancashire boiler
(b) Cochran boiler
(c) Babcock and Wilcox boiler
(d) Scotch Marine boiler

36. Major loss of energy in a typical power plant takes place in
(a) Condenser (b) Pump
(c) Boiler (d) Turbine

37. What is the critical point of steam generation in a 'once through' boiler ?
(a) 211.2 bar (b) 221.2 bar
(c) 231.2 bar (d) 241.2 bar

38. The motion between a pair which takes place in ______ is known as incompletely constrained motion.
(a) One direction only
(b) Two directions only
(c) More than one direction
(d) None of these

39. A typewriter mechanism has six links, seven binary joints and no higher pairs. This mechanism could be
(a) unsound in kinematics.
(b) sound in kinematics.
(c) It depends on fixed links.
(d) Cannot say anything.

40. If shaft angle is 'ϴ' and friction angle in 'ϕ', maximum efficiency of spiral gear will be
(a) $\sin(\theta+\varphi)+\frac{1}{\sin(\theta+\varphi)}+1$
(b) $\sin(\theta-\varphi)+\frac{1}{\cos(\theta+\varphi)}+1$
(c) $\cos(\theta+\varphi)+\frac{1}{\sin(\theta-\varphi)}+1$
(d) $\cos(\theta+\varphi)+\frac{1}{\cos(\theta-\varphi)}+1$

41. A rotary internal combustion engine has following number of cylinders:
(a) Seven (b) Six
(c) Four (d) Three

42. The purpose of link is to
(a) Transmit motion (b) Guide links
(c) Provide support (d) All of these

43. In any truncated conical pivot bearing, for uniform wear, the frictional torque transmitted is
(a) $\mu W cosec(\alpha)\,(r_1+r_2)$
(b) $\frac{1}{2}\mu W cosec(\alpha)\,(r_1+r_2)$
(c) $\mu W cosec(\alpha)\,(r_1-r_2)$
(d) $\frac{1}{2}\mu W cosec(\alpha)\,(r_1-r_2)$

44. The Coriolis is acceleration leads the sliding velocity by
(a) 45^0 (b) 90^0
(c) 135^0 (d) 180^0

45. For products subjected to large vibrations, which of the joint is better?
(a) Threaded (b) Hinged
(c) Welded (d) Ball and socket

46. When a fastner is threaded into a tapped hole, it is called as
(a) Screw (b) Bolt
(c) Washer (d) Nut

47. Set screws can be subjected to
(a) Tensile load only.
(b) Compressive load only.
(c) Both tensile and compressive load.
(d) Neither tensile nor compressive load.

48. For a double threaded screw, nominal dia. and pitch are 100 mm and 12 mm respectively. The tangent of helix angle will be
(a) 0.021 (b) 0.041
(c) 0.061 (d) 0.081

49. For a velocity ratio requirement of 70 : 1, which type of gear is more suitable ?
(a) Spur (b) Worm
(c) Helical (d) Bevel

50. The section modulus of a circular plate of diameter, d, about an axis, through its centre of gravity, is
(a) $\frac{\pi d^3}{16}$ (b) $\frac{\pi d^4}{16}$
(c) $\frac{\boldsymbol{\pi d^3}}{\mathbf{32}}$ (d) $\frac{\pi d^4}{32}$

51. The property of any material due to which it can be rolled into plates is called
(a) Ductility (b) Elasticity
(c) Malleability (d) Plasticity

52. A 2 m long bar is extended by 2 mm under axial stress of 2 N/mm^2. The modulus of resilience is
(a) 0.01 (b) 0.02
(c) 0.10 (d) 0.20

53. What is the limiting value of Poisson's ratio?
(a) 0 and 0.2 (b) 0 and 0.5
(c) 0.2 and 0.5 (d) 0.5 and 0.8

54. During bending of a beam, which layer remain unchanged?
(a) Neutral Axis (b) Load Axis

(c) Support Axis (d) Rotational Axis

55. For a mild steel body of effective depth 400 mm, the depth of neutral axis is
(a) 172 mm (b) 212 mm
(c) 272 mm (d) 312 mm

56. The load at the end of a cantilever beam is increased. Probable failure may occur at
(a) middle (b) end
(c) support (d) anywhere

57. A steel rod of 40 mm diameter and 4 m length is subjected to an axial load of 80 kN. Calculate the elongation, if E = 200 GPa.
(a) 1.13 mm (b) 1.23 mm
(c) 1.27 mm (d) 1.33 mm

58. Which of the following is not an amorphous material?
(a) Rubber (b) Plastic
(c) Lead (d) Glass

59. Normalising is best used for which material?
(a) Low and medium carbon steel
(b) High Carbon Steel
(c) Cast Iron
(d) Steel wires and plates

60. For a BCC structure atomic packing factor is
(a) 0.54 (b) 0.64
(c) 0.68 (d) 0.741

Solution: a = side of unit cell.
r = radius of atom.
Diagonal of unit cell = $\sqrt{3}a$
For BCC structure,
$\sqrt{3}a = 4r$
$\frac{r}{a} = \frac{\sqrt{3}}{4}$
Atomic fraction = $\frac{n \times \frac{4}{3}\pi r^3}{a^3}$
n = number of effective cell.
For BCC structure, n =2
Atomic fraction
$$= \frac{2 \times \frac{4}{3}\pi r^3}{a^3} = \frac{8}{3}\pi\left(\frac{r}{a}\right)^3$$
$$= \frac{8}{3}\pi\left(\frac{\sqrt{3}}{4}\right)^3 = 0.68$$

61. Which one of the following factor is not related to quality of coke?
(a) Moisture
(b) Ignitability
(c) Shape
(d) Conductivity

62. What does TRIP steel stands for?
(a) Transformation Induced Plasticity
(b) Transformation Induced Property
(c) Transformation Induced
(d) Transformation Induced Pearlite

63. Fixture is used as a ______ used in the manufacturing industry.
(a) Work-holding or support device
(b) Tool-holding device
(c) Cutting tool
(d) Welding tool

64. In metal machining, the zone where the heat is generated due to friction between the moving chip and the tool face is called
(a) Friction zone
(b) Work-tool contact zone
(c) Shear zone
(d) None of (A), (B), (C)

65. Thrust force will increase with increase in
(a) Tool nose radius
(b) Cutting edge angle
(c) Rake angle
(d) End angle

66. The tool life can be enhanced by
(a) Increasing rake angle
(b) Decreasing rake angle
(c) Increasing side cutting rake angle
(d) Decreasing side cutting rake angle

67. Which of the following are moulding material defects?
(a) Cut and Washes
(b) Fusion
(c) Metal Penetration
(d) All of these

68. Strength of the weld is due to diffusion and plastic deformation of the flying surface in
(a) Laser beam welding
(b) Ultrasonic welding
(c) Diffusion welding
(d) Gas welding

69. Under no load condition, voltage needed to generate the arc is termed as
(a) Short circuit voltage
(b) Open circuit voltage
(c) Closed circuit voltage
(d) Open arc voltage

70. During a machining process, chip velocity is 0.2 m/s with chip thickness ratio of 0.6. The cutting velocity is
(a) 0.23 m/s (b) 0.28 m/s
(c) 0.33 m/s (d) 0.38 m/s

71. When the molten metal is passed through an orifice, it breaks into pieces under high pressure fluid, the process is known as
(a) Crushing
(b) Electrolysis
(c) Reduction
(d) Atomization

72. The planning of material requirements, does not include
(a) Bill of material
(b) Inventory level
(c) Production schedule
(d) Material price

73. Elements of TQM does not include
(a) Customer focus
(b) Continuous improvement
(c) Intrinsic decision making
(d) Team leadership

74. In plant layout, greater flexibility is obtained in case of
(a) Process layout
(b) Product layout
(c) Fixed position layout
(d) Combination layout

75. Which of the following is independent of sales forecast?
(a) Productivity
(b) Inventory control
(c) Production control
(d) Production plan

76. Which of the following time estimate is related to PERT?
(a) One time estimate
(b) Two time estimate
(c) Three time estimate
(d) Four time estimate

77. The simplex method is used for
(a) Linear programming
(b) Value analysis
(c) Operation research
(d) Model analysis

78. Which one is not correct about critical ratio scheduling?
(a) Determines the status of each activity.
(b)Establishes priorities among various activities.
(c) Determines status of each activity.
(d) Useful in automobile industry only.

79. If t_0 is optimistic time, t_p is pessimistic time and t_n is most likely time, then the probabilistic time is given by
(a) $\frac{(4t_0+t_p+t_n)}{6}$
(b) $\frac{(t_0+4t_p+t_n)}{6}$
(c) $\frac{(t_0+t_p+4t_n)}{6}$
(d) $\frac{(t_0+t_p+t_n)}{3}$

80. A product can be produced by two methods. First have a fixed cost of 1500 and variable cost of 30. The second has a fixed cost of 2000 and variable cost of 20. The breakeven quantity between the two methods is
(a) 20 (b) 50
(c) 70 (d) 90

81. Queuing theory is associated with
(a) Production time
(b) Waiting time
(c) Planning time
(d) Sales time

82. Which of following register of the processor is connected to memory BUS?
(a) PC (b) MAR
(c) RAM (d) IR

83. A box that can represent two different condition in a flow chart.
(a) Circle
(b) Square

(c) Diamond
(d) Parallelogram

84. A flow chart that outlines the main segments of any program:
(a) Micro (b) Queue
(c) Macro (d) Union

85. An example of the delimiter in a FORTRAN program is
(a) Semi colon (b) Double colon
(c) Single colon (d) Comma

86. Which one is a valid variable declaratrion in FORTFAN?
(a) Real : : Celcius
(b) Real Celcius
(c) Celcius Real
(d) Real : : Celcius

87. When the sleeve of a porter governor move upwards, the governor speed
(a) Decreases
(b) Increases
(c) Remain constant
(d) First increases, then decreases

88. A taper provided on the pattern for its easy and clean withdrawal from the mould is known as
(a) Shrinkage allowance
(b) Distortion allowance
(c) Machining allowance
(d) Draft allowance

89. In order to balance the reciprocating masses
(a) Only primary forces and couples must be balanced.
(b) Only secondary forces and couples must be balanced
(c) Both (a) and (b)
(d) None of (a), (b) or (c)

90. In high speed engines, the cam follower should move
(a) with uniform velocity.
(b) in cycloidal motion.
(c) in simple harmonic motion.
(d) in circular motion.

91. Screws used for power transmission should have
(a) fine threads
(b) strong teeth
(c) low efficiency
(d) high efficiency

92. A body is subjected to a direct tensile stress of 300 MPa in one plane accompanied by a simple shear stress of 200 MPa. The maximum shear stress will be
(a) 150 MPa (b) 200 MPa
(c) 250 MPa (d) 300 MPa

93. The energy stored in a body when strained within elastic limit is known as
(a) Strain energy (b) Impact energy
(c) Resilience (d) Elastic energy

94. Work done in a free expansion process is
(a) Positive (b) Negative
(c) Zero (d) Maximum

95. Carnot cycle efficiency is maximum when
(a) Initial temperature is 0 K
(b) Final temperature is 0 K
(c) Initial temperature is 0 ^{0}C
(d) Final temperature is 0 ^{0}C

96. A piston cylinder arrangement has air at 600 kPa, 290 K and volume of 0.01 m^3. During a constant pressure process, if it gives 54 kJ of work, the final volume must be
(a) 0.10 m^3 (b) 0.05 m^3
(c) 0.01 m^3 (d) 0.15 m^3

97. For a reversible process
(a) $ds = \frac{dQ}{T}$ (b) $ds < \frac{dQ}{T}$
(c) $ds > \frac{dQ}{T}$ (d) $ds \geq \frac{dQ}{T}$

98. Flow work is analogous to
(a) Stirring work
(b) Electrical work
(c) Displacement work
(d) Shaft work

99. Which one of the following represents the energy in storage?
(a) Work (b) Heat
(c) Energy (d) Internal energy

100. The short coming of first law of thermodynamics is
(a) Direction of process

(b) Possibility of process
(c) Quality of energy
(d) Quantity of energy

ANSWER

1 (b)	21 (d)	41 (a)	61 (*)	81 (b)
2 (b)	22 (c)	42 (d)	62 (a)	82 (b)
3 (b)	23 (c)	43 (b)	63 (a)	83 (c)
4 (c)	24 (b)	44 (b)	64 (a)	84 (c)
5 (c)	25 (c) , (b)	45 (c)	65 (b)	85 (d)
6 (a)	26 (b)	46 (a)	66 (c)	86 (a), (d)
7 (b)	27 (a)	47 (b)	67 (d)	87 (b)
8 (*)	28 (b), (d)	48 (d)	68 (c)	88 (d)
9 (a)	29 (a)	49 (b)	69 (b)	89 (c)
10 (c)	30 (c)	50 (c)	70 (c)	90 (b)
11 (c)	31 (d)	51 (c)	71 (d)	91 (d)
12 (a)	32 (a)	52 (*)	72 (d)	92 (c)
13 (c)	33 (c)	53 (b)	73 (c)	93 (a), (c)
14 (a)	34 (d)	54 (a)	74 (a)	94 (c)
15 (c)	35 (c)	55 (b)	75 (a)	95 (b)
16 (b)	36 (a)	56 (c)	76 (c)	96 (a)
17 (d)	37 (b)	57 (c)	77 (a)	97 (a)
18 (d)	38 (c)	58 (c)	78 (d)	98 (c)
19 (b)	39 (b)	59 (a)	79 (c)	99 (d)
20 (a)	40 (d)	60 (c)	80 (b)	100 (a),(b) (c)

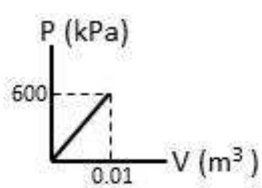
Solutions

3. A polytropic process, n = − 1

$\frac{P}{V}$ = constant

$P_1 = 0$, $V_1 = 0$

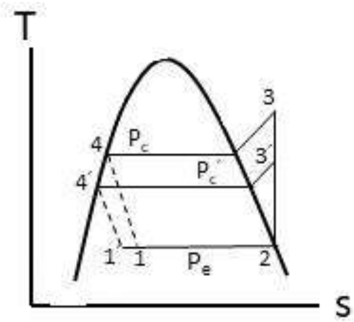
$P_2 = 600$ kPa, $V_2 = 0.01\ m^3$



Work done W = Area under P-V diagram

$= \frac{1}{2} \times 600 \times 0.01 = 3$ KJ

7. T-S diagram



$$\text{COP}_1 = \frac{Heat\ transfer\ in\ process\ 1{-}2}{Net\ work\ done\ in\ cycle\ 1{-}2{-}3{-}4{-}1}$$

$$\text{COP}_2 = \frac{Heat\ transfer\ in\ process\ 1{-}2}{Net\ work\ done\ in\ cycle\ 1'{-}2{-}3'{-}4'{-}1'}$$

Net work done in a cycle 1-2-3-4-1 is equal to area under T-s diagram in closed area 1-2-3-4-1.

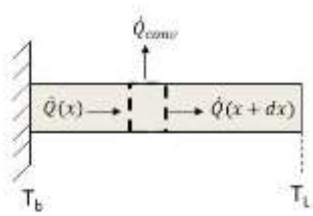
Net work done in a cycle $1' - 2 - 3' - 4' - 1'$ is equal to area under T-s diagram in closed area $1' - 2 - 3' - 4' - 1'$.

Form figure we can say that,

$\text{COP}_2 > \text{COP}_1$

So if pressure range is low then COP is increased.

12.



$$\dot{Q}(x+dx) + \dot{Q}_{conv} = \dot{Q}(x)$$

$$-kA_c\left(\frac{dT}{dx}\right)_{x+dx} + \ hpdx(T - T_\infty) = -kA_c\left(\frac{dT}{dx}\right)_x$$

$$hpdx(T - T_\infty) = kA_c\left(\frac{dT}{dx}\right)_{x+dx} - kA_c\left(\frac{dT}{dx}\right)_x$$

$$hp\ (T - T_\infty) = kA_c\frac{\left[\left(\frac{dT}{dx}\right)_{x+dx} - \left(\frac{dT}{dx}\right)_x\right]}{dx}$$

$$hp\ (T - T_\infty) = kA_c\frac{\left[\left(\frac{dT}{dx}\right)_{x+dx} - \left(\frac{dT}{dx}\right)_x\right]}{dx}$$

$$\frac{hp}{kA_c}(T - T_\infty) = \frac{d^2T}{dx^2}$$

$Let,\ T - T_\infty = \theta$

$$\frac{hp}{kA_c}\theta = \frac{d^2\theta}{dx^2}$$

$$\frac{hp}{kA_c} = m^2$$

$$m^2\theta = \frac{d^2\theta}{dx^2}$$

$D^2 - m^2 = 0$

$\theta = C_1e^{-mx} + C_2e^{mx}$

For infinitely long fin,

$T(x = L) = T_\infty$

Θ(x = L) = T(x= L) - T_∞ = T_∞ - T_∞ = 0

$C_2 = 0$

$$\eta = \frac{\dot{Q}_{fin}}{\dot{Q}_{max}}$$

$$\dot{Q}_{fin} = \sqrt{hpkA_c}(T_b - T_\infty)$$

$$\dot{Q}_{max} = hA_{fin}(T_b - T_\infty)$$

$$\eta = \frac{\sqrt{hpkA_c}(T_b - T_\infty)}{hA_{fin}(T_b - T_\infty)} = \frac{\sqrt{hpkA_c}}{hpL} = \frac{1}{mL}$$

$$m = \sqrt{\frac{hp}{kA_c}}$$

13. In lumped heat transfer model, temperature variation inside the body is negligible.

$\dot{Q} = hA(T - T_\infty)$

$\dot{Q} = -mC_P\frac{dT}{dt}$

$-mC_P\frac{dT}{dt} = hA(T - T_\infty)$

$(T - T_\infty) = \theta$

$\frac{d\theta}{dt} = -\frac{hA}{mC_P}\theta$

After integrating above differential equation we get,

$\ln\frac{\theta}{\theta_0} = -\frac{hA}{mC_P}t$

$\theta = \theta_0 e^{-\frac{hA}{mC_P}t}$

temperature profile is exponential.

22. $y_p = y_c + \frac{I_{x'x'}}{Ay_c}$

$= \frac{h}{2} + \frac{b\frac{h^3}{12}}{bh\,\frac{h}{2}}$

$= \frac{h}{2} + \frac{h}{6}$

$y_p = \frac{2}{3}h$

Position of centre of pressure from base

$= h - \frac{2}{3}h = \frac{h}{3}$

39. F = 3(N-1) – 2j –h

N = 6, j = 7, h = 0

F = 3(6-1) – 2×7 – 0 = 1

50. Area moment of inertia about an axis passing through center and lie in the plane of circle.

$I = \frac{AR^2}{4}$

Section modulus of a circular plate

$$Z = \frac{I}{y_{max}} = \frac{\frac{AR^2}{4}}{R} = \frac{\pi R^3}{4} = \frac{\pi d^3}{32}$$

57. Diameter of steel rod D = 40 mm

Length of steel rod L = 4 m

Axial load P = 80 kN

Young's Modulus E = 200 GPa

Elongation $\delta = \frac{PL}{AE} = \frac{80\times10^3 N\times4\,m}{\frac{\pi}{4}\times0.04^2\,m^2\times200\times10^9\,N/m^2}$

$\delta =$ 0.00127 m

60. a = side of unit cell.

r = radius of atom.

Diagonal of unit cell = $\sqrt{3}a$

For BCC structure,

$\sqrt{3}a = 4r$

$\frac{r}{a} = \frac{\sqrt{3}}{4}$

Atomic fraction = $\frac{n\times\frac{4}{3}\pi r^3}{a^3}$

n = number of effective cell.

For BCC structure, n =2

Atomic fraction

$$= \frac{2\times\frac{4}{3}\pi r^3}{a^3} = \frac{8}{3}\pi\left(\frac{r}{a}\right)^3$$

$$= \frac{8}{3}\pi\left(\frac{\sqrt{3}}{4}\right)^3 = 0.68$$

70. Chip velocity V_c = 0.2 m/s
Chip thickness ratio = 0.6
Conservation of mass
Chip velocity × chip thickness
= Cutting velocity × depth of cut
Chip thickness ratio (r) = $\frac{depth\ of\ cut}{chip\ thickness}$
0.2 / r = Cutting velocity
0.2 / 0.6 = 0.33 = cutting velocity

92. $\sigma_x = 300$ MPa , $\tau_{xy} = 200$ MPa, $\sigma_y = 0$ MPa

$$\tau_{max} = \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2} = \sqrt{150^2 + 200^2}$$

= 250 MPa

96. P_1 = 600 kPa, V_1 = 0.01 m^3, T_1 = 290 K
Constant pressure process
Work done = P ($V_2 - V_1$)
54000 = 600000 (V_2 – 0.01)
V_2 = 0.1 m^3

1. Which of the following mechanism generates intermittent rotary motion from continuous rotary motion?
(a) Scotch yoke mechanism
(b) Geneva mechanism
(3) Elliptical trammel
(d) Whitworth mechanism

2. A slider moving in a curve surface will have its instantaneous center –
(a) at their point of contact
(b) at infinity
(c) at the centre of curvature
(d) anywhere on the curve surface

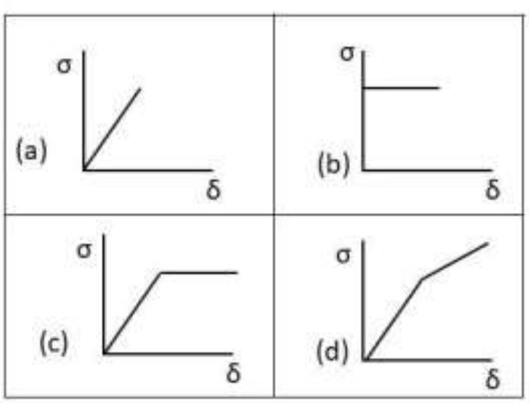
3. A planar linkage having 8 links and 9 joints of single degree of freedom will have . . . . degree of freedom
(a) 1 (b) 2
(c) 3 (d) 4

4. In two spur gears in mesh having involute profiles, the line of action is tangential to –
(a) pitch circle (b) base circle
(c) addendum circle (d) Dedendum circle

5. A slider moving at 150 mm/s on a link rotating at 60 rpm will have . . . . Coriolis accelearation.
(a) 600π mm/s^2 (b) 400π mm/s^2
(c) 700π mm/s^2 (d) 300π mm/s^2

6. Modulus of Rigidity is related to –
(a) Length (b) Shape
(c) Size (d) Volume

7. The stress –strain curve of an ideal elastic material with strain hardening will be as –



8. What is the mode of failure of a short mild steel column (having slenderness ratio less than 10) under axial compressive load?
(a) Fracture (b) Buckling
(c) Yielding (d) Both (b) and (c)

9. A solid circular shaft is subjected to pure torsion. The ratio of maximum shear to maximum normal stress at any point would be –
(a) 1 : 1 (b) 1 :2
(c) 2 : 1 (d) 2 :3

10. Material used for machine tool beds is –
(a) cast iron (b) mild steel
(c) high carbon steel (d) alloy steel

11. The crystal structure of austenite is –
(a) body centered cubic
(b) face centered cubic
(c) hexagonal closed packed
(d) body centered tetragonal

12. In a 3 –D state of stress, the independent stress components required to define state – of – stress at a point are –
(a) 3 (b) 6
(c) 12 (d) 9

13. Detrimental property of a material for shock load applications is –
(a) High density (b) Low toughness
(c) High strength (d) Low hardness

14. What causes transformation of deformed Martensite into austenite phase?
(a) Heating (b) Cooling
(c) Both (a) and (b) (d) Quenching

15. Brass is an alloy of –
(a) copper and zinc (b) tin and zinc
(c) copper and tin (d) copper and aluminum

16. Cutting tool material 18 – 4 – 1 HSS has which one of the following compositions?
(a) 18% W, 4% Cr, 1% V
(b) 18% Cr, 4% W, 1% V
(c) 18% W, 4% Ni, 1% V
(d) 18% Cr, 4% Ni, 1% V

17. A built – up – edge is formed while machining –
(a) Ductile materials at high speed

(b) Ductile materials at low speed
(c) Brittle materials at high speed
(d) Brittle materials at low speed

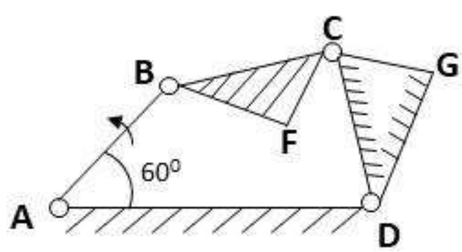
18. Why does crater wear start at some distance from the tool tip ?
(a) Tool strength is minimum at that region
(b) Cutting fluid cannot penetrate that region
(c) Tool temperature is maximum in that region
(d) Stress on rake face is maximum at that region

19. The process of removing the burrs or flash from a forged component in drop forging is called –
(a) Swaging (b) Perforating
(c) Trimming (d) Fettling

20. Which one of the following methods is used for the manufacturing of collapsible tooth – paste tubes?
(a) Impact extrusion (b) Direct extrusion
(c) Deep drawing (d) Piercing

21. The maximum efficiency of a screw jack is . . . . .
(a) $\frac{1-\sin\Phi}{1+\sin\Phi}$ (b) $\frac{1+\sin\Phi}{1-\sin\Phi}$
(c) $\frac{1-\tan\Phi}{1+\tan\Phi}$ (d) $\frac{1+\tan\Phi}{1-\tan\Phi}$

22. A four – link mechanism shown in the figure has link lengths as AB = 50 mm, BC = 66 mm, CD = 56 mm and AD = 100 mm. If an instant when DAB = 60^0 and the link AB has an angular velocity of 10.5 rad/s in the counter-clockwise direction, the velocity of B relative to A (vector v_{ba} (in m/s) of the point C is . . . . . .



(a) 0.131 (b) 0.262
(c) 0.393 (d) 0.525

23. In a gear train in which the axes of the shafts over which the gears are mounted, more relative to a fixed axis, is called . . . .
(a) Compound gear train
(b) Simple gear train
(c) Epicyclic gear train
(d) Reverted gear train

24. If E is the Young's modulus, K is the bulk modulus and C is the modulus of rigidity, the relation between them is . . . . . .
(a) $E = \frac{3K}{9K + C}$ (b) $E = \frac{9KC}{3K + C}$
(c) $E = \frac{3K + C}{9KC}$ (d) $E = \frac{3K}{9K + C}$

25. The word kanban is most appropriately associated with –
(a) Economic order quantity
(b) Just – in – time production
(c) Capacity planning
(d) Product design

26. As production systems move from projects to batch production to mass production to continuous production –
(a) demand volume increases
(b) products become more customized
(c) production systems become less automated
(d) production systems become more flexible

27. For activities on the critical path –
(a) earliest start time (ES) = latest start time (LS)
(b) earliest start time (ES) > latest start time (LS)
(c) earliest start time (ES) < latest start time (LS)
(d)earliest start time (ES)= latest finish time (LF)

28. Which of the following is not a type of predictable demand behavior?
(a) trend (b) random variation
(c) cycle (d) seasonal pattern

29. The ratio of transverse contraction strain to longitudinal extension strain in the direction of stretching force within elastic limits and for a homogenous material is . . . .
(a) Modulus of Elasticity
(b) Modulus of Rigidity
(c) Bulk Modulus
(d) Poisson Ratio

30. The smallest portion of a crystal which when repeated in different directions generates the entire crystal is . . . .
(a) crystal lattice (b) unit cell
(c) lattice point (d) gage length

31. Permanent deformation of solid material under the influence of long-term exposure of high level

of mechanical stresses that are still below the yield strength along with subjected to heat is . . .
(a) Elasticity (b) Isotropy
(c) Hardness (d) Creep

32. The atomic packing factor for face-centered cubic structure is . . . .
(a) 0.34 (b) 0.52
(c) 0.68 (d) 0.74

33. The statement that molecular weights of all gases occupy the same volume is known as –
(a) Avogadro's hypothesis
(b) Gas law
(c) Dalton's law
(d) Thermodynamics law

34. It is desired to store 28 kg of nitrogen at 14 MPa pressure and 27 ^{0}C in a cylinder. Assuming that nitrogen behaves like an ideal gas, determine the size of the cylinder.
(a) 0.01782 m^3 (b) 0.1782 m^3
(c) 1.782 m^3 (d) 17.82 m^3

35. The first law of thermodynamics was developed by –
(a) Joule (b) Kelvin
(c) Charles (d) Carnot

36. Which one of the following non-dimensional numbers is used for transition from laminar to turbulent flow in free convection?
(a) Reynolds number (b) Nusselt number
(c) Peclet number (d) Rayleigh number

37. Which one of the following is correct? The effectiveness of a fin will be maximum in an environment with-
(a) Free convection
(b) Forced convection
(c) Radiation
(d) Convection and radiation

38. Which one of the following expansion processes takes place in a vapour compression cycle?
(a)Polytropic process with change in temperature
(b)Adiabatic process with work transfer temperature
(c) Isentropic process with change in enthalpy
(d) Adiabatic process with constant enthalpy

39. A good refrigerant should have-
(a)Large latent heat of vaporization and low operating pressures
(b)Small latent heat of vaporization and high operating pressures
(c) Large latent heat of vaporization and high
(d)Small latent heat of vaporization and low operating pressures

40. If a mass of moist air in an airtight vessel is heated to a higher temperature, then –
(a) Specific humidity of the air increases
(b) Specific humidity of the air decreases
(c) Relative humidity of the air increases
(d) Relative humidity of the air decreases

41. A Pelton wheel is ideally suited for –
(a) High head and low discharge
(b) High head and high discharge
(c) Low head and low discharge
(d) Medium head and medium discharge

42. The ability of casting material to fill the mould cavity is described by . . . . .
(a) cohesiveness (b) reactiveness
(c) fluidity (d) permeability

43. The primary cause for deflection of arc during arc welding is . . . .
(a) hydrostatic field (b) magnetic field
(c) explosive field (d) wind velocity field

44. Another name for Military organization is . . . . .
(a) Line organization
(b) Functional organization
(c) Line and staff organization
(d) Hybrid organization

45. A worker takes an average of 10 minutes to complete a task. If the performance rating is 110% and an allowance of 15% is permissible, the standard time (in minutes) for completing the task is . . . .
(a) 9 (b) 10
(c) 11 (d) 12.9

46. The property of a working substance which increases or decreases as the heat is supplied or removed in a reversible manner is . . . .
(a) entropy (b) external energy
(c) internal energy (d) enthalpy

47. A composite wall has two layers of different materials having thermal conductivities of k_1 and k_2. If each layer has the same thickness, the equivalent thermal conductivity of the wall is . . .

(a) $k_1 + k_2$ (b) $\frac{k_1+k_2}{k_1 k_2}$

(c) $\frac{2k_1k_2}{k_1+k_2}$ (d) $k_1 k_2$

48. When a hot fluid is flowing over a cold flat plate, the temperature gradient is . . . . . .

(a) zero at the surface

(b) negative at the surface

(c) zero at the edge of the thermal boundary layer

(d) positive at the edge of the thermal boundary layer

49. The critical radius is the insulation radius at which the resistance to heat flow is . . . .

(a) Minimum (b) Zero

(c) Maximum (d) Double

50. Amongst the following options what remains constant during adiabatic saturation process on unsaturated air?

(a) Dew point temperature

(b) Relative humidity

(c) Wet bulb temperature

(d) Dry bulb temperature

51. The formation of frost on cooling coils in a refrigerator . . . .

(a) improves C.O.P of the system

(b) increases power consumption

(c) increases heat transfer

(d) reduces power consumption

52. If a gas is to be liquefied, its temperature must be . . . . . .

(a) increased to two times of critical temperature

(b) increased to five times of the critical temperature

(c) raised to ten times of the critical temperature

(d) decreased below the critical temperature

53. Dew point temperature is the temperature at which condensation begins when the air is cooled at constant –

(a) Volume (b) Pressure

(c) Entropy (d) Enthalpy

54. If w = Specific weight of water in N/m^3, a = Cross sectional area of jet in m^2 and V = Velocity of jet in m/s, the force exerted (in N) by a jet of water impinging normally on a fixed plate is . . . .

(a) $waV/2g$ (b) waV/g

(c) $waV^2/2g$ (d) waV^2/g

55. If V_1 is inlet jet velocity, u is blade velocity and ϕ = outlet blade angle (bucket angle), the hydraulic efficiency of a Pelton wheel is expressed as

(a) $\eta_h = \frac{(2u)(V_1-u)(1+\cos\phi)}{V_1^2}$

(b) $\eta_h = \frac{(2u)(V_1+u)(1+\cos\phi)}{V_1^2}$

(c) $\eta_h = \frac{(2u)(V_1+u)(1-\cos\phi)}{V_1^2}$

(d) $\eta_h = \frac{(2u)(V_1-u)(1-\cos\phi)}{V_1^2}$

56. Convergent-divergent nozzle is said to be choked when

(a) critical pressure is attained at the exit and Mach number at this section is sonic

(b) Velocity at the throat becomes supersonic

(c) exit velocity becomes supersonic

(d) mass flow rate through the nozzle reaches a maximum value

57. A steam turbine, in which a part of the steam after partial expansion, is used for process heating and the remaining steam is further expanded for power generation, is known as

(a) Back pressure turbine

(b) Impulse turbine

(c) Low pressure turbine

(d) Pass out turbine

58. Compression ratio of I.C. engine is . . . .

(a) the ratio of the volume of its combustion chamber from its largest capacity to its smallest capacity.

(b) the ratio of clearance volumes available in the combustion cylinder.

(c) the ratio of pressure after compression to pressure before compression

(d) the ratio of pressure before compression to pressure after compression.

59. Vapor lock in a gasoline – fueled internal combustion engine is basically

(a) due to partial stoppage of fuel supply due to vaporization of fuel in the supply
(b) due to mechanical seizure in the exhaust system
(c) due to accelerated supply of fuel to the engine
(d) due to freezing of liquid fuel

60. The ignition quality of petrol is expressed by-
(a) Octane number (b) Cetane number
(c) Calorific value (d) Efficiency number

61. Which of the following is an inversion of single slider-crank chain?
(a) Elliptical trammel (b) Hand Pump
(c) Scotch Yoke (d) Oldham's Coupling

62. The Velocity ratio in the case of compound train of wheels is equal to –
(a) $\frac{Number\ of\ teeth\ on\ first\ driver}{Number\ of\ teeth\ on\ last\ follower}$
(b) $\frac{Number\ of\ teeth\ on\ last\ follower}{Number\ of\ teeth\ on\ first\ driver}$
(c) $\frac{Product\ of\ teeth\ on\ the\ drivers}{product\ of\ teeth\ on\ the\ followers}$
(d) $\frac{Product\ of\ teeth\ on\ the\ followers}{product\ of\ teeth\ on\ the\ drivers}$

63. A body of weight 50 N is kept on a plane inclined at an angle of 30^0 to the horizontal. It is in limiting equilibrium. The coefficient of friction is equal to-
(a) $\frac{1}{\sqrt{3}}$ (b) $\sqrt{3}$
(c) $\frac{1}{50\sqrt{3}}$ (d) $\frac{\sqrt{3}}{5}$

64. Find the extension of a bar of length 'L' and weight 'w/unit length' having uniform cross section area 'A' suspended from top, due to its self –weight and a load 'P' applied at bottom (along the direction of self-weight) . What is the extension if P = weight of the bar?
(a) $\frac{PL}{AE}$ (b) $\frac{wL^2}{2E}$
(c) $\frac{3wL^2}{2E}$ (d) $2\left[\frac{PL}{AE}+\frac{wL^2}{2E}\right]$

65. The value of J in equation $\frac{T}{J}=\frac{s}{y}=\frac{G\theta}{L}$ for a circular solid shaft of diameter 'D' will be –
(a) $\frac{\pi D^4}{32}$ (b) $\frac{\pi D^4}{64}$
(c) $\frac{\pi D^3}{64}$ (d) $\frac{\pi D^3}{32}$

66. While designing a shaft, pulley and key for a system
(a) Shaft is the weakest member
(b) Pulley is the weakest member
(c) key is the weakest member
(d) All are designed for equal strength

67. Eutectic reaction for iron-carbon system occurs at –
(a) 600 ^{0}C (b) 723 ^{0}C
(c) 1147 ^{0}C (d) 1490 ^{0}C

68. The percentage of carbon in gray cast iron is in the range of –
(a) 0.25 to 0.75% (b) 1.25 to 1.75%
(c) 3 to 4% (d) 8 to 10%

69. The vibration frequency used for the tool in the Ultrasonic machining is of the order of –
(a) 10,000 oscillations per second
(b) 20,000 oscillations per second
(c) 35,000 oscillations per second
(d) 45,000 oscillations per second

70. Which one of the following materials will require the largest size of riser for the same size of castings?
(a) Aluminium (b) Cast iron
(c) Steel (d) Copper

71. The proportion of acetylene and oxygen used in gas welding is –
(a) 2 :1 (b) 1:1
(c) 1 : 2 (d) 3 :4

72. An isolated system –
(a) is a specified region when transfer of energy and/or mass take place.
(b) is a region of constant mass and only energy is allowed to cross the boundaries
(c) cannot transfer either energy or mass to or from the surroundings.
(d) is one in which within the system is not necessarily constant.

73. In the polytropic process equation pv^n = consant if η is infinitely large, the process is termed as –
(a) Constant volume
(b) Constant pressure
(c) Constant temperature
(d) Adiabatic

74. For same compression ratio –

(a) Thermal efficiency of Otto cycle is greater than that of Diesel cycle.
(b) Thermal efficiency of Otto cycle is less than that of Diesel cycle.
(c) Thermal efficiency of Otto cycle is same than that of Diesel cycle.
(d) Mechanical efficiency of Otto cycle is than that of Diesel cycle.

75. If the temperature of the source is increased, the efficiency of the Carnot engine-
(a) decreases
(b) increases
(c) will be equal to the efficiency of a practical engine
(d) does not change

76. In a reversible adiabatic process the ratio (T_1/T_2) is equal to –
(a) $\left(\frac{P_1}{P_2}\right)^{\frac{\gamma-1}{\gamma}}$ (b) $\left(\frac{v_1}{v_2}\right)^{\frac{\gamma-1}{\gamma}}$
(c) $(v_1 v_2)^{\frac{\gamma-1}{2\gamma}}$ (d) $\left(\frac{v_2}{v_1}\right)^{\gamma}$

77. A stocking finds that monthly demand for a particular ball pen is 2000. The price of each pen is 0.8 rupees and cost of placing an order is Rs 20. The cost of stocking the pens per month is 10% of price of pen. What is EOQ?
(a) 1000 (b) 2000
(c) 500 (d) 750

78. A PERT activity has an optimistic time of three days, pessimistic time of 15 days and the expected time is 7 days. The most likely time of the activity is –
(a) 5 days (b) 6 days
(c) 7 days (d) 9 days

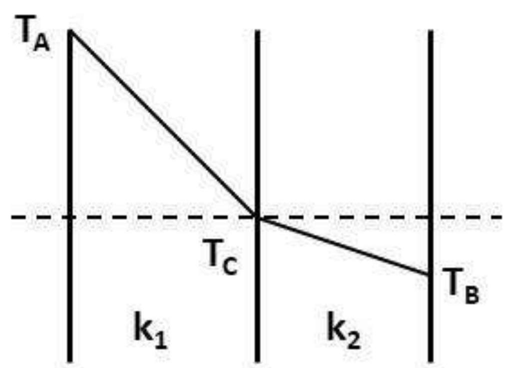
79. Preliminary work sampling studies show that machine was idle 25% of this time based on a sample of 100 observations. The number of observations needed for a confidence level of 95 % (k =2) and an accuracy of $\pm$5% is –
(a) 400 (b) 1200
(c) 3600 (d) 4800

80. Preliminary work sampling studies show that machine was idle 25% of the time based on a sample of 100 observations. The number of observations needed for a confidence level of 95% (k =2) and an accuracy of $\pm$5% is –
(a) 400 (b) 1200
(c) 3600 (d) 4800

81. The equation of effectiveness $\varepsilon = 1 - e^{-NTU}$ of heat exchanger is valid (NTU is number of transfer units) in the case of –
(a) boiler and condenser for parallel flow
(b) boiler and condenser for counter flow
(c) boiler and condenser for parallel and counter flow
(d) gas turbine for both parallel and counter flow

82. The radial heat transfer rate through hollow cylinder increases as the ratio of outer radius to inner radius –
(a) decreases
(b) increases
(c) constant
(d) decreases as well as increases

83. The temperature variation under steady heat conduction across a composite slab of two materials of conductivities k_1 and k_2 is shown in fig. Then which one of the following statements



(a) $k_1 > k_2$ (b) $k_1 = k_2$
(c) $k_1 = 0$ (d) $k_1 < k_2$

84. The radiation heat transfer from an inner cylindrical surface of radius r_1 and emissivity ε_1 at temperature T_1 to concentric cylinder of radius r_2, emissivity ε_2 and at temperature T_2 is proportional to –
(a) $\frac{T_1^4-T_2^4}{\left[\frac{1}{\varepsilon_1}+\left(\frac{1}{\varepsilon_2}-1\right)\left(\frac{r_1}{r_2}\right)\right]}$ (b) $\frac{T_1^4-T_2^4}{\left[\frac{1}{\varepsilon_1}-\left(\frac{1}{\varepsilon_2}-1\right)\left(\frac{r_1}{r_2}\right)\right]}$
(c) $\frac{T_1^4-T_2^4}{\left[\frac{1}{\varepsilon_1}+\left(\frac{1}{\varepsilon_2}-1\right)\left(\frac{r_2}{r_1}\right)\right]}$ (d) $\frac{\left(\frac{r_2}{r_1}\right)(T_1^4-T_2^4)}{\frac{1}{\varepsilon_1}+\left(\frac{1}{\varepsilon_2}-1\right)}$

85. In radiative heat transfer a gray surface is one-
(a) which appears gray to the eye

(b) Whose emissivity is independent of wavelength
(c) Which has reflectivity equal to zero.
(d) which appears equally bright from all directions

86. Non-dimensional form of natural convection heat transfer coefficient is –
(a) Grashof number (b) Reynolds number
(c) Nusselt number (d) Prandtl number

87. A centrifugal pump lifts water through a height h and delivers it at a velocity v_d. The loss of head through piping is h_f . The gross lift is –
(a) h + h_f (b) $h_f + \frac{v_d^2}{2g}$
(c)) h + h_f + $\frac{v_d^2}{2g}$ (d) h + $\frac{v_d^2}{2g}$

88. Which one of the following sets of condition clearly apply to an ideal fluid?
(a) Viscous and compressible
(b) Non Viscous and incompressible
(c) Non Viscous and compressible
(d) Viscous and incompressible

89. If the velocity vector in a two dimensional flow field by $\vec{v} = 2\,xy\,\hat{\imath} + (2y^2 - x^2)\hat{\jmath}$; then the vorticity vector curl $\vec{v}$ will be –
(a) $2y^2\hat{\jmath}$ (b) $6y\hat{k}$
(c) Zero (d) -$4x\hat{k}$

90. The Reynolds number for flow of a certain fluid in a circular tube is specified as 2500. What will be the Reynolds number when the tube diameter is increased by 20% and the fluid velocity is decreased by 40% keeping fluid the same?
(a) 1200 (b) 1800
(c) 3600 (d) 200

91. If there are 'm' physical quantities and 'n' fundamental dimensions in a particular process, the number of non-dimensional parameters is-
(a) m + n (b) m × n
(c) m - n (d) m / n

92. if x is the distance measured from the leading edge of a flat plate, then laminar boundary layer thickness varies as-
(a) $\frac{1}{x}$ (b) $x^{\frac{4}{5}}$
(c) x^2 (d) $x^{\frac{1}{2}}$

93. In the unsaturated air the state of vapour is-
(a) Wet (b) Superheated
(c) Saturated (d) Unsaturated

94. During sensible heating of moist air, enthalpy –
(a) increases (b) decreases
(c) remains constant (d) none of the above

95. The relative humidity, during cooling and dehumidification of moist air-
(a) increases
(b) decreases
(c) can increase or decrease
(d) none of the above

96. A heat pump operating between high temperature T_1 and low temperature T_2 has its COP expressed as –
(a) $\frac{T_1}{T_1 - T_2}$ (b) $\frac{T_2}{T_1 - T_2}$
(c) $\frac{T_1 - T_2}{T_1 + T_2}$ (d) $\frac{T_1 + T_2}{T_1 - T_2}$

97. Voltage developed to strike spark in the spark plug is in the range of –
(a) 6 to 12 Volts
(b) 1000 to 2000 Volts
(c) 20000 to 25000 Volts
(d) None of the above

98. Which among the following is the boiler mounting?
(a) Blow off cock (b) Feed pump
(c) Economizer (d) Superheater

99. A curve showing the variation of load on a power station with respect to time is known as-
(a) Load curve (b) Load duration curve
(c) Diversity factor (d) Performance curve

100. A power generation station is to supply four regions of loads with peak demands of 10 MW, 15 MW, 20 MW and 30 MW. If the diversity factor is 1.5, the maximum demand on the station is –
(a) 70 MW (b) 60 MW
(c) 50 MW (d) 40 MW

Answer

1 (b)	21 (a)	41 (a)	61 (b)	81 (c)
2 (c)	22 (d)	42 (c)	62 (d)	82 (a)

3 (c)	23 (c)	43 (b)	63 (a)	83 (d)
4 (b)	24 (b)	44 (a)	64 (*)	84 (a)
5 (a)	25 (b)	45 (d)	65 (a)	85 (b)
6 (b)	26 (a)	46 (a)	66 (c)	86 (c)
7 (d)	27 (a)	47 (c)	67 (c)	87 (c)
8 (c)	28 (b)	48 (c)	68 (c)	88 (b)
9 (a)	29 (d)	49 (a)	69 (b)	89 (d)
10 (a)	30 (b)	50 (c)	70 (c)	90 (b)
11 (b)	31 (d)	51 (b)	71 (b)	91 (c)
12 (b)	32 (d)	52 (d)	72 (c)	92 (d)
13 (b)	33 (a)	53 (b)	73 (a)	93 (b)
14 (a)	34 (b)	54 (d)	74 (a)	94 (a)
15 (a)	35 (a)	55 (a)	75 (b)	95 (c)
16 (a)	36 (d)	56 (d)	76 (a)	96 (a)
17 (b)	37 (a)	57 (d)	77 (a)	97 (c)
18 (c)	38 (d)	58 (a)	78 (b)	98 (a)
19 (c)	39 (a)	59 (a)	79 (b)	99 (a)
20 (a)	40 (d)	60 (a)	80 (d)	100 (c)

Solutions

3. Number of links N = 8
Number of binary joints j = 9
$F = 3(N - 1) - 2j = 3(8 - 1) - 2 \times 9$
$F = 21 - 18 = 3$

5. Coriolis acceleration
$a_c = 2V\omega = 2 \times 150 \text{ mm/s} \times \frac{2\pi \times 60}{60} \text{ rad/s}$
$= 600\pi \text{ mm/s}^2$

1. If the elements of a kinematic pair make surface contact when in motion then it is called a :
(a) Lower pair (b)Closed pair
(c) Higher pair (d)Surface pair

2. A six-link mechanism is required to have mobility or degree of freedom equal to one. All the pairs in the mechanism are single degree of freedom pairs. Pick the correct statement about the Mechanism:
(a) It will have six pairs.
(b) It will have 7 pairs and all the links will be binary links
(c) It will have 7 pairs and two of the six links will be ternary links
(d) It is not possible to have a mechanism with six links.

3. Which of the following is an exact straight line mechanism employing at least one sliding pairs?
(a) Peaucillier mechanism
(b) Scott-Russel mechanism
(c) Hart's mechanism
(d) Watt's mechanism

4. A straight link has a straight slot along the length of the link in which a sliding block is free to slide. The slotted link is rotating at uniform angular velocity of 10 rad/s about one of its ends. The sliding block in the link is also moving outwards at a uniform speed of 5 m/s relative to the slotted link. What is the magnitude of acceleration of the slider in a direction perpendicular to the link?
(a) 100 m/s^2 (b)50 m/s^2
(c) 200 m/s^2 (d)Zero

5. Which of the following gears is not employed to connect non-parallel and non-intersecting shafts?
(a) Worm and worm gear
(b) Hypoid gears
(c) Double helical gears
(d) Crossed helical gears

6. Which of the following is not correct for involute gears?
(a) The path of contact of two gears during mesh is along a straight line.
(b) Slight change of centre distance does not affect correct tooth action.
(c) The pressure angle remains constant.
(d) Interference is inherently absent.

7. The gear train in which the axes of the first and the last gear in the train coincide is called a :
(a) Simple gear train
(b) Reverted gear train
(c) Epicyclic gear train
(d) Compound gear train

8. A block weighing 100 N is resting on a surface. The coefficient of friction between the block and surface is 0.3. A horizontal force of 20 N is applied on the block. What is the magnitude of force of friction acting on the block?
(a) 30 N (b)100 N
(c) 50 N (d) 20 N

9. A machine requires torque increasing linearly from 0 to 100 N-m during its cycle of operation of one revolution. The mean speed of the shaft is $10\sqrt{\pi}$rad/s. Assuming the hub and arms do not contribute to the moment of inertia, what will be the mass of rim of a rim type flywheel of 1 m mean diameter, if the total fluctuation of speed has to be limited to 1%?
(a) 25 kg (b)50 kg
(c) 100 kg (d)250 kg

10. Balancing of inertia forces due to reciprocating parts in a single cylinder engine is done by extending the crank to the opposite side and placing a counter-mass there. Pick the correct statement about balancing of inertia forces in this way:
(a) Only primary inertia force can be completely balanced
(b) Only secondary inertia can be completely balanced
(c) The primary inertia force can never be completely balanced in this way.
(d) If only a fraction of reciprocating part's mass is balanced, then the primary inertia force can be completely balanced.

11. A rotating shaft carries a single rotor and the static deflection of the shaft at the rotor is 0.1 m. What will be transverse natural frequency of the shaft in Hertz, if the acceleration due to gravity is 10 m/s^2?
(a) 5π (b) $\frac{5}{\pi}$
(c) 10π (d)None of the above

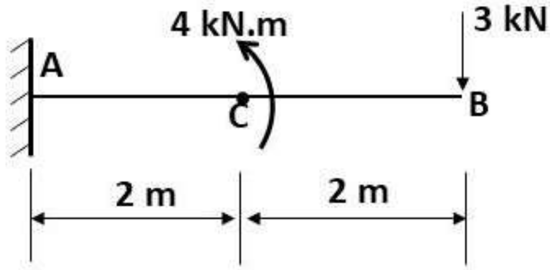
12. When does the phenomenon of necking become prominent in a simple tension test?
(a) After elastic limit
(b) After yield point
(c) After proportional limit
(d) From around the ultimate stress

13. The endurance limit is found by testing specimen of standard size, usually 7.5 mm, in a standard rotating beam test. What will be the actual endurance limit of parts with size greater than that used in the test ?
(a) less than the value determined with standard test.
(b) more than the value determined with standard test.
(c) same as the value determined with standard test.
(d) less than the value determined with standard test upto certain size than it will increase with the increasing size.

14. Few statements about creep in materials are given below:
1. Creep means regaining the original shape after removal of stresses
2. Creep implies development of additional strains when the material is loaded for prolonged period of time
3. Creep is more at elevated temperatures.
4. Creep means loading the material in plastic range

Which of the above statements are all correct?
(a) 1, 2 and 3 (b)1 and 4
(c) 2 and 3 (d)2 and 4

15. With the usual sign convention for bending moment, i.e. , a positive bending moment causes compression in top fiber, what is sign, magnitude and location of numerically largest bending moment in the beam shown in the figure?



(a) + 10 kN-m at C
(b) – 8 kN-m at A
(c) – 16 kN-m at A
(d) + 4 kN-m at A

16. For a material with the Poisson's ratio υ, the modulus of elasticity E and the bulk modulus of elasticity K are same. Which of the following is correct?
(a) The material has υ = 0
(b) The material has υ = ½
(c) The material has υ = 1/3
(d) The material has υ = 3/4

17. The normal stresses on two perpendicular planes through a point in a stressed material are 80 MPa (tensile) and 20 MPa (tensile) respectively. A shear stress of 40 MPa is also acting on these planes. What is the value of maximum shear stress at the point?
(a) 50 MPa (b) Zero
(c) 40 MPa (d)60 MPa

18. Pick the correct statement about the maximum bending stress in the various leafs of a leaf or laminated spring, assuming it has been designed
(a) It increases uniformly from the shortest leaf to the longest leaf.
(b) It is largest in the longest leaf.
(c) It is largest in the shortest leaf
(d) It is same in all leafs

19. A closely coiled helical spring is cut into two equal parts. What will be the ratio of the deflection of any of the resulting spring to the deflection of the original spring for the same load?
(a) 2 (b)½
(c) 1 (d)3/4

20. A solid shaft is replaced by a hollow shaft with outer diameter same as the diameter of the solid shaft. The internal diameter of the hollow shaft is kept as $3/4^{th}$ of its outer diameter. What is the ratio of torque transmitting capacity of hollow shaft to that of the solid shaft?
(a) 175/256 (b)3/4
(c) 9/16 (d) 27/64

21. Pick the correct statement about the hoop stress in a thick cylinder subjected to internal pressure:

1. It varies linearly from zero at the outer surface to maximum at the inner surface
2. It varies parabolically from a minimum stress at the outer surface (with non-zero magnitude) to a maximum value at the inner surface
3. It varies parabolically from zero a minimum stress at the outer surface (with non-zero magnitude) to a maximum value at the inner surface.
4. It remains constants across the thickness

22. Which of the following pairs describe the correct coordination number for body centred cubic and face centred cubic unit cell structures respectively?
(a) 8 and 6 (b)12 and 8
(c) 6 and 8 (d) 8 and 12

23. Which of the following unit cells are arranged in ascending order of atomic packing factor?
(a) BCC, FCC, SC
(b) BCC, FCC, HCP
(c) HCP, FCC, BCC
(d) FCC, HCP, BCC

24. Consider the following statements about edge dislocations in crystal structures:
1. The Berger vector is perpendicular to the dislocation line.
2. The Berger vector is parallel to the dislocation line.
3. Only shear stress field exists.
4. It can exhibit both climb and glide motions.
Which of the above statements are all correct?
(a) 1 and 4 (b)1, 3 and 4
(c) 2 and 4 (d)3 and 4

25. Which of the following is a false statement about work hardening?
(a) It increases hardness.
(b) It increases yield strength
(c) It increases ductility
(d) It involves plastic deformations at temperature lower than the recrystallization temperature.

26. Which of the following is not the purpose of annealing?
(a) Increasing hardness
(b) Increasing ductility
(c) Improving machinability
(d) Refining grain size

27. What is the theoretical limit of carbon content in iron-carbon alloys upto which they can be called as steel?
(a) 6 % (b) 3%
(c) 1% (d) 2%

28. Which of the following is a thermosetting plastic?
(a) Polyethylene (b) Bakelite
(c) Polyvinyl chloride (d) Nylon

29. What is the corrosion that occurs in certain materials where the loaded surfaces are in contact and have relative motion called?
(a) Fretting corrosion (b) Stress corrosion
(c) Hertzian corrosion (d) Galvanic corrosion

30. Which of the following is not a constituent of babbits?
(a) Tin (b) Antimony
(c) Nickel (d) Copper

31. What do the symbols □ and ▽ represent in work study?
(a) Delay and storage respectively
(b) Processing and storage respectively
(c) Storage and inspection respectively
(d) Inspection and storage respectively

32. For a certain cycle of operations on a job, the observed time is 10 minutes. The performance rating of the worker is 120% and total allowances 10% of normal time. What will be the standard time for the worker?
(a) 9.17 minutes (b) 13.0 minutes
(c) 13.2 minutes (d) 14.0 minutes

33. A company requires 9000 units of a product annually. It costs Rs. 3 per unit. The cost per purchase order is Rs. 300 and the inventory carrying cost per unit per year is 20% of the unit cost. The economic order quantity EOQ for the company is:
(a) 4000 units (b) 3500 units
(c) 3000 units (d) 5000 units

34. In PERT analysis a critical activity has:
(a) Maximum float (b) Zero float

(c) Maximum cost (d) Minimum cost

35. Which of the following actions will not reduce break-even point?
(a) Reducing fixed cost
(b) Reducing variable cost
(c) Increasing sales price
(d) Decreasing sales price

36. Military organization is shown as:
(a) Line organization
(b) Line and staff organization
(c) Functional organization
(d) Matrix organization

37. Which of the following material handling systems will be most suitable for transporting a large number of discrete items on continuous basis in a factory?
(a) Overhead cranes (b) Trucks
(c) Hoists (d) Conveyors

38. Which of the following is not included in prime cost?
(a) Direct overheads
(b) Factory overheads
(c) Direct labour cost
(d) Direct material cost

39. Vehicle manufacturing assembly line is an example of:
(a) product layout (b) process layout
(c) manual layout (d) fixed layout

40. Which of the following is not a technique for plant layout?
(a) Process charts
(b) Travel charts
(c) Man-machine charts
(d) Relationship charts

41. Which of the following materials, usually added to moulding sand does act as binder?
(a) Kaolinite (b) Bentonite
(c) Illite (d) Dextrin

42. What is the function of skin-bob provided in the gating system of moulds?
(a) To trap heavier and lighter impurities
(b) To promote directional solidification
(c) To control the flow of molten metal
(d) To smoothen the flow of molten metal

43. Which one among the following welding processes uses non-consumable electode?
(a) Gas metal arc welding
(b) Submerged arc welding
(c) Gas tungsten arc welding
(d) Flux coated arc welding

44. Pick the wrong statement about AC and DC power sources for arc welding:
(a) The problem of magnetic blow is greatly reduced with AC power source.
(b) Arc stability is higher with DC power source.
(c) The DC power source provides high efficiency.
(d) AC power sources are considerably less expensive.

45. What is the process in which flat shape is cut from a sheet, the cut out portion being the desired part called?
(a) Blanking (b) Piercing
(c) Notching (d) Perforating

46. Which of the following is a feature of forging process?
(a) Cost of tooling is less.
(b) Mechanical properties of parts are improved.
(c) Even intricate shapes with cavities can be forged.
(d) The product has very good surface finish.

47. Which of the following statements is not correct about climb or down milling?
(a) It gives poorer surface finish than up milling.
(b) The work is fed in the same direction as the cutter rotation.
(c) The chip thickness is maximum at the beginning of the cut.
(d) Power required is less.

48. Clapper block (or box) is used in which machine tools?
(a) Lathe (b) Shaper
(c) Milling (d)Turret lathe

49. In taper turning method by swiveling the compounded slide, the feed motion is given by:
(a) moving the carriage
(b) moving the cross slide

(c) engaging the half nut
(d) moving the compound slide

50. A larger rake angle will result in:
(a) Higher shear plane angle and lower cutting force
(b) Lower shear plane angle and lower cutting force
(c) Higher shear plane and higher cutting force
(d) Lower shear plane angle and higher cutting force

51. Which of the following is not a constituent of high speed tool material?
(a) Tungsten (b)Molybdenum
(c) Titanium (d)Chromium

52. A company claims to have developed a revolutionary fan that consumes 25 W and delivers 0.8 kg/s of air at a velocity of 10 m/s. The claim has to be verified using appropriate law of thermodynamics. Which of the following combinations of conclusion and the law employed for the same is correct?
(a) Invalid – First law
(b) Invalid- Second law
(c) Valid- First law
(d) Valid- Second law

53. During a process involving one kg of working fluid in an insulated cylinder-piston arrangement the temperature of the fluid decreases from 350^0 C to 250 ^{0} C. The specific heat of the fluid at constant volume is 0.8 kJ/kg.^{0}C . Considering the contents of the cylinder as the system, what will be the work done and its nature?
(a) 80 kJ (on the system)
(b) Zero
(c) 80 kJ (by the system)
(d) 125 kJ (by the system)

54. During a process involving one kg of working fluid in an insulated cylinder-piston arrangement the temperature of the fluid decreases from 350 ^{0}C to 250 ^{0} C. The specific heat of the fluid at constant volume is 0.8 kJ/kg ^{0}C. Considering the contents of the cylinder as the system, what will be the work done and its nature?
(a) Isothermal process
(b) Isobaric process
(c) Adiabatic process
(d) Isochroic process

55. Heat and work are:
(a) Intensive properties
(b) Extensive properties
(c) Point functions
(d) Path functions

56. Three engines A, B and C operate between same temperature heat source and sink. The engines A, B and C use ideal gas, air and steam respectively as the working fluid. Also, the heat input to the engine A is highest and that to the engine C is the lowest. Choose the correct statements about the thermal efficiencies of the engines:
(a) Engine A will have highest efficiency
(b) Engine C will have highest efficiency
(c) Engine B will have highest efficiency
(d) All the engines will have same efficiency.

57. The lowest and highest temperatures in Otto cycle are T_1 and T_3 respectively. If the temperatures at the end of compression and expansion processes are T_2 and T_4 respectively, then what will be values of these temperatures for maximum work done in the cycle?
(a) $T_2 = T_4$ = mean of T_1 and T_3
(b) $T_2 > T_4$
(c) $T_2 = T_3$ and $T_4 = T_1$
(d) $T_2 = T_4 = \sqrt{T_1 T_3}$

58. The air standard efficiencies of Otto cycle, Diesel cycle and dual cycle are represented by η_{otto} η_{diesel} and η_{dual} respectively. Pick the correct statement about their relative values for the same compression ratio and heat input:
(a) $\eta_{Otto} > \eta_{dual} > \eta_{diesel}$
(b) $\eta_{diesel} > \eta_{dual} > \eta_{otto}$
(c) $\eta_{dual} > \eta_{diesel} > \eta_{otto}$
(d) $\eta_{otto} > \eta_{diesel} > \eta_{dual}$

59. Choose the wrong statement about the regenerative vapour power cycle employing bled steam for feed water heating:
(a) It increases the thermodynamic efficiency of the cycle
(b) The Thermal stresses in the boiler are reduced
(c) Work done per kg of steam is increased

(d) It requires boiler of larger capacity for same level of power output as compared to a simple Rankine cycle.

60. Which of the following gas power cycles has unequal expansion and compression strokes?
(a) Stirling cycle (b) Atkinson cycle
(c) Joule cycle (d) Ericsson cycle

61. Which of the following gas power cycles has, in ideal conditions, thermodynamic efficiency equal to a Carnot cycle operating between the same temperature limits?
(a) Ericsson cycle (b) Joule cycle
(c) Atkinson cycle (d) Dual cycle

62. What is the specific name of the equation governing three-dimensional steady state heat conduction with self –heat generation?
(a) Fourier equation
(b) Laplace equation
(c) Poisson equation
(d) Diffusion equation

63. A pipe carrying hot fluid is to insulated by two layers of insulators, A and B, having thermal conductivites k and 2k respectively and of equal radial thickness. If the heat transfer coefficient from the outer surface to the air remains constant, how the two insulators must be placed to minimize the heat transfer?
(a) Material A must be outside
(b) Material B must be outside
(c) The heat transfer will be same regardless of their relative placement.
(d) The order of placement will depend upon the outside heat transfer coefficient.

64. A pipe of 40 mm outside radius carrying hot fluid in a factory is to be insulated by a layer of insulator having thermal conductivity 0.5 W/m. ^{0}C. The heat transfer coefficient for convection from pipe surface (bare as well as insulated) to the air is 10 W/m^{20}C. The objective of providing insulation is to reduce the heat loss from the pipe. Choose the correct statement about the thickness of insulation to be provided:
(a) Any thickness of insulator will always reduce heat loss.
(b) Any thickness of insulation will always increase heat loss in this case.
(c) Heat loss will be minimum if the outside radius of insulation is 50 mm.
(d) In order to achieve a heat loss less than that obtained with the bare pipe, the outside radius of insulation has to be more than a certain value that requires calculations but it will be definitely greater than 50 mm.

65. Following ways have been suggested to increase the effectiveness of an infinitely long fin:
1. Using fin material of high thermal conductivity.
2. Increasing the ratio of area to parameter of cross section of the fin.
3. Increasing the convective heat transfer coefficient.
4. Increasing the ratio of parameter to area of cross section of the fin.
Which of the above actions will all increases the effectiveness of the fin?
(a) 1 and 4 only (b) 1, 2 and 3
(c) 2 and 3 only (d) 1 and 2 only

66. A smaller sphere (1) of radius 50 mm is inside a large sphere (2) of radius 100 mm. What will be the value of the radiation shape factor F_{22} :
(a) 3/4 (b) 4/3
(c) 1.0 (d) Zero

67. In a counter flow heat exchanger, the cold fluid enters at 20 ^{0}C and leaves at 40^0 C. The hot fluid enters at 140^0 C and leaves at 120^0 C. What is the heat transferred per unit area per unit heat transfer coefficient?
(a) 20 W (b) 80 W
(c) 100 W (d) 60 W

68. In a counter flow heat exchanger with effectiveness of 0.75, the properties and flow rate are such that the both fluids have thermal capacity equal to 1000 W/^{0}C. What will be the area of heat exchanger required, if the heat transfer coefficient is 100 W/m^{20}C?
(a) 40 m^2 (b) 30 m^2
(c) 20 m^2 (d) None of the above

69. A 2 m long vertical pipe of 400 mm diameter is placed in a fluid with dynamic viscosity, thermal conductivity and specific heat of 1/1200 N.s/m^2 , 100 W/m. ^{0}C and 120 J/kg. ^{0}C respectively. if the Grashoff number is 10^9 and the empirical relation governing the free convection in this case is known to be Nu = 0.1 (Gr . Pr)$^{1/3}$, where the symbols have standard or usual meaning. The curvature effect of pipe may be neglected. What will be the value of heat transfer coefficient due to free convection at the pipe surface?

(a) 125 W/m^2.K (b) 100 W/m^2.K
(c) 25 W/m^2.K (d) 500 W/m^2.K

70. The heat transfer coefficient in laminar film condensation on a vertical plate is maximum at:
(a) Upper edge of the plate
(b) Lower edge of the plate
(c) Middle of the plate
(d) It remains constant over the plate.

71. A body placed in all enclosure (which may be assumed black body) is thermal equilibrium with it. Which of the following is true for emissivity – (ε) and absorptivity (α) of the body ?
(a) $\alpha > \varepsilon$ (b) $\alpha < \varepsilon$
(c) $\alpha = \varepsilon$ (d) $\alpha = \varepsilon / 2$

72. The ratio of temperatures at the beginning and end of isentropic expansion process in Bell-Coleman air refrigeration cyclw is 1.25. What is the COP of the cycle?
(a) 0.25
(b) 4.0
(c) 5.0
(d) The data are insufficient

73. Choose the correct statement about the effect of changing various operating conditions of a vapour compression refrigeration system is not correct?
(a) It can work efficiently only at design load.
(b) Its cost is too high.
(c) It requires frequent maintenance
(d) It puts high starting load on the compressor

74. Which of the following statements about using capillary tube as expansion device in vapour compression refrigeration system is not correct?
(a) It can work efficiently only at design load.
(b) Its cost is too high
(c) It requires frequent maintenance
(d) It puts high starting load on the compressor

75. What is the function of rectifier in a practical vapour absorption refrigeration system?
(a) To convert AC supply to DC supply.
(b) To condense the weak ammonia solution
(c) To remove the water vapours from the ammonia coming out from the analyser
(d) To control the pressure of vapours entering the condenser.

76. In the following refrigerants x represents any digit. Which of these is a hydrocarbon refrigerant?
(a) R-xx1 (b) R-xx0
(c) R-7xx (d) R-x2

77. Consider the following psychometric terms:
1. Degree of saturation
2. Specific humidity
3. Humidity ratio
4. Relative humidity
Which of the above terms have the same meaning”
(a) 1 and 2 (b) 2 and 3
(c) 1, 2 and 3 (d) 3 and 4

78. Which of the following psychometric properties is not shown as straight inclined lines on the psychometric chart?
(a) Wet bulb temperature
(b) Enthalpy
(c) Specific volume
(d) Relative humidity

79. Which of the following property remains constant during sensible heating and cooling of air?
(a) Enthalpy
(b) Wet bulb temperature
(c) Specific humidity
(d) Relative humidity

80. What is the full form of the term ADP employed in air conditioning?
(a) Apparatus dew point
(b) Adiabatic dew point
(c) Ambient design point
(d) Air conditioning design point

81. What is the line on the psychometric chart joining the state of mixture of fresh air and re-circulated air entering the cooling coil to the state of ADP of cooling coil called?
(a) Mean SHF line
(b) Room SHF line

(c) Effective SHF line
(d) Grand SHF line

82. Which of the following is true for a Newtonian fluid?
(a) Viscous shear stress is independent of velocity gradient.
(b) Viscous shear stress depends linearly on velocity gradient.
(c) Viscous shear stress is zero at all velocity gradients.
(d) Viscous shear stress decreases with velocity gradient.

83. The stream function for a 2 dimensional flow is given by $\psi = 4xy$. Choose the wrong conclusion about the nature of the flow?
(a) The flow satisfies continuity equation
(b) The flow is a rotational flow
(c) The flow is a potential flow
(d) The flow is irrotational flow

84. Water is flowing in an inclined pipe of uniform diameter and 100 m length with its outlet being 10 m above the inlet. If the pressure at the outlet is 100 kPa, assuming the specific weight of water as 10,000 N/m^3, what is the pressure at the inlet?
(a) 150 kPa (b)50 kPa
(c) 75 kPa (d)200 kPa

85. Which of the following non-dimensional number is not correctly defined?
(a) Reynolds number = inertia force / viscous force
(b) Froude number = (inertia force / gravity force)$^{1/2}$
(c) Weber number = inertia force / pressure force
(d) Euler number = pressure force / inertial force

86. Which of the following is not correct for laminar flow in circular pipes?
(a) Velocity is maximum at the centre of the pipe
(b) The variation of velocity from the pipe surface to the centre of pipe is parabolic.
(c) The average velocity is half the maximum velocity
(d) The velocity equals the average velocity at a distance of 0.75 time radius from the centre of the pipe.

87. In which type of the impeller of centrifugal pump, the head remains constant with variation in discharge?
(a) Forward curved vanes
(b) Radial vanes
(c) Backward curved vanes
(d) Both forward and backward curved vanes

88. Select the wrong statement about the clearance volume and volumetric efficiency of a reciprocating, air compressor:
(a) The volumetric efficiency decreases with increased clearance volume
(b) The volumetric efficiency decreases with increased pressure ratio.
(c) The volumetric efficiency increases with increased pressure ratio.
(d) The clearance volume has no effect on work done per kg of air delivered.

89. In an impulse steam turbine, the steam enters at a rate of 2 kg/s with a velocity of 500 m/s with an axial component of 300 m/s. The peripheral speed of blades is 200 m/s. The steam leaves the blades in axial direction. What is the power developed by the turbine?
(a) 160 kW (b)200 kW
(c) 100 kW (d)Insufficient data

90. Which of the following is not an advantage of gas turbines over IC engines?
(a) The weight of turbines per unit power is much less.
(b) There is no problem of knocking or other abnormal combustion.
(c) No or greatly reduced cooling requirements.
(d) Better part load efficiency.

91. What is the speed of the cam shaft in four stroke engines?
(a) Double the crankshaft speed
(b) Half the crankshaft speed
(c) Equal to the crankshaft speed
(d) Three fourth the crankshaft speed

92. Which of the following actions will not reduce the tendency of knocking in an SI engine?

(a) Reducing compression ratio
(b) Reducing load
(c) Retarding spark timing
(d) Reducing engine speed

93. Which of the following is a desired quality of SI engine fuel for reduced knocking?
(a) Higher octane number
(b) Lower octane number
(c) Higher cetane number
(d) Higher Analine point

94. The valve of a CI engine nozzle has a cylindrical or conical projection protruding through the mouth of the nozzle and the nozzle body has an auxiliary hole. What is this type of nozzle called?
(a) Multihole nozzle
(b) Pintle nozzle
(c) Pintaux nozzle
(d) Open nozzle

95. Which of the following is a fire tube type high pressure boiler?
(a) Velox boiler
(b) Benson boiler
(c) Loeffler boiler
(d) Lancahsire boiler

96. Which of the following boiler accessories utilizes the waste heat of flue gases to heat the feed water?
(a) Water preheater (b)Economiser
(c) Feed heater (d)Superheater

97. Which of the following is a function of surge tank provided in hydroelectric power plants?
(a) To provide backup storage of water to meet demand in the months when the water level in the dam reduces.
(b) To increase the efficiency of the turbine
(c) To avoid cavitation in the turbine
(d) To reduce water hammer effect due to sudden closing of water

98. In which of the following methods, the available energy is directly converted to electrical energy without the aid of a turbine or engine?
(a) Magneto Hydo Dynamic system
(b) Tidal power plant
(c) Geothermal power plant
(d) Solar thermal power plant

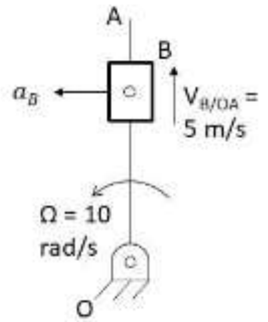
99. From the view point of moderating ratio only, which of the following is best moderator?
(a) Ordinary water (b)Carbon
(c) Heavy water (d)Beryllium

100. The peak load on a power plant is 40 MW and a group of four loads having maximum demand of 15 MW, 12 MW, 18 MW and 5 MW respectively are connected to the plant. The capacity of the plant is 60 MW. What is diversity factor of the plant?
(a) 1.5
(b) 1.25
(c) 0.8
(d) 0.7

Answer

1 (a)	21 (b)	41 (*)	61 (a)	81 (b)
2 (c)	22 (d)	42 (a)	62 (c)	82 (b)
3 (b)	23 (b)	43 (c)	63 (b)	83 (b)
4 (a)	24 (a)	44 (c)	64 (d)	84 (d)
5 (c)	25 (c)	45 (a)	65 (a)	85 (*)
6 (d)	26 (a)	46 (b)	66 (a)	86 (d)
7 (b)	27 (d)	47 (a)	67 (c)	87 (b)
8 (d)	28 (b)	48 (b)	68 (b)	88 (c)
9 (c)	29 (a)	49 (d)	69 (d)	89 (a)
10 (c)	30 (c)	50 (a)	70 (a)	90 (d)
11 (b)	31 (d)	51 (c)	71 (c)	91 (b)
12 (d)	32 (c)	52 (a)	72 (b)	92 (d)
13 (a)	33 (c)	53 (c)	73 (*)	93 (a)
14 (c)	34 (b)	54 (b)	74 (*)	94 (c)
15 (b)	35 (d)	55 (d)	75 (c)	95 (a)
16 (c)	36 (a)	56 (d)	76 (b)	96 (b)
17 (a)	37 (d)	57 (d)	77 (b)	97 (d)
18 (d)	38 (b)	58 (a)	78 (d)	98 (a)
19 (b)	39 (a)	59 (c)	79 (c)	99 (c)
20 (a)	40 (c)	60 (b)	80 (a)	100 (b)

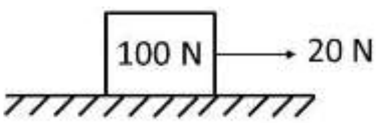
Solutions
4.



Coriolis acceleration (a_c) = 2 v ω

$a_c = 2 \times 5 \times 10 = 100$ m/s^2

8.



$N = mg = 100\ N$

Maximum static friction force

$= \mu N$

$= 0.3 \times 100$ N

$= 30$ N

Applied external force is 20 N is less than maximum static friction force 30 N. So friction force is equal to applied force.

Friction force F_s = 20 N

11. $\omega = \sqrt{\frac{k}{m}}$ and $k\,\Delta = m\,g$

$\omega = \sqrt{\frac{g}{\Delta}} = \sqrt{\frac{9.8}{0.1}} = 9.9$ rad/s

$2\pi f = 9.9$

$f = \frac{5}{\pi}$

17. $\sigma_x = 80\ MPa$, $\sigma_y = 20\ MPa$,

$\tau = 40\ MPa$

Maximum principal stress

$$\sigma_1 = \frac{\sigma_x + \sigma_y}{2} + \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau^2}$$

$= 100$ MPa

Minimum principal stress

$$\sigma_2 = \frac{\sigma_x + \sigma_y}{2} - \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau^2} = 0 \text{ MPa}$$

Maximum shear stress

$\tau_{max} = \frac{\sigma_1 - \sigma_2}{2} = 50$ MPa

19. Deflection of spring = $\frac{mg}{k}$

If spring is cut into two equal parts then resulting stiffness of spring is two times stiffness of original spring.

$\Delta' = \frac{mg}{2k} = \frac{\Delta}{2}$

20. $\frac{T_H}{T_S} = \frac{\frac{\tau \times J_H}{R}}{\frac{\tau \times J_S}{R}} = \frac{J_H}{J_S} = \frac{\frac{\pi}{2}(R^4 - r^4)}{\frac{\pi}{2}R^4} = \frac{D^4 - d^4}{D^4}$

Given d = (3/4) D

$\frac{T_H}{T_S} = 1 - \left(\frac{d}{D}\right)^4 = 1 - \frac{3^4}{4^4} = \frac{175}{256}$

33. Demand D = 9000

Ordering cost C_0 = Rs 300

Holding cost C_h = 20% of unit cost

$EOQ = \sqrt{\frac{2\ D\ C_0}{C_h}} = \sqrt{\frac{2 \times 9000 \times 300}{0.2 \times 3}}$

$= 3000$ units

53. mass = 1 kg, $T_1 = 350\ ^0$C,

$T_2 = 250\ ^0$C,

$C_v = 0.8$ kJ/kg ^{0}C.

$\Delta Q = \Delta U + \Delta W = mC_v\Delta T + \Delta W$

$0 = 1 \times 800 \times -100 + \Delta W$

$\Delta W = 80$ kJ

67. Counter flow heat exchanger

$T_{c,in} = 20^0$ C $\quad T_{c,o} = 40^0$ C

$T_{h,in} = 140^0$ C $\quad T_{h,o} = 120^0$ C

$\Delta T_1 = T_{h,in} - T_{c,o} = 100\ ^0$C

$\Delta T_2 = T_{h,0} - T_{c,in} = 100\ ^0$C

if $\Delta T_1 = \Delta T_2$ then $\Delta T_{LMTD} = \Delta T_1 = 100\ ^0$C

Heat transfer per unit area per unit heat transfer coefficient.

$\frac{\dot{Q}}{UA_s} = \Delta T_{LMTD} = 100$ W

68. Counter flow heat exchanger

$\epsilon = 0.75$, $C_c = C_h = 1000$ W/^{0}C,

U = 100 W/m^2 ^{0}C

If $c = \frac{C_{max}}{C_{min}} = 1$

$\varepsilon = \frac{NTU}{1 + NTU} = 0.75$

NTU = 3

$\frac{UA_s}{C_{min}} = 3$

$\frac{100 \times A_s}{1000} = 3$

$A_s = 30$ m^2

1. An ideal refrigerator is operating between a condenser temperature of 37 ^{0} C and an evaporator temperature of – 3 ^{0} C. If the machine is functioning as a heat pump its coefficient of performance (COP) will be

(a) 6.0 (b) 6.75

(c) 7.0 (d) 7.75

Ans. (d)

COP of heat pump

$$COP = \frac{T_1}{T_1 - T_2}$$

$$COP = \frac{37+273}{37-(-3)} = 7.75$$

2. On a psychometric chart, what does a vertical downwards line represents

(a) Adiabatic saturation

(b) Sensible cooling

(c) Dehumidification

(d) Humidification

3. The knocking tendency in CI engine increases with

(a) decrease of compression ratio

(b) increase in coolant water temperature

(c) increase of compression ratio

(d) increase of temperature of inlet air

4. The specific fuel consumption per kW-hr for diesel engine is very close to

(a) 0.4 kg/kW-hr (b) 0.33 kg/kW-hr

(c) 0.27 kg/kW-hr (d) 0.47 kg/kW-hr

5. Equivalence evaporation is defined as

(a) the ratio of heat actually used in producing stream to the heat liberated in the furnace

(b) the amount of water evaporated in kg per kg of coal burnt

(c) evaporation of water from and at 100 ^{0} C into dry saturated steam

(d) evaporation of 15.635 kg of water per hour from and at 100 ^{0} C

6. High positive incidence in an axial compressor bladed leads to

(a) suppression of separation of flow on the blade

(b) choking of the flow

(c) separation of flow on the suction side of the blade

(d) separation of flow on the pressure side of the blade

7. If K is the ratio of the rate of production of neutrons to the rate of loss of neutrons, the reactor is called a critical reactor, when

(a) K = 0 (b) $0 < K < 1$

(c) K = 1 (d) K > 1

8. The volumetric efficiency of a well-designed SI engine lies in the range of

(a) 40% - 50%

(b) 51% - 60 %

(c) 61% - 70 %

(d) 71% - 90 %

9. A Centrifugal compressor is used for which of the following?

(a) High pressure ratio and low mass flow

(b) Low pressure ratio and high mass flow

(c) High pressure ratio and high mass flow

(d) Low pressure ratio and high mass flow

10. The free convection heat transfer is significantly affected by

(a) Reynolds number

(b) Grashof number

(c) Prandtl number

(d) Stanton number

11. The thermal radiation occur in the portion of electromagnetic spectrum between the wave lengths

(a) 10^{-2} micron to 10^{-4} micron

(b) 10^{-1} micron to 10^{-2} micron

(c) 0.1 micron to 10^{2} micron

(d) 10^{2} onwards

12. The change in entropy is zero during

(a) hyperbolic process

(b) constant pressure process

(c) adiabatic process

(d) polytropic process

13. Joule-Thomson coefficient is given as

(a) $\left(\frac{\partial T}{\partial G}\right)_P$

(b) $\left(\frac{\partial T}{\partial P}\right)_h$

(c) $\left(\frac{\partial U}{\partial T}\right)_P$

(d) $\left(\frac{\partial P}{\partial T}\right)_h$

14. If x is the distance from the leading edge of a plate, then the thickness of laminar boundary layer varies as
(a) $\frac{1}{x}$
(b) $x^{4/5}$
(c) $x^{1/2}$
(d) x^2

15. Shielding in a nuclear reactor is generally done to protect against
(a) excess electrons
(b) X-rays
(c) α- and β- rays
(d) neutron and gamma rays

16. Reynolds analogy states that
(a) $St = \frac{C_{fx}}{4}$
(b) $St = \frac{C_{fx}}{2}$
(c) $St = \sqrt{C_{fx}}$
(d) $St = C_{fx}$

17. The air-fuel ratio for a gas turbine is generally kept closer to
(a) 20 : 1 (b) 30: 1
(c) 40: 1 (d) 60: 1

18. The volumetric efficiency of a reciprocating compressor
(a) Increases with increasing clearance ratio
(b) increases with increase in compression index
(c) does not change with change in clearance ratio and pressure ratio
(d) decreases both with increasing clearance ratio and pressure ratio

19. The work ratio in a simple gas turbine plant in terms of pressure ratio r_p is
(a) $1 - \frac{T_3}{T_1}(r_p)^{\frac{\gamma-1}{\gamma}}$
(b) $1 - \frac{T_1}{T_3}(r_p)^{\frac{\gamma-1}{\gamma}}$
(c) $1 - \frac{T_1}{T_3}(r_p)^{\frac{\gamma}{\gamma-1}}$
(d) $1 - \frac{T_1}{T_3}(r_p)^{\frac{1}{\gamma}}$

20. A boling water reactor uses which of the following as fuel?
(a) U-234 (b) U-235
(c) Enriched uranium (d) Plutonium

21. In a gas turbine cycle, the turbine output is 600 kJ/kg, the compressor work is 400 kJ/kg and the heat supplied is 1000 kJ/kg. The thermal efficiency of the cycle is
(a) 20 % (b) 40 %
(c) 60 % (d) 80 %

22. Clausius - Clapeyron equation gives the slope of the curve in
(a) p-v diagram (b) p-h diagram
(c) p-T diagram (d) T-S diagram

23. An ideal gas of mass m and temperature T_1 undergoes a reversible isothermal process from an initial pressure P_1 to final pressure P_2. The heat loss during the process is Q. The entropy change ΔS of the gas is
(a) $mR \ln\frac{P_2}{P_1}$ (b) $mR \ln\frac{P_1}{P_2}$
(c) $mR \ln\frac{P_2}{P_1} - \frac{Q}{T_1}$ (d) $zero$

24. In a reversible isothermal expansion process, the fluid expands from 10 bar and 2 m^3 to 2 bar and 10 m^3. During this expansion process, 100 kW of heat is supplied. Then the work done during the process is
(a) 33.3 kW (b) 80 kW
(c) 100 kW (d) 20 kW

25. The heat loss in a sudden expansion from 6 cm diameter pipe to 12 cm diameter pipe, in terms of velocity V_1 in the smaller diameter pipe is
(a) $\frac{3}{16}\frac{V_1^2}{2g}$ (b) $\frac{5}{16}\frac{V_1^2}{2g}$
(c) $\frac{7}{16}\frac{V_1^2}{2g}$ (d) $\frac{9}{16}\frac{V_1^2}{2g}$

26. Thermal conductivity through walls of a cylinder of inner and outer radii r_1 and r_2. respectively is inversely proportional to
(a) $(r_2 - r_1)$ (b) $\frac{1}{r_2 - r_1}$

(c) $\ln\frac{r_2}{r_1}$ (d) $\frac{1}{\ln\frac{r_2}{r_1}}$

27. The maximum work output from two finite bodies-one at temperature T_1 and the other at temperature T_2 is

(a) $W_{max} = C_p(\sqrt{T_1} - \sqrt{T_2})^2$

(b) $W_{max} = C_p(\sqrt{T_1} + \sqrt{T_2})^2$

(c) $W_{max} = C_p(\sqrt{T_1}\sqrt{T_2})^{\frac{1}{2}}$

(d) $W_{max} = \frac{C_p}{2}(\sqrt{T_1} + \sqrt{T_2})^2$

28. Most of the gases exhibit drop in temperature upon expansion. However, this may not be true in case of

(a) carbon dioxide (b) oxygen

(c) hydrogen (d) helium

29. If the dryness fraction of a sample by throttling calorimeter is 0.8 and that by separating calorimeter is also 0.8, then the actual dryness fraction of sample will be taken as

(a) 0.8 (b) $\sqrt{0.8}$

(c) 0.64 (d) 0.5

30. In a simple impulse turbine, the nozzle angle at the entrance is 30^0. For the maximum diagram efficiency, what is the blade speed ratio?

(a) 0.259 (b) 0.75

(c) 0.3 (d) 0.433

31. What is the value of shape factor for two infinite parallel surfaces separated by a distance x?

(a) 0 (b) ∞

(c) 1 (d) x

32. An engine operates between temperature limits of 900 K and T_2 and the other engine operates between T_2 and 400 K. For both engines to be equally efficient , T_2 should be equal to

(a) 600 K (b) 625 K

(c) 650 K (d) 700 K

33. Which one of the following parameters is significant to ascertain chemical equilibrium of a system?

(a) Clapeyron equation

(b) Maxwell relations

(c) Gibb's function

(d) Helmholtz function

34. if $\psi = x^2 - y^2$ is the stream function in a two-dimensional flow field, then the magnitude of velocity vector at point (1, 1) would be

(a) 0 (b) $2\sqrt{2}$

(c) 4 (d) 8

35. In a two-stage reciprocating air compressor, the suction and delivery pressure are 1 bar and 4 bar respectively. For the maximum efficiency the intercooler pressure is

(a) 1.5 bar (b) 2.5 bar

(c) 2.0 bar (d) 3.0 bar

36. In a vapour absorption refrigerator, heat is rejected in

(a) condenser only

(b) absorber only.

(c) generator only

(d) condenser and absorber

37. Two long parallel plates of same emissivity 0.5 are maintained at different temperatures and have radiation heat exchange between them. A radiation shield of emissivity 0.25 placed in the middle will reduce radiation heat exchange to

(a) 1 (b) $\frac{1}{4}$

(c) $\frac{3}{10}$ (d) $\frac{3}{5}$

38. In a nozzle designed for the maximum discharge conditions, the flow velocity in the convergent section of the nozzle

(a) is sonic

(b) is subsonic

(c) is supersonic

(d) depends upon the initial pressure and condition of steam

39. For steady, fully developed flow inside a straight pipe of diameter D, neglecting gravity effects, the pressure drop ΔP over a length L and the wall shear stress τ_w.

(a) $\tau_w = \frac{\Delta PD}{4L}$

(b) $\tau_w = \frac{\Delta PD^2}{4L^2}$

(c) $\tau_w = \frac{\Delta PD}{2L}$

(d) $\tau_w = \frac{4\Delta PL}{D}$

40. In order to have the maximum power from a Pelton turbine, the bucket speed must be
(a) Equal to the jet speed
(b) Equal to half of jet speed
(c) Equal to twice the jet speed
(d) Independent of the jet speed

41. Stalling of blades in an axial flow compressor is the phenomenon of
(a) Air stream blocking the passage
(b) Motion of air at sonic velocity
(c) Unsteady, periodic and reversible flow
(d) Airstream not able to follow the blade contour

42. During chemical dehumidification process of air
(a) dry-bulb temperature and specific humidity decrease
(b) dry-bulb temperature increases and specific humidity decreases
(c) dry-bulb temperature decreases and specific humidity increases
(d) dry-bulb temperature and specific humidity increases

43. The latent heat load in an auditorium is 25% of sensible heat load. The value of sensible heat factor is then equal to
(a) 0.25
(b) 0.5
(c) 0.8
(d) 1.0

44. Which of the following parameters remain constant during a sensible cooling or heating process?
(a) Dry-bulb temperature
(b) Wet-bulb temperature
(c) Humidity ratio
(d) Relative humidity

45. In order to have a low by-pass factor of cooling coil, the fin spacing and the number of tubes rows should be respectively
(a) wide apart and high
(b) wide apart and low
(c) close and low
(d) close and high

46. An emissive power of a black body is P. If its absolute temperature is doubled, the emissive power becomes
(a) 2P
(b) 4P
(c) 8P
(d) 16P

47. An increase in the mean effective pressure of a diesel engine with fixed compression ratio can be obtained with increase in
(a) speed of the engine
(b) charge density
(c) cut-off ratio
(d) back pressure

48. The order of values of thermal efficiency of Otto, diesel and dual cycles, when they have the same maximum pressure and heat input, is given by
(a) Cost is low
(b) Efficiency is high
(c) Construction is simple
(d) Ease in use

49. Shock effect in the nozzle generally occurs in
(a) Converging section
(b) throat
(c) diverging section
(d) exit

50. The normal operating range and air fuel ratio for a CI engine with diesel fuel is
(a) 8 : 1 to 12 : 1
(b) 12 : 1 to 22 : 1
(c) 20 : 1 to 30 : 1
(d) 18 : 1 to 70 : 1

Answer

1 (d)	11 (c)	21 (a)	31 (c)	41 (d)
2(c)	12 (c)	22 (c)	32 (a)	42 (b)
3 (a)	13 (b)	23 (b)	33 (c)	43 (c)
4 (c)	14 (c)	24 (c)	34 (b)	44 (c)
5 (b)	15 (d)	25 (d)	35 (c)	45 (d)
6 (c)	16 (b)	26 (d)	36 (d)	46 (d)
7 (c)	17 (d)	27 (a)	37 (c)	47 (c)
8 (d)	18 (d)	28 (d)	38 (b)	48 (c)
9 (d)	19 (b)	29 (c)	39 (a)	49 (c)

10 (b) 20 (c) 30 (d) 40 (b) 50 (b)

1. In a four-bar chain or quadric cycle chain
(a)each of the four pairs is a turning pair
(b)one is a turning pair and three are sliding pairs
(c)two are turning pairs and two are sliding pairs
(d)three are turning pairs and one is a sliding pair

2. When two links are connected by a pin joint, their instantaneous centre lies
(a) on their point of contact
(b) at the centre of curvature
(c) at the centre of circle
(d) at the pin joint

3. For low and moderate speed engines, the cam follower should move with
(a) simple harmonic motion
(b) uniform velocity
(c) uniform acceleration and retardation
(d) cycloidal motion

4. A porter governor is a/an
(a) pendulum-type governor
(b) deadweight governor
(c) spring-loaded governor
(d) inertia governor

5. In gear trains, if the axes of the first and last wheels are coaxial, then the train is known as
(a) simple train of wheels
(b) compound train of wheels
(c) reverted gear train
(d) epicyclic gear train

6. In a turning moment diagram, the variations of energy above and below the mean resisting torque is called
(a) fluctuation of energy
(b) maximum fluctuation of energy
(c) coefficient of fluctuation of energy
(d) dissipation of energy

7. If the rotating mass of a rim-type flywheel is distributed on another rim-type flywheel whose mean radius is half of the mean radius of the former, then the energy stored in the latter at the same speed will be
(a) four times the first one
(b) same as the first one
(c) one-fourth of the first one
(d) one and half times the first one

8. The unbalanced force due to reciprocating masses
(a) varies in magnitude but constant in direction
(b) varies in direction but constant in magnitude
(c) varies in both magnitude and direction
(d) constant in both direction and magnitude

9. In steady-state forced vibrations, the amplitude of vibrations at resonance is ______ damping coefficient.
(a) equal to
(b) directly proportional to
(c) inversely proportional to
(d) independent of

10. In a butt welded joint, the size of weld is ____ the throat of the weld
(a) 0.5 time (b) equal to
(c) $\sqrt{2}$ times (d) double

11. A screw is specified by its
(a) major diameter (b) minor diameter
(c) pitch (d) pitch diameter

12. The shock-absorbing capacity of a bolt may be increased by
(a) increasing its shank diameter
(b) decreasing its shank diameter
(c) tightening the bolt properly
(d) making the shank diameter equal to core diameter of the thread

13. In a steam engine, the piston rod is usually connected to the cross-head by means of a/an
(a) knuckle joint (b) cottered joint
(c) Oldham's coupling (d) universal joint

14. The shear stress at a point in a shaft subjected to a torque is
(a) directly proportional to the polar moment of inertia and to the distance of the point from the axis
(b) directly proportional to the applied torque and inversely proportional to the polar moment of inertia
(c) inversely proportional to the applied torque and polar moment of inertia
(d) inversely proportional to the applied torque and polar moment of inertia

15. When the speed of belt increases

(a) the coefficient of friction between the belt and pulley increases
(b) the coefficient of friction between the belt and pulley decreases
(c) the power transmitted will decrease
(d) the power transmitted will increase

16. The effective stress in wire ropes during normal working is equal to the stress due to
(a) axial load plus stress due to bending
(b) acceleration/retardation of masses plus stress due to bending
(c) axial load plus stress due to acceleration/retardation
(d) bending plus stress due to acceleration/ retardation

17. The backlash for spur gear depends upon
(a) module
(b) pitch line velocity
(c) tooth profile
(d) Both (a) and (b)

18. In gears, the contact ratio is the ratio of
(a) length of path of contact to the circular pitch
(b) length of arc of contact to the circular pitch
(c) length of arc of approach to the circular pitch
(d) length of arc of recess to the circular pitch

19. The Young's modulus of a material is 125 GPa and Poisson's ratio is 0.25. The modulus of rigidity of the material is
(a) 50 GPa (b) 30 GPa
(c) 5 GPa (d) 500 GPa

20. A body is subjected to a tensile stress of 1200 MPa on one plane and another tensile stress of 600 MPa on a plane at right angles to the former. It is also subjected to a shear stress of 400 MPa on the same planes. The maximum normal stress will be
(a) 400 MPa (b) 500 MPa
(c) 900 MPa (d) 1400 MPa

21. The bending moment at a section tends to bend or deflect the beam and the internal stresses resist bending. The resistance offered by the internal stresses to the bending is called
(a) compressive stress
(b) shear stress
(c) bending stress
(d) elastic modulus

22. The rectangular beam A has a length l, width b and depth d. Another beam B has the same length and width but depth is double that of A. The elastic strength of beam B will be ____ as compared to beam A.
(a) same (b) double
(c) one-fourth (d) four times

23. When a shaft of diameter D is subjected to a twisting moment T and bending moment M, then equivalent bending moment M_e is given by
(a) $\sqrt{M^2 + T^2}$
(b) $\sqrt{M^2 - T^2}$
(c) $\frac{1}{2}\left(M + \sqrt{M^2 + T^2}\right)$
(d) $\frac{1}{2}\left(M - \sqrt{M^2 + T^2}\right)$

24. A column is said to be a short column, when
(a) Its length is very small
(b) Its cross-sectional area is small
(c) the ratio of its length to the least radius of gyration is less than 80
(d) the ratio of its length to the least radius of gyration is more than 80

25. In a tensile test, when a material is stressed beyond elastic limit, the tensile strain _____ as compared to the stress
(a) decreases slowly
(b) increases slowly
(c) decreases more quickly
(d) increases more quickly

26. The property of a material necessary for forgings, in stamping images on coins and in ornamental work is
(a) elasticity (b) plasticity
(c) ductility (d) malleability

27. The percentage of carbon in cast iron varies from
(a) 0.1 to 0.5 (b) 0.5 to 1.0
(c) 1.0 to 1.7 (d) 1.7 to 4.5

28. Steel containing 0.8 to 1.5 percent carbon, is known as
(a) mild steel
(b) dead-mild steel
(c) medium-carbon steel
(d) high-carbon steel

29. The hardness of steel increases if it contains
(a) pearlite (b) ferrite
(c) cementite (d) martensite

30. A steel is heated at about 875 ^{0}C where the structure consist of entirely austenite. It is then cooled suddenly at a temperature of about 250 ^{0}C – 520 ^{0}C. This process of heat treatment is known as
(a) normalizing (b) annealing
(c) austempering (d) Martempering

31. Bronze is an alloy of
(a) copper and zinc
(b) copper and tin
(c) copper, tin and zinc
(d) copper and chromium

32. Thermosetting plastics are those materials which
(a) are formed to shape under heat and pressure and results in a permanently hard product
(b) do not become hard with application of heat and pressure
(c) are flexible and can withstand considerable wear under suitable conditions
(d) are used as a friction lining for clutches and brakes

33. In a centrifugal casing method
(a) core is made of sand
(b) core is made of ferrous material
(c) core is made of non-ferrous metal
(d) no core is used

34. Which of the following statements is correct for orthogonal cutting system?
(a) the cutting edge of the tool is perpendicular to the direction of tool travel.
(b) the cutting edge clears the width of the workpiece on either ends.
(c) the chip flows over the tool face and the directions of the chip flow velocity is normal to the cutting edge
(d) All of the above

35. Continuous chips with built-up edge are formed during the machining of
(a) brittle materials
(b) ductile metals
(c) hard metals
(d) soft metals

36. The correct sequence of tool materials in increasing order of their ability to retain their hot hardness is
(a) carbide, ceramic, cermet, borazon
(b) ceramic, carbide, borazon, cermet
(c) cermet, carbide, ceramic, borazon
(d) borazon, ceramic, carbide, cermet

37. It is desired to perform the operations like drilling, reaming, counterboring, etc., on a workpiece. Which of the following machines will be used ?
(a) Sensitive drilling machine
(b) Radial drilling machine
(c) Gang drilling machine
(d) Multiple spindle drilling machine

38. In centreless grinding workpiece, centre will be
(a) above the line joining the two-wheel centres
(b) below the line joining the two-wheel centres
(c) on the line joining the two-wheel centres
(d) at the intersection of the line joining the wheel centres with the plane of the workpiece

39. Internal gears can be made by
(a) hobbing
(b) shaping with pinion cutter
(c) shaping with rack cutter
(d) milling

40. The consumable electrode is used in
(a) carbon arc welding
(b) submerged arc welding
(c) TIG arc welding
(d) MIG arc welding

41. Any number of equal divisions on the periphery of a circle can be obtained on a milling machine by
(a) direct indexing
(b) simple indexing
(c) compound indexing
(d) differential indexing

42. A jig is defined as a device which
(a) holds and locates a workpiece and guides and controls one or more cutting tools
(b) holds and locates a workpiece during a workpiece during an inspection or for a manufacturing operation
(c) is used to check the accuracy of a workpiece

(d) all of the above

43. A diamond locating pin is used in jigs and fixtures because
(a) diamond is very hard and wear resistant
(b) it occupies very little space
(c) it helps in assembly with tolerance on centre distance
(d) it has a long life

44. Which one of the following techniques is used for determining allowances in time study?
(a) Acceptance sampling
(b) Linear regression
(c) Performance rating
(d) Work sampling

45. If F is the fixed cost, Y is the variable cost per unit (or total variable costs) and P is the selling price of each unit (or total sales value), then break-even point is equal to
(a) $\frac{F\times V}{P}$
(b) $\frac{F\times P}{V}$
(c) $\frac{F}{1+\frac{V}{P}}$
(d) $\frac{F}{1-\frac{V}{P}}$

46. Slack represents the difference between the
(a) earliest completion time and latest allowable time
(b) latest allowable time and earliest completion time
(c) earliest completion time and normal expected time
(d) latest allowable time and normal allowable time

47. The type of organization preferred for a steel industry is
(a) line organisation
(b) functional organisation
(c) line and staff organisation
(d) line, staff and functional organization

48. In order to avoid excessive manipulation of facilities, the layout preferred is
(a) product layout
(b) process layout
(c) group layout
(d) static layout

49. Which one of the following charts gives simultaneously information about the progress of work and machine tooling?
(a) process chart
(b) Machine load chart
(c) Man-machine chart
(d) Gantt chart

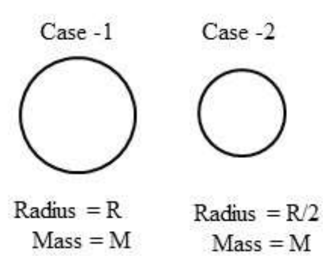
50. In Value engineering, important consideration is given to
(a) customer satisfaction
(b) function concept
(c) profit maximization
(d) cost reduction

Answer

1 (a)	11 (a)	21 (c)	31 (b)	41 (b)
2 (d)	12 (b)	22 (d	32 (a)	42 (a)
3 (a)	13 (b)	23 (c)	33 (d)	43 (c)
4 (b)	14 (b)	24 (c)	34 (d)	44 (d)
5 (c)	15 (c)	25 (d)	35 (b)	45 (d)
6 (a)	16 (a)	26 (b)	36 (c)	46 (a)
7 (c)	17 (d)	27 (d)	37 (c)	47 (d)
8 (a)	18 (b)	28 (d)	38 (a)	48 (b)
9 (c)	19 (a)	29 (c)	39 (b)	49 (c)
10 (b)	20 (d)	30 (c)	40 (d)	50 (d)

Solutions

7.



Case – I: $K.E_1 = \frac{1}{2}I\omega^2 = \frac{1}{2}MR^2\omega^2$

Case – 2: $K.E_2 = \frac{1}{2}I'\omega^2 = \frac{1}{2}M\left(\frac{R}{2}\right)^2\omega^2$

$$K.E_2 = \frac{1}{8}MR^2\omega^2$$

$$K.E_2 = \frac{K.E_1}{4}$$

9. Steady state amplitude X_0

$X_0 = \frac{F_0}{\sqrt{(k-m\omega^2)^2 + (c\omega)^2}}$

If excitation frequency is equal to natural frequency $\omega = \omega_n$

$X_0 = \frac{F_0}{c\omega_n}$

19. Young's modulus E = 125 GPa

Poisson's ratio ϑ = 0.25

E = 2G (1 + ϑ)

125 = 2 G (1 + 0.25)

G = 50 GPa

20. $\sigma_x = 1200$ MPa, $\sigma_y = 600$ MPa , $\tau_{xy} = 400$ MPa

Maximum principal stress

$$\sigma_{max} = \frac{\sigma_x+\sigma_y}{2} + \sqrt{\left(\frac{\sigma_x-\sigma_y}{2}\right)^2 + \tau_{xy}^2}$$

$$\sigma_{max} = \frac{1200 + 600}{2} + \sqrt{\left(\frac{1200 - 600}{2}\right)^2 + 400^2}$$

= 1400 MPa

22. If length of beam is L, width of beam b, depth of beam is d.

$\sigma_b = \frac{\boldsymbol{6M}}{\boldsymbol{bd^2}}$

If length of beam is L, width of beam b, depth of beam is 2d.

$\sigma_b = \frac{6M}{4bd^2}$

$$\frac{Bending\ stress\ in\ beam\ A}{Bending\ stress\ in\ beam\ B} = \frac{\frac{6M}{bd^2}}{\frac{6M}{4bd^2}} = 4$$

23. Maximum bending stress due to moment M

$$\sigma_{b,max} = \frac{M \times y_{max}}{I} = \frac{M \times R}{\frac{\pi R^4}{4}} = \frac{4M}{\pi R^3}$$

Maximum shear stress due to twisting moment T

$$\tau_{max} = \frac{T \times R}{\frac{\pi R^4}{2}} = \frac{2T}{\pi R^3}$$

Maximum principal stress

$$\sigma_{max} = \frac{\sigma_{b,max}}{2} + \sqrt{\left(\frac{\sigma_{b,max}}{2}\right)^2 + \tau_{max}^2}$$

$$\sigma_{max} = \frac{2}{\pi R^3}\left[M + \sqrt{M^2 + T^2}\right] = \frac{4M_e}{\pi R^3}$$

$$M_e = \frac{M + \sqrt{M^2 + T^2}}{2}$$

1. Which of the following is an example of irreversible process?
(a) Polytropic expansion of fluid
(b) Unrestricted expansion of gases
(c) Isothermal expansion
(d) Electrolysis

2. A frictionless heat engine can be 100% efficient only if its exhaust temperature is
(a) equal to its input temperature
(b) less than its input temperature
(c) 0 ^{0}C
(d) 0 K

3. Which of the following is considered as thermodynamic potential?
(a) Temperature (b) Internal energy
(c) Enthalpy (d) Entropy

4. In a two-stage gas turbine plant with intercooling and reheating
(a) both work ratio and thermal efficiency improve
(b) work ratio improves but thermal efficiency decreases
(c) thermal efficiency improves but work ratio decreases
(d) both work ratio and thermal efficiency decrease

5. The specific heat relation is
(a) $C_P - C_v = \frac{vT\beta^2}{k}$
(b) $C_P - C_v = \frac{vTk}{\beta^2}$
(c) $C_P - C_v = \frac{pTk}{\beta^2}$
(d) $C_P - C_v = \frac{v^2T\beta}{k}$

6. An ideal gas is heated from temperature T_1 and T_2 by keeping its volume constant. The gas is expanded back to its initial temperature according to the law $pV^n = c$. If the entropy change in the two processes are equal, then the value of n in terms of the adiabatic index v is
(a) $n = \frac{v+1}{2}$ (b) $n = \frac{v-1}{2}$
(c) $n = \frac{v+2}{2}$ (d) $n = \frac{v+4}{2}$

7. The maximum percentage gain in regenerative feed heating cycle, the thermal efficiency
(a) increases with number of feed heaters increasing
(b) decreases with number of feed heaters increasing
(c) remains same unaffected by number of feed heaters
(d) None of the above

8. A Carnot engine, working between 400 ^{0}C and 40 ^{0}C, produces 130 kJ of work. The entropy change during heat rejection process is
(a) 113 kJ (b) 133 kJ
(c) 131 kJ (d) 123 kJ

9. Mole fraction of a component of gas mixture is equal to
(a) $\frac{1}{f}$ (b) f^2
(c) f (d) $\frac{f}{p}$
where,
f = volume fraction
p = pressure of the mixture

10. When the fuel is burned and water is released in the liquid phase, the heating value of fuel is called
(a) higher heating value
(b) lower heating value
(c) enthalpy of formation
(d) None of the above

11. The mass of excess air supplied is equal to
(a) $\frac{23}{100} \times$ mass of excess carbon
(b) $\frac{23}{100} \times$ mass of excess oxygen
(c) $\frac{100}{23} \times$ mass of excess carbon
(d) $\frac{100}{23} \times$ mass of excess oxygen

12. In an Otto cycle, the temperature at the beginning and end of the isentropic compression are 316 K and 596 K respectively. The compression ratio will be
(a) 4.588 (b) 4.858
(c) 4.885 (d) 4.558

13. For the same maximum pressure and temperature of Otto, diesel and dual combustion air standard cycles
(a) the compression ratios will be the same

(b) the heat supplied to the cycles will be the same
(c) the air standard efficiency will have the same value
(d) the heat rejected by the engine will be the same

14. Which one of the following is not the chief effect of detonation?
(a) A loud pulsating noise which may be accompanied by a vibration of the engine
(b) A loud pulsating noise from the wheel assembly
(c) An increase in the heat lost to the surface of combustion chamber
(d) An increase in carbon deposits

15. A single-cylinder, two stroke petrol engine develops 4 kW indicated power. If the mean effective pressure is 6.5 bar and piston diameter is 100 mm, the average speed of the piston is
(a) 23.5 m/s (b) 47 m/s
(c) 94 m/s (d) 186 m/s

16. The smallest quantity of a substance, which can exist by itself in a chemically recognizable form, is known as
(a) element (b) compound
(c) atom (d) molecule

17. The locomotive boiler has
(a) 137 fire tubes and 44 superheated tubes
(b) 147 fire tubes and 34 superheated tubes
(c) 157 fire tubes and 24 superheated tubes
(d) 167 fire tubes and 14 superheated tubes

18. In a boiler, various heat losses take place. The biggest loss is due to
(a) moisture in fuel
(b) dry flue gases
(c) steam formation
(d) unburnt carbon

19. The missing equality per stroke is equal to
(a) cylinder feed – indicated mass of steam
(b) cylinder feed + indicated mass of steam
(c) mass of cushion steam + indicated mass of steam
(d) mass of cushion steam – cylinder feed

20. The critical pressure ratio for initially dry saturated steam is
(a) 0.528 (b) 0.546
(c) 0.577 (d) 0.582

21. De-Lavel turbines are mostly used
(a) where low speeds are required
(b) for small power purposes and low speeds
(c) for small power purposes and high speeds
(d) for large power purposes

22. In a reaction turbine, when the degree of reaction is zero, then there is
(a) no heat drop in the moving blades
(b) no heat drop in the fixed blades
(c) maximum heat drop in the moving blades
(d) maximum heat drop in the fixed blades

23. The purpose of governing in steam turbine is to
(a) reduce the effective heat drop
(b) reheat the steam and improve its quality
(c) completely balance against end thrust
(d) maintain the speed of the turbine

24. The reheat factor depends upon
(a) initial pressure and superheat
(b) exit pressure
(c) turbine stage efficiency
(d) All of the above

25. The maximum efficiency of a reaction turbine is
(a) $\frac{2sin^2\alpha}{1+sin^2\alpha}$ (b) $\frac{1+sin^2\alpha}{2sin^2\alpha}$
(c) $\frac{2cos^2\alpha}{1+cos^2\alpha}$ (d) $\frac{1+cos^2\alpha}{2cos^2\alpha}$
where, α = nozzle angle

26. A single-stage reciprocating air compressor is required to compress 1 kg of air from 1 bar to 4 bar. The initial temperature is 27 ^{0}C. The work developed during isentropic compression is
(a) 146.96 kJ (b) 146.04 kJ
(c) 146.63 kJ (d) 146.89 kJ

27. What is the minimum work required to compress 1 kg of air from 1 bar, 27 ^{0}C to 16 bar in two stages, if the law of compression is $pv^{1.25}$ = constant and the inter-cooling is prefect?
[Take : R = 287 J/kg-K]
(a) 275.09 kN-m (b) 175.09 kN-m
(c) 375.09 kN-m (d) 475.09 kN-m

28. The compressor mostly used for supercharging of IC engine is a/an
(a) radial-flow compressor
(b) axial – flow compressor
(c) roots blower
(d) reciprocating compressor

29. The region outside the Mach cone is called
(a) zone of action
(b) zone of silence
(c) control volume
(d) None of the above

30. A Parson's turbine is also known as
(a) 25% reaction turbine
(b) 50% reaction turbine
(c) 75 % reaction turbine
(d) impulse turbine

31. Reheating in a gas turbine
(a) increases thermal efficiency
(b) increases compressor work
(c) increases turbine work
(d) decreases thermal efficiency

32. Which one of the following is the expression of stock strength?
(a) $\frac{2v}{v+1}[m_1^2 - 1]$ (b) $\frac{v+1}{2v}[m_1^2 - 1]$
(c) $\frac{2v}{v-1}\frac{1}{[m_1^2-1]}$ (d) $\frac{v+1}{2v}\frac{1}{[m_1^2-1]}$

33. The flow of steam is supersonic
(a) at the entrance to the nozzle
(b) at the throat of the nozzle
(c) in the convergent portion of the nozzle
(d) in the divergent portion of the nozzle

34. The boiling point of carbon dioxide is
(a) – 20.5 ^{0}C (b) – 50 ^{0}C
(c) – 73.6 ^{0}C (d) – 78.3 ^{0}C

35. A bootstrap air cooling system has
(a) one heat exchanger
(b) two heat exchangers
(c) three heat exchangers
(d) four heat exchangers

36. Most air- cooled condensers are designed to operate with a temperature difference of
(a) 5 ^{0}C (b) 8 ^{0}C
(c) 14 ^{0}C (d) 22 ^{0}C

37. The pressure at the inlet of a refrigerant compressor is called
(a) suction pressure
(b) discharge pressure
(c) critical pressure
(d) back pressure

38. A long pipe of 0.6 m outside diameter is buried in earth with axis at a depth of 1.8 m. The surface temperatures of the pipe and the centre are 95 ^{0}C and 25 ^{0}C respectively. The conductivity of the centre is 0.51 W/m ^{0}C. The heat loss from the pipe per meter length is
(a) 90.25 W (b) 45.125 W
(c) 180.50 W (c) 100 W

39. The thickness of thermal and hydrodynamic boundary layers is equal, if
(a) pr =1 (b) pr > 1
(c) pr < 1 (d) pr = Nu

40. The rate of heat transfer from a solid surface to a fluid is obtained from
(a) Netwon's law of cooling
(b) Fourier's law
(c) Kirchhoff's law
(d) Stefan's law

41. Transmission of heat by molecular collision is
(a) scattering (b) conduction
(c) convection (d) radiation

42. Least value of Prandtl number can be excepted in case of
(a) water (b) liquid metals
(c) salt solution (d) sugar solution

43. The buoyant force acting on a floating body passes through
(a) metacenter of the body
(b) CG of the body
(c) centroid of the volume of the body
(d) centroid of the displaced volume

44. A reservoir having a surface area of 500 m^2 is emptied by a 0.5 m wide rectangular weir. How long should it take to empty the reservoir from a height of 3.2 m to 0.1 m above the sill?
[Take: C_d = 0.65]
(a) 16 minutes and 5 seconds
(b) 8 minutes and 5 seconds

(c) 32 minutes and 5 seconds
(d) 10 seconds

45. A rectangular channel of 4 m width conveys water at 8 m^3/sec under critical condition. The specific energy for this flow is
(a) 1.1123 m (b) 1.4830 m
(c) 0.3703 m (d) 0.7416 m

46. Which one of the following is dimensionless?
(a) $\frac{\partial P}{\partial x}.\frac{D^4}{\mu Q^2}$ (b) $\frac{\partial P}{\partial x}.\frac{D^3}{\mu Q}$
(c) $\frac{\partial P}{\partial x}.\frac{D^4}{\mu Q}$ (d) $\frac{\partial P}{\partial x}.\frac{\mu Q}{D^4}$

47. If it is required to convey the same discharge by replacing a pipe of diameter D by two equal parallel pipes of diameter d each, then $\frac{d}{D}$ should be
(a) 0.37 (b) 0.42
(c) 0.50 (d) 0.76

48. The critical angle of attack of an aerofoil is that, where
(a) the lift becomes zero
(b) the drag becomes zero
(c) the drag begins to rise
(d) the lift begins to drop

49. For laminar flow in a round pipe, the energy correction factor is
(a) 0.50 (b) 1.00
(c) 1.33 (d) 2.0

50. The velocity gradient in the transverse direction for a fluid flow equals
(a) the pressure gradient in the flow
(b) the rate of shear strain
(c) the stress at that point
(d) the strain at that point

Answer

1 (b)	11 (d)	21 (c)	31 (a)	41 (c)
2 (d)	12 (c)	22 (a)	32 (a)	42 (c)
3 (c)	13 (d)	23 (d)	33 (d)	43 (d)
4 (a)	14 (b)	24 (d)	34 (c)	44 (a)
5 (a)	15 (c)	25 (c)	35 (b)	45 (a)
6 (a)	16 (a)	26 (c)	36 (c)	46 (c)
7 (a)	17 (c)	27 (a)	37 (a)	47 (d)
8 (a)	18 (b)	28 (a)	38 (a)	48 (d)
9 (c)	19 (a)	29 (b)	39 (d)	49 (c)
10 (a)	20 (c)	30 (b)	40 (a)	50 (b)

1. The maximum and minimum speeds of a flywheel are 630 rpm and 600 rpm. Then the coefficient of fluctuation of speed:
(a) 0.0476 (b) 0.0300
(c) 0.0487 (d) 0.0500

2. A strain gauge oriented in a direction at an angle θ with x-axis, measures:
(a) $\varepsilon_x sin^2\theta + \varepsilon_y cos^2\theta + \gamma_{xy}\cos\theta\sin\theta$
(b) $\varepsilon_x cos^2\theta + \varepsilon_y sin^2\theta + 2\gamma_{xy}\cos\theta\sin\theta$
(c) $\varepsilon_x cos^2\theta + \varepsilon_y sin^2\theta + \gamma_{xy}\cos\theta\sin\theta$
(d) $\varepsilon_x cos^2\theta + \varepsilon_y sin^2\theta - \gamma_{xy}\cos\theta\sin\theta$

3. Heat exchange takes place, in which the product of pressure and volume remains constant, is known as:
(a) Isothermal process
(b) Hyperbolic process
(c) Isentropic process
(d) Adiabatic process

4. The efficiency of carnot cycle when it operates between the temperature of 373 and 273 K is:
(a) 0.268 (b) 0.134
(c) 0.183 (d) 0.366

5. In a 4-stroke petrol engine, the actual volume of fresh charge admitted is:
(a) more than stroke volume
(b) less than stroke volume
(c) equal to clearance volume
(d) equal to stroke volume

6. Manganese is added to Carbon steels:
(a) Make the steel ductile and good bending qualities
(b) decrease the elastic deformation
(c) Raise the yield point
(d) Make the steel tougher and harder

7. Petrol engine carburetors are manufactured by:
(a) Shell casting
(b) Die casting
(c) Centrifugal casting
(d) Sand casting

8. Torsional –sectional-modulus of a shaft is also called as:
(a) Polar modulus
(b) Torsional rigidity
(c) Sectional modulus
(d) torsion modulus

9. In case of Izod test, the specimen is kept as:
(a) Cantilever beam
(b) Overhanging beam
(c) Fixed ended beam
(d) Simply supported beam

10. Stellite preserve hardness up to temperature of:
(a) 900 ^{0}C (b) 350 ^{0}C
(c) 500 ^{0}C (d) 1100 ^{0}C

11. A thermodynamic open system is one in which:
(a) Mass do not cross boundary nut energy can
(b) Neither mass nor energy crosses the boundary
(c) Bothe energy and mass cross the boundary
(d) Mass crosses the boundary but not the energy

12. The continuity equation is the result of the application of the following law to the flow field:
(a) Netwons second law of motion
(b) First law of thermodynamics
(c) Conservation of energy
(d) Conservation of mass

13. Slow plastic deformation of a material under constant stress is:
(a) Proof deformation
(b) Creep
(c) Gradual deformation
(d) Fatigue

14. A cantilever beam of length 100 mm is subjected an end load of 150 N. If Young's Modulus is 200 GPa and Moment of Inertia is 5000 mm^4, the maximum deflection of this beam is:
(a) 0.5 mm (b) 5 mm
(c) 0.05 mm (d) 0.01 mm

15. In GTAW, the material coated on pure tungsten electrode to enhance its current capacity is:
(a) Manganese (b) Radium
(c) Titanium (d) Thorium

16. A body of specific weight w_1 floats on a liquid of specific weight w_2. Then the ratio of the volume of the object above the liquid to its volume is:
(a) $w_1/(w_2 - w_1)$

(b) $(w_2 - w_1)/w_1$
(c) $(w_2 - w_1)/w_2$
(d) $w_2/(w_2 - w_1)$

17. In an adiabatic process, the work done for a given pair of end states depends on:
(a) End states only
(b) Heat transferred
(c) Value of index n
(d) Mass of the system

18. A pinion rotates at 1200 rpm and transits a torque of 20 Nm. This pinion of 40 teeth mesh with the other spur gear having 60 teeth. The torque transmitted by the gear is:
(a) 20 Nm (b) 15 Nm
(c) 30 Nm (d) 40 Nm

19. A thin spherical shell of diameter 200 mm is subjected to an internal pressure of 2 MPa, if admissible tensile stress is 40 MPa, then thickness of the shell is:
(a) 5 mm (b) 2 mm
(c) 10 mm (d) 2.5 mm

20. An ideal fluid:
(a) has no viscosity and incompressible
(b) viscous at low temperature
(c) viscous but incompressible
(d) is viscous and compressible

21. The Heat transfer takes place due to
(a) Mass transfer
(b) Change in Entropy
(c) Change of temperature
(d) Change of pressure

22. The value of Poison's ratio depend upon:
(a) Material of the test specimen
(b) Nature of load, tensile or compressive
(c) Dimensions of the test specimen
(d) Magnitude of load

23. Thermal conductivity is the maximum for which substance:
(a) Diamond (b) Aluminium
(c) Ice (d) Silver

24. The Bernoulli Equation for a fluid is concerned with:
(a) Conservation of energy
(b) Work
(c) Momentum
(d) Force

25. In free body diagrams, the Principle of transmissibility states that the force acting on the body is a:
(a) rolling vector
(b) wedging vector
(c) unit vector
(d) sliding vector

26. When a body of mass moment of inertia about its axis (I) is rotated about the axis with an angular velocity (ω) , then the kinetic energy of rotation is:
(a) $0.5\ (I^2\omega)$ (b) $0.5\ (I\omega^2)$
(c) $I\omega^2$ (d) $2\ (I\omega^2)$

27. A line joining σ_y (yield strength) on mean stress axis and σ_e (endurance limit) on stress amplitude axis is called as:
(a) Gerber line (b) Langer line
(c) Soderberg line (d) Goodman line

28. A composite bar made of copper and steel is heated to 120 ^{0}C from room temperature. If $\alpha_c > \alpha_s$, the stress induced in copper bar is:
(a) Tensile stress (b) Compressive stress
(c) Shear stress (d) No stress

29. The foundry crucible is made with:
(a) Steel (b) Graphite
(c) Cast iron (d) Lead

30. High-speed compression engines operate on:
(a) Otto cycle (b) Carnot cycle
(c) Dual cycle (d) Diesel cycle

31. CNC machines allow the machine operator to set the zero point at any position on the machine table. This feature is called:
(a) Machine zero (b) fixed zero
(c) floating zero (d) fixed origin

32. The tool made of cemented carbide wear out faster at:
(a) medium speed (b) very fast speed
(c) slow speed (d) fast speed

33. One tonne refrigeration machine means:

(a) One tonne of ice melts for 0 ^{0}C in 24 hours
(b) mass of the machine
(c) One tonne of water is converted into ice
(d) One tonne of refrigerant is used

34. A square bar of side 5 mm and 200 mm long, experience an extension of 0.01 mm upon a load of 100 N. Then Young's Modulus of the material is:
(a) 800 MPa (b) 400 MPa
(c) 80 GPa (d) 200 GPa

35. A rectangular plate 1m wide and 2 m depth is held just below the surface of the water. The total pressure on this lamina is:
(a) 19.62 kN (b) 2 kN
(c) 9.81 kN (d) 98.1 kN

36. A perfect gas is heated at constant pressure from 30 ^{0}C till its volume become double. Then the final temperature is:
(a) 60 ^{0}C (b) 303 ^{0}C
(c) 120 ^{0}C (d) 333 ^{0}C

37. Shear stress concentration factor for coil spring is:
(a) $(2C)/(2C+1)$
(b) $(2C)/(2C-1)$
(c) $(2C-1)/(2C)$
(d) $(2C+1)/(2C)$

38. Pick the analytic surface entity from the list.
(a) spline surface (b) Gordon surface
(c) coons patches (d) ruled surface

39. For full annealing of hypereutectoid steel requires temperature 30 ^{0}C to 50 ^{0}C:
(a) below the lower critical temperature
(b) above the upper critical temperature
(c) below the upper critical temperature
(d) above the lower critical temperature

40. In forced vibration, the ratio of the maximum displacement to deflection due to static force is:
(a) Magnification factor
(b) Damping factor
(c) Damping coefficient
(d) Logarithmic decrement

41. According to the kinetic theory of gases, the absolute zero temperature is attained because of:
(a) kinetic energy of molecule is zero
(b) Specific heat of gas is zero
(c) Volume of gas is zero
(d) Pressure of gas is zero

42. The relative velocity of end B with respect to other end A in a rigid link AB is:
(a) perpendicular to AB
(b) parallel to AB
(c) inclined to AB
(d) along AB

43. Oscillations of a floating body are small when the metacentric height is:
(a) Negative (b) very small
(c) zero (d) large

44. Dimensions of surface tension are:
(a) ML^oT^{-1} (b) MLT^{-2}
(c) ML^oT^{-2} (d) M^oLT^{-2}

45. In electric discharge machining, better surface finish is obtained at:
(a) high frequency and low discharge current
(b) high frequency and high discharge current
(c) low frequency and high discharge current
(d) low frequency and low discharge current

46. A point at which the extension of steel material is faster than the load increment is:
(a) Plastic point (b) Breaking point
(c) Yield point (d) Ultimate stress point

47. A control system that measures certain output process variables and uses these to control speed and feed is called:
(a) in-process control
(b) operator control
(c) adaptive control
(d) feed – back control

48. Friction factor for laminar flow in a pipe is given by:
(a) $Re/24$ (b) $Re/64$
(c) $16/Re$ (d) $64/Re$

49. The vibration of a revolving shaft, at its nodal point is:
(a) Double than at the ends
(b) Maximum
(c) Zero
(d) Minimum

50. A Wheatstone bridge is used for electrical strain gauges, because it has:
(a) high sensitivity
(b) low sensitivity
(c) zero sensitivity
(D) infinite sensitivity

51. An imaginary circle on a gear which gives a rolling action, as same as the motion as the actual gear, is called:
(a) Pitch circle
(b) Addendum circle
(c) Clearance circle
(d) Dedendum circle

52. In a reverted gear train with four gears, two gears P And Q are meshing, Q-R is a compound gear, while R and S are meshing. The modulus of P and R are 6 mm and 5 mm respectively. The numbers of teeth in P, Q and R are 24, 36 and 40 respectively. The number of teeth in gear S is:
(a) 42 (b) 32
(c) 28 (d) 38

53. Two cubical castings of the same metal and sizes of 2 cm side and 4 cm side are moulded in green sand. If the smaller casting solidifies in 2 mins, the expected time of solidification of larger casting will be:
(a) 4 mins (b) 2 mins
(c) 16 mins (d) 8 mins

54. In a locomotive, the effect of 'hammer blow' can be reduced by:
(a) decreasing the speed and having pairs of wheels coupled together
(b) uncoupling the pairs of wheels
(c) increasing the speed
(d) balancing whole of the reciprocating parts

55. The carbon content in Tool Steels is:
(a) 0.3 to 0.8%
(b) 0.1 to 0.4%
(c) 0.8 to 1.5 %
(d) 1.5 to 3.6 %

56. Ratio of indicated thermal efficiency to the corresponding air standard cycle efficiency is:
(a) overall efficiency
(b) net efficiency
(c) indicated efficiency
(d) relative efficiency

57. In chemical machining, the etch factor is expressed as:
(a) Undercut/depth of cut
(b) tool wear/Workpiece wear
(c) Workpiece wear/tool wear
(d) Depth of cut/Undercut

58. Product of allowable bending stress and sectional modulus is
(a) Radius of gyration
(b) Moment of inertia
(c) Moment of resistance
(d) Moment of rigidity

59. The specific heat of a gas remains constant at all temperatures and pressures is discussed in:
(a) Joule's Law (b) Regnault's Law
(c) Charles' Law (d) Boyle's Law

60. A constituent makes the steel soft and less strength:
(a) Cementite (b) Ferrite
(c) Pearlite (d) Austenite

61. Which one of the dimensions number is significant when studying surface tension phenomena in a flow problem?
(a) Mach number (b) Weber number
(c) Euler number (d) Froude number

62. The pressure of fluid due to hammer blow is proportional to:
(a) Inversely to density of fluid
(b) Inversely to $\sqrt{(density}$ of fluid
(c) Directly to $\sqrt{(density}$ of fluid
(d) Directly to density of fluid

63. The Notch sensitivity (q) is determined by the equation in terms of where
(a) $(K_f + 1)/(K_t - 1)$
(b) $(K_f - 1)/(K_t - 1)$
(c) $(K_f - 1)/(K_t - 1)$
(d) $(K_f + 1)/(K_t + 1)$

64. Vibrations of transient in nature occurs in:
(a) Undamped vibrations
(b) Transverse vibrations
(c) Damped vibrations

(d) Torsional vibrations

65. The product of Kinematic Viscosity and mass density is:
(a) Specific viscosity
(b) Coefficient of Viscosity
(c) absolute viscosity
(d) Viscosity index

66. Spherical metal powders are produced by
(a) Automization
(b) Reduction
(c) Oxidation
(d) Electrolytic process

67. Side rake angle of a single point cutting tool is the angle:
(a) by which the face of the tool is inclined towards back
(b) between the surface of the flank below the point and a line drawn from the point perpendicular to the base
(c) between the surface of the flank below the point and a plane at right angles to the centre line of the point of the tool
(d) by which the face of the tool is inclined sideways

68. In elastic collisions of bodies:
(a)neither momentum of the colliding bodies nor the total kinetic energy are recoverable.
(b) only the total momentum of the colliding objects is conserved.
(c) both of the momentum and total kinetic energy are conserved.
(d) only the total kinetic energy is conserved.

69. The phase difference between transmitted and disturbing force for a negative isolation factor is:
(a) 120^0 (b) 90^0
(c) 45^0 (d) 180^0

70. The vibration isolation for a forced vibration system is possible, when:
(a) $\omega/\omega_n < 1$ (b) $\omega/\omega_n > 2^{0.5}$
(c) $\omega/\omega_n < 2^{0.5}$ (d) $\omega/\omega_n = 1$

71. A body of mass 100 kg with natural frequency 10 rad/sec has a critical damping:
(a) 2000 N/m/sec (b) 1000 N/m/sec
(c) 3142 N/m/sec (d) 10 N/m/sec

72. The theoretical velocity of jet at vena contracta in terms of Head of water is:
(a) $\sqrt{2}\, gh$ (b) 2gh
(c) $\sqrt{(2g)h}$ (d) $\sqrt{2gh}$

73. Atmospheric pressure head is equal to:
(a) Zero of water
(b) 10.3 m of water
(c) 8 m of water
(d) 2.5 m of water

74. In a pair of spur gear with external involute profile, the interference of tooth can be minimized by:
(a) Decreasing pressure angle
(b) Increasing number of gear teeth
(c) Decreasing module
(d) Decreasing center distance between gear pair

75. In the relation $V\ T^n = C$, the value of n for carbide tools is:
(a) 0.20 to 0.25
(b) 0.25 to 0.40
(c) 0.40 to 0.55
(d) 0.1 to 0.2

76. In deep drawing of sheets, the value of limiting draw ratio depends on:
(a) thickness of a sheet
(b) type of press used
(c) percentage elongation of sheet metal
(d) yield strength of sheet metal

77. The type of reamer used for reaming operation in a blind hole is:
(a) No reaming possible
(b) left-hand spiral fluted reamer
(c) right-hand spiral fluted reamer
(d) straight fluted reamer

78. A shaft is subjected to a bending moment 3 kN/mm and twisting moment 4kN/mm, then equivalent twisting is:
(a) 7 (b) 1
(c) 25 (d) 5

79. Two walls of the same thickness and cross-sectional area have thermal conductivities in the ratio 1 : 2. If the ratio of temperature drop across the two walls is 2:3, what is the ratio of heat flow?
(a) 1 : 2 (b) 2 :1

(c) 1 : 3 (d) 3 :1

80. The lowest temperature occur in vapour compression cycle is:
(a) Evaporator
(b) Compressor
(c) Expansion valve
(d) Condenser

81. The velocity parameters within the given fields are same when:
(a) Nusselt number are different
(b) Nusselt number are same
(c) Reynolds number are different
(d) Reynolds number are same

82. The angle of twist for the equivalent bar to spring is given by:
(a) $6PDN/Gd^3$ (b) $8PD^2N/Gd^4$
(c) $16PD^2N/Gd^4$ (d) $4PD^2N/Gd^4$

83. The position of a particle which is confined to move along a straight line is $S = 4t^3-32t+100$, where S is measured in meters and t in seconds. The time required for the particle to reach a velocity of 76 m/s from its initial condition at t = 0 is:
(a) 3 sec (b) 9 sec
(c) 12 sec (d) 4 sec

84. Cast iron pipes are manufactured by:
(a) Die casting method
(b) Centrifugal casting method
(c) Lost wax method
(d) Sand casting method

85. The α iron has a crystal structure:
(a) Closed packed hexagonal
(b) Face centered cubic
(c) Simple Cubic
(d) Body –centred cubic

86. One Ton refrigeration is equal to:
(a) 3.51 kW (b) 4.74 kW
(c) 7.12 HP (d) 1.0 kW

87. Euler's dimensionless number relates the following:
(a) Pressure force and inertial force
(b) Viscous force and inertial force
(c) Inertial force and gravity force
(d) Viscous force and buoyancy force

88. For power measurement, the following dynamometer is used when the speed is high and the viscous force is small:
(a) Froude water vortex dynamometer
(b) Telsa fluid friction dynamometer
(c) Amsler dynamometer
(d) Rope brake dynamometer

89. For a Mild steel, the Engineering stress-strain curve and True stress-strain curve are looks similar up to:
(a) Proportional limit
(b) Ultimate strength point
(c) Elastic limit
(d) Yield point

90. A barometer reads 765 mm of Hg. The atmospheric pressure is:
(a) 0.51 bar (b) 7.65 bar
(c) 3.82 bar (d) 1.02 bar

91. When a fluid flows through various cross-sections, the Cavitation occurs because of:
(a) High pressure
(b) Low viscosity
(c) High velocity
(d) Low pressure

92. Knock in a diesel engine occurs due to:
(a) instantaneous burning of the first part of the change
(b) reduction of delay period
(c) instantaneous auto ignition of last part of change
(d) delayed burning of the first part of the charge

93. A circular disc is rolling on a straight path, then the instantaneous centre of rotation is at:
(a) the centre of the disc
(b) Infinity
(c) their point of contact
(d) the centre of gravity of the disc

94. The boiling point of Refrigerant R-32 is:
(a) – 10 ^{0}C (b) - 52 ^{0}C
(c) – 43 ^{0}C (b) - 76 ^{0}C

95. When a material solidify due to latent heat of fusion is known as:
(a) Thermometry (b) Supercooling
(c) Undercooling (d) Thermal arrest

96. A column has an effective length twice the actual length, then the ends of column are:
(a) hinged at both the ends
(b) fixed at one end and free at the other end
(c) fixed at one end and hinged at the other end
(d) fixed at both the ends

97. Which of the following mechanism has Coriolis component?
(a) Four bar chains
(b) Slider crank mechanism
(c) Quick return mechanisms
(d) Gnome engine

98. A pipe 500 mm in diameter is 981 m long. It delivers water at a velocity of 2 m/s. The loss of head when f = 0.008 is
(a) 20.2 m (b) 12.8 m
(c) 6.4 m (d) 35.6 m

99. In carbon dioxide mouling process, the binder used is:
(a) Soldium silicate
(b) Sodium bentonite
(c) Phenol formaldehyde
(d) Calcium bentonite

100. Austempering heat treatment process is practiced to improve:
(a) brittleness (b) hardness
(c) toughness(d)ductility

Answer

1 (c)	21 (b)	41 (a)	61 (b)	81 (d)
2 (c)	22 (a)	42 (a)	62 (c)	82 (c)
3 (a)	23 (a)	43 (d)	63 (c)	83 (a)
4 (a)	24 (a)	44 (c)	64 (c)	84 (b)
5 (b)	25 (d)	45 (a)	65 (c)	85 (d)
6 (d)	26 (b)	46 (c)	66 (a)	86 (a)
7 (b)	27 (c)	47 (c)	67 (d)	87 (a)
8 (a)	28 (b)	48 (d)	68 (c)	88 (b)
9 (a)	29 (b)	49 (c)	69 (d)	89 (d)
10 (d)	30 (c)	50 (a)	70 (b)	90 (d)
11 (c)	31 (c)	51 (a)	71 (a)	91 (d)
12 (d)	32 (c)	52 (b)	72 (d)	92 (a)
13 (b)	33 (a)	53 (d)	73 (b)	93 (c)
14 (c)	34 (c)	54 (a)	74 (b)	94 (b)
15 (d)	35 (a)	55 (c)	75 (a)	95 (d)
16 (c)	36 (d)	56 (d)	76 (a)	96 (b)
17 (a)	37 (d)	57 (a)	77 (c)	97 (c)
18 (c)	38 (d)	58 (c)	78 (d)	98 (b)
19 (d)	39 (d)	59 (b)	79 (c)	99 (a)
20 (a)	40 (a)	60 (b)	80 (a)	100 (c)

1. The vehicle moving on a level circular path will exert pressures such that
(a) The reaction on the outer wheels will be more
(b) The reaction on the inner wheels will be more
(c) The reaction on the wheels are equal
(d) The reaction depends upon the speed of wheel

2. For a spring mass system, the frequency of vibration is 'N' what will be the frequency when one more similar spring is added in series
(a) $N/2$ (b) $N/\sqrt{2}$
(c) $\sqrt{2}/N$ (d) 2N

3. Whirling speed of a shaft coincides with the natural frequency of its
(a) Longitudinal vibration
(b) Transverse vibration
(c) Torsional vibration
(d) Coupled bending-torsional vibration

4. Conductivities of semi conductors range from
(a) 10^{-9} to 10^{4} $ohm^{-1}cm^{-1}$
(b) 10^{-8} to 10^{3} $ohm^{-1}cm^{-1}$
(c) 10^{-7} to 10^{4} $ohm^{-1}cm^{-1}$
(d) 10^{-9} to 10^{3} $ohm^{-1}cm^{-1}$

5. Velocity factor is used to take care of
(a) effect of high velocity
(b) possibility of fatigue failure
(c) possibility of high wear
(d) pitting

6. Single plate clutch is used in
(a) four wheelers
(b) two wheelers
(c) mopeds
(d) applications where torque is high

7. Short shoe brakes have an angle of contact less than
(a) 10^0 (b) 20^0
(c) 60^0 (d) 45^0

8. Slip in the case of a centrifugal pump
(a) Increases the flow rate
(b) Reduces the energy transfer
(c) Reduces the speed
(d) Increases cavitation

9. In fully developed turbulent flow, if the diameter is halved without changing the flow rate, the frictional drop will change by the factor
(a) 32 times (b) 16 times
(c) 8 times (d) 4 times

10. In a steady flow of incompressible fluid, as the diameter is doubled, the velocity will
(a) be halved
(b) be doubled
(c) increase four fold
(d) decrease four fold

11. Which one of the following is a valid potential function?
(a) $\varphi = clu\ x$
(b) $\varphi = c\ \cos x$
(c) $\varphi = 3xy$
(d) $\varphi = c(x^2 + y^2)$

12. If a body is in stable equilibrium the metacentric height should be
(a) zero (b) positive
(c) negative (d) depends on the fluid

13. A horizontal cylinder half filled with fuel is having an acceleration of 10 m/s^2. The gravitational forces are negligible. The free surface of the liquid will be
(a) horizontal
(b) slopes in the direction of acceleration
(c) vertical
(d) slopes in the direction opposite of acceleration

14. The excess pressure in a droplet of 0.002 m diameter a fluid with surface tension of 0.01 N/m is
(a) 10 (b) 20
(c) 4 π (d) 0.00004 π

15. The amount of energy added by heat transfer to the cycle to produce unit of network output is called
(a) Heat rate
(b) Work ratio
(c) Back work ratio
(d) Thermal efficiency

16. The value of dryness fraction at critical point for water-steam phase transformation may be
(a) 0 (b) 1
(c) either 0 (or) 1 (d) all of these

17. For a reversible engine cycle, the clausius inequality says,
(a) $\oint \frac{dQ}{T} > 0$ (b) $\oint \frac{dQ}{T} < 0$
(c) $\oint \frac{dQ}{T} = 0$ (d) $\frac{dQ}{T} + du = 0$

18. If carnot engine rejects at temperature of 400 K and accepts at 750 K. What shall be heat absorbed, if heat rejected is 1000 KJ
(a) 946 kJ (b) 800 kJ
(c) 1875 kJ (d) 750 kJ

19. Latent heat of vaporization of water at critical point is
(a) 334 J/kg (b) 234 J/kg
(c) 334 kJ/kg (d) Zero

20. In reference to Thermodynamic equilibrium, it is required to have
(a) Mechanical Equilibrium
(b) Chemical Equilibrium
(c) Thermal Equilibrium
(d) Mechanical, Chemical and Thermal Equilibrium

21. Free convection flow depends on all of the following EXCEPT
(a) Density
(b) Coefficient of viscosity
(c) Gravitational flow
(d) Velocity

22. For a current wire of 20 mm diameter exposed to air (h = 20 W/m^{2}K), maximum heat dissipation occurs when thickness of insulation (k = 0.5 W/mK) is,
(a) 20 mm (b) 25 mm
(c) 28 mm (d) 10 mm

23. Match List I with List II and select the current answer using the codes given below:

List I	List II
(A) Momentum transfer	1. Thermal diffusivity
(B) Mass transfer	2. Kinematic viscosity
(C) Heat transfer	3. Diffusion coefficient

	A	B	C
(a)	2	3	1
(b)	1	3	2
(c)	3	2	1
(d)	1	2	3

24. A steel ball of mass 1 kg and specific heat 0.4 kJ/kg is at a temperature of 60^0 C. It is dropped into 1 kg of water at 20^0 C. The final steady state temp of water is,
(a) 23.5^0 C (b) 30^0 C
(c) 35^0 C (d) 40^0 C

25. Hardening by carburizing is limited to
(a) 0.05 mm (b) 0.1 mm
(c) 2 mm (d) 5 mm

26. The slowest cooling rate is achieved when steel is quenched in
(a) Fused salt (b) Air
(c) Brine (d) Mixture of water

27. Which one of the following was not used for understanding the mechanics of the heat treatments?
(a) TTT diagrams
(b) CCT diagrams
(c) Hardenability
(d) Phase diagrams

28. Heat treatment process to soften hardened steel was
(a) Normalizing (b) Annealing
(c) Tempering (d) Spheroidizing

29. In which of the process line defects were not formed
(a) Solidification of metals
(b) Recrystallisation of metals
(c) Deformations of metals
(d) Melting of metals

30. The molten metal is poured from the pouring basin to the gate with the help of a
(a) Riser (b) Sprue
(c) Runner (d) Core

31. In hot working of metals, the working temperature is
(a) Below the recrystallization temperature
(b) Above the recrystallization temperature
(c) Equal to the melting point of the metal

(d) 150^0C

32. In oxy-acetylene gas welding, for complete combustion, the volume of oxygen required per unit ton of acetylene is

(a) 1 (b) 1.5
(c) 2 (d) 2.5

33. Match the List I with List II and choose the correct answer:

List I	List II
(a) Seiko	1. Orderliness
(b) Seiketso	2. Clean up
(c) Seiso	3.Personal cleanliness
(d) seiton	4. Proper arrangement

(a)	4	3	2	1
(b)	4	3	1	2
(c)	3	4	2	1
(d)	1	3	2	4

34. A least accurate measuring device was

(a) Air gauge
(b) Micrometer screw gauge
(c) Steel rule
(d) Optical projector

35. Gratings are used in connection with

(a) Flatness measurement
(b) Roundness measurement
(c) Surface texture
(d) Linear displacement

36. Which of the following methods is not concerned with the surface finish measurement? options missing

(a) Spectrophotometry method
(c) Field emission method
(d) Critical angle of attack method

37. A ring gauge is used to measure

(a) Outside diameter only
(b) Roundness only
(c) Both outside diameter and roundness
(d) Only external threads

38. Extended Binary-coded decimal interchange code uses

(a) 8 – bit code (b) 16-bit code
(c) 32-bit code (d) 7-bit code

39. Localizing an object in an image and selectively analyzing the object in a series of redundant layers is known as

(a) Maxwell pyramid
(b) Faraday pyramid
(c) Gaussian pyramid
(d) Turning test

40. CAE and CAM are linked through

(a) A common database and communication system
(b) NC tape programming and automated design
(c) Assembly automation and tool production
(d) Parts production and testing

41. Flexible manufacturing allows for

(a) Automated design
(b) Factory management
(c) Tool design and tool production
(d) Quick and inexpensive product changes

42. Calligraphic is

(a) coloured image
(b) coloured drawing
(c) line drawing
(d) dot matix

43. In robotics, precision of movement is a complex issue and it is described as three attributes namely spatial resolution, repeatability and

(a) Soundness (b) accuracy
(c) speed (d) sensation

44. In the production of a product, the fixed costs are Rs. 6,000 and the variable cost is Rs. 10 per product. If the sale price of the product is Rs. 12 the break even volume of the product to made will be

(a) 2000 (b) 3000
(c) 4000 (d) 6000

45. In a transportation problem, the materials are transported from 3 plants to 5 ware houses, the basic fessible solution must contain exactly, which one of the following allocated cells?

(a) 3 (b) 5
(c) 7 (d) 8

46. Fulkerson's rule deals with

(a) Numbering of events in PERT/CPM model
(b) The simulation model
(c) Queuing theory model
(d) Transportation model

47. The time which results in the least possible direct cost of an activity is known as
(a) Normal time (b) Slow time
(c) Crash time (d) Standard time

48. Positive slack on a PERT indicates that project is
(a) ahead of schedule
(b) beyond schedule
(c) on critical path
(d) as per schedule

49. 'Planning involves the selection of objectives, policies, procedures and programmes from among alternatives' was stated by
(a) Koontz and O Donnell
(b) Hodge
(c) Alford and Betty
(d) Hurley

50. Which one of the following element was not involved in directing?
(a) Motivation (b) Leadership
(c) Communication(d) Delegation

51. Four stroke petrol engines as compared to two stroke petrol engines having same output rating and same compression ratio have
(a) Higher thermal efficiency
(b) Higher specific fuel consumption
(c) Higher specific output
(d) Higher torque

52. In a four stroke I.C. Engine cam shaft rotates at options missing
(a) Same speed as crank shaft
(b) Half the speed of crank shaft
(d) 1.5 times the speed of crank shaft

53. In a typical medium speed 4-stroke cycle diesel engine, the inlet valve [TDC- Top Dead Centre, BDC- Bottom Dead Centre]
(a) Opens at 20^0 before TDC and closes at 35^0 after BDC
(b) Opens at TDC and closes at BDC
(c) Opens at 10^0 after TDC and closes at 20^0 before BDC
(d) Remain open for 200^0

54. The most perfect method of scavenging is
(a) Cross scavenging
(b) Uniflow scavenging
(c) Loop scavenging
(d) Reverse flow scavenging

55. Modern CRDI engines uses injection pressure of the order of
(a) 400 bar
(b) 800 bar
(c) 1000 bar
(d) 1600 bar

56. _____ permits one shaft to drive two other shafts with equal efforts at three different shaft speeds.
(a) Universal joint
(b) Stub axels
(c) Differential
(d) Axle housing

57. The parking brakes employed in vehicles are operated
(a) Mechanically
(b) Hydraulically
(c) Pneumatically
(d) Electronically

58. The operation of removing trapped air from the hydraulic braking system is known as
(a) Trapping (b) Tapping
(c) Bleeding (d) Cleaning

59. Which of the following chassis layout is fitted with transfer case?
(a) Front engine – Front wheel drive
(b) Rear engine – Rear wheel drive
(c) Front engine – all wheel drive
(d) Front engine – Rear wheel drive

60. The slots or openings in a disc wheel enhances
(a) Vehicle body cooling
(b) Passenger compartment cooling
(c) Engine-Radiator cooling
(d) Brake system cooling

61. Air brakes are mostly used in case of
(a) Cars (b) Jeeps

(c) Trucks (d) Three-wheels

62. In petrol engine, increase of cooling water temperature will
(a) Increase the knocking tendency
(b) Decrease the knocking tendency
(c) Not affect the knocking tendency
(d) Increase or decrease knocking tendency depending on strength and time of spark

63. Which of the following statement is not correct with respect to alcohols as alternate fuels in I.C. Engines?
(a) Alcohols are corrosive in nature
(b) Alochol contains about half the heat energy of gasoline
(c) Auto-knock charactersistics of alchol is poor
(d) Alcohol does not vaporize as easily as gasoline

64. The thermostat in I.C. engines permitting hot water to go to radiator is set around
(a) 70 – 80^0 C
(b) 80 – 85^0 C
(c) 85 – 95^0 C
(d) Above 100^0 C

65. There are three types of Disc Brake
(a) Fixed Caliper, Tab-Action and Two-Piston
(b) Fixed Caliper, Sliding Caliper and Floating Caliper
(c) Floating Caliper, Swinging Caliper and Proportioning Caliper
(d) Fixed caliper, floating caliper and Swinging caliper

66. Free pedal play in car clutches is about
(a) 3 mm (b) 300 mm
(c) 30 mm (d) 60 mm

67. The co-efficient of friction for the clutch facing is approximately
(a) 0.1 (b) 0.4
(c) 0.8 (d) 1.2

68. The torque transmitting capacity of fluid coupling [T] for a given slip varies with impeller internal diameter 'D' and its speed 'N' as
(a) $T \propto D^3N^2$ (b) $T \propto D^3N^3$
(c) $T \propto D^5N^5$ (d) $T \propto D^5N^2$

69. ________ are welded to the rear wheel house panel, the floor panel and the rear of the rocker panel in a car.
(a) Rear doors
(b) Rear windows
(c) Rear quarter panels
(d) Trunk lid

70. Technician A says, the conventional body design will have more floor height, hence stability will be increased. Technician B says the weight of the frame is more, hence less vehicle speed. Out of these
(a) A is correct
(b) B is correct
(c) Both A and B are correct
(d) Neither A nor B are correct

71. Acute angles between backrest and seat squab results in
(a) Compressed thorax
(b) Numness in arms
(c) Thigs press on the stomach
(d) Numness in feet

72. Which one of the following is incorrect with respect to painting of vehicles?
(a) Paints creates a thermal boundary layer on the surface
(b) Paints prevents rapid corrosion of parts
(c) Paint colour increases the ability to be seen
(d) Paint colour increases the aesthetic look

73. In viscous damping, the damping force is _______ the velocity of vibrating body.
(a) proportional to
(b) Inversely proportional to
(c) Square of
(d) Cube of

74. The ratio of damping constant to the critical damping constant is called as
(a) Logarithmic decrement
(b) Damping ratio
(c) Magnification factor
(d) Transmissibility ratio

75. Consider the following degrees of freedom
(i) Pitch
(ii) Roll

(iii) Xaw

The DOF which is not included in half car model is

(a) (i) and (ii) (b) (i) and (iii)

(c) (ii) and (iii) (d) (i), (ii) and (iii)

76. The active spring component of actively body control system influence the motion of vehicle's body within _______ range of its natural frequency.

(a) 1 to 2 Hz (b) 5 to 10 Hz

(c) 20 to 30 Hz (d) 50 to 100 Hz

77. The unit of under steer coefficient is

(a) Radian (b) MM/MM

(c) N/M (d) M

78. A front engine, front wheel drives with a large proportion of the vehicle weight on front tyres may tend to exhibit ______ behavior

(a) Reverse steer (b) Under steer

(c) Neutral steer (d) Over steer

79. What are the gain and natural frequency of the following system transfer function G(S) = $\frac{36}{S^2+3S+36}$

(a) 36, 6 (b) 6, 6

(c) 1, 6 (d) 6,1

80. To implement the derivative term, we usually use a low-pass filter. The time constant of a low-pass filter should be

(a) much smaller than the derivative time constant

(b) much smaller than the integral time constant

(c) much smaller than the system time constant

(d) much larger than the derivative time constant

81. A PID controller has a proportional band of 50%, the proportional gain is

(a) $K_P = 50$ (b) $K_p = {PB}/{50}$

(c) $K_P = 50$ PB (d) $K_p = {100}/{PB}$

82. Which of these descriptions is true of the step response of an over damped system?

(a) it rises to a steady state value with no overshoot

(b) It rises to a steady state value with little overshoot

(c) It rises to a steady state value with large overshoot

(d) it does not settle to a steady state value

83. The short hand formulae for calculating the closed loop transfer function for simple system is

(a) forward / (1+ open loop)

(b) forward * feed back / (1 + open loop)

(c) forward / (1 + forward)

(d) loop / (1 + open loop)

84. The percentage overshoot of a second order system to a step input depends only on

(a) the value of the step input

(b) the value of the damping ratio

(c) the value of the gain

(d) natural frequency

85. Three way catalytic converters reduce the emission of

(a) CO, CO_2 and soot

(b) CO, NO_x and HC

(c) CO_2, NO_x and HC

(d) CO, HC and soot

86. NO_x emission is maximum in S.I. engines when the fuel ratio is

(a) exactly stoichiometric

(b) lean mixture

(c) rich mixture

(d) nearby stoichiometric

87. Efficient operation of catalytic converters require maintenance of

(a) temperature and pressure

(b) temperature and equivalence ratio

(c) pressure and equivalence ratio

(d) temperature

88. Rhodium in the catalytic convertor promotes the reduction of

(a) HC (b) CO

(c) NO_x (d) Smoke

89. The three way catalytic converters, having following combination of catalysis used,

(a) Platinum, Palladium and Rhodium

(b) Platinum, Palladium and Nickel

(c) Palladium, Rhodium and Nickel

(d) Platinum, Rhodium and Nickel

90. A Gasoline engine running in a closed room is dangerous because the exhaust gas contains mainly
(a) Blue smoke
(b) Water vapor
(c) Carbon monoxide
(d) Air

91. Knocking takes place in C.I. Engines
(a) at the start of combustion
(b) at the end of combustion
(c) during combustion
(d) during the delay period

92. The purpose of preventive maintenance is to
(a) help schedule breakdowns
(b) eliminate routine service work
(c) force the driver to use his own service station
(d) help prevent failure

93. Service specifications are set by the
(a) Vehicle manufacture
(b) Technician
(c) Service manager
(d) Society of Automotive Engineers

94. Most shops discourage customers from roaming around the shop work areas because the customers
(a) often want to help
(b) may steal the data and shared it to the competitor
(c) could be in danger without reality it
(d) may find out they are paying for warranty work

95. A power window motor operates in one direction but not the other direction. What is the most likely cause of this complaint?
(a) worn brushes
(b) defective permanent magnets
(c) loss of residual magnetism in the armature
(d) defective power window switch

96. The main purpose of the field coils in a DC motor is to
(a) create a stationary magnetic field in the stator
(b)create a magnetic field in the armature
(c)create a CEMF
(d)reverse the polarity in the armature winding just as commutation occurs.

97. The stator winding in an alternator are being tested with an ohmmeter. The resistance measured between each of the three windings is nearly 0 ohms. What does it indicate?
(a) The stator windings do not have an open circuit
(b)The stator windings are shorted to the stator frame
(c)The stator windings are open
(d)The stator windings are magnetized

98. A wavefrom repeats itself 60 times per second. What is the frequency of the waveform?
(a) 120 hertz (b) 1 hertz
(c) 60 hertz (d) 3600 hertz

99. A rectifier diode bridge in an alternator is used to
(a) Convert DC into AC
(b) Regulate voltage output
(c) Bridge the gap between the stator and the rotor
(d) Convert or rectify the negative half of a sine wave into the positive half of a sine wave

100. If the ratio of the length of connecting rod to the crank radius increases
(a) primary unbalanced forces increase
(b)primary unbalanced force decrease
(c)secondary unbalanced forces increase
(d)secondary unbalance forces decrease

101. The radius of gyration 'k' for a solid cylinder of radius 'R' is equal to
(a) $\sqrt{2}R$ (b) $R/\sqrt{2}$
(c) 0.6324 R (d) 0.5 R

102. A ball is thrown up. The sum of kinetic and potential energies will be maximum at
(a) the ground (b) the highest point
(c) the centre (d) all the points

103. The potential energy an elevator losses in coming down from the top of a building to stop at the ground floor is
(a) lost to the driving motors
(b) converted into heat

(c) lost in friction of the moving surfaces
(d) used up in lifting the counter poise weight

104. The motion transmitted between the teeth of two spur gears in mesh is generally
(a) Sliding
(b) Rolling
(c) Rotary
(d) Partly sliding and partly rolling

105. If a constant force 'F' acts on abody of mass 'm' for time 't' and changes its velocity from u to v under an acceleration of 'a' all in the same direction, then for equilibrium of the body
(a) $F = \frac{mu}{t}$
(b) $F = \frac{mv}{t}$
(c) $F = m\left(\frac{v-u}{t}\right)$
(d) $F = m\left(\frac{v+u}{t}\right)$

106. Due to addition of extra full length leaves the deflection of a semi-elliptic spring
(a) increases
(b) decreases
(c) does not change
(d) is doubled

107. Strain rosettes are generally used for
(a) measurement of load
(b) measurement of shear strain
(c) measurement of longitudinal strain
(d) measurement of resilience

108. Rivets are generally used for
(a) shape
(b) diameter of head
(c) overall length
(d) shank diameter

109. A propped cantilever is indeterminate externally to
(a) The second degree
(b) The third degree
(c) The fourth degree
(d) The fifth degree

110. Design of power transmission shafting is based on
(a) Maximum shear stress theory of failure
(b) St. Ventant theory
(c) Rankine's theory
(d) Heigh's theory

111. If the radius of wire stretched by a load is doubled then its Young's modulus
(a) will be doubled
(b) will be halved
(c) becomes four times
(d) remains unaffected

112. One kgf/cm^2 when converted to SI units is
(a) 0.0981 MPa (b) 0.98 MPa
(c) 10^4 Pa (d) 1 Pa

113. Flow separation in flow past a solid object is caused by
(a) a reduction of pressure to vapour pressure
(b) a negative pressure greadient
(c) a positive pressure gradient
(d) the boundary layer thickness reducing to zero

114. If x is the distance measured from the leading edge of a flate plate, the laminar boundary layer thickness varies as
(a) $\frac{1}{x}$ (b) $x^{4/5}$
(c) x^2 (d) $x^{1/2}$

115. A pump handling a liquid raises its pressure from 1 bar to 30 bar. Take the density of the liquid as 990 kg/m^3. The isentropic specific work done by the pump in kJ/kg is
(a) 0.10 (b) 0.30
(c) 2.50 (d) 2.93

116. Which of the following is not a property of the system?
(a) Temperature (b) Pressure
(c) Volume (d) Heat

117. 'COP' of a reversible heat pump is 1.2. if it is reversed to run as reversible heat engine then its efficiency shall be
(a) 0.833 (b) 0.2
(c) 1.2 (d) 0.5

118. The change of entropy, when heat is absorbed by the gas, is
(a) positive
(b) negative
(c) positive or negative
(d) zero

119. For each mole of oxygen, number of moles of nitrogen required for complete combustion of carbon are
(a) 20/21 (b) 2/21
(c) 77/21 (d) 79/21

120. Two sphere A and B of same material have radii 1 m and 4 m and temperature 4000 K and 2000 K respectively. Which one of the following statement is correct related to heat transfer by radiation?
(a) Greater than that of sphere 'B'
(b) Less than that of sphere 'B'
(c) Equal to that of sphere 'B'
(d) Equal to double that of sphere 'B'

121. Formation of frost on evaporator in a refrigerator
(a) increases heat transfer rate
(b) results in loss of heat due to poor heat transfer
(c) is immaterial
(d) decreases compressor power

122. In SI unit, one ton of refrigeration is equal to
(a) 210 KJ/min
(b) 210 kJ/sec
(c) 3.5 kW/min
(d) 3.5 KW/hour

123. Which is more viscous lub oil given below?
(a) SAE 30 (b) SAE 40
(c) SAE 70 (d) SAE 80

124. The air standard efficiency of an otto cycle compared to Diesel cycle for given compression ratio is
(a) same (b) less
(c) more (d) unpedicatable

125. For evaporators and condensers, for the given conditions, the Logarithmic Mean Temperature Difference (LMTD) for parallel flow is
(a) Equal to that for counter flow
(b) greater than that for counter flow
(c) Less than that for counter flow
(d) Very much smaller than that for counter flow

126. Which one of the following materials, deformation of crystals was not by twinning?
(a) Zinc (b) Tin
(c) Iron (d) Aluminium

127. Balls for ball bearings are made of
(a) High carbon
(b) Mild steel
(c) Stainless steel
(d) Carbon-chrome steel

128. Which of the following is a copper free alloy?
(a) Brass (b) Phosphor bronze
(c) Invar (d) Muntz metal

129. Iron-carbon alloy containing 1.7 to 4.3% carbon is called
(a) Eutectoid cast Iron
(b) Hyper eutectic cast Iron
(c) Hypo-eutectic cast Iron
(d) Eutectoid steel

130. Match the List I alloys with List II applications and select the correct answer using the codes given below

List I	List II
(a) Chromel	1. Journal bearing
(b) Babbit alloy	2. Milling cutter
(c) Numonic alloy	3. Thermo couple wire
(d) High speed steels	4. Gas turbine blade

	(a)	(b)	(c)	(d)
(a)	3	1	4	2
(b)	3	4	1	2
(c)	2	4	1	3
(d)	2	1	4	3

131. Hard-zone cracking in low alloy steel due to welding is the result of an absorption of
(a) N_2 (b) O_2
(c) H_2 (d) C

132. Cutting power consumption in turning can be significantly reduced by
(a) increasing rake angle of the tool
(b) increasing the cutting angle of the tool
(c) widening the nose radius of the tool
(d) increasing the clearance angle

133. A grinding wheel of 150 mm diameter is rotating at 3000 rpm. The grinding speed is
(a) 7.5π m/s (b) 15π m/s

(c) 45π m/s (d) 0.450π m/s

134. In ultrasonic machining process, the material removal rate will be higher for materials with
(a) higher toughness
(b) higher ductility
(c) lower toughness
(d) higher fracture strain

135. In Electro-Discharge machining, the work piece is connected to
(a) Cathode (b) Anode
(c) Earth (d) Electrolyte

136. Feed drives in CNC milling machines are provided by
(a) synchronous motors
(b) induction motors
(c) stepper motors
(d) servo-motors

137. The rake angle in a drill
(a) increase from centre to periphery
(b) decrease from centre to periphery
(c) remains constant
(d) is irrelevant to the drilling operation

138. For general use the measuring tip of a comparator should be
(a) Flat (b) Spherical
(c) Conical (d) Grooved

139. The gauges which are only for checking the size and condition of other gauges are called
(a) Plug gauge (b) Master gauge
(c) Limit gauge (d) Inspection gauge

140. Statistical quality control was developed by
(a) Frederick Taylor
(b) Walter Shewhart
(c) George Dantzing
(d) W.E. Deming

141. Match the List I with List II and select the correct answer given below:

List I	List II
(a) Talysurf	1. T slots
(b) Telescopic gauge	2. Flatness
(c) Transfer calipers	3. Internal dia
(d) Autocollimeter	`4. Roughness

	(a)	(b)	(c)	(d)
(a)	1	2	3	4
(b)	4	3	1	2
(c)	4	3	2	1
(d)	3	4	1	2

142. Which of the following errors are not controllable?
(a) Caliberation errors
(b) Environmental errors
(c) Avoidable errors
(d) Random errors

143. A technique for displaying applications where complex 3-D geometric are required for the exterior shell of a product is called
(a) 2-D modeling
(b) Solid modeling
(c) 3-D modeling
(d) Surface modeling

144. The resolution of electrostatic plotter is expressed in terms of
(a) number of lines per unit area
(b) number of dots per inch
(c) ratio of darkened are to gross area
(d) number of lines per inch

145. The difference between CAD and CAM is that CAD software is directed at product design while CAM software is
(a) concerned with production and control of tool design
(b) concerned with management programs
(c) specifically for PC board design
(d) designed for communications

146. A Robot is basically a
(a) machining device
(b) inspection device
(c) material handler
(d) machine tool

147. Basic tool required for work study is
(a) graph sheet
(b) Process chart
(c) Planning chart
(d) Stop watch

148. The individual human variability in time studies to determine the production standards is taken care of by
(a) personal allowances
(b) work allowances
(c) error allowances
(d) machine allowances

149. Buffer stock + Reserve stock + Safety stock equals
(a) Order quality
(b) EOQ
(c) Reorder point
(d) Maximum inventory level

150. Petrol engines are not suitable for part-load operation; because
(a) mechanical efficiency is poor due to increasing internal losses at increased throttling
(b) of fear of pre-iginition
(c) of huge knocking
(d) of increased detonation tendency

151. A distributor in spark ignition engines performs the function of
(a) distributing the right quantity of fuel oil to the desired cylinder
(b) adding additives to fuel oil
(c) adding additives to fuel oil
(d) providing the correct firing order in the engine

152. If the compression ratio of an engine working on Otto cycle is increased for 5 to 7, the % of increase in efficiency will be
(a) 2% (b) 8%
(c) 4% (d) 14%

153. In air standard diesel cycle at fixed 'r' and fixed 'γ'
(a) ($\eta_{thermal}$) increases with increase in heat addition and cut-off ratio
(b) ($\eta_{thermal}$) decreases with increase in heat addition and cut-off ratio
(c) ($\eta_{thermal}$) increases with increase in heat addition and cut-off ratio
(d) ($\eta_{thermal}$) remain the same with increase in heat addition and cut-off ratio

154. The specific fuel consumption for a petrol engine first decreases with increase in fuel air ratio and then increases with further increases in fuel air ratio. The minimum value occurs in the range of,
(a) chemical correct mixture
(b) lean mixture
(c) rich mixture
(d) unpredictable

155. The main function of the tread pattern of the tyre is that
(a) Tread groove pass air between the tyre and the road surface, there by preventing tyre from over-heating
(b) The crests between the thread grooves absorb noise
(c) The tread groove expels water that is drawn between the tyre and road surface
(d) The tread pattern protects the tyre's inner carcass from small stones and pieces of glass

156. The tyre is designated as "175/65 R 14 82S", then the load index for the tyre is
(a) 175 (b) 65
(c) 14 (d) 82

157. The object of air conditioning a car is to control these in the
(a) Temperature and Pressure
(b) Pressure and Humidity
(c) Humidity and Temperature
(d) Humidity and Pressure

158. The angle of inclination of the front wheel tyre with respect to the vertical plane is
(a) Caster (b) Camber
(c) Wheel track (d) Toe-out

159. ________ permits the motion to be transmitted from the gear box output shaft to the pinion shaft of the differential, irrespective of the inclination of the drive shaft.
(a) Riveted joints
(b) Welded joints
(c) Slip joints
(d) Universal joints

160. The energy stored per unit volume in coil spring as compared to leaf spring is
(a) Equal amount
(b) Double the amount
(c) Four times higher
(d) Six times higher

161. In hydraulic Brakes 'Bleeding' refers to
(a) The process of removing air out from the braking system
(b) The process of filling the brake fluid in the brake cylinders
(c) The leakage of brake fluid in the brake system
(d) The process of emptying the brake fluid from the brake system

162. The ratio of total load on the spring to the maximum deflection is called as
(a) spring Tension
(b) Spring life
(c) Spring efficiency
(d) Spring rate

163. To prevent the automatic-level control system from reacting too quickly, the system includes
(a) a height control valve
(b) an air compressor
(c) an air dryer
(d) a time-delay mechanism

164. In an electric air suspension system, the following components are used
(a) Electric air compressor, a micro computer control module, four air springs, there height semons and the air distribution section
(b) Four air spring only
(c) Four coil spring only
(d0 Electric air compressor only

165. The component of the torque convertor that allows multiplication of torque is the
(a) Turbine (b) Impeller
(c) Pump (d) Stator

166. Cushioning springs in clutch plate are meant to reduce
(a) Torsional vibrations
(b) Vehicle speed
(c) Jerky starts
(d) None of the above

167. The sliding dog clutch in the constant mesh gear box is to transmit the power from the
(a) Primary shaft to lay shaft
(b) Lay shaft to output shaft
(c) primary shaft to output shaft
(d) None of the above

168. In a fully automated centrifugal clutch the reaction plate is installed in between
(a) The pressure plate and cover pressing
(b) The pressure plate and fly wheel
(c) The pressure plate and the driven plate
(d) Cover processing and bob weight

169. In a simple epicyclic gear train for transmission of torque. The following component must be held stationary
(a) Sun gear
(b) Annular gear
(c) The carrier unit
(d) Any one of the above

170. Automatic transmission as compared to manual transmission are usually
(a) More fuel efficient
(b) less fuel efficient
(c) Equally efficient
(d) None of the above

171. The interior of a vehicle is given an aesthetic look by adding
(a) Panels
(b) Mechanisms
(c) Trims
(d) Firewall

172. Which of the following device is used to measure the airflow velocity in wind tunnel testing?
(a) Anemometer
(b) Altimeter
(c) Barometer
(d) Steam generator

173. The most commonly used supplementary restraint system is
(a) Seat belt
(b) Disc brakes
(c) Air bags
(d) Telescopic steering column

174. Bumper and other collision absorbing materials is made up of
(a) Light alloys of Brass
(b) Light alloys of Copper
(c) Light alloys of Aluminium

(d) wood blocks

175. Choose one feature that improves the forward visibility of a vehicle
(a) Brake light
(b) Hazard lights
(c) Turn indicators
(d) Cornering head light

176. Which type of bus is more suited for the following features?
Engine in front of passenger compartment
Low ratio of useful length to overall length
Poor aerodynamic shape and high tare weight
(a) Classic type bus
(b) Doubleducker bus
(c) Split level bus
(d) Articulated bus

177. In constant speed test, the vehicle is driven with
(a) Constant speed at various steer angle
(b) Constant speed at constant steer angle
(c) Constant speed at various turing radii
(d) Constant speed at constant steer angle with constant radius

178. The coefficient of rolling resistance is defined as the ratio between
(a) Rolling resistance to lateral load
(b) Lateral load to rolling resistance
(c) Rolling resistance to normal load
(d) Normal load to rolling resistance

179. Engine overheating may be due to
(a) Struck radiator pressure cap
(b) open thermostat
(c) excess coolant
(d) broken fan belt

180. Yaw velocity can be measured using
(a) Proximity sensor
(b) speed sensor
(c) Gyro sensor
(d) Torque sensor

181. A regulator problem is where the closed loop system must
(a) try to follow a series of set point changes
(b) remove any disturbances acting on the system
(c) respond very quickly
(d) respond very slowly

182. Engine Knock can be measured by using
(a) Combustion pressure sensor
(b) Mechanical vibratoion sensor
(c) Ion current measurement
(d) All the above

183. The knocking sensitivity of engines could be reduced by
(a) Compact combustion chamber geometry
(b) Central position of the spark plug
(c) Increased turbulence
(d) all the above

184. Reducing the combustion –chamber surface area
(a) reduces the amount of unburned HC in the exhaust gas
(b) increases the amount of unburned HC in the exhaust gas
(c) reduces the amount of NO_x in the exhaust gas
(d) increase the amount of unburned HC and NO_x in the exhaust gas

185. Reducing the compression ratio of an engine reduces the combustion temperature, and this
(a) reduces the amount of NO_x formed
(b) increases the amount of NO_x formed
(c) reduces the amount of HC formed
(d) increases the amount of H_2O formed

186. The function of the air aspirator system is
(a) Furnishes the addition air for reduce HC and NO_x emission
(b) Furnishes the addition air for reduce HC and CO emission
(c) Furnishes the addition air for reduce HC and CO but increase of NO_x
(d) Furnishes the addition air for increase of HC and reduce CO and NO_x

187. Lead compounds were added in gasoline to
(a) reduce HC emissions
(b) reduce knocking
(c) reduce exhaust temeprature
(d) increase power output

188. Hydro carbon emission in CI Engine is mainly due to
(a) over mixing of fuel and air
(b) under mixing of fuel and air
(c) constant mixing of fuel and air
(d) Both (a) and (b)

189. The automatic on-off and time delay head lamp control
(a) turns the head lamps off as the driver gets out the car
(b) times the flashing of the lights when the hazard system is energized
(c) turns the head lamps off after a present time delay following the truning off of the engine
(d) turns the head lamps off 13 minutes after the driver leaves the car

190. Blade in the hack saw cuts during the
(a) Forward stroke
(b) Backstroke
(c) Both stroke
(d) Pressure applied

191. NO_x emission in SI engines will be lowest during
(a) Acceleration (b) Deceleration
(c) Cruising (d) Idling

192. Two controlling devices in the automatic transmission operated by hydraulic pressure are the bonds and
(a) pistons
(b) gears
(c) planetary gear sets
(d) clutches

193. The alternator produces electricity in its
(a) rotor field coil
(b) stator windings
(c) regulator
(d) armature commutator

194. The electronic spark control used on some turbo charged engines
(a) refer as the spark if detonation begins
(b) takes the place of mechanical advance mechanisms
(c) advances the spark to suit operating conditions
(d) reduce spark voltage if detonation begins

195. In the starting motor, magnetism
(a) rotate the armature and demeshes the pinion
(b) rotate the armature and meshes the pinion
(c) prevents high armature speed as the engine starts
(d) sends cracking force in one direction only

196. In a test to determine braking efficiency of a vehicle weighing 1200 kg is placed on a brake testing machine. The brake tester shows the following reading. Front right: 2120 N; Front left 2080 N; Rear Right : 1490 N; Rear left : 1510 N; Then the braking efficiency is
(a) 50% (b) 60%
(c) 70% (d) 80%

197. The important requirement of a catalytic convertor is
(a) High surface area and low volume heat capacity
(b) Low surface area and low volume heat capacity
(c) High surface area and high volume heat capacity
(d) Low surface area and high volume heat capacity

198. A combination of roll and pitch is called as
(a) Levelling pitch
(b) Diagonal pitch
(c) Grunding pitch
(d) Cushioning pitch

199. In the Passenger cars, the following type of carburetor is preferred
(a) Horizontal type
(b) Upward draught type
(c) Downward draught type
(d) Inclined draught type

200. Most commonly used lubrication system in heavy vehicles is the
(a) Splash Lubrication system
(b) pressure Lubrication system
(c) Gravity Lubrication system
(d) Petrol Lubrication system

1. Mild Steel is an example of
(a) Substitution solid solution
(b) Interstitial solid solution
(c) Inter metallic compound
(d) None of above

2. Bronze contains
(a) 70% Cu and 30% Zn
(b) 90% Cu and 10% Zn
(c) 75% Cu and 25% Zn
(d) None of the above

3. The processes, used to make the steel magnetically softer, are
(a) Annealing and Decarburization
(b) Decarburization and Quenching
(c)Annealing, Grain growth and decarburization
(d) Grain growth and Quenching

4. German Silver is an alloy of
(a) Silver and Tin
(b) Silver and Gold
(c) Nickel and Copper
(d) Nickel, Copper and Zinc

5. Babbit metal is an alloy of which one of the following?
(a) Lead and Tin
(b) Lead and Magnesium
(c) Tin and Bismuth
(d) None of the above

6. Griffith theory of failure is suitable for
(a) Mild Steel (b) Low Carbon Steel
(c) Alloy steel (d) Glass

7. The processes, used to make the steel magnetically softer, are
(a) Annealing and Decarburization
(b) Decarburization and Quenching
(c) Annealing, Grain growth and Decarburization
(d) Grain growth and Quenching

8. The ductile- brittle transition temperature
(a) depends on size and shape of material, rate of loading, presence of notches, impurities and operating temperature
(b) depend on size but does not depend on shape of material
(c) does not depend on size of material
(d) does not depend on rate of loading but depends on presence of impurities

9. Dielectric strength can be reduced by
(a) removing cracks
(b) absence of imperfections
(c) absence of flaws
(d) impurities, cracks and pores

10. The [1 1 0] direction in a cubic unit cell is parallel to the following
(a) Face diagonal of unit cell
(b) Edge of the cube
(c) Body diagonal of the cube
(d) None of the above

11. When mechanical properties of a material remain same in all directions at each point, such a material is called
(a) Isotropic (b) Homogenous
(c) Orthotropic (d) Anisotropic

12. Iron is Face centered cubic (FCC) at which one of the following temperatures?
(a) Room temperature (b) 1400 ^{0}C
(c) 910 ^{0}C (d) None of the above

13. The ductile- brittle transition temperature
(a) depends on size and shape of material, rate of loading, presence of notches, impurities and operating temperature
(b) depend on size but does not depend on shape of material
(c) does not depend on size of material
(d) does not depend on rate of loading but depends on presence of impurities

14. Match the items in List – 1 to that of the List – 2 and choose the correct alternative.

List – 1	List – 2
A. Alnico V	1. Metallic Magnet
B. Ferrexodur	2. Ceramic Magnet
C. Nickel Oxide	3. Anti ferromagnetic
D. Ferrites	4. Compounds containing trivalent iron
	5. Ferrimagnetic
	6. Soft magnetic

Alternatives:

(a)	1	2	3	4
(b)	6	2	3	4
(c)	4	6	1	2

(d) 2 1 6 1

15. Choose the correct statement from the following:
(a) Ceramic compounds involve simple coordination than their corresponding components.
(b) Ceramic compounds are more ductile.
(c) Ceramic compounds are more stable with respect to thermal and chemical environments than their components.
(d) Ceramic compounds have less resistance to slip.

16. Dielectric strength can be reduced by
(a) removing cracks
(b) absence of imperfections
(c) absence of flaws
(d) impurities, cracks and pores

17. Select the correct answer out of the following alternatives about ' Cyclic Stresses'.
(a) That a material can tolerate are much greater than stresses produced under static loading.
(b) Can lead to fatigue if the stress level is above the endurance limit.
(c) Can lead to fatigue if the stress level is below the endurance limit.
(d) Are not introduced in the axle of a running train

18. Dislocation in material is called
(a) Point defect (b) Line defect
(c) Plane defect (d) Volumetric defect

19. Match the items in List -1 to the corresponding items in the List-2

List-1 (Heat Treatment)	List-2 (Effect on Properties)
A. Annealing	1. Refine grain structures
B. Nitriding	2. Improves the hardness of the whole mass
C. Martempering	3. Improves surface hardness
D. Normalising	4. Improves ductility

Choose the correct from the following:

	A	B	C	D
(a)	3	1	4	2
(b)	3	1	2	4
(c)	1	3	4	2
(d)	1	3	2	4

21. The crystal structure of α-iron is
(a) Simple cubic
(b) Face centered cubic
(c) Body centered cubic
(d) Close – packed Hexagonal

22. Select the proper sequence for the following:
1. Proportional limit 2. Elastic Limit
3. Yield Point 4. Fracture/failure point
(a) 1- 2 – 3 -4
(b) 2 – 1 – 3 -4
(c) 1- 2 -4 – 3
(d) 2 -1 – 4 – 3

23. The Macro-structure of a material is generally examined by
(a) X- ray techniques
(b) Spectroscopic techniques
(c) Optical microscope
(d) Metallurgical microscope

24. Gradual time dependent deformation under constant load or self weight is called
(a) Erosion (b) Decay
(c) Tension (d) Creep

25. Which ingredient is responsible for corrosion resistant capability in Stainless Steel?
(a) Iron (b) Chromium
(c) Zinc (d) Sulphur

26. The property of material, which enables it to withstand bending without fracture, is known as
(a) Mechanical Strength
(b) Stiffness
(c) Flexural rigidity
(d) Ductility

27. The Material commonly used for making machine tool bed is
(a) Mild Steel (b) Aluminum
(c) Brass (d) Cast Iron

28. Which one of the following is the ferrous material?
(a) Zinc (b) Iron
(c) Silicon Carbide (d) Copper

29. Babbit material are used for
(a) Gears (b) Bearings
(c) Bolts (d) Clutch liners

30. The ultimate tensile strength of low carbon steel by working at high strain rate will
(a) increase
(b) decrease
(c) remain constant
(d) first increase, then decrease

31. Pure iron is the structure of
(a) Ferrite (b) Pearlite
(c) Austenite (d) Cementite

32. An example of amorphous material is
(a) Zinc (b) Lead
(c) Glass (d) Sulphur

33. Binding material in cemented carbide tool is
(a) Graphite (b) Lead
(c) Carbon (d) Cobalt

34. Which of the following are the reasons for reduction of tool life in a machining operation?
1. Temperature rise of cutting edge.
2. Chipping of tool edge to mechanical impact.
3. Gradual wear at tool point.
4. Increase in feed of cut at constant cutting force
Select the answer from the following:
(a) 1, 2 & 4(b) 1, 2 & 3
(c) 1, 3 & 4(d) 1, 2, 3 & 4

35. Choose the alternative, which explains the correct relationship between the given statements, (A) & (R) from the code given below :
Assertion (A) : In ECM, the shape of the cavity is the mirror image of the tool, but
unlike EDM, the tool wear in ECM is a cathode.
Reason (R) : The tool in ECM is a Cathode.
Code :
(a) Both (A) & (R) are true. (R) is the correct explanation of (A).
(b) Both (A) & (R) are true. (R) is not the correct explanation of (A).
(c) (A) is false, but (R) is true.
(d) (A) is true, but (R) is false.

36. An orthogonal cutting operation is being carried out under the following conditions: Cutting Speed = 2 m/sec, Depth of cut = 0.5 mm, Chip thickness = 0.6 mm.
What is the chip velocity?
(a) 2 m/sec (b) 2.4 m/sec
(c) 1 m/sec (d) 1.66 m/sec

37. The rake angle of a cutting tool is 15^0 , the shear angle is 45^0 and the cutting velocity is 35 mpm. What is the velocity of chip along the tool face?
(a) 28.5 mpm (b) 27.3 mpm
(c) 25.3 mpm (d) 23.5 mpm

38. In EDM, metal removal rate is proportional to
(a) Frequency of charging
(b) Energy delivered in each spark
(c) Both (a) and (b)
(d) None of the above

39. Which of the following is not true in case of jigs and fixtures?
(a) Consistency in dimension
(b) Fast production speed is not possible
(c) Auto-location control
(d) None of the above

40. A cutting tool is turning a work piece of 40 mm diameter, revolving at 300 rpm. If tool life is 120 min, find the value of constant C as per the Taylor's tool life equation, Assuming n = 1/7.
(a) 85 (b) 80
(c) 70 (d) 75

41. Which of the following should be more to reduce wear of a tool?
(a) Weight (b) Density
(c) Hardness (d) (b) & (c) both

42. Which of the following instruments is used to measure smoothness of a metallic surface?
(a) Talysurf
(b) Coordinate Measuring Machine
(c) Profile Projector
(d) None of the above

43. Life of a single point cutting tool is influenced by which of the following factors?
(a) Cutting speed (b) Feed rate
(c) Depth of cut (d) All the above

44. The Plug gauge is used to
(a) Check the size and shape of holes
(b) Measure the diameter of holes
(c) Measure the diameter of shafts
(d) Measure the diameters of shafts and holes

45. The relationship between the shear angle (∅), friction angle (β), cutting rake angle (α) and the machining constant (C) for the work material is
(a) 2α + β – φ = C
(b) 2α + β + φ = C
(c) 2φ + β – α = C
(d) 2 φ + β + α = C

46. Explosive forming is not used for the following:
(a) Making very small complex parts.
(b) For large parts typical of aerospace industry.
(c) Both (a) and (b) above are correct.
(d) None of the above is correct.

47. In Electro-Discharge-Machining (EDM), the tool is made of
(a) High Speed Steel
(b) Copper
(c) Cast Iron
(d) Glass

48. The process in which the material removal rate is governed by Faraday's law is?
(a) ECM (b) EDM
(c) AJM (d) LBM

49. In USM, the tool is vibrated with the frequency of
(a) 5 kHz (b) 10 kHz
(c) 15 kHz (d) 20 kHz

50. Continuous chips will be formed when machining speed is
(a) low
(b) medium
(c) high
(d) independent of speed

51. Profile of a gear tooth can be checked by
(a) Optical projector
(b) Optical pyrometer
(c) Bench micrometer
(d) Sine bar.

52. For TIG welding, which of the following gases are used?
(a) Hydrogen and Carbon-di-oxide
(b) Argon and Helium
(c) Argon and Neon
(d) Hydrogen and Oxygen

53. Which of the following materials require the largest shrinkage allowance while making a pattern for casting?
(a) Aluminium (b) Brass
(c) Cast Iron (d) Duralumin

54. Which of the following values of index n is associated with carbide tools when Taylor's tool life equation VT^n = constant is applied ?
(a) 0.65 to 0.90 (b) 0.45 to 0.60
(c) 0.20 to 0.40 (d) 0.10 to 0.15

55. In an orthogonal cutting experiment, with a tool of rake angle γ = 75^0 and shear angle ϕ = 22.8^0, then friction angle β will be
(a) 41.9^0 (b) 51.4^0
(c) 61.2^0 (d) None of the above

56. Which of the following operation does not use a jig?
(a) Tapping (b) Reaming
(c) Drilling (d) Turning

57. Which is the false statement about electro discharge machining?
(a) It can machine very hard material
(b) Very good surface finish is obtained
(c) section to be machined should be thick
(d) Metal removal rate is very slow.

58. Choose the false statement from the following:
(a) Control chart indicate whether the process is in control or not.
(b) $\bar{X}$ and R charts are used to evaluate dispersion of measurements.
(c) P-chart is a control chart for percentage defective
(d) C-charts are prepared for large and complex components.

59. The following is not the characteristics of explosive forming:
(a) Low capital cost of the set up.
(b) Very large components can be formed.
(c) Only a simple die is required.
(d) The tooling material is very expensive.

60. The following is not true for ECM :
(a) It can machine highly complicated shapes in a single pass.
(b) Tool life is very high.

(c) Machinability of the work material is independent of its physical and mechanical properties.
(d) Kerosene is use as electrolyte.

61. Electro-discharge machining uses the following fluid:
(a) Kerosene
(b) Sodium hydroxide
(c) Water
(d) Aqueous salt solution

62. A good machinability rating would indicate
(a) long tool life, high power requirement and less machining time.
(b) long tool life, low power requirement and a good surface finish.
(c) short tool life and a good surface finish.
(d) long tool life, high power requirement and a good surface finish.

63. In EDM process, the workpiece is connected to
(a) Cathode (b) Anode
(c) Earth (d) None of the above

64. A hole of 1 mm is to be drilled in glass. It could be best done by
(a) Laser drilling
(b) Plasma drilling
(c) Ultrasonic drilling
(d) Electron beam drilling

65. A comparator for its working depends on
(a) comparison with standard such as slip gauges
(b) accurately calibrated scale
(c) optical device
(d) limit gauge

66. TMU means
(a) Time Motion Unit
(b) Time Method Unit
(c) Time Measurement Unit
(d) Time Movement Unit

67. Which one of the following is most important parameter for EDM ?
(a) Thermal capacity (b) Hardness
(c) Strength (d) Geometry

68. Which of the following is not the characteristic of work sampling?
(a) Any interruption during study will not affect the results.
(b) The study causes less fatigue.
(c) Uneconomical for short cycle jobs.
(d) A stop watch is needed.

69. Which one of the followings statements is not correct regarding simplex method of linear programming?
(a) It is an iterative procedure.
(b) It has a trial basic feasible solution to constraints.
(c) It has a trial basic feasible solution does not constitute a convex set.
(d) It improves the first trial solution by a set of rules.

70. The following is not true for linear programming problems:
(a) Objective function is expressed as a linear function of variables.
(b) Resources are not limited.
(c) Some alternative course of actions are also available.
(d) Decision variables are inter related.

71. Which of the following are said to be benefits of assembly line balancing?
1. It mimises the in-process inventory
2. It reduces the work content.
3. It smoothens the production flow.
4. It maintains the required rate of output.
Select the correct answer using the codes given below:
Code :
(a) 1, 2 and 3(b) 2, 3 and 4
(c) 1, 3 and 4(d) 1, 2 and 4

72. Value Engineering is concerned with the saving of
(a) Un-necessary costs
(b) Administrative difficulties
(c) Overhead costs
(d) Time

73. In the EOQ model, if the unit ordering cost gets doubled, then the EOQ will be
(a) reduced to half
(b) doubled
(c) increased 1.414 times
(d) decreased 1.414 times

74. The leaving basic variable in simplex method is the basic variable that
(a) has the lowest value.
(b) has the largest coefficient in the key row.
(c) goes to zero first, as the entering basic variable is increased.
(d) has the smallest coefficient in the key row.

75. ABC analysis is used in
(a) Job analysis
(b) Production Schedule
(c) Inventory Control
(d) Simulation

76. In ABC analysis, 'A' items are responsible to share approximately the following percentage of cost:
(a) 80 (b) 60
(c) 40 (d) 20

77. BEP indicates the recovery of
(a) variable costs only
(b) both fixed and variable costs
(c) fixed cost
(d) both fixed and variable costs along with margin of profit

78. Which of the following is true about the initial basic feasible solution in simplex method?
(a) It is an optimal solution
(b) All basic variables are zero.
(c) Solution is not possible.
(d) Any one basic variable is zero

79. The probability law used for calculating the control limits of 'P' chart is
(a) Binomial
(b) Poisson
(c) Normal
(d) Exponential

80. When order quantity increases, the ordering cost will
(a) increase (b) decrease
(c) remains same (d) None of the above

81. Which type of layout is preferred in order to avoid excessive multiplication of facilities?
(a) Process layout
(b) Product layout
(c) Fixed position layout
(d) Cellular manufacturing

82. An assembly activity is represented in an operation process chart by the symbol
(a) ~ (b) A
(c) D (d) ±

83. In an m × n transportation problem, the maximum number of basic variables is
(a) m + n (b) m – n
(c) m + n -1 (d) m + n + 1

84. In the model M/M/I: ∞/FCFS with utilization factor ρ, the expected line length is equal to
(a) $1 - \rho$ (b) $\frac{1}{1-\rho}$
(c) $\frac{\rho}{1-\rho}$ (d) $\frac{\rho^2}{1-\rho}$

85. Group 'C' items constitute the following percentage of items in ABC analysis:
(a) 10 (b) 20
(c) 50 (d) 70

86. In linear programming problem, the shadow price is
(a) the value assigned to one unit capacity
(b) the maximum cost per unit item
(c) the lowest sale price
(d) None of the above

87. Annual demand for a product, costing ' 100 per piece, is 900. Ordering cost per order is 100 and the holding cost is 2 per unit per year.The economic order quantity is
(a) 200 (b) 300
(c) 400 (d) 500

88. The mathematical technique for finding the best use of limited resources of a company in the optimum manner is known as
(a) Value analysis
(b) Network analysis
(c) Linear programming
(d) Queuing theory

89. Which of the following charts indicates variability of variability within the collected samples ?
(a) $\bar{X}$ chart (b) σ chart
(c) c chart (d) u chart

90. Which statement is wrong about diamagnetic materials?
(a) Their susceptibility is positive.
(b) Their permeability is less than one.
(c) Super-conductors are diamagnetic.
(d) They repel the external magnetic flux.

91. Super conductivity is that state of a material at which it electrical resistance
(a) becomes zero.
(b) becomes infinite.
(c) starts showing a change
(d) stops being affected by temperature change.

92. The difference between Graphite and Diamond is that
(a) Diamond is transparent while Graphite is opaque
(b) Diamond is insulator while Graphite is conductor
(c) Diamond has all primary bonds while Graphite has three primary and one secondary bonds.
(d) All the above

93. Identify the pair which has same dimensions:
(a) Force and power
(b) Energy and work
(c) Momentum and energy
(d) Impluse and momentum

94. In the following figure, the tension in the rope AC is
Figure missing
(a) 17.32 N (b) 56.60 N
(c) 169.90 N (d) 113.20 N

95. The maximum frictional force, which comes into play, when a body just begins to slide over the surface of the other body, is known as
(a) Limiting friction
(b) Static friction
(c) Dynamic friction
(d) Coefficient of friction

96. A body subjected to coplanar non-concurrent forces will remain in a state of equilibrium if
(a) $\sum F_x = 0$
(b) $\sum F_y = 0$
(c) $\sum M = 0$
(d) All the above three

97. A body subjected to coplanar non-concurrent force system. If the body is to remain in a state of equilibrium, then
(a) $\sum F_x = \sum F_y = \sum F_z = 0$
(b) $\sum M_x = \sum M_y = 0$
(c) $\sum M_y = \sum M_z = 0$
(d) None of the above

98. In the analysis of truss, the force system acting at each pin
(a) is concurrent but not coplanar
(b) is coplanar and concurrent
(c) is coplanar and non-concurrent
(d) does not satisfy rotational equilibrium

99. For truss as shown below, the forces in the member AB and AC are
Figure missing
(a) Tensile in each
(b) Compressive in each
(c) Compressive and tensile respectively
(d) Tensile and compressive respectively

100. Two equal and mutually perpendicular forces of magnitude ‘P’, are acting at a point. Their resultant force will be
(a) $P\sqrt{2}$, at an angle of 30^0 with the line of action of any one force.
(b) $P\sqrt{2}$, at an angle of 45^0 with the line of action of each force.
(c) $2P\sqrt{2}$, at an angle of 45^0 with the line of action of each force.
(d) Zero

101. The relationship, between number of joints (J), and the number of members (m), in a perfect truss, is given by
(a) m = 3j-2 (b) m = 2j -3
(c) m = j -2 (d) m = 2j -1

102. Four forces P, 2P, 3P & 4P act along the sides of a square, taken in order. The resultant force is
(a) zero (b) $\sqrt{5}$ P
(c) $2\sqrt{2}$ P (d) 2P

103. Varignon’s theorem is related to
(a) Principal of moments
(b) Principle of momentum
(c) Principle of force

(d) Principle of inertia

104. If a force of 30 N is required to move a mass of 35 kg on a flat surface horizontally at a constant velocity, what will be the coefficient of friction?
(a) 0.067 (b) 0.087
(c) 0.098 (d) 0.092

105. A train crosses a tunnel in 30 seconds time. The speed of the train at entry and at exit from the tunnel are 36 and 54 km/hour respectively. If acceleration remains constant, the length of the tunnel is
(a) 350 m (b) 360 m
(c) 375 m (d) 400 m

106. The escape velocity on the surface of the earth is
(a) 11.2 km/s (b) 8.2 km/s
(c) 3.2 km/s (d) 1.2 km/s

107. A motor boat whose speed in still water is 15 km/hr goes 30 km downstream and comes back in a total time of four and half hours. The stream has a speed of
(a) 3 km/hr (b) 4 km/hr
(c) 5 km/hr (d) 6 km/hr

108. If the period of oscillation is to become double, then
(a) the length of simple pendulum should be doubled.
(b) the length of simple pendulum should be quadrupled.
(c) the mass of the pendulum should be doubled.
(d) the length and mass should be doubled.

109. A spring scale reads 20 N as it pulls a 5.0 kg mass across a table. what is the magnitude of the force exerted by the mass on the spring scale?
(a) 4.0 N (b) 5.0 N
(c) 20.0 N (d) 49.0 N

110. A thin circular ring of mass 100 kg and radius 3 m resting on a smooth surface is subjected to a sudden application of a tangential force of 300 N at a point on its periphery. The angular acceleration of the ring will be
(a) 1.0 rad/sec^2 (b) 1.5 rad/sec^2
(c) 2.0 rad/sec^2 (d) 2.5 rad/sec^2

111. The unit of energy in S.I. unit is
(a) Dyne (b) watt
(c) Newton (d) Joule

112. If the sum of all the forces acting on a moving object is zero, the object will
(a) continue moving with constant velocity
(b) accelerate uniformly
(c) change the direction of motion
(d) slow down and stop

113. Dynamic friction as compared to static friction is
(a) less (b) same
(c) more (d) None of the above

114. When a body is thrown up at an angle of 45^0 with a velocity of 100 m/sec, it describes a parabola. Its velocity on point of return down will be
(a) zero (b) 50 m/sec
(c) $100/\sqrt{2}$ m/s (d) $100\sqrt{2}$ m/s

115. A projectile on a level ground will have maximum range if the angle of projection is
(a) 30^0 (b) 45^0
(c) 60^0 (d) 75^0

116. Which one of the following is not an example of plane motion?
(a) Motion of a duster on a black board
(b) Motion of ball point of pen on the paper.
(c) Motion of a cursor on the computer screen.
(d) Motion of a nut on a threaded bolt.

117. Which one of the following is a scalar quantity?
(a) Force (b) Displacement
(c) Speed (d) Velocity

118. A 44 N block is thrust up a 30^0 inclined plane with an initial speed of 5 m/sec. It travels a distance of 1.5 m before it comes to rest. The frictional force acting upon it would be
(a) 18.3 N (b) 15.3 N
(c) 12.3 N (d) 9.3 N

119. A body is moving with a velocity 1 m/s and a force F is needed to stop it within a certain distance. If the speed of the body becomes three times, the force needed to stop it within the same distance would be
(a) 1.5 F (b) 3.0 F

(c) 6.0 F (d) 9.0 F

120. In a loaded beam, the term $\frac{dM}{dx}$ represents
(a) Deflection at a section
(b) Slope at a section
(c) Intensity of loading at a section
(d) Shear force at a section

121. A beam is of rectangular section. The distribution of shearing stress across a section is
(a) parabolic
(b) Rectangular
(c) Triangular
(d) None of the above

122. In a stressed field, the change in angle between two initially perpendicular lines is called
(a) Normal strain (b) Shear strain
(c) Principal strain (d) Poisson's ratio

123. A metallic cube is subjected to equal pressure (P) on its all the six faces. If $\in_v$ is volumetric strain produced, the ratio $\frac{P}{\in_v}$ is called
(a) Elastic modulus
(b) Shear modulus
(c) Bulk modulus
(d) Strain-Energy per unit volume

124. To express stress-strain relations for a linearly elastic, homogenous, isotropic material, minimum number of material constants needed are
(a) Two (b) Three
(c) Four (d) One

125. A tension member with a cross-sectional area of 30 mm^2 resists a load of 60 kN. What is the normal stress induced on the plane of maximum shear stress?
(a) 2 kN/mm^2 (b) 1 kN/mm^2
(c) 4 kN/mm^2 (d) 3 kN/mm^2

126. If the Mohr's circle for a state of stress becomes a point, the state of stress is
(a) Pure shear state of stress
(b) Uniaxial state of stress
(c) Identical principal stresses
(d) None of the above

127. Torsional rigidity of a solid cyclindrical shaft of diameter 'd' is proportional to
(a) d (b) d^2
(c) d^4 (d) $\frac{1}{d^2}$

128. In theory of simple bending of beams, which one of the following assumptions is incorrect?
(a) Elastic modulus in tension and compression are same for the beam materials.
(b) Plane sections remain plane before and after bending
(c) Beam is initially straight.
(d) Beam material should not be brittle.

129. A cylindrical shell of diameter 200 mm and wall thickness 5 mm is subjected to internal fluid pressure of 10 N/mm^2. Maximum shearing stress induced in the shell in N/mm^2 , is
(a) 50 (b) 75
(c) 100 (d) 200

130. Consider the following statements:
1. An I.C. engine transforms chemical energy into mechanical energy.
2. A compressed spring possess potential energy.
3. A football rolling on the ground performs plane motion.
4. Strain gauges are used to measure torque.
Following are the correct statements:
(a) 1 and 2 only (b) 2 and 3 only
(c) 3 and 4 only (d) 1, 2 and 4 only

131. In a static tension tests of a low carbon steel sample, the gauge length affects
(a) yield stress
(b) ultimate tensile stress
(c) percentage elongation
(d) percentage reduction in cross-sectional area

132. One end of a metallic rod is fixed rigidly and its temperature is raised. It will experience
(a) zero stress (b) tensile stress
(c) compressive stress (d) None of the above

133. Two cantilever steel beams of identical length and of rectangular section are subjected to same point load at their free end. In one beam, the longer side of section is vertical, while in the other, it is horizontal. Beam defects at free end:
(a) equally irrespective of their disposition.
(b) more in case of longer side vertical.
(c) less in case of longer side horizontal.
(d) less in case of longer side vertical.

134. A long column of length (l) with both ends hinged, is to be subjected to axial load. For the calculation of Euler's buckling load, its equivalent length is

(a) $l/2$ (b) $l/\sqrt{2}$
(c) l (d) $2l$

135. Match List-I with List – II and select the correct answer using the code given below the lists.

List – I (Characteristic)	List – II (Member)
A. Kernel of section	1. Helical spring
B. Tie and Struct	2. Bending of Beams
C. Section modulu	3. Eccentric loading of short column
D. Stiffness	4. Roof truss

Code:

	A	B	C	D
(a)	1	2	3	4
(b)	3	4	2	1
(c)	4	1	2	3
(d)	2	3	1	4

136. The bending moment diagram for a simply supported beam AB of length 'L' is shown below:

Figure missing

$CD_1 = CD_2 = \frac{M}{2}$

Sagging moment: positive

Hugging moment : negative

What is the load acting on beam AB?

(a) An upward concentrated load $\frac{M}{2}$ at C.
(b) A downward concentrated load $\frac{M}{2}$ at C.
(c) An anticlockwise moment 'M' at C
(d) A clockwise moment 'M' at C.

137. Two simply supported beams of equal lengths, cross sectional areas, and section moduli, are subjected to the same concentrated load at its mid-length. One beam is made of steel and other is made of Aluminium. The maximum bending stress induced will be in

(a) Steel beam
(b) Aluminium beam
(c) Both beams of equal magnitude
(d) The beam according to their Elastic Moduli magnitude.

138. Two strips of equal lengths and widths are joined together by two rivets, one at each end. One strip is of copper and the other of steel. Now, the temperature of this assembly is lowered, the rivets will undergo.

(a) Bending
(b) Single shear
(c) Double shear
(d) Both (a) & (b) above

139. A uniform metal bar of weight 'W', length 'l', cross-sectional 'A' is hung vertically with its top end rigidly fixed. Which section of the bar will experience maximum shear stress?

(a) Top-section (b) Mid-section
(c) Bottom-section (d) $l/3$ from top

140. Which one of the following will result into a constant strength beam?

(a) The bending moment at every section of the beam is constant.
(b) Shear force at every section is same.
(c) The beam is of uniform section over its whole length.
(d) The ratio of bending moment to the section modulus for every section along the length is same

141. A beam of Z-section is called a

(a) doubly symmetric section beam
(b) singly symmetric section beam
(c) a-symmetric section beam
(d) none of the above

142. The outside diameter of a hollow shaft is twice its inside diameter. The ratio of its torque carrying capacity to that of a solid shaft of the same material and the same outside diameter is

(a) 15/16 (b) 3/4
(c) 1/2 (d) 1/16

143. Choose the correct relationship in the given statements of Assertion (A) and Reason (R).

Assertion (A) : A plane state of stress does not necessarily result into a plane state of strain.

Reason (R): Normal stresses acting along X and Y directions will also result into strain along the Z-direction.

Code:

(a) Both (A) & (R) are correct. (R) is the correct explanation of (A)
(b) Both (A) & (R) are correct. (R) is not the correct explanation of (A).

(c) (A) is true, but (R) is false.
(d) (A) is false, but (R) is true.

144. A body is subjected to unequal like direct stresses σ_1 and σ_2 in two mutually perpendicular planes along with simple shear stress q
Figure missing
Which among the following is then a wrong statement?
(a) The principal stresses at a point are

$$P_1, P_2 = \frac{\sigma_1+\sigma_2}{2} \pm \sqrt{\left[\left(\frac{\sigma_1-\sigma_2}{2}\right)^2 + q^2\right]}$$

(b) The position of principal planes with the plane of stress σ_1, are

$$\theta_1 = \frac{1}{2}\tan^{-1}\frac{2q}{\sigma_1 - \sigma_2}\,;\ \theta_2 = \theta_1 + 45^0$$

(c) Maximum shear stress is

$$(\sigma_t)_{max} = \pm\sqrt{\left[\left(\frac{\sigma_1 - \sigma_2}{2}\right)^2 + q^2\right]}$$

(d) Planes of maximum shear are inclined at 45^0 to the principal planes.

145. Slenderness ratio has dimension of
(a) cm (b) cm^{-1}
(c) cm^2 (d) None

146. When a body is subjected to direct tensile stresses (σ_x and σ_y) in two mutually perpendicular directions, accompanied by a simple shear stress τ_{xy}, then in Mohr's circle method, the circle radius is taken as
(a) $\frac{\sigma_x-\sigma_y}{2} + \tau_{xy}$
(b) $\frac{\sigma_x+\sigma_y}{2} + \tau_{xy}$
(c) $\frac{1}{2}\sqrt{(\sigma_x - \sigma_y)^2 + 4\,\tau_{xy}^2}$
(d) $\frac{1}{2}\sqrt{(\sigma_x + \sigma_y)^2 + 4\,\tau_{xy}^2}$

147. The ratio of hoop stress to longitudinal stress in thin walled cylinders in
(a) 1 (b) 1/2
(b) 2 (d) 1/4

148. The theory applicable for the analysis of thick cyclinders, is
(a) Lame's theory
(b) Rankine's theory
(c) Poisson's theory
(d) Caurbon's theory

149. The unit of modulus of elasticity is same as those of
(a) stress, strain and pressure
(b) stress, pressure and modulus of rigidity
(c) stress, force and modulus of rigidity
(d) stress, force and pressure

150. The relation among the elastic constants E, G and K is
(a) $E = \frac{KG}{9K+G}$ (b) $E = \frac{9KG}{K+G}$
(c) $E = \frac{9KG}{K+3G}$ (d) $E = \frac{9KG}{3K+G}$

151. Which of the following has no unit?
(a) Kinematic viscosity
(b) Strain
(c) Surface Tension
(d) Bulk Modulus

152. What does the elasticity of material enables it to do?
(a) Regain the original shape after the removal of applied force.
(b) Draw into wires by the application of force.
(c) Resist fracture due to high impact.
(d) Retain deformation produced under load permanently.

153. Which of the following brakes is commonly used in motor cars?
(a) Band Brake
(b) Shoe Brake
(c) Internal expanding Shoe Brake
(d) All the above

154. Which one of the following is not an example of higher pair?
(a) Disc Cam and roller follower
(b) Spur Gear meshing teeth
(c) Ball bearing
(d) Bush Bearing

155. The minimum number of teeth which can be cut for standard tooth for a given pressure angle '$\emptyset$' the following
(a) $\sin^2\emptyset$ (b) $2/\sin^2\emptyset$
(c) $2\sin^2\emptyset$ (d) $\frac{2}{\sin 2\emptyset}$

156. When there is no slip, the power transmitted by belts is proportional to
(a) $(T_1 - T_2)V$ (b) $(T_1 + T_2)V$

(c) $(T_1/T_2)V$ (d) $\frac{(T_1-T_2)}{V}$

157. When two gear teeth are in mesh, then pure rolling occurs at the
(a) root of tooth (b) tip of tooth
(c) Pitch point (d) flank

158. In a governor, If the equilibrium speed is constant for all radii of rotation of balls, the governor is said to be
(a) stable governor
(b) unstable governor
(c) inertia governor
(d) isochronous governor

159. The instantaneous centre of rotation of a circular disc rolling on a straight path is at
(a) the centre of the disc
(b) their point of contact
(c) the centre of gravity of the disc
(d) infinity

160. For a safe design, a friction clutch is designed assuming
(a) uniform wear
(b) uniform pressure
(c) any one of the above
(d) None of the above

161. In a simple gear train, there is odd number of idlers. the direction of rotation of the driver and the driven gears will be
(a) same
(b) opposite
(c) depends upon the number of teeth of the gears
(d) depends upon the diameter of idlers used

162. In free vibrations, the acceleration vector leads the displacement vector by
(a) $\pi/3$ (b) $\pi/2$
(c) $2\pi/3$ (d) π

163. At a certain speed, revolving shafts tend to vibrate violently in transverse directions, this speed is known as
(a) whirling speed
(b) critical speed
(c) whipping speed
(d) All the above

164. If the speed of the engine varies between 390 and 410 rpm in a cycle of operation, the coefficient of fluctuation of speed will be
(a) 0.01 (b) 0.03
(c) 0.05 (d) 0.07

Solution:
Coefficient of fluctuation of speed
$= \frac{N_{max} - N_{min}}{(N_{max}+N_{min})/2} = \frac{410-390}{(410+390)/2} = 0.05$

165. When teeth formed on the cones are straight, the gears are known as
(a) worm gear (b) helical gear
(c) straight bevel (d) spiral bevel

166. Creep in belts occurs due to which one of the following:
(a) Belt and pulley surfaces are smooth
(b) Belt is thick
(c) Due to unequal tensions on the two sides of the pulley
(d) The pulley diameters are large

167. The point on the Cam with maximum pressure angle is known as the
(a) Cam center (b) couples
(c) Trace point (d) Prime point

168. Static balancing involves balancing of
(a) forces (b) couples
(c) masses (d) All the above

169. The motion of a nut on a threaded bolt is
(a) Helical (b) Plane
(c) Spherical (d) None of the above

170. Spur gears have/are
(a)straight teeth perpendicular to the axis
(b) curved teeth perpendicular to the axis
(c) not subjected to axial thrust due to tooth load.
(d) subjected to axial thrust due to tooth load.

171. Coriolis' component of acceleration occurs in
(a) quick return mechanism
(b) four bar mechanism
(c) slider crank mechanism
(d) none of the above

172. Identify the wrong statement:
(a) A mechanism is an assemblage of four or more links.

(b) A slider crank chain requires at least four links and four turning pairs.
(c) A kinematic chain requires at least four links and four turning pairs.
(d) Open pairs are those whose elements are not held together mechanically.

173. Any distributed mass can be replaced by two point masses to have the same dynamical properties, if
(a) The sum of the two masses is equal to the total mass.
(b) The combined centre of mass coincides with that of the rod.
(c) The moment of inertia of two point masses about perpendicular axis through their combined centre of mass is equal to that of the rod.
(d) All the above.

174. For steady state forced vibrations, the phase lag at resonance condition is
(a) 0^0 (b) 45^0
(c) 80^0 (d) 90^0

175. The maximum efficiency of a screw jack having square threads and friction angle of 30^0 will be
(a) 11 % (b) 20 %
(c) 30 % (d) 33 %

176. If the damping factor for a vibrating system is unity, then the system is
(a) critically damped (b) under damped
(c) over damped (d) zero damped

177. A gear train, in which at least one of the gear axes is in motion relative to the frame, is known as
(a) reverted gear train
(b) non-reverted gear train
(c) epicyclic gear train
(d) none of the above

178. In a mechanism having six links, the number of instantaneous centres of rotation present are
(a) 15 (b) 12
(c) 9 (d) 6

179. A flywheel in an I.C. engine:
(a) controls the supply of fuel to the engine
(b) controls the cyclic fluctuation of speed
(c) controls the speed variation due to load
(d) All the above

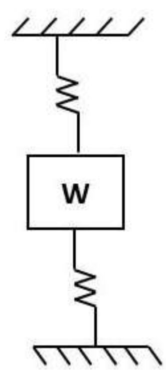
180. In a slotted lever and crank quick return mechanism used in shapers, the beginning and end of cutting stroke occurs when
(a) cranked lever are in line with each other
(b) crank is perpendicular to lever
(c) crank is horizontal
(d) lever is horizontal

181. Stress and Strain are tensor of
(a) zero-order
(b) first order
(c) second order
(d) None of the above

182. $\sigma_x + \sigma_y = \sigma_{x'} + \sigma_{y'} = \sigma_1 + \sigma_2$
The above relation is called
(a) independency of normal stresses
(b) constancy of normal stresses
(c) first invariant of stress
(d) all the above

183. In a slider-crank mechanism, the piston velocity is maximum, when:
(a) Crank is perpendicular to line of stroke.
(b) Crank and connecting rod are collinear.
(c) Crank is perpendicular to connecting rod.
(d) None of the above.

184. A body of weight w is supported by two springs as shown below. The equivalent spring constant is:



(a) $\frac{1}{K_1} + \frac{1}{K_2}$
(b) $K_1 + K_2$
(c) $K_1 - K_2$
(d) $K_1 K_2$

Answer

1 (b)	41 (*)	81 (*)	121 (a)	161 (a)
2 (a)	42 (a)	82 (*)	122 (b)	162 (d)
3 (c)	43 (*)	83 (d)	123 (c)	163 (d)
4 (d)	44 (*)	84 (*)	124 (a)	164 (c)
5 (a)	45 (*)	85 (a)	125 (b)	165 (c)
6 (*)	46 (*)	86 (*)	126 (c)	166 (*)
7 (*)	47 (b)	87 (b)	127 (c)	167 (d)
8 (*)	48 (a)	88 (*)	128 (d)	168 (a)
9 (*)	49 (d)	89 (*)	129 (a)	169 (*)
10 (a)	50 (c)	90 (*)	130 (a)	170 (c)
11 (a)	51 (a)	91 (*)	131 (*)	171 (a)
12 (c)	52 (*)	92 (*)	132 (a)	172 (b)
13 (*)	53 (b)	93 (b)	133 (d)	173 (d)
14 (*)	54 (*)	94 (*)	134 (a)	174 (d)
15 (*)	55 (d)	95 (a)	135 (b)	175 (d)
16 (*)	56 (*)	96 (d)	136 (c)	176 (a)
17 (*)	57 (*)	97 (*)	137 (c)	177 (c)
18 (b)	58 (*)	98 (b)	138 (*)	178 (a)
19 (*)	59 (*)	99 (*)	139 (a)	179 (b)
20 (c)	60 (*)	100 (*)	140 (d)	180 (b)
21 (c)	61 (a)	101 (b)	141 (b)	181 (c)
22 (a)	62 (*)	102 (*)	142 (a)	182 (c)
23 (b)	63 (*)	103 (a)	143 (a)	183 (c)
24 (d)	64 (*)	104 (b)	144 (b)	184 (b)
25 (b)	65 (*)	105 (c)	145 (*)	
26 (c)	66 (*)	106 (a)	146 (c)	
27 (d)	67 (*)	107 (c)	147 (b)	
28 (b)	68 (*)	108 (b)	148 (a)	
29 (b)	69 (*)	109 (c)	149 (b)	
30 (*)	70 (*)	110 (a)	150 (d)	
31 (a)	71 (*)	111 (d)	151 (b)	
32 (c)	72 (a)	112 (a)	152 (a)	
33 (d)	73 (c)	113 (a)	153 (*)	
34 (*)	74 (*)	114 (d)	154 (d)	
35 (*)	75 (c)	115 (b)	155 (b)	
36 (d)	76 (a)	116 (d)	156 (a)	
37 (a)	77 (*)	117 (c)	157 (c)	
38 (*)	78 (b)	118 (b)	158 (d)	
39 (b)	79 (*)	119 (d)	159 (b)	
40 (d)	80 (b)	120 (d)	160 (a)	

162. Acceleration vector

$$a = -\omega^2 A\sin(\omega t + \varphi)$$

$$a = \omega^2 A\sin(\omega t + \varphi + \pi)$$

Acceleration vector leads with an angle of π with respect to displacement vector.

174. $\tan\varphi = \frac{c\omega}{k - m\omega^2}$

At resonance condition,

Excitation frequency is equal to natural frequency

$\omega = \omega_n$

$k - m\omega_n^2 = 0$

$\tan\varphi = \infty$

$\varphi = 90^0$

175. $\eta_{max} = \frac{1-\sin\varphi}{1+\sin\varphi}$

$\varphi = 30^0$

$$\eta_{max} = \frac{1 - \sin 30^0}{1 + \sin 30^0} = 0.33$$

178. IC $= \frac{n(n-1)}{2} = \frac{6\times 5}{2} = 15$

125. On plane of maximum shear stress,

normal stress = $\frac{\sigma_x + \sigma_y}{2}$

$\sigma_x = \frac{60}{30} = 2$ kN /mm^2

$\sigma_y = 0$ kN /mm^2

$\sigma_n = \frac{2+0}{2} = 1$ kN/mm^2

134. critical bucking load, when both ends fixed

$$P_{cr} = \frac{4\pi^2 EI}{L^2} = \frac{\pi^2 EI}{(L/2)^2}$$

Effective length = L/2

147. Hoop stress in thin walled cylinder

$2\times\sigma_\theta\times t\times L = P\times D\times L$

$\sigma_\theta = \frac{PD}{2t}$

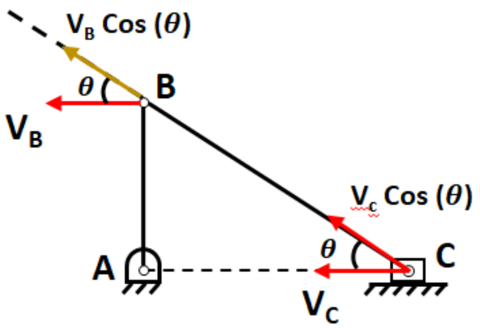
Longitudinal stress in thin walled cylinder

$\sigma_z\times\pi D\times t = P\times\frac{\pi}{4}D^2$

$\sigma_z = \frac{PD}{4t}$

$\frac{\sigma_\theta}{\sigma_z} = 2$

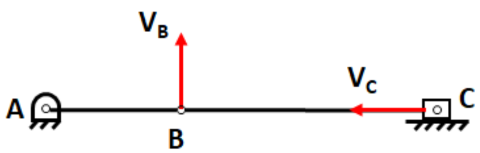
183. (a) When crank is perpendicular to line of stroke



$V_B \cos\theta = V_C \cos\theta$

$V_C = V_B = \omega_{AB} \times AB$

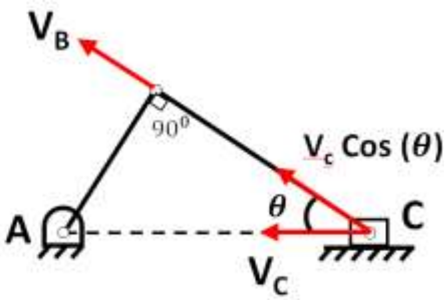
(b) Crank and connecting rod are collinear



$V_B \ \cos 90^0 = V_c \ \cos 0^0$

$V_c = 0$ m/s

(c) Crank is perpendicular to connecting rod



$V_B = V_c \cos\theta$

$V_c = \frac{\omega r}{\cos\theta}$

184. Equivalent stiffness of spring

$K_e = K_1 + K_2$

$\omega = \sqrt{\frac{K_e}{M}} = \sqrt{\frac{K_1 + K_2}{M}}$

1. In a hydrodynamic journal bearing, there is
(a) a very thin film of lubricant between the journal and the bearing such that there is contact between the journal and the bearing.
(b) a thick film of lubricant between the journal and the bearing.
(c) no lubricant between the journal and the bearing.
(d) a forced lubricant between the journal and the bearing.

2. Whirling speed of the shaft is the speed at which
(a) the shaft tends to vibrate in longitudinal direction
(b) torsional vibrations occur
(c) the shaft tends to vibrate vigorously in transverse direction
(d) combination of transverse and longitudinal vibration occurs

3. Tearing efficiency of a riveted joint is the ratio of
(a) Tearing strength of solid plate/ tearing strength of punched plate
(b) Tearing strength of punched plate/ tearing strength of the solid plate
(c) Tearing strength of a rivet/tearing strength of solid plate
(d) None of the above

4. Module of a gear is
(a) D/T
(b) T/D
(c) 2D/T
(d) 2T/D
(where D = Pitch diameter of gear, T = Number of teeth on gear.)

5. In lathe, the main spindle shaft holding the chuck is subjected to
(a) compression, torsion and thrust load
(b) torsion, impact and trust load
(c) bending, torsion and trust load
(d) bending, tensile and torsion load

6. Effect which occurs when a transverse magnetic field is applied to a current carrying conductor plate is
(a) Piezoelectric effect
(b) Dynamic Coulomb effect
(c) Hall effect
(d) None of the above

7. A test during which the output readings are compared with the corresponding standard values of measured measured by a device is
(a) Resolution
(b) Modulation
(c) Calibration
(d) Compensation

8. A vernier caliper has 25 divisions on its vernier scale and is able to measure a least value of 0.5 mm on its main scale. Its least count is equal to
(a) 0.125 mm
(b) 0.02 mm
(c) 0.25 mm
(d) 0..002 mm

9. A device used to smoothen the cyclic fluctuations of speed while delivering constant output power from the engine irrespective of the varying load demand is
(a) Governor
(b) Differential gear box
(c) Cam
(d) None of the above

10. Mass ‘m’ is rotating with a speed of ‘ω’ rad/sec at radius ‘r’ from the axis of the shaft. It is balanced by mass ‘B’ at radius ‘b’. The shaft speed is doubled for balance. Then the value of balancing mass ‘B’ is
(a) doubled
(b) halved
(c) quadrupled
(d) unaffected

11. For machines mounted on springs and dampers, damping is beneficial only when the frequency ratio is
(a) $\frac{\omega}{\omega_n} = 1$
(b) $\frac{\omega}{\omega_n} < 1$
(c) $\frac{\omega}{\omega_n} < \sqrt{2}$
(d) $\frac{\omega}{\omega_n} > \sqrt{2}$
ω = uniform angular velocity
ω_n = natural frequency

12. For a shaft speed more than the whirling speed, the phase difference between the displacement and centrifugal force is

(a) 0°　　　(b) 45°

(c) 90°　　　(d) 180°

13. In which of the following devices is an emf generated when an external force is applied on certain crystalline material ?

(a) Condenser microphone

(b) Resistance load cell

(c) Electrodynamic generator

(d) None of the above

14.

15.

16.

17.

18.

19.

1	8 (b)			
2 (c)	9 (d)			
3 (b)	10 (d)			
4 (a)	11 (d)			
5	12			
6	13			
7				

1	2	3 (a)	4 (d)	5	6	7 (c)

1. Along the 'triple line' in a p-v diagram showing all three phases of water, which one of the following statements is correct?
(a) A substance has the same pressure and temperature but different specific volume
(b) A substance has same temperature and specific volume but different pressure
(c) A substance has same specific volume and pressure but different temperature
(d) A substance has same specific volume, pressure and temperature

2. Internal energy of a system is dependent on the following aspects:
1. Molecular weight
2. Molecular structure
3. Degree of molecular activity
Which of the above are correct?
(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

3. In a cyclic process, the heat transfer are +30J, -50 J, -10J and + 60 J. The net work for the cyclic process is
(a) 30 Nm (b) 40 Nm
(c) 50 Nm (d) 60 Nm
For cyclic process,
Net work transfer = Net heat transfer
= + 30 – 50 – 10 + 60
= 30 Nm

4. A researcher claims that he has developed an engine, which while working between source and sink temperatures of 377 ^{0}C and 27 ^{0}C rejects only 50% of absorbed heat. What will his engine be?
(a) An impossible engine
(b) A Stirling engine
(c) A reversible engine
(d) A practical engine

Efficiency of cycle = $\frac{\dot{W}_{net}}{\dot{Q}_H} = \frac{\dot{Q}_H - \dot{Q}_L}{\dot{Q}_H}$ = 0.5
Efficiency of Carnot cycle
$= 1 - \frac{T_L}{T_H} = 1 - \frac{273+27}{273+377}$ = 0.54

Since efficiency of cycle is less than reversible cycle. Therefore cycle is practical.

5. A reversible engine works between temperature limits of 260 ^{0}C and 60 ^{0}C. To improve the performance, we have to
(a) Raise the source temperature to 300 ^{0}C
(b) Lower the sink temperature to 30 ^{0}C
(c) Insulate the engine
(d) None of the above

6. In a real gas equation pv = zRT, depending on the values of pressure and temperature of the real gas, the value of z
(a) Should always be less than 1
(b) May be less than 1, may be greater than 1 or equal to 1
(c) Should always be greater than 1
(d) Should always be equal to 1

7. A system executes a cyclic process during which there are two processes as given below:
${}_1Q_2$ = 460 kJ, ${}_2Q_1$ = - 100 kJ, and ${}_1W_2$ = 210 kJ
What will be work interaction in process ${}_2W_1$?

(a) 100 kJ (b) -210 kJ

(c) 150 kJ (d) – 150 kJ

For cyclic process

$$\oint dQ = \oint dW$$

$$Q_{1\to2} + Q_{2\to1} = W_{1\to2} + W_{2\to1}$$

$$460 - 100 = 210 + W_{2\to1}$$

$W_{2\to1}$ = 150 kJ

8	9	10	11 (a)	12	13 (c)	14 (d)

8. For the same compression ratio, the efficiency of an air standard Otto cycle is

(a) More than the efficiency of an air standard Diesel cycle

(b) Less than the efficiency of an air standard Diesel cycle

(c) Equal to the efficiency of an air standard Diesel cycle

(d) None of the above

9. A Carnot engine operates between 37 ^{0}C and 347 ^{0}C. If the engine produces 620 kJ of work, the entropy change during heat addition is

(a) 1 kJ/K (b) 2 kJ/K

(c) 3 kJ/K (d) 4 kJ/K

10. An amount of 1000 kJ of heat is added to a system during a constant pressure vaporization process at a temperature of 227 ^{0}C . The available energy added to the system, if the temperature of the surroundings is 27 ^{0}C, is

(a) 600 kJ (b) 500 KJ

(c) 400 kJ (d) 300 kJ

11. Consider the following statements:

1. In an ideal gas, there are no intermolecular forces of attraction and repulsion.
2. At very low pressure, all gases and vapours approach ideal gas behavior
3. Enthalpy of an ideal gas depends only on temperature.

Which of the above statements are correct?

(a) 1, 2 and 3

(b) 1 and 2 only

(c) 1 and 3 only

(d) 2 and 3 only

12. Consider the following statements pertaining to the properties of prefect, non-reacting gas mixtures:

1. The total volume of a mixture is the sum of partial volumes at the same pressure and temperature.
2. The entropy of a mixture of gases is the same as the entropies of the constituents.
3. The total pressure of a mixture of gases is equal to both pressure and volume fraction.Which of the above statements is/are correct?

(a) 1, 2, 3 and 4

(b) 1, 2 and 3 only

(c) 1, 2 and 4 only

(d) 3 and 4 only

Options missing

13. An inventor claims to have developed a refrigeration unit which maintains – 10 ^{0}C in the refrigerator which is kept in a room where the surrounding temperature is 25 ^{0}C and which has COP 8.5. His claim is

(a) Valid

(b) Marginally correct

(c) Invalid

(d) Nome of the above

Max COP of refrigerator

$= \frac{Refrigeration\ effect}{Input\ work} = \frac{T_L}{T_H - T_L} = \frac{273-10}{25+10} = \frac{263}{35} = 7.5$

Since coefficient of performance of refrigerator is greater than maximum COP of ideal refrigerator. Therefore, his claim is invalid

14. An Otto cycle has a compression ratio of 8. If 250 kJ of work is extracted from the cycle, the heat rejected by the cycle is

(a) 500 kJ (b) 442.69 kJ

(c) 331.4 kJ (d) 192.69 kJ

Efficiency of Otto cycle

$$\eta = 1 - \frac{1}{r^{\gamma-1}}$$

$$= 1 - \frac{1}{8^{1.4-1}} = 0.565$$

$$\frac{W_{net}}{Q_{in}} = 0.565$$

$$Q_{in} = \frac{W_{net}}{0.565} = \frac{250}{0.565} = 442.5\ kJ$$

$$Q_{in} - Q_{out} = W_{net}$$

$$442.5 - Q_{out} = 250$$

Q_{out} = 192.5 kJ

15	16 (b)	17 (d)	18	19	20 (b)	21	22	23	24

15. In an engine working on air standard Stirling cycle the temperature at the beginning of isothermal compression is 127 ^{0}C. The engine thermal efficiency is 50%. The specific heat of air at constant volume is C_V. The heat transferred to the regenerator is

(a) 200 C_V kJ/kg

(b) 300 C_V kJ/kg
(c) 400 C_V kJ/kg
(d) 500 C_V kJ/kg

16. An ideal spark ignition engine has a compression ratio of 9. What is its Air standard efficiency if ratio of specific heats is 1.5?
(a) 63% (b) 67%
(c) 70% (d) 72%
Efficiency of Otto cycle
$$\eta = 1 - \frac{1}{r^{\gamma-1}} = 1 - \frac{1}{9^{1.5-1}} = 0.67$$

17. A Carnot heat pump works between 27 ^{0}C and 327 ^{0}C. What will be its COP?
(a) 0.09 (b) 1.00
(c) 1.09 (d) 2.0
COP = $\frac{T_H}{T_H - T_L} = \frac{273+327}{327-27} = \frac{600}{300} = 2$

18. Practically it is not feasible to design an engine which closely follows the 'Carnot cycle' For the following reasons:
1. Transfer of heat energy at constant temperature is very difficult to achieve
2. Isentropic processes are very fast processes
3. It makes use of smaller pressure ratios
4. Thermal efficiency is not a function of source and sink temperatures
Which of the above reasons are correct?
(a) 1 and 2
(b) 2 and 3
(c) 3 and 4
(d) 4 and 1

19. Two identical finite bodies of constant heat capacity at temperatures T_1 and T_2 are available to do work in a heat engine. The final temperature T_f reached by the bodies on delivery of maximum work is
(a) $T_f = \frac{T_1+T_2}{2}$
(b) $T_f = \sqrt{T_1 T_2}$
(c) $T_f = T_1 - T_2$
(d) $T_f = \sqrt{T_1^2 + T_2^2}$

20. The mechanical efficiency of a single cylinder four stroke engine is 80%. If the frictional power is estimated to be 25 kW, the indicated power will be
(a) 100 kW (b) 125 kW
(c) 150 kW (d) 175 kW
Mechanical efficiency = $\frac{B.P}{I.P} = \frac{I.P - F.P}{I.P} = 0.8$

$I.P = \frac{F.P}{0.2} = \frac{25}{0.2}$ = 125 kW

21. A single cylinder four stroke engine operating at 80% of mechanical efficiency develops a brake power of 60 kW. The indicated power and the power lost due to friction respectively are
(a) 40 kW and 15 kW
(b) 75 kW and 20 kW
(c) 40 kW and 20 kW
(d) 75 kW and 15 kW

22. The following reasons are mentioned while recommending supercharging for the engines used in areoplanes and submarines:
1. More volumetric efficiency, better combustion and increased power output.
2. Higher peak pressure, increased temperature and smaller size.
Which of the above reasons is/are correct?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

23. Consider the following statements regarding supercharging of Diesel engines:
1. The mechanical efficiency of a supercharged Diesel engine is slightly better than that of naturally aspirated engine.
2. There is reduction in smoke in the caser of supercharged engine in the overload operation.
3. Increased valve overlap is used in supercharged engine.
Which of the above statements are correct?
(a) 1, 2 and 3
(b) 1 and 2 only
(c) 1 and 3 only
(d) 2 and 3 only

24. In Diesel engines, the control of black smoke in exhaust can be achieved by:
1. Running the engine at lower load.
2. Maintaining the injection system perfect.
3. Using Diesel fuel of higher Cetane number.
Which of the above statements are correct?
(a) 1, 2 and 3
(b) 1 and 2 only
(c) 1 and 3 only
(d) 2 and 3 only

25. The source of energy which keeps the sun shining for billions of years is
(a) Combustion of Hydrogen
(b) Nuclear fusion of light elements
(c) Nuclear fission of heavy elements
(d) Interaction of currents in the interior of the sun with the galactic magnetic field

26. Which one of the following statements is correct?
(a) During heating and humidification process, humidity ratio decreases
(b) During cooling and dehumidification process, humidity ratio increases
(c) During cooling and dehumidification process, dry bulb temperature increases
(d) During heating and humidification process, dry bulb temperature increases

27. A dimensionless quantity that connects the link between velocity flow field and the temperature field is
(a) Nusselt number
(b) Prandtl number
(c) Reynolds number
(d) Grashof number

28. The conduction heat diffuses in a material when the material has:
1. High thermal conductivity
2. Low density
3. High specific heat
4. High viscosity
Which of the above are correct?
(a) 1 and 2
(b) 2 and 3
(c) 3 and 4
(d) 4 and 1

29. In an equation of Fourier law of heat conduction, heat flow through a body per unit time is $Q = -kA\frac{dT}{dx}$, the negative sign of k in this equation is to take care of
(a) Decreasing temperature along the direction of increasing thickness
(b) Increasing temperature along the direction of increasing thickness
(c) Constant temperature along the direction with constant thickness
(d) All of the above

30. A flat wall with a thermal conductivity of 0.2 kW/mK has its inner and outer surface temperatures 600 ^{0}C and 200 ^{0}C respectively. If the heat flux through the wall is 200 kW/m^2, what is the thickness of the wall?
(a) 10 cm (b) 20 cm
(c) 30 cm (d) 40 cm

31. Which of the following thermodynamic properties are intensive properties?
1. Density
2. Entropy
3. Viscosity
(a) 1, 2 and 3
(b) 1 and 2 only
(c) 2 and 3 only
(d) 1 and 3 only

32. In a concentric double-pipe heat exchanger where one of the fluids undergoes phase change
(a) The two fluids should flow opposite to each other
(b) The two fluids should flow parallel to each other
(c) The two fluids should flow normal to each other
(d) The directions of flow of the two fluids are of no consequence

33. The characteristic length for computing Grashof number in the case of horizontal cylinder is
(a) The length of the cylinder
(b) The diameter of the cylinder
(c) The perimeter of the cylinder
(d) The radius of the cylinder

34. For which of these confriguration is a minimum temperature difference required for natural convection to set in
(a) Fluid near a heated vertical plate
(b) Fluid near a heated plate inclined at 45^0 to the vertical
(c) Fluid over a heated horizontal plate
(d) Fluid near a heated cylinder

35. A counter flow shell and tube heat exchanger is used to heat water with hot exhaust gases. The water (c = 4180 J/kgK) flows at the rate of 2 kg/s and the exhaust gases (c = 1000 J/kgK) flow at the rate of 5 kg/s. If the heat transfer coefficient is 200 W/m^{2}K, the NTU of the heat exchanger is
(a) 4.5 (b) 2.4
(c) 8.6 (d) 1.28

36. In a two-fluid heat exchanger, the inlet and outlet temperatures of the hot fluid are 65 ^{0}C and 40 ^{0}C respectively. For the cold fluid, these are 15 ^{0}C and 43 ^{0}C. The heat exchanger is a
(a) Parallel flow heat exchanger
(b) Counter flow heat exchanger
(c) Mixed flow heat exchanger
(d) Phase-change heat exchanger

37. In a double-pipe heat exchanger, the cold fluid is water with inlet temperature 20 ^{0}C and mass flow rate 10 kg/s. Assume that for water C_p = 4.2 kJ/kg^{0}C, independent of temperature. What is the maximum temperature to which the cold fluid can be heated in a parallel flow and in a counter flow heat exchanger?
(a) 80 ^{0}C in both parallel flow and counter flow
(b) 50 ^{0}C in both parallel flow and counter flow
(c) 40 ^{0}C in parallel flow and 50 ^{0}C in counter flow
(d) 40 ^{0}C in parallel flow and 80 ^{0}C in counter flow

38. If a body is at 2000 K, the wavelength at which the body emits maximum amount of radiation is
(a) 1.45 μm (b) 1.45 cm
(c) 0.345 cm (d) 0.345 μm

39. An isothermal cubical (10 m × 10 m × 10 cm) blackbody at 200 ^{0}C is suspended in air. The total radiation emitted by this body to its surrounding will be
(a) 1702.9 kW
(b) 1800 .7 kW
(c) 54.4 kW
(d) 2838.1 kW

40. A 1 m diameter spherical cavity is maintained at a uniform temperature of 500 K. The emissivity of the material of the sphere is 0.5; One 10 mm diameter hole is drilled. The maximum rate of radiant energy streaming through the hole will be
(a) 2782 W (b) 0.139 W
(c) 1392 W (d) 0.278 W

41. For a hemispherical furnace with a flat circular base of diameter D, the view factor from the dome to its base is
(a) 0.5 (b) 1
(c) 0 (d) 0.32

42. In a vapour compression refrigeration system, the high pressure liquid from the condenser/receiver is cooled below its saturation temperature to
(a) Reduce the net work per cycle
(b) Reduce the net refrigerating effect
(c) Increase the net refrigerating effect
(d) Reduce the pressure on the high pressure side

43. Specific humidity is defined as Mass of
(a) Water vapour contained in air-vapour mixture per kg of dry air
(b) Water vapour contained per kg of air-vapour mixture
(c) Dry air contained per kg of air-vapour mixture
(d) None of the above

44. In an ideal Vapour Compression Refrigeration cycle the enthalpy values at sailent points are as follow:
At inlet to compressor: 1500 kJ/kg
At outlet to compressor: 1800 kJ/kg
At inlet to evaporator: 300 kJ/kg
What is the COP of the cycle?
(a) 3 (b) 4
(c) 5 (d) 6

45. In the figure shown below, E is the heat engine with efficiency of 0.4 and R is the refrigerator. If $Q_2 + Q_4 = 3Q_1$, the COP of the refrigerator will be
(a) 3.0 (b) 4.5
(c) 5.0 (d) 5.5

46. The COP of an ideal refrigerator is N. If the machine is operated as a heat pump between the same temperature limits, its COP will be
(a) N – 1 (b) N
(c) N + 1 (d) 2N

47. An ideal refrigerator based on reversed Carnot cycle works between - 23 ^{0}C and + 27 ^{0}C. What will be the required power in kW, if a cooling rate of 1.5 kW is desired?
(a) 0.25 kW (b) 0.3 kW
(c) 3.25 kW (d) 7.5 kW

48. Consider the following functions:
1. Minimizing friction
2. Sealing the gas between suction and discharge ports
3. As a coolant to transfer heat from the crankcase to the compressor shell
4. To dampen the noise generated by moving parts

Which of the above functions do lubricants in refrigeration systems perform?
(a) 1, 2, 3 and 4
(b) 1 and 2 only
(c) 2 and 3 only
(d) 3 and 4 only

49. Consider the following statements for sensible heating. In this process:
1. Wet bulb temperature increases
2. Relative humidity decreases
3. Vapour pressure remains constant
Which of the above statements are correct?
(a) 1, 2 and 3
(b) 1 and 2 only
(c) 1 and 3 only
(d) 2 and 3 only

50. An air-conditioning system operating on the reversed Carnot cycle is required to remove heat from the room at a rate of 25 kW to maintain its temperature constant at 20 ^{0}C. The temperature constant at 20 ^{0}C. The temperature of the surroundings being 35 ^{0}C, the power required to operate this air-conditioning system will be
(a) 1.28 kW (b) 4.02 kW
(b) 5.12 kW (d) 12.80 kW

51. The pressure inside a soap bubble of 50 mm diameter is 25 N/m^2 above the atmospheric pressure. The surface tension in soap film would be
(a) 0.156 N/m (b) 0.312 N/m
(c) 0.624 N/m (d) 0.078 N/m

52. A Newtonian fluid is one which
(a) is viscous but incompressible
(b) has a linear relationship between the shear stress and the rate of angular deflection
(c) exhibits an increase in viscosity with increasing rate of deformation
(d) exhibits a decrease in viscosity with increasing rate of deformation

53. Unlike the viscosity of liquids, the viscosity of gases increases with increasing temperature. This is due to
(a) Increased cohesive force between the molecules
(b) Increased momentum transfer in the molecules
(c) Decreased momentum transfer in the molecules
(d) Increase in both cohesive force and momentum transfer

54. Manometer is a device used for measuring
(a) velocity at a point in a fluid
(b) Pressure at a point in a fluid
(c) Discharge of a fluid
(d) None of the above

55. When a dolphin glides through air, it experiences an external pressure of 0.75 m of mercury. The absolute pressure on dolphin when it is 5 m below the free surface of the water is
(a) 0.10 N/mm^2 (b) 0.5 N/mm^2
(c) 1.0 N/mm^2 (d) 0.15 N/mm^2

56. Which one of the following statements is correct?
(a) For a floating body, the stable equilibrium condition exists when position of metacenter remains higher than the centre of gravity of the body
(b) For a floating body, the stable equilibrium condition exists when position of metacenter remains lower than the centre of gravity of the body
(c) For a floating body, the neutral equilibrium condition exists when position of metacenter remains higher than the centre of gravity of the body
(d) For a floating body, the unstable equilibrium condition exists when position of metacenter remains higher than the centre of gravity of the body

57. A 2-D flow field is defined as $\vec{V} = \vec{\imath}x - \vec{\jmath}y$. The equation of streamline passing through the point (1,1) is
(a) $xy - 1 = 0$
(b) $xy + 1 = 0$
(c) $xy + 2 = 0$
(d) $xy - 2 = 0$

58. A flownet is a graphical representation of streamlines and equipotential lines such that these lines
(a) Intersect each other at various different angles forming irregular shaped nets
(b) Intersect each other orthogonally forming curvilinear squares

(c) Indicate the direction but not magnitude of vector

(d) Indicate the direction and magnitude of vector

59. Which one of the following statements is correct for the velocity potential?

(a) Existence of velocity potential is an indication of irrotational nature of the flow

(b) The velocity potential automatically satisfies the continuity equation

(c) Velocity potential can be defined only for 2-dimensional flow

(d) All of the above

60. Angle of diverging portion of the ventrimeter is limited to 7^0, because:

1. Flow decelerates in the diverging portion and pressure increases in the downstream direction. Hence, the fluid experience an adverse pressure gradient, If the divergence angle is large.

2. Flow separation takes place due to adverse pressure gradient when divergent angle is large.

3. If the divergence angle is large, a negative pressure is created at the throat which obstructs the flow of fluid.

Which of the above reasons are correct?

(a) 1, 2 and 3

(b) 1 and 2 only

(c) 1 and 3 only

(d) 2 and 3 only

61. In the above layout of piping, what is the velocity in 200 mm diameter pipe?

Figure missing

(a) 2.5 m/s (b) 5.55 m/s

(c) 7.25 m/s (d) 9.56 m/s

62. Bernoulli's equation is applicable between any two points located in

(a) Rotational flow of an incompressible fluid

(b) Irrotational flow of compressible or incompressible fluid

(c) Steady, rotational flow of an incompressible fluid

(d) Steady, irrotational flow of an incompressible fluid

63. Winter flow through a smooth circular pipe of diameter D and length L because of a pressure difference ΔP across the length. The volume flow rate is Q and the flow is turbulent with Reynolds number 10^5. If the pressure difference is increased to 4ΔP the volume flow rate will be

(a) 2 Q

(b) A little more than 2Q

(c) A little less than 2Q

(d) 4Q

64. When the pressure drop across a converging-diverging nozzle is different from the design value for isentropic flow; which of the following is possible?

(a) There is one normal shock in the converging part and one normal shock in diverging part

(b) There is only one normal shock in the converging part and none in the diverging part

(c) There is only one normal shock in the diverging part and none in the converging part

(d) There are two or more normal shocks, depending on the pressure drop, in the diverging part and none in the converging part

65. Consider the following statements pertaining to boundary layer on solid surfaces:

1. The boundary layer separation takes place if the pressure gradient is zero.

2. The condition of boundary layer separation is $\left(\frac{\partial u}{\partial y}\right)_{y=0} = 0.$

3. Boundary layer on a flat plate is laminar if the Reynolds number is less than 5×10^5.

Which of the above statements is/are correct?

(a) 1 , 2 and 3

(b) 1 and 2 only

(c) 2 and 3 only

(d) 1 and 3 only

66. For laminar flow through a round pipe, the shear stress

(a) Remains constant over the cross-section

(b) Varies linearly with the radial distance

(c) Must be zero at all points

(d) Varies parabolic ally with radial distance

67. Consider flow of oil and water through a channel; the boundary conditions at the interface are

Figure missing

(a) Velocity and shear stress are continuous

(b) Shear stress is continuous and velocity is discontinuous

(c) Shear stress is zero and velocity is continuous
(d) Shear stress is zero

68. Which one of the following statements is not correct in the context of laminar flow through a pipeline?
(a) Shear stress is zero at the centre and varies linearly with pipe radius
(b) Head loss is proportional to square of the average flow velocity
(c) The friction factor varies inversely with flow Reynolds number
(d) No dispersion of die injected into the flow stream

69. Laminar flow between closely spaced parallel plates is governed by the considerations of which one of the following pair of forces?
(a) Pressure and inertial forces
(b) Gravity and inertial forces
(c) Viscous and inertial forces
(d) Pressure and viscous forces

70. Across the normal shock, fluid properties change in such a manner that the:
1. Velocity of flow is subsonic
2. Pressure increases
3. Specific volume decreases
4. Temperature decreases
Which of the above are correct?
(a) 1, 2, 3 and 4
(b) 2, 3 and 4 only
(c) 1 and 4 only
(d) 1, 2 and 3 only

71. In a compressible flow with friction chocking through a constant area duct with supersonic flow at inlet, if the pipe length is reduced with the same exit pressure
(a) Exit flow will still be sonic
(b) The velocity at exit is subsonic
(c) The flow will still be supersonic
(d) A shock will appear at the exit

72. When a converging-diverging nozzle is operated at off-design conditions, a normal shock forms in the diverging portion. The nozzle can be assumed to be perfectly insulated from the surroundings. Then across the shock
(a) The velocity undergoes a jump but pressure and entropy remain unchanged
(b) The pressure undergoes a jump but velocity and entropy remain unchanged
(c) The velocity and pressure undergo a jump, but entropy remains unchanged because there is no heat transfer
(d) Velocity, pressure and entropy all undergo a jump

73. Formation and collapse of vapour bubbles are believed to be the root cause for cavitations in hydraulic turbines. Most favourable condition for the formation of bubbles is set in the turbines at
(a) Penstock/Nozzle
(b) Guide vanes/Inlet of the runner
(c) Vanes receiving impact of jet
(d) Outlet of the runner/ Entrance of the draft tube

74. For fully developed laminar flow through a circular pipe with Reynold's number Re the friction factor is
(a) Inversely proportional to Re
(b) Proportional to Re
(c) Proportional to square of Re
(d) Independent of Re

75. Chocked flow through an isentropic nozzle implies:
1. Discharge is maximum
2. Discharge is zero
3. Nozzle exit pressure ≤ critical pressure
4. Mach number at the throat is unity
Which of the above statements are correct?
(a) 1, 2, 3 and 4
(b) 1, 2 and 3 only
(c) 1, 3 and 4 only
(d) 2, 3 and 4 only

76. In a two stage gas turbine plant, with intercooling and reheating
(a) Both work ratio and thermal efficiency increase
(b) Work ratio increases but thermal efficiency decreases
(c) Thermal efficiency increases but work ratio decreases
(d) Both work ratio and thermal efficiency decrease

77. The ratio of power outlet of the pump to the power input to the pump is known as
(a) Mechanical efficiency
(b) Static efficiency
(c) Overall efficiency
(d) Manometric efficiency

78. A pump is defined as a device which converts
(a) Hydraulic energy into mechanical energy
(b) Mechanical energy into hydraulic energy
(c) Kinetic energy into mechanical energy
(d) None of the above

79. The specific speed of a pump is defined as the speed of the unit of such a size that it
(a) Delivers unit discharge at unit head
(b) Requires unit power to develop unit head
(c) Delivers unit discharge at unit power
(d) Produces unit power with unit head available

80. Negative slip occurs in reciprocating pumps, when delivery pipe is
(a) Long and suction pipe is short and pump is running at low speed
(b) Long and suction pipe is short and pump is running at high speed
(c) Short and suction pipe is long and pump is running at low speed
(d) Short and suction pipe is long and pump is running at high speed

81. Consider the following statements:
1. The wheel can be operated freely in air
2. Pressure at the exit of the nozzle is atmospheric
3. Pressure does not vary along the moving vanes
4. Change in direction of momentum imparts thrust over moving vanes
Which of the above statements are applied to impulse turbine?

(a) 1, 2 and 3 only

(b) 1, 2 and 4 only

(c) 3 and 4 only

(d) 1, 2, 3 and 4

82. A water jet 0.0015 m^2 in area issues from a nozzle with 15 m/s velocity. It is made to impinge perpendicular on to a plate that moves away from the jet with a velocity of 5 m/s. The force on the plate due to this impact is

(a) 150 N (b) 1470 N
(c) 340 N (d) 900 N

83. Consider the following statements with regard to hydraulic turbines:
1. Kaplan turbines are most efficient at part load operations.
2. If n is the number of jets in a Pelton turbine, then the specific speed is proportional to n^2
3. The flow ratio of Francis turbines are in the range of 0.1 – 0.3
Which of the above statements is/are correct ?
(a) 1, 2 and 3
(b) 1 and 2 only
(c) 1 and 3 only
(d) 2 and 3 only

84. A converging-diverging nozzle is operated at a pressure difference which is not the design value for isentropic flow. As a consequence a normal shock is formed in the diverging portion. In this situation the Mach number at the throat is
(a) Less than 1
(b) More than 1
(c) Exactly 1
(d) Could be less or more than 1 depending on the pressure difference

85. The air pre-heater of a boiler is located between
(a) Forced draft fan and furnace
(b) Furnace and economizer
(c) Economizer and chimney
(d) Superheater and furnace

86. A super critical boiler requires
(a) Only preheater and superheater
(b)Preheater, evaporator and superheater
(c) Only preheater
(d) Only superheater

87. The correct sequence of location of equipment in the flue gas path from furnace exit up to chimney is
(a) Superheater, economizer, air heater, electrostatic precipitator and induced draft fans
(b) Superheater, economizer, electrostatic precipitator, induced draft fans and air heater
(c) Superheater, electrostatic precipitator, , economizer, air heater and induced draft fans.
(d) Superheater, electrostatic precipitator, induced draft fans, economizer and air heater

88. The main advantage of the water tube boiler over the fire-tube boiler is
(a) The water tube boiler can operate safely at higher pressure
(b) Soot deposition in the tubes is avoided
(c) Corrosion of the tubes is less
(d) Fouling of the tubes is reduced

89. A super critical boiler consists of only economizer and superheater an dit does not have an evaporator because
(a) Water temperature can be raised to critical temperature in the economizer itself
(b) High evaporation rate is achieved through forced circulation, of water through tubes
(c) Enthalpy of evaporation becomes zero at critical pressure or above that
(d) Flue gas used to run rotary compressor supply high pressure air to the furnace

90. The effect of considering friction in steam nozzle for the same pressure ratio leads to
(a) Increase in dryness fraction of exit steam
(b) Decrease in dryness fraction of exit steam
(c) No change in the quality of exit steam
(d) Decrease r increase of dryness fraction of exit steam depending upon inlet quality

91. In a half-degree reaction Parson's turbine, operating at design conditions, the enthalpy drop of steam in one stage of the turbine occurs
(a) Entirely in the fixed blades
(b) Entirely in the moving blades
(c) Half in the fixed blades and half in the moving blades
(d) None of the above

92. The collection efficiency of cyclone separators increases with:
1. Decreasing particle size
2. Increasing particle density
3. Decreasing gas velocity
4. Increasing number of gas revolutions
5. Increasing cyclone diameter
Which of the above statements are correct?
(a) 1, 3 and 4 only
(b) 2 and 4 only
(c) 2, 4 and 5 only
(d) 1,2 , 3, 4 and 5

93. Reheating of steam in a steam power plant:
1. Increases the cycle efficiency
2. Reduces the turbine speed
3. Reduces blade erosion
4. Increase specific output
Which of the above statements are correct?
(a) 1, 2, 3 and 4
(b) 1, 2 and 3 only
(c) 2 and 4 only
(d) 1, 3 and 4 only

94. Following points expresses the effect of keeping high clearance volume for the cylinders in reciprocating compressor. Which one of the following points is disagreeable?
(a) By increasing clearance volume volumetric efficiency decreases
(b) By increasing clearance volume power consumption increases
(c) By increasing clearance volume chances of piston striking cylinder head gets reduced
(d) By increasing clearance volume maximum compression pressure value decreases

95. Consider the following statements:
1. Stalling is the separation of flow from the blade surface.

2. Surging leads to physical damage due to impact loads and high frequency vibration.

3. Mass flow rate is minimum if chocking occurs.

Which of the above statements are correct?

(a) 1, 2 and 3

(b) 1 and 3 only

(c) 1 and 2 only

(d) 2 and 3 only

96. Across the normal shockwave:
1. Stagnation pressure decreases whereas stagnation temperature remains constant
2. Mach number before the shock wave is always greater than one and after the shockwave, the Mach number need not be less than one
3. Across the shockwave there is rise in pressure and temperature
4. The product of Mach number downstream of normal shockwave and upstream of normal shockwave is always one

Which of the above statements are correct?
(a) 1 and 3
(b) 2 and 3
(c) 1 and 4
(d) 2 and 4

97. Which of the following statements are correct?
1. Velocity compounded impulse turbine give less speed and less efficiency.
2. For an ideal centrifugal compressor, the pressure produced depends on impeller velocity and diameter.
3. While flowing through the rotor blades in a gas continuously decreases.
4. While flowing through the rotor blades in an axial flow compressor, the relative velocity of air continuously decreases.

(a) 1 and 3
(b) 2 and 3
(c) 1 and 4
(d) 2 and 4

98. What is the power required to drive a centrifugal air compressor, when impeller diameter is 0.45 m and N is 7200 rpm?
(a) 28.78 kW/kg/s
(b) 30.78 kW/kg/s
(c) 27.78 kW/kg/s
(d) 26.78 kW/kg/s

99. Cooling of reciprocating compressor cyclinder:
1. Increases the volumetric efficiency
2. Increases the work input
3. Decreases the volumetric efficiency
4. Decreases the work input

Which of the above statements are correct?
(a) 1 and 2 (b) 2 and 3
(c) 3 and 4 (d) 1 and 4

100. In supersonic flow of air, a diverging passage results in
(a) Increase in velocity and pressure
(b) Decrease in pressure and density
(c) Increase in velocity and density
(d) Decrease in velocity and pressure

101. Statement (I) : Negative temperatures are impossible on the Kelvin scale.

Statement (II): The Kelvin scale is thermodynamic temperature scale.

102. Statement (I): A breeder reactor does not require moderator.

Statement (II): The parasite absorption of neutrons is low.

103. Statement (I): Property tables list different values of some properties for a substance at the same state as a result of using different reference states.

Statement (II): The reference state chosen is of no consequence in thermodynamic process calculations as long as we use values from the single consistent set of tables.

104. Statement (I): In an air conditioned room, the reflective coating should be on the inside of the window.

Statement (II): Window pane glass is transparent to solar radiation.

105. Statement (I): The coefficient of discharge for a mouthpiece is higher than that of an orifice.

Statement (II) : The discharge through an orifice varies as $H^{1/2}$ whereas the discharge through a mouthpiece varies as $H^{2/3}$ (where H is the head causing the flow in both cases).

106. Statement (I): A rocket engine can operate even in vacuum and in any fluid medium.

Statement (II): Rocket engine is a pure reaction engine which produces propulsive thrust.

107. Statement (I): Both pressure and temperature across the normal shock increase.
Statement (II): The stagnation pressure across the normal shock decreases.

108. Statement (I): When a given body floats in different liquids, the volume displaced will decrease with increase in the specific gravity of the fluid.

Statement (II): The weight of the floating body is equal to the weight of the volume displaced.

109. Statement (I): The vertical boilers are used to save the floor space.

Statement (II): Horizontal boilers are more efficient than vertical boilers.

110. Statement (I): A small insect can sit on the free surface of a liquid through insect's density is higher than that of the liquid.

Statement (II): Liquids have viscosity

111. Statement (I): An SI engine requires greater spark advance at lower loads.

Statement (II): Increased dilution by residual gases at lower loads reduces the combustion rate.

112. Statement (I) : In Boiling water Reactor (BWR) coolant serves the triple function of coolant, moderator and working fluid
Statement (II) : The steam flowing to the turbine is produced directly in the reactor core.

113. Statement (I): Modern turbines have velocity compounding at the initial stages and pressure region of reaction blading.

Statement (I): Excessive tip leakage occurs in the high pressure region of reaction blading.

114. Statement (I): In CI engines increase of load decreases the knocking tendency.

Statement (II) : Increase of load increases the temperature of mixture and thereby decrease in delay angle.

115. Statement (I): In impulse turbines pressure changes occurs only in the nozzles of the machine. The pressure of liquid does not change while flowing through the rotor of the machine.

Statement (II): The pressure of liquid changes while it flows through the rotor through the rotor of the machine in Reaction turbine.

116. Statement (I) : The efficiency of a boiler is more if it is provided with mechanical draught rather than with natural draught.

Statement (II): Natural draught is very costly but highly efficient.

117. Statement (I) : In common rail system, the nozzle construction must be closely matched to ensure equality of fuel discharge from cylinder to cylinder

Statement (II): The discharge from the nozzles is regulated by the size of orifice and pressure drop.

118. Statement (I): The term surge indicates a phenomenon of instability which takes place at low flow values and which involves an entire system including not only the centrifugal compressor, But also the group of components traversed by the fluid upstream and down stream of it.

Statement (II): Chocking is defined as separation of fluid from the rotor blades of centrifugal compressor.

119. Statement (I): The four stroke cycle internal combustion reciprocating engines run at higher speeds than the two stroke cycle engines.

Statement (II): The separate exhaust and intake strokes of the four stroke cycle engines provide greater opportunity from critical parts such as piston.

120. Statement (I): An impulse turbine can run without change in its hydraulic efficiency even if its casing is damaged.

Statement (II): An impulse turbine will not have draft tube.

1. A stone weighs 400 N in air and when immersed in water it weighs 225 N. If the specific weight of water is 9810 N/m^3, the relative density of the stone will be nearly

(a) 5.9 (b) 4.7
(c) 3.5 (d) 2.3

2. A flat plate 0.1 m^2 area is pulled at 30 cm/s relative to another plate located at a distance of 0.01 cm from it, the fluid separating them being water with viscosity of 0.001 Ns/m^2. The power required to maintain velocity will be

(a) 0.05 W (b) 0.07 W
(c) 0.09 W (d) 0.11 W

3. When the pressure of liquid is increased from 3 MN/m^2 to 6 MN/m^2, its volume is decreased by 0.1%. The bulk modulus of elasticity of the liquid will be

(a) 3×10^{12} N/m^2 (b) 3×10^9 N/m^2
(c) 3×10^8 N/m^2 (d) 3×10^4 N/m^2

4. A curve that is everywhere tangent to the instantaneous local velocity vector, is

(a) Streak line (b) Path line
(c) Normal line (d) Streamline

5. A 120 mm diameter jet of water is discharging from a nozzle into the air a velocity of 40 m/s. The power in the jet with respect to a datum at the jet will be

(a) 380 kW (b) 360 kW
(c) 340 kW (d) 320 kW

6. Which of the following application regarding Navier-Strokes equations are correct ?

(1) Laminar unidirectional flow between stationary parallel plates.
(2) Laminar unidirectional flow between parallel plates having no relative motion.
(3) Laminar flow in circuit pipes
(4) Laminar flow between concentric rotating cylinders.

(a) 1, 2 and 3 only (b) 1, 3 and 4 only
(c) 1,2 and 4 only (d) 2,3 and 4 only

7. A crude oil having a specific gravity of 0.9 flows through a pipe of diameter 0.15 m at the rate of 8 lps. If the value of μ is 0.3 ns/m^2 , the Reynolds number will be nearly

(a) 295 (b) 235
(c) 205 (d) 165

8. Two pipes of lengths 2500 m each and diameters 80 cm and 60 cm and the total flow is 250 litre/s. The rates of flow in the pipes are nearly

(a) 0.17 m^3/s and 0.1 m^3/s
(b) 0.23 m^3/s and 0.1 m^3/s
(c) 0.17 m^3/s and 0.4 m^3/s
(d) 0.23 m^3/s and 0.4 m^3/s

9. A fluid of mass density 1790 kg/m^3 and viscosity 2.1 Ns/m^2 flows at a velocity of 3 m/s in a 6 cm diameter pipe. The head loss over a length of 12 m pipe will be nearly

(a) 62.0 m (b) 54.0 m
(c) 46.5 m (d) 38.5 m

10. Which of the following characteristics regarding fluid kinematics is/are correct ?

(1) Streamline represents an imaginary curve in the flow field so that the tangent to the curve at any point represents the direction of instantaneous velocity at that point.
(2) Path lines, streamlines and streak lines are identical in steady flow.

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

11. To maintain 0.08 m^3/s flow a petrol with a specific gravity of 0.7, through a steel pipe of 0.3 m diameter and 800 m length, with coefficient of friction of 0.0025 in the Darcy relation, the power required will be nearly

(a) 0.6 kW (b) 1.0 kW
(c) 2.6 kW (d) 3.0 kW

12. The diameter of a nozzle d for maximum transmission of power through it, is

(a) $\left[\frac{D^5}{8fL}\right]^{\frac{1}{4}}$

(b) $\left[\frac{D^5}{8fL}\right]^{\frac{1}{2}}$

(c) $\left[\frac{8D^5}{fL}\right]^{\frac{1}{4}}$

(d) $\left[\frac{8D^5}{fL}\right]^{\frac{1}{2}}$

Where:
D = Diameter of pipe
f = Coefficient of friction
L = Length of pipe

13. A piston-cylinder device with air at an initial temperature of 30^0 C undergoes an expansion process for which pressures and volume are related as given below:

P(kPa)	100	37.9	14.4
V(m^3)	0.1	0.2	0.4

The work done by the system for n = 1.4 will be

(a)4.8kJ
(b) 6.8 kJ
(c) 8.4 kJ
(d) 10.6 kJ

14. A domestic food freezer maintains a temperature of – 15^0C. The ambient air temperature is 30^0 C. If heat leaks into the freezer at the continuous rate of 1.75 kJ/s, the least power necessary to pump this heat out continuously will be nearly
(a) 0.1 kW
(b) 0.2 kW
(c) 0.3 kW
(d) 0.4 kW

15. An ideal gas is flowing through an insulated pipe at the rate of 3 kg/s. There is a 10% pressure drop from an inlet to exit of the pipe. The values of R = 0.287 kJ/kg.K and T_0 = 300 K. The rate of energy loss for the pressure drop due to friction, will be nearly
(a) 34 kW
(b) 30 kW
(c) 26 kW
(d) 22 kW

16. A cyclic heat engine operates between a source temperature of 800^0 C and a sink temperature of 800^0 C and a sink temperature of 30^0 C. The least rate of heat rejection per kW net output of engine will be nearly
(a) 0.2 kW
(b) 0.4 kW
(c) 0.6 kW
(d) 0.8 kW

17. A frictitious pressur that, if it acted on the piston during the entire power stroke, would produce the same amount of net work as that produced during the actual cycle is called
(a) Quasi equivalent pressure
(b) Mean equivalent pressure
(c) Mean effective pressure
(d) Quasi static pressure

18. An ideal cycle based on the concept of combination of two heat transfer processes, one at constant volume and the other at constant pressure, is called
(a) Otto cycle
(b) Dual cycle
(c) Diesel cycle
(d) Carnot cycle

19. The ideal thermodynamic cycle for the development of gas-turbine engine is
(a) Otto
(b) Stirling
(c) Ericsson
(d) Brayton

20. If the pressure at exhaust from the turbine is the saturation pressure corresponding to the temperature desired in the process heater, such a turbine is called
(a) Condensing turbine
(b) Extraction turbine
(c) Pass out turbine
(d) Back pressure turbine

21. The purpose of providing fins on heat transfer surface is to increase
(a) Temperature gradient so as to enhance heat transfer by convection
(b) Effective surface area to promote rate of heat transfer by convection
(c) Turbulence in flow for enhancing heat transfer by convection
(d) Pressure drop of the fluid

22. For fully developed laminar pipe flow, the average velocity is
(a) one-half of the maximum velocity
(b) One-third of the maximum velocity
(c) One-fourth of the maximum velocity
(d) Two-third of the maximum velocity

23. The overall heat transfer coefficient due to convection and radiation for a steam maintained at 200^0C running in a large room at 30^0C is 17.95 W/m^{2}K. If the emissivity of the pipe surface is 0.8; the value of $\sigma = 5.67 \times 10^{-8}$ W/m^{2}K. the heat transfer coefficient due to radiation will be nearly
(a) 17 W/m^{2}K
(b) 14 W/m^{2}K
(c) 11 W/m^{2}K
(d) 8 W/m^{2}K

24. Large heat transfer coefficients for vapour condensation can be achieved by promoting
(a) Film condensation
(b) Dropwise condensation
(c) Cloud condensation
(d) Dew condensation

25. Which one of the following valves is provided for starting the engine manually, during cold weather conditions?
(a) Starting jet valve
(b) Compensating jet valve
(c) Choke valve
(d) Auxiliary air valve

26. A 4-cylinder, 4-stroke single acting petrol engine consumes 6 kg of fuel per minute at 800 rpm when the air-fuel ratio of the mixture supplied is 9 : 1. The temperature is 650 K and

pressure is 2.5 bar at the end of compression stroke. Take R = 300 Nm/kgK, diameter of cylinder as 8 cm, stroke of cylinder as 10 cm. The compression ratio will be nearly
(a) 6.2
(b) 5.7
(c) 5.2
(d) 4.6

27. Ice is formed at 0^0C from water at 20^0C. The temperature of the brine is - 8^0 C. The refrigeration cycle used in perfect reversed Carnot cycle. Latent heat of ice = 335 kJ/kg, and c_{pw} = 4.18. The ice formed per kWh will be nearly
(a) 81.4 kg
(b) 76.4 kg
(c) 71.8 kg
(d) 68.8 kg

28. A Freon 12 simple saturation cycle operates at temperatures of 35^0 C and - 15^0C for the condenser and evaporator. If the refrigeration effect produced by the cycle is 111.5 kJ/kg and the work required by the compressor is 27.2 kJ/kg, the value of COP will be nearly
(a) 4.1
(b) 3.6
(c) 3.1
(d) 2.6

29. A cold storage is to be maintained at – 5^0C while the surroundings are at 35^0C. The heat leakage from the surroundings into the cold storage is estimated to be 29 kW. The actual COP of the refrigeration plant used is one-third of an ideal plant working between the same temperatures. The power required to drive the plant will be
(a) 10 kW
(b) 11 kW
(c) 12 kW
(d) 13 kW

30. A single acting two-stage air compressor deals with 4 m^3/min of air at 1.013 bar and 15^0 C with a speed of 250 rpm. The delivery pressure is 80 bar. If the inter cooling is complete, the intermittent pressure after first stage will be
(a) 9 bar
(b) 8 bar
(c) 7 bar
(d) 6 bar

31. The ideal gas-refrigeration cycle is the same as the
(a) Brayton cycle
(b) Reversed Brayton cycle
(c) Vapour compression refreigeration cycle
(d) Vapour absorption refrigeration cycle

32. If the atmospheric conditions are 20^0C, 1.013 bar and specific humidity of 0.0095 kg/kg of dry air, the partial pressure of vapour will be nearly
(a) 0.076 bar
(b) 0.056 bar
(c) 0.036 bar
(d) 0.016 bar

33. In air-conditioning systems, air may be cooled and dehumidified by
1. Spraying chilled water to air in the form of fine mist.
2. Circulating chilled water or brine in a tube placed across the air flow.
3. Placing the evaporator coil across the air flow.
Which of the above statements are correct?
(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1,2 and 3

34. A duct of rectangular cross-section 600 mm x 400 mm carries 90 m^3/min of air having density of 1.2 kg/m^3. When the quantity of air in both cases is same, the equivalent diameter of a circular duct will be nearly
(a) 0.86 m
(b) 0.76 m
(c) 0.64 m
(d) 0.54 m

35. A room having dimensions of 5 m x 5m x 3 m contains air at 25^0C and 100 kPa at a relative humidity of 75%. The corresponding value of P_s is 3.169 kPa. The partial pressure of dry air will be nearly
(a) 106 kPa
(b) 98 kPa
(c) 86 kPa
(d) 78 kPa

36. A measure of feeling warmth or coolness by the human body in response to the air temperature, misture content and air motion is called
(a) Dry bulb temperature
(b) Effective temperature
(c) Wet bulb temperature
(d) Dew point temperature

37. While designing a Pelton wheel, the velocity of wheel ‘u’ is

(a) $K_u\sqrt{gH}$
(b) $2K_u\sqrt{gH}$
(c) $K_u\sqrt{2gH}$
(d) $2K_u\sqrt{2gH}$
where:
K_u = Speed ratio
H = Net head on turbine
g = Gravity

38. The turbines of the same shape will have the same
(a) Thomas number
(b) Reynolds number
(c) Specific speed
(d) Rotational speed

39. A centrifugal pump is required to lift 0.0125 m^3/s of water from a wall with depth 30 m . if rating of the pump motor is 5 kW, and the density of water is 1000 kg/m^3, the efficiency of the pump will be nearly
(a) 82%
(b) 74 %
(c) 66%
(d) 58 %

40. An inward flow reaction turbine has an external diameter of 1 m and its breadth at inlet is 250 mm. if the velocity of flow at inlet is 2m/s and 10% of the area of flow is blocked by blade thickness, the weight of water passing through the turbine will be nearly
(a) 10 kN/s
(b) 14 kN/s
(c) 18 kN/s
(d) 22 kN/s

41. The process of abstracting steam at a certain section of the turbine and subsequently using it for heating feed water supplied to the boiler is called
(a) Reheating
(b) Regeneration
(c) Bleeding
(d) Binary vapour cycle

42. When blade speed ratio is zero, no work is done because the distance travelled by the blade is zero if the torque on the blade
(a) is minimum
(b) is zero
(c) is maximum
(d) remains the same

43. In an axial flow turbine, the utilization factor has an absolute maximum value of unity, for any degree of reaction if the value of nozzle angle α is
(a) 270^0
(b) 180^0
(c) 90^0
(d) 0^0

44. Which of the following are essential for a good combustion chamber of turbojet engine?
1. It should allow complete combustion of fuel.
2. It should maintain sufficiently high temperatures in the zone of combustion in addition to proper atomization of fuel thus leading to continuous combustion
3. It should not have high rate of combustion
4. The pressure drop should be as small as possible
(a) 1, 2 and 4 only
(b) 1, 2 and 3 only
(c) 1, 3 and 4 only
(d) 2, 3 and 4 only

45. If m_f is the mass of fuel supplied per kg of air in one second, then the mass of gases leaving the nozzle of turbojet will be
(a) $(1 - m_f)$ kg/s
(b) $\frac{1}{1+m_f}$kg/s
(c) $(1 + m_f)$ kg/s
(d) $\frac{1}{1-m_f}$kg/s

46. Which one of the following may be considered as a single cylinder two-stroke reciprocating engine running at 2400 rpm to 2700 rpm for rapid chain of impulses?
(a) Turbo jet (b) Pulse jet
(c) Ram jet (d) Athodyd jet

47. In jet propulsion of ships, when the inlet orifices are at right angles to the direction of motion of the ships, the efficiency of propulsion η is
(a) $\frac{2u^2}{V+u}$ (b) $\frac{2Vu}{(V+u)^2}$
(c) $\frac{2u}{(V+u)^2}$ (d) $\frac{2Vu}{V+u}$
where :
V = Absolute velocity of the issuing jet
u = Velocity of the moving ship

48. 0.8 kg of air flows through a compressor under steady state conditions. The properties of air at entry are: pressure 1 bar, velocity 10 m/s, specific volume 0.95 m^3/kg and internal energy 30 kJ/kg. The corresponding values at exit are 8 bar, 6 m/s, 0.2 m^3/kg and 124 kJ/kg. Neglecting change in potential energy, the power input will be
(a) 117 kW (b) 127 kW

(c) 137 kW (d) 147 kW

49. In a power plant, the efficiency of the electric generator, turbine, boiler, cycle and the overall plant are 0.97, 0.95, 0.92, 0.42 and 0.33 respectively. In the generated electricity, the auxiliaries will consume nearly
(a) 7.3 % (b) 6.5 %
(c) 5.7 % (d) 4.9 %

50. The higher power requirements for compression in a steam power plant working on Carnot vapour cycle
(a) Increases the plant efficiency as well as work ratio
(b) Reduces the plant efficiency as well as work ratio
(c) Does not affect the plant efficiency as well as work ratio
(d) Increases the plant efficiency and reduces work ratio

51. For the same compression ratio, the Brayton cycle efficiency is
(a) Same as the Diesel cycle efficiency
(b) Equal to the Otto cycle efficiency
(c) More than the Diesel cycle efficiency
(d) Less than the Otto cycle efficiency

52. An economizer in a steam generator performs the function of preheating the
(a) Combustion air
(b) Feed water
(c) Input fuel
(d) Combustion air as well as input fuel

53. Air enters the compressor of a gas turbine plant operating on Brayton cycle at 1 bar and 27 ^{0}C. The pressure ratio in the cycle is 6. If the relation between the turbine work W_T and compressor work W_c is $W_T = 3W_c$ and $\gamma = 1.4$, the cycle efficiency will be nearly
(a) 40 % (b) 50 %
(c) 60 % (d) 70 %

54. A fluidized bed combustion system having an output of 35 MW at 80% efficiency when using a coal of heating value 26 MJ/kg with a sulphur content of 3.6 % requires a particular limestone to be fed to it at a calcium-sulphur molar ratio of 3.0 so as to limit emissions of SO_2 adequately. The limestone used contains 85% $CaCO_3$. The required flow rate of limestone will be
(a) 2405 kg/h (b) 2805 kg/h
(c) 3205 kg/h (d) 3605 kg/h

55. In Orsat apparatus, when the percentage of carbon dioxide, oxygen and carbon monoxide are known, the remaining gas is assumed to be
(a) Hydrogen (b) Sulphur dioxide
(c) Nitrogen (d) Air

56. The partial vacuum created by the fan in the furnace and flues, draws the products of the combustion from the main flue and allows them to pass up to the chimney. Such a draught is called
(a) Balanced draught
(b) Forced draught
(c) Induced draught
(d) Artificial draught

57. Which of the following are applied (used) ways of compounding steam turbines?
1. Pressure compounding
2. Temperature compounding
3. Velocity compounding
(a) 1, 2 and 3
(b) 1 and 2 only
(c) 2 and 3 only
(d) 1 and 3 only

58. A steam ejector which removes air and other non-condensable gases from the condenser is known as
(a) Wet air pump
(b) Dry air pump
(c) Centrifugal pump
(d) Circulating pump

59. In a heat exchanger, 50 kg of water is heated per minute from 50 ^{0}C to 110 ^{0}C by hot gases which enter the heat exchanger at 250 ^{0}C. The value of C_p for water is 4.186 kJ/kg.K and for air is 1 kJ/kg.K. If the flow rate of gases is 100 kg/min, the net change in enthalpy of air will be nearly
(a) 17.6 MJ/min (b) 15.0 MJ/min
(c) 12.6 MJ/min (d) 10.0 MJ/min

60. The phenomenon that enables cooling towers to cool water to a temperature below the dry bulb temperature of air is termed as
(a) Chemical dehumidification
(b) Adiabatic evaporative cooling
(c) Cooling and dehumidification
(d) Sensible cooling

61. The angle through which the Earth must tun to bring the meridian of a point directly in line with the Sun’s rays is called
(a) Altitude angle
(b) Hour angle
(c) Solar azimuth angle
(d) Zenith angle

62. In which type of collector is solar radiation focused into the absorber from the top, rather than from the bottom?
(a) Fresnel lens
(b) Paraboloidal
(c) Concentrating
(d) Compound parabolic

63. A flat plate collector is 150 cm wide and 180 cm high and is oriented such that it is perpendicular to the sun rays. Its active area is 90% of the panel size. If it is in a location that receives solar insolation of 1000 W/m^2 peak, the peak power delivered to the area of the collector will be
(a) 1.23 kW (b) 2.43 kW
(c) 4.46 kW (d) 6.26 kW

64. A surface having high absorptance for short-wave radiation (less than 2.5 μm) and a low emittance of long-wave radiation (more than 2.5 μm), is called
(a) Absorber (b) Emitter
(c) Selective (d) Black

65. In a solar tower power system, each mirror is mounted on a system called
(a) Regenerator
(b) Linear Fresnel
(c) Dish
(d) Heliostat

66. The ratio of PV cell's actual maximum power output to its theoretical power output is called
(a) Quantum factor
(b) Fill factor
(c) Quantum efficiency
(d) PV factor

67. With respect to the wind turbine blades, TSR means
(a) Tip Swift Ratio
(b) Tip Sharp Ratio
(c) Tip Speed Ratio
(d) Tip Swing Ratio

68. For a wind turbine 10 m long running at 20 rpm in 12.9 kmph wind, the TSR will be nearly
(a) 3.6 (b) 5.8
(c) 7.6 (d) 9.8

69. Which one of the following is an enclosure or housing for the generator, gear box and any other parts of the wind turbine that are on the top of the tower?
(a) Turbine blade (b) Nacelle
(c) Turbine head (d) Gear box

70. The force required for producing tides in the ocean is
(a) 70 % due to Moon and 30 % due to Sun
(b) 30% due to Moon and 70% due to Sun
(c) 45% due to Moon and 55% due to Sun
(d) 55% due to Moon and 45% due to Sun

71. Which of the following are related to the Proton Exchange Membrane Fuel Cell (PEMFC)?
1. Polymer electrolyte
2. Hydrogen fuel and oxygen
3. Pure water and small amount of electricity
4. Nitrogen gas
(a) 1 and 3 only
(b) 2 and 4 only
(c) 1 and 2 only
(d) 3 and 4 only

72. Which of the following are the essential functions of fuel cells?
1. The charging (or electrolyser) function in which the chemical AB is decomposed to A and B.
2. The storage function in which A and B are held apart.
3. The charge function in which A and B are charged with the simultaneous generation of electricity.
(a) 1 and 3 only
(b) 2 and 3 only
(c) 1 and 2 only
(d) 1, 2 and 3

73. The position of centroid can be determined by inspection, if an area has
(a) Single axis of symmetry
(b) Two axes of symmetry
(c) An irregular shape
(d) Centre axes of symmetry

74. Which of the following statements of D'Alembert's principle are correct?
1. The net external force F actually acting on the body and the inertia force F_I together keep the body in a state of fictitious equilibrium.
2. The equation of motion may be written as F + (-ma) = 0 and the fictitious force (-ma) is called an inertia force.
3. It tends to give solution of a static problem an appearance akin to that of a dynamic problem.
(a) 1 and 3 only
(b) 1 and 2 only
(c) 2 and 3 only
(d) 1, 2 and 3

75. The linear relationship between stress and strain for a bar in simple tension or compression is expressed with standard notations by the equation

(a) $\sigma = E\varepsilon$ (b) $\sigma = E\upsilon$

(c) $\sigma = G\upsilon$ (d) $\sigma = G\varepsilon$

76. A punch is used for making holes in steel plates with thickness 8 mm. If the punch diameter is 20 mm and force required for creating a hole is 110 kN, the average shear stress in the plate will be nearly

(a) 139 MPa (b) 219 MPa

(c) 336 MPa (d) 416 MPa

77. A rod of length 2 m and diameter 50 mm is elongated by 5 mm when an axial force of 400 kN is applied. The modulus of elasticity of the material of the rod will be nearly

(a) 66 GPa (b) 72 GPa

(c) 82 GPa (d) 96 GPa

78. A beam of span 3 m and width 90 mm is loaded as shown in the figure. If the allowable bending stress is 12 MPa, the minimum depth required for the beam will be

(a) 218 mm (b) 246 mm

(c) 318 mm (d) 346 mm

79. A vertical hollow aluminium tube 2.5 m high fixed at the lower end, must support a lateral load of 12 kN at its upper end. If the wall thickness is $\frac{1}{8}$ th of the outer diameter and the allowable bending stress is 50 MPa, the inner diameter will be nearly

(a) 186 mm (b) 176 mm

(c) 166 mm (d) 156 mm

80. A wooden beam AB supporting two concentrated loads P has a rectangular cross-section of width = 100 mm and height = 150 mm. The distance from each end of the beam to the nearest load is 0.5 m. If the allowable stress in bending is 11 MPa and the beam weight is negligible, the maximum permissible load will be nearly

(a) 5.8 kN (b) 6.6 kN

(c) 7.4 kN (d) 8.2 kN

81. Which of the following statements regarding thin and thick cylinders, subjected to internal pressure only, is/are correct ?

1. A cylinder is considered thin when the ratio of its inner diameter to the wall thickness is less than 15.

2. In thick cylinders, tangential stress has highest magnitude at the inner surface of the cylinder and gradually decreases towards the outer surface.

(a) 1 only (b) 2 only

(c) Both 1 and 2 (d) Neither 1 nor 2

82. A cylindrical storage tank has an inner diameter of 600 mm and a wall thickness of 18 mm. The transverse and longitudinal strains induced are 255×10^{-6} mm/mm and 60×10^{-6} mm/mm, and if G is 77 GPa, the gauge pressure inside the tank will be

(a) 2.4 MPa (b) 2.8 MPa

(c) 3.2 MPa (d) 3.6 MPa

83. A compressed air spherical tank having an inner diameter of 450 mm and a wall thickness of 7 mm is formed by welding. If the allowable shear stress is 40 MPa, the maximum permissible air pressure in the tank will be nearly

(a) 3 MPa (b) 5 MPa

(c) 7 MPa (d) 9 MPa

84. A solid bar of circular cross-section having a diameter of 40 mm and length of 1.3 m is subjected to torque of 340 N.m. If the shear modulus of elasticity is 80 GPa, the angle of twist between the ends will be

(a) 1.26^0 (b) 1.32^0

(c) 1.38^0 (d) 1.44^0

85. Which one of the following statements regarding screw dislocations is correct?

(a) It lies parallel to its Burgers vector.

(b) It moves in the direction parallel to its Burgers vector.

(c) It initially requires very less force to move.

(d) It moves very fast as compared to edge dislocation.

86. The percentage of pearlite in a slowly cooled melt of 0.5% of carbon steel is

(a) 48.5 % (b) 52.5 %

(c) 58.5 % (d) 62.5 %

87. In the study of phase diagrams, the rule which helps to calculate the relative proportions of liquid and solid material present in the mixture at any given temperature is known as

(a) Hume-Rothery rule

(b) Lever rule

(c) Gibb's phase rule

(d) Empirical rule

88. The phenomenon that artificially increases the dielectric constant of plastics containing fillers is known as

(a) Gamma polarization

(b) Interfacial polarization

(c) Post-forming drawing

(d) Reinforcement drawing

89. The addition of alloying element nickel to cast iron will primarily improve
(a) Wear resistance
(b) Toughness
(c) Carbide formation
(d) Machinability

90. A unidirectional fibre-epoxy composite contains 65% by volume fibre and 35% epoxy resin. If the relative density of the fibre is 1.48 and of the resin is 1.2, the percentage weight of fibre will be nearly
(a) 70 % (b) 75 %
(c) 80 % (d) 85 %

91. Which of the following are the advantages of nano-composite materials?
1. Decreased thermal expansion coefficients
2. Higher residual stress
3. Reduced gas permeability
4. Increased solvent resistance
(a) 1, 2 and 3 only
(b) 1, 3 and 4 only
(c) 1, 2 and 4 only
(d) 2, 3 and 4 only

92. A rod of copper originally 305 mm long is pulled in tension with a stress of 276 MPa. If the modulus of elasticity is 110 GPa and the deformation is entirely elastic, the resultant elongation will be nearly
(a) 1.0 mm (b) 0.8 mm
(c) 0.6 mm (d) 0.4 mm

93. A 1.25 cm diameter steel bar is subjected to a load of 2500 kg. The stress induced in the bar will be
(a) 200 MPa (b) 210 MPa
(c) 220 MPa (d) 230 MPa

94. The maximum energy which can be stored in a body up to the elastic limit is called
(a) Proof resilience (b) Modulus of resilience
(c) Impact toughness (d) Endurance strength

95. A cast iron bed plate for a pump has a crack length of 100 μm. If the Young's modulus of cast iron is 210 GN/m^2 and the specific surface energy is 10 J/m^2, the fracture strength required will be nearly
(a) 1.0×10^8 N/m^2 (b) 1.2×10^8 N/m^2
(c) 1.4×10^8 N/m^2 (d) 1.6×10^8 N/m^2

96. A 13 mm diameter tensile specimen has 50 mm gauge length. If the load corresponding to the 0.2% offset is 6800 kg, the yield stress will be nearly
(a) 31 kg/mm^2 (b) 43 kg/mm^2
(c) 51 kg/mm^2 (d) 63 kg/mm^2

97. The magnitude of the velocity of any point on the kinematic link relative to the other point on the same kinematic link is the product of
(a) A square root of an angular velocity of the link and the distance between the two points under consideration
(b) An angular velocity of the link and the square of distance between the two points under consideration
(c) A square of an angular velocity of the link and the distance between the two points under consideration
(d) An angular velocity of the link and the distance between the two points under consideration

98. In a mechanism, the number of Instantaneous centres (I –centres) N is
(a) $\frac{n(n-1)}{2}$ (b) $\frac{n(2n-1)}{2}$
(c) $\frac{2n(n-1)}{3}$ (d) $\frac{n(2n-1)}{3}$

99. In cycloidal motion of cam follower, the maximum acceleration of follower motion f_{max} at $\theta = \frac{\varphi}{4}$ is
(a) $\frac{h\pi\omega^2}{2\varphi^2}$ (b) $\frac{3h\pi\omega^2}{2\varphi^2}$
(c) $\frac{2h\pi\omega^2}{\varphi^2}$ (d) $\frac{3h\pi\omega^2}{\varphi^2}$
where:
h = Maximum follower displacement
ω = Angular velocity of cam
Φ = Angle for the maximum follower displacement for cam rotation

100. A shaft of span 1 m and diameter 25 mm is simply supported at the ends. It carries a 1.5 kN concentrated load at mid-span. If E is 200 GPa, its fundamental frequency will be nearly
(a) 3.5 Hz (b) 4.2 Hz
(c) 4.8 Hz (d) 5.5 Hz

101. A vibrating system consists of mass of 50 kg, a spring with a stiffness of 30 kN/m and a damper. If damping is 20% of the critical value, the natural frequency of damped vibrations will be
(a) 16 rad/s (b) 20 rad/s
(c) 24 rad/s (d) 28 rad/s

102. A refrigerator unit having a mass of 35 kg is to be supported on three springs, each having spring stiffness s. The unit operates at 480 rpm. If only 10% of the shaking force is allowed to

transmit to the supporting structure, the value of stiffness will be nearly
(a) 2.7 N/mm (b) 3.2 N/mm
(c) 3.7 N/mm (d) 4.2 N/mm

103. In which one of the following tooth profiles, does the pressure angle remain constant throughout the engagement of teeth?
(a) Cycloidal (b) Involute
(c) Conjugate (d) Epicycloid

104. If the axes of the first and last wheels of a compound gear coincide, it is called
(a) Simple gear train
(b) Compound gear train
(c) Epicyclic gear train
(d) Reverted gear train

105. In a reciprocating engine, the force along the connecting rod F_Q is
(a) $\frac{F_P}{\sqrt{n^2-\sin^2\theta}}$ (b) $\frac{F_P}{2\sqrt{n^2-\sin^2\theta}}$
(c) $\frac{nF_P}{2\sqrt{n^2-\sin^2\theta}}$ (d) $\frac{nF_P}{\sqrt{n^2-\sin^2\theta}}$
where:
F_P = Force on piston
$n = \frac{L}{r}$
θ = Angle for crank from IDC

106. A mass m_1 attached to a shaft at radius r_1, rotating with angular velocity ω rad/s, can be balanced by another single mass m_2 which is attached to the opposite side of the shaft at radius r_2, in the same plane, if
(a) $m_1r_2 = m_2r_1$ (b) $m_1r_1 = m_2r_2$
(c) $m_1r_1\omega_1 = m_2r_2\omega_2$ (d) $m_1r_2\omega_1 = m_2r_1\omega_2$

107. For a single cylinder reciprocating engine speed is 500 rpm, stroke is 150 mm, mass of reciprocating parts is 21 kg, mass of revolving parts is 15 kg at crank radius. If two-thirds of reciprocating masses and all the revolving masses are balanced, the mass at a radius of 150 mm will be
(a) 7.5 kg (b) 10.5 kg
(c) 12.5 kg (d) 14.5 kg

108. If the axes of the rolling of the ship and of the stabilizing rotor are parallel, it will result in
(a) A higher bow and lower stern
(b) A lower bow and higher stern
(c) Turning towards left
(d) No gyroscopic effect

109. Coaxing is a process of
(a) Improving the fatigue properties, attained by under-stressing and then raising the stress in small increments
(b) Decreasing the hardness by full annealing
(c) Increasing the uniaxial tensile strength by heating above recrystallization temperature and quenching in oil media
(d) Maintaining the ductility of the material by chemical treatment

110. According to the distortion-energy theory, the yield strength in shear is
(a) 0.277 times the yield stress
(b) 0.377 times the maximum shear stress
(c) 0.477 times the yield strength in tension
(d) 0.577 times the yield strength in tension

111. For the predication of ductile yielding, the theory of failure utilized is
(a) Maximum strain energy theory
(b) Distortion energy theory
(c) Maximum normal strain theory
(d) Mohr theory

112. A steel specimen is subjected to the following principal stresses : 120 MPa tensile, 60 MPa tensile and 30 MPa compressive. If the proportionality limit for the steel specimen is 250 MPa; the factor of safety as per maximum shear stress theory will be nearly
(a) 1.3 (b) 1.7
(c) 2.3 (d) 2.7

113. For which one of the following loading conditions is the standard endurance strength multiplied by a load factor, $K_e = 0.9$?
(a) Reversed beam bending loads
(c) Reversed axial loads with no bending
(c) Reversed axial loads with intermediate bending
(d) Reversed torsion loads

114. A 120 mm wide uniform plate is to be subjected to a tensile load that has a maximum value of 250 kN and a minimum value of 100 kN. The properties of the plate material are : endurance limit stress is 225 MPa, yield point stress is 300 MPa. If the factor of safety based on yield point is 1.5, the thickness of the plate will be nearly
(a) 12 mm (b) 14 mm
(c) 16 mm (d) 18 mm

115. A steel connecting rod having S_{ut} = 1000 MN/m^2, S_{yt} = 900 MN/m^2 is subjected to a completely reversed axial load of 50 kN. By neglecting any column action, if the value of k_e = 0.85, k_b = 0.9, k_a = 0.82, k_t = 1.5, q = 0.6 and N = 2, the diameter of the rod will be nearly

(a) 20 mm (b) 23 mm
(c) 26 mm (d) 29 mm

116. During crushing or bearing failure of riveted joints
(a) The holes in the plates become oval shaped and joints become loose
(b) There is tearing of the plate at an edge
(c) The plates will crack in radial directions
(d) The rivet heads will shear out by applied stress

117. The double riveted joint with two cover plates for boiler shell is 1.5 m in diameter subjected to steam pressure of 1 MPa. If the joint efficiency is 75%, allowable tensile stress in the plate is 83 MN/m^2, compressive stress is 138 MN/m^2 and shear stress in the rivet is 55 MN/m^2, the diameter of rivet hole will be nearly
(a) 8 mm (b) 22 mm
(c) 36 mm (d) 52 mm

118. A bearing supports a radial load of 7000 N and a thrust load of 2100 N. The desired life of the ball bearing is 160 × 10^6 revolutions at 300 rpm. If the load is uniform and steady, service factor is 1, radial factor is 0.65, thrust factor is 3.5, k = 3 and rotational factor is 1, the basic dynamic load rating of a bearing will be nearly
(a) 65 kN
(b) 75 kN
(c) 85 kN
(d) 95 kN

119. A solid cast iron disk, 1 m in diameter and 0.2 m thick, is used as a flywheel. It is rotating at 350 rpm. It is brought to rest in 1.5 s by means of a brake. If the mass density of cast iron is 7200 kg/m^3, the torque exerted by the brake will be nearly
(a) 3.5 kN m
(b) 4.5 kN m
(c) 5.3 kN m
(d) 6.3 kN m

120. The torque transmitting capacity of friction clutches can be increased by
(a) Use of friction material with a lower coefficient of friction
(b) Decreasing the mean radius of the friction disk
(c) Increasing the mean radius of the friction disk
(d) Decreasing the plate pressure

121. The time taken to face a workpiece of 80 mm diameter for the spindle speed of 90 rpm and cross feed of 0.3 mm/rev will be
(a) 4.12 min
(b) 3.24 min
(c) 2.36 min
(d) 1.48 min

122. A feed f for the lathe operation is
(a) $\frac{N}{L \times T_m}$ mm/rev
(b) $\frac{L}{N \times T_m}$ mm/rev
(c) $\frac{T_m}{N \times L}$ mm/rev
(d) $\frac{T_m \times L}{N}$ mm/rev
where:
T_m = Machining time in min
N = Speed in rpm
L = Length of cut in mm

123. The main advantage of the radial drilling machine is that
(a) It is very compatible and handy for machining
(b) It is accurate, economical, portable and least time consuming while machining
(c) Heavy workpieces can be machined in any position without moving them
(d) Small workpieces can be machined and it can be used for mass production as well

124. For the purpose of sampling inspection, the maximum percent defective that can be considered satisfactory as a process average is
(a) Rejectable Quality Level (RQL)
(b) Acceptable Quality Level (AQL)
(c) Average Outgoing Quality Limit (AOQL)
(d) Lot tolerance Percent Defective (LTPD)

125. Hard automation is also called
(a) Selective automation
(b) Total automation
(c) Group technology
(d) Fixed position automation

126. The method of CNC programming which enables the programmer to describe part geometry using variables is
(a) Computer assisted part programming
(b) Computer aided drafting programming
(c) Conversational programming
(d) Parametric programming

127. Revolving joint of the robot is referred to as
(a) L joint
(b) O joint
(c) T joint

(d) V joint

128. Repairing of a machine consists of 5 steps that must be performed sequentially. Time taken to perform each of the 5 steps is found to have an exponential distribution with a mean of 5 minutes and is independent of other steps. If these machines break down in Poisson fashion at an average rate of 2/hour and if there is only one repairman, the average idle time for each machine that has broken down will be
(a) 120 minutes
(b) 110 minutes
(c) 100 minutes
(d) 90 minutes

129. A portion of the total float within which an activity can be delayed for start without affecting the floats of preceding activities is called
(a) Safety float
(b) Free float
(c) Independent float
(d) Interfering float

130. An oil engine manufacturer purchases lubricant cans at the rate of Rs 42 per piece from a vendor. The requirement of these lubricant cans is 1800 per year. If the cost per placement of an order is Rs. 16 and inventory carrying charges per rupee per year is 20 paise, the order quantity per order will be
(a) 91 cans
(b) 83 cans
(c) 75 cans
(d) 67 cans

131. Consider the following data regarding the acceptance sampling process:
N = 10,000, n =89, c =2, P = 0.01, and P_a = 0.9397
The Average Total Inspection (ATI) will be
(a) 795
(b) 687
(c) 595
(d) 487

132. The Non-Destructive Inspection (NDI) technique employed during inspection for castings of tubes and pipes to check the overall strength of a casting in resistance to bursting under hydraulic pressure is
(a) Radiographic inspection
(b) Magnetic particle inspection
(c) Fluorescent penetrant
(d) Pressure testing

133. Consider the situation where a microprocessor gives an output of an 8-bit word. This is fed through an 8-bit digital-to-analogue converter to a control valve. The control valve requires 6.0 V being fully open. If the fully open state is indicated by 11111111, the output to the valve for a change of 1-bit will be
(a) 0.061 V
(b) 0.042 V
(c) 0.023 V
(d) 0.014 V

134. Which of the following factors are to be considered while selecting a microcontroller ?
1. Memory requirements
2. Processing speed required
3. Number of input/output pins
(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

135. Which of the following statements regarding interface circuit are correct?
1. Electrical buffering is needed when the peripheral operates at a different voltage or current to that on the microprocessor bus system or there are different ground references.
2. Timing control is needed when the data transfer rates of the peripheral and the microprocessor are different.
3. Changing the number of lines is needed when the codes used by the peripherals differ from those used by the microprocessor.
(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

136. Alternative paths provided by vertical paths from the main rung of a ladder diagram, that is, paths in parallel, represents
(a) Logical AND operations
(b) Logical OR operations
(c) Logical NOT operations
(d) Logical NOR operations

137. The resolution of an encoder with 10 tracks will be nearly
(a) 0.15^0
(b) 0.25^0
(c) 0.35^0
(d) 0.45^0

138. Which of the following features is/are relevant to variable reluctance stepper motors?
1. Smaller rotor mass; more responsive
2. Step size is small
3. More sluggish
(a) 1 only

(b) 2 only
(c) 3 only
(d) 1, 2 and 3

139. Which of the following statements regarding hydraulic pumps are correct?
1. The gear pump consists of two close-meshing gear wheels which rotate in opposite directions.
2. In vane pump, as the rotor roatates, the vanes follows the contours of the casing
3. The leakage is more in vane pump compared to gear pump
(a) 1, 2 and 3
(b) 1 and 2 only
(c) 1 and 3 only
(d) 2 and 3 only

140. The selection of the right controller for the application depends on
1. The degree of control required by the application.
2. The individual characteristics of the plants.
3. the desirable performance level including required response, steady-state deviation and stability.
Which of the above statements are correct?
(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

141. Consider a system described by
$$\dot{x} = Ax + Bu$$
$$y = Cx + Du$$
The system is completely output controllable if and only if
(a) The matrix $[CB \vdots CBA \vdots CB^2A \vdots \ldots \vdots CB^{n-1}A \vdots D]$ is of rank n
(b) The matrix $[CB \vdots CAB \vdots CA^2B \vdots \ldots \vdots CA^{n-1}B \vdots D]$ is of rank n
(c) The matrix $[BC \vdots BAC \vdots BA^2C \vdots \ldots \vdots BA^{n-1}C \vdots D]$ is of rank n
(d) The matrix $[BC \vdots ABC \vdots CA^2B \vdots \ldots \vdots CB^{n-1}A \vdots D]$ is of rank n

142. Which one of the following symbols is used as the notation for designating arm and body of robot with jointed arm configuration?
(a) TRL
(b) TLL, LTL, LVL
(c) LLL
(d) TRR, VVR

143. A compliant motion control of robots can be understood by the problem of controlling of
(a) Position and velocity of joints
(b) Position and acceleration of the end-effector
(c) Manipulator motion and its force interactions with the environment
(d) Joint velocities of given end-effector velocity

144. For the vector v = 25 i + 10 j + 20 k, perform a translation by a distance of 8 in the x-direction, 5 in the y-direction and 0 in the z-direction. The translated vector Hv will be
(a) $\begin{bmatrix} 1 \\ 20 \\ 33 \\ 15 \end{bmatrix}$
(b) $\begin{bmatrix} 33 \\ 15 \\ 20 \\ 1 \end{bmatrix}$
(c) $\begin{bmatrix} 15 \\ 33 \\ 1 \\ 20 \end{bmatrix}$
(d) $\begin{bmatrix} 1 \\ 15 \\ 20 \\ 33 \end{bmatrix}$

145. Statement (I):
The greater the chemical affinity of two metals, the more restricted is their solid solubility and greater is the tendency of formation of compound.
Statement (II):
Wider the separation of elements in the periodic table, greater is their chemical affinity.

146. Statements (I);
The size of a memory unit is specified in terms of the number of storage locations available; 1 K is 2^{10} = 1024 locations and thus a 4 K memory has 4096 locations.
Statements (II);
Erasable and programmable ROM (EPROM) is a form of memory unit used for ROMS that can be programmed and their contents altered.

147. Statement (I):
Microprocessors which have memory and various input/output arrangements, all on the same chip, are called microcontrollers.
Statement (II);
The microcontroller is the integration of a microprocessor with RAM, ROM, EPROM, EEPROM and I/O interfaces, and other peripherals such as timers, on a single chip.

148. Statement (I) :
Capacitive proximity sensor can only be used for the detection of metal objects and is best with ferrous metals.
Statement (II);
One form of capacitive proximity sensor consists of a single capacitor plate probe with the other plate being formed by the object, which has to be metallic and earthed.

149. Statement (I):
SCARA configuration provides substantial rigidity for the robot in the vertical direction, but compliance in the horizontal plane.
Statement (II):
A special version of the Cartesian coordinate robot is the SCARA, which has a very high lift capacity as it designed for high rigidity.

150. Statement (I):
The stepper motor is a device that produces rotation through equal angles, the so-called steps, for each digital pulse supplied to its input.
Statement (II);
Stepper motors can be used to give controlled rotational steps but cannot give continuous rotation, as a result their applications are limited to step angles only.

1 (d)	31	61	91	121
2 (c)	32	62	92	122
3 (b)	33	63	93	123
4 (d)	34	64	94	124
5	35	65	95	125
6	36	66	96	126
7 (c)	37	67	97	127
8	38	68	98	128
9	39	69	99	129
10	40	70	100	130
11	41	71	101	131
12	42	72	102	132
13	43	73 (b)	103	133
14	44	74	104	134
15	45	75 (a)	105	135
16	46	76	106	136
17	47	77	107	137
18	48	78	108	138
19	49	79	109	139
20	50	80	110	140
21	51	81	111	141
22	52	82	112	142
23	53	83	113	143
24	54	84	114	144
25	55	85	115	145
26	56	86	116	146
27	57	87 (b)	117	147
28	58	88	118	148
29	59	89	119	149
30	60	90	120	150

1. $mg = 400$ N,

$mg - F_B = 225$ N

$400 - F_B = 225$ N,

$F_B = 175$ N

$\rho g V = 400$ N,

$\rho_w g V = 175$ N

$\frac{\rho}{\rho_w} = \frac{400}{175} = 2.3$

2. $P = F \times v$

$= \tau \times A \times v$

$= \mu \frac{du}{dy} \times A \times v$

$P = 0.001 \times \frac{30\ cm/s}{0.01\ cm} \times 0.1\ m^2 \times 0.3\ m/s$

$= 0.9$ W

3. $K = -\frac{\Delta P}{\frac{\Delta V}{V}} = -\frac{3 \times 10^6}{-\frac{0.1}{100}} = 3 \times 10^9\ N/m^2$

7. S.G = 0.9,

$\dot{Q} = 8$ lps $= 8 \times 10^{-3}\ m^3/s$

$\dot{Q} = V \times A = V \times \frac{\pi}{4} d^2 = V \times \frac{\pi}{4} 0.15^2$

V = 0.45 m/s.

$Re = \frac{\rho VD}{\mu} = \frac{0.9 \times 10^3 \times 0.45 \times 0.15}{0.3} = 203$

9. Head loss in the pipe

$h_f = \frac{4fLv^2}{2gD}$

$L = 12m,\ v = 3\ m/s,\ D = 6\ cm,\ \mu = 2.1\ Ns/m^2,$

$\rho = 1790\ kg/m^3$

Re = $\frac{\rho VD}{\mu}$

= $\frac{1790 \times 3 \times 0.06}{2.1}$

= 153 < 2300 (laminar flow)

f = $\frac{64}{Re}$ = $\frac{64}{153}$ = 0.418

$h_f = \frac{4 \times 0.395 \times 12 \times 3^2}{2 \times 9.8 \times 0.06} = 145$m

1. The magnitude of the velocity of any point on the kinematic link relative to the other point on the same kinematic link is the product of

(a) A square root of an angular velocity of the link and the distance between the two points under consideration

(b) An angular velocity of the link and the square of distance between the two points under consideration

(c) A square of an angular velocity of the link and the distance between the two points under consideration

(d) An angular velocity of the link and the distance between the two points under consideration

[IES -2020]

Answer (d)

2. In a mechanism, the number of Instantaneous centres (I –centres) N is

(a) $\frac{n(n-1)}{2}$ (b) $\frac{n(2n-1)}{2}$

(c) $\frac{2n(n-1)}{3}$ (d) $\frac{n(2n-1)}{3}$

[IES -2020]

Answer (a)

3. In which one of the following tooth profiles, does the pressure angle remain constant throughout the engagement of teeth?

(a) Cycloidal (b) Involute

(c) Conjugate (d) Epicycloid

[IES -2020]

Answer (b)

4. If the axes of the first and last wheels of a compound gear coincide, it is called

(a) Simple gear train

(b) Compound gear train

(c) Epicyclic gear train

(d) Reverted gear train

[IES -2020]

Answer (d)

5. In a reciprocating engine, the force along the connecting rod F_Q is

(a) $\frac{F_P}{\sqrt{n^2-\sin^2\theta}}$ (b) $\frac{F_P}{2\sqrt{n^2-\sin^2\theta}}$

(c) $\frac{nF_P}{2\sqrt{n^2-\sin^2\theta}}$ (d) $\frac{nF_P}{\sqrt{n^2-\sin^2\theta}}$

where:

F_P = Force on piston

$n = \frac{L}{r}$

θ = Angle for crank from IDC

[IES -2020]

6. A mass m_1 attached to a shaft at radius r_1, rotating with angular velocity ω rad/s, can be balanced by another single mass m_2 which is attached to the opposite side of the shaft at radius r_2, in the same plane, if

(a) $m_1r_2 = m_2r_1$

(b) $m_1r_1 = m_2r_2$

(c) $m_1r_1\omega_1 = m_2r_2\omega_2$

(d) $m_1r_2\omega_1 = m_2r_1\omega_2$

[IES -2020]

7. A shaft of span 1 m and diameter 25 mm is simply supported at the ends. It carries a 1.5 kN concentrated load at mid-span. If E is 200 GPa, its fundamental frequency will be nearly

(a) 3.5 Hz (b) 4.2 Hz

(c) 4.8 Hz (d) 5.5 Hz

[IES -2020]

8. A vibrating system consists of mass of 50 kg, a spring with a stiffness of 30 kN/m and a damper. If damping is 20% of the critical value, the natural frequency of damped vibrations will be

(a) 16 rad/s (b) 20 rad/s

(c) 24 rad/s (d) 28 rad/s

[IES -2020]

9. A refrigerator unit having a mass of 35 kg is to be supported on three springs, each having spring stiffness s. The unit operates at 480 rpm. If only 10% of the shaking force is allowed to transmit to the supporting structure, the value of stiffness will be nearly

(a) 2.7 N/mm (b) 3.2 N/mm

(c) 3.7 N/mm (d) 4.2 N/mm

IES -2020]

10. For a single cylinder reciprocating engine speed is 500 rpm, stroke is 150 mm, mass of reciprocating parts is 21 kg, mass of revolving parts is 15 kg at crank radius. If two-thirds of reciprocating masses and all the revolving masses are balanced, the mass at a radius of 150 mm will be

(a) 7.5 kg (b) 10.5 kg

(c) 12.5 kg (d) 14.5 kg

[IES -2020]

11. If the axes of the rolling of the ship and of the stabilizing rotor are parallel, it will result in
(a) A higher bow and lower stern
(b) A lower bow and higher stern
(c) Turning towards left
(d) No gyroscopic effect
[IES -2020]

12. Which of the following statements are correct with respect to inversion of mechanisms?
1. It is a method of obtaining different links of the same kinematic chain.
2. It is a method of obtaining different mechanisms by fixing the same links of different kinematic chains.
3. In the process of inversion, the relative motions of the links of the mechanisms produced remain unchanged.
4. In the process of inversions, the relative motions of the links of the mechanisms produced will change accordingly.

Select the correct answer using the code given below.
(a) 1 and 3 (b) 1 and 4
(c) 2 and 3 (d) 2 and 4
[IES 2019]

13. For the follower with stroke S, following the cycloidal motion, the radius of the rolling circle will be
(a) S $\times 2\pi$ (b) $\frac{S}{2\pi}$
(c) $\frac{2\pi}{S}$ (d) $S + 2\pi$
[IES 2019]

14. A vertical shaft of 100 mm diameter and 1 m length has its upper end fixed at the top. The other end carries a disc of 5000 N and the modulus of elasticity of the shaft material is 2×10^5 N/mm^2. Neglecting the weight of the shaft, the frequency of the longitudinal vibrations will be nearly
(a) 279.5 Hz (b) 266.5 Hz
(c) 253.5 Hz (d) 241.5 Hz
[IES 2019]

15. The accurate method of finding the natural frequency of transverse vibrations of a system of several loads attached to some shaft is
(a) Dunkerley method
(b) energy method
(c) Stodola method
(d) Dunkerley and energy method
[IES 2019]

16. The speed at which the shaft runs, so that the deflection of the shaft from the axis of rotation become infinite, is known as
(a) whipping speed
(b) damping speed
(c) resonant speed
(d) gravitational speed

17. Which one of the following is not the correct statement with respect to the involute profile toothed gears in mesh?
(a) Pressure angle remain constant from the start till the end of the engagement.
(b) The base circle diameter and the pitch circle diameter of the two mating involutes are proportional.
(c) When two involutes are in mesh, the angular velocity ratio is proportional to the size of the base circles.
(d) The shape of the involute profile depends only on the dimensions of the base circle.

18. The centre distance C between two gears, in terms of base circle radii R_1, R_2 and the pressure angle ϕ, is
(a) $\frac{\cos\varphi}{R_1 + R_2}$ (b) $\frac{R_1 + R_2}{\cos\varphi}$
(c) $\left(\frac{R_1}{R_2}\right).\cos\varphi$ (d) $\left(\frac{R_2}{R_1}\right).\cos\varphi$

1. Water is discharged from a tank maintained at a constant head of 5 m above the exit of a straight pipe 100 m long and 15 cm in diameter. If the friction coefficient for the pipe is 0.01, the rate of flow will be nearly

(a) 0.04 m^3/s (b) 0.05 m^3/s
(c) 0.06 m^3/s (d) 0.07 m^3/s

[IES 2019]

2. A plate weighing 150 N and measuring 0.8 m × 0.8 m just slides down an inclined plane over an oil film of 1.2 mm thickness for an inclination of 30^0 and velocity of 0.2 m/s. Then the viscosity of the oil used is

(a) 0.3 N s/m^2 (b) 0.4 N s $/m^2$
(c) 0.5 N s/m^2 (d) 0.7 N s/m^2

[IES 2019]

3. A spherical balloon of 1.5 m diameter is completely immersed in water and chained to the bottom. If the chain has a tension of 10 kN, the weight of the balloon will be nearly

(a) 9.11 kN (b) 8.22 kN
(c) 6.44 kN (d) 7.33 kN

[IES 2019]

4. A nozzle at the end of an 80 mm hosepipe produces a jet 40 mm in diameter. When it is discharging the water 1200 Lpm., the force on the joint at the base of the nozzle will be

(a) 180 N (b) 200 N
(c) 220 N (d) 240 N

[IES 2019]

5. A vertical water pipe, 1.5 m long, tapers from 75 mm diameter at the bottom to 150 mm diameter at the top and the rate of flow is 50 L/s upwards. if the pressure at the bottom end is 150 kN/m^2, the pressure at the top will be nearly

(a) 195.2 kN/m^2 (b) 191.4 kN/m^2
(c) 187.6 kN/m^2 (d) 183.8 kN/m^2

[IES 2019]

6. The stream function for a flow field is $\Psi = 3x^2y + (2+t)y^2$. The velocity at a point P for position vector $r = i + 2j - 3\,k$ at time t = 2 will be

(a) 19i – 12 j (b) 21i – 12 j
(c) 19i + 22 j (d) 21i + 22 j

[IES 2019]

7. In a laminar flow through pipe, the point of maximum instability exists at a distance of y from the wall which is

(a) 3/2 of pipe radius R
(b) 2/3 of pipe radius R
(c) 1/2 of pipe raidus R
(d) 1/3 of pipe radius R

[IES 2019]

8. $Q = \frac{\partial u'}{\partial x} = -\frac{\partial v'}{\partial y}$ for a turbulent flow signifies

(a) conservation of bulk momentum transport
(b) increase in u' in x –direction followed by increase in v' in negative y –direction
(c) turbulence is anisotropic
(d) turbulence is isotropic

[IES 2019]

9. A flow field satisfying $\nabla.\vec{V} = 0$ as the continuity equation represents always

(a) a steady compressible flow
(b) an incompressible flow
(c) an unsteady and incompressible flow
(d) an unsteady and compressible flow

[IES 2019]

10. An oil of viscosity 8 poise flows between two parallel fixed plates, which are kept at a distance of 30 mm apart. If the drop of pressure for a length of 1m is 0.3×10^4 N/m^2 and width of the plates is 500 mm, the rate of oil flow between the plates will be

(a) 4.2×10^{-3} m^3/s
(b) 5.4×10^{-3} m^3/s
(c) 6.6×10^{-3} m^3/s
(d) 7.8×10^{-3} m^3/s

[IES 2019]

11. In case of transmission of hydraulic power by a pipeline to a turbine in a hydroelectric power station, the maximum power transmission efficiency through the pipeline is

(a) 76% (b) 67%
(c) 54% (d) 42%

[IES 2019]

12. A pipe, having a length 200 m and 200 mm diameter with friction factor 0.015, is to be replaced by a 400 mm diameter pipe of friction factor 0.012 to convey the same quantity of flow. The equivalent length of the new pipe for the same head loss will be

(a) 8300 m (b) 8240 m
(c) 8110 m (d) 8000 m

[IES 2019]

13. Certain quantities cannot be located on the graph by a point but are given by the area under the curve corresponding to the process. These quantities in concepts of thermodynamics are called as

(a) cyclic functions (b) point functions
(c) path functions (d) real functions

[IES 2019]

14. When 25 kg of water at 95 ^{0}C is mixed with 35 kg at 35 ^{0}C, the pressure being taken as constant at surrounding temperature of 15 ^{0}C, and C_P of water is 4.2 kJ/kgK, the decrease in available energy due to mixing will be nearly

(a) 270.5 kJ (b) 277.6 kJ
(c) 281.8 kJ (d) 288.7 kJ

[IES 2019]

15. A frictionless piston cylinder device contains 5 kg of steam at 400 kPa and 200 °C. The heat is now transferred to the steam until the temperature reaches 250 °C. If the piston is not attached to a shaft, its mass is constant, and by taking the values of specific volume v1 as 0-53434 m3 /kg and v2as 0.59520 m3 /kg, the work done by the steam during this process is

(a) 121.7 kJ (b) 137.5 kJ
(c) 153.3 kJ (d) 189.1 kJ

[IES 2019]

16. A diesel engine has a compression ratio of 14 and cutoff takes place at 6% of the stroke. The air standard efficiency will be

(a) 74.5 % (b) 60.5%
(c) 52.5% (d) 44.5%

[IES 2019]

17. A gas mixture consists of 3 kg of 0_2 , 5 kg of N_2 and 12 kg of CH_4 . The mass fraction and mole fraction of 0_2 are

(a) 0-25 and 0-125
(b) 0-15 and 0-092
(c) 0-25 and 0.092
(d) 0-15 and 0-125

[IES 2019]

18. An insulated pipe of 50 mm outside diameter with c = 0 8 is laid in a room at 30 °C. If the surface temperature is 250 °C and the convective heat transfer coefficient is 10 W/m2K, the total heat loss per unit length of the pipe will be

(a) 896-6 W/m (b) 818-8 W/m
(c) 786-4 W/m (d) 742-2 W/m

[IES 2019]

1. A wire of 8 mm diameter at a temperature of 60 ^{0}C is to be insulated by a material having k = 0 0.174 W/mK. The heat transfer coefficient on the outside h_a = 8 W/m^{2}K and ambient temperature T_a = 25 ^{0}C. The maximum thickness of insulation for maximum heat loss will be

(a) 15.25 mm (b) 16.50 mm
(c) 17.75 mm (d) 18.25 mm

2. In liquid metals, thermal boundary layer develops much faster than velocity boundary layer due to

(a) lower value of Nusselt number
(b) higher value of Prandtl number
(c) lower value of Prandtl number
(d) higher value of Nusselt number

3. The temperature of a body of area 0.1 m^2 is 900 K. The wavelength for maximum monochromatic emissive power will be nearly

(a) 2.3 μm (b) 3.2 μ m
(c) 4.1 μm (d) 5.0 μ m

4. Consider the following statements:
For the laminar condensation on a vertical plate, the Nusselt theory says that

1. inertia force in the film is negligible compared to viscosity and weight
2. heat flow is mainly by conduction through the liquid film, convection in liquid film as well as in vapour is neglected
3. velocity of vapour is very high

Which of the above statements are correct

(a) 1, 2 and 3
(b) 1 and 2 only
(c) 1 and 3 only
(d) 2 and 3 only

5. In transition boiling, heat flux decreases due to which of the following?

1. Low value of film heat transfer coefficient at the surface during 100 ^{0}C to 120 ^{0}C surface temperature
2. Major portion of heater surface is covered by vapour film which has smaller thermal conductivity as compared to liquid
3. Nucleate boiling occurs very fast

Select the correct answer using the code given below.

(a) 1 only (b) 2 only
(c) 3 only (d) 1, 2 and 3

6. A hemispherical furnace of radius 1.0 m has a roof temperature of T_1 = 800 K and emissivity ε_1 = 0.8 . The flat floor of the furnace has a temperature T_2 = 600 K and emissivity ε_2 = 0.5. The view factor F_{12} from surface 1 to 2 will be

(a) 0.3 (b) 0.4
(c) 0.5 (d) 0.6

7. Consider the following statements:
Combustion chamber is

1. the volumes between TDC and BDC during the combustion process
2. the space enclosed between the upper part of the cylinder and the top of the piston during the combustion process

Which of the above statements is/are correct?

(a) 1 only (b) 2 only
(c) 3 only (d0 1, 2 and 3

8. A 4-stroke diesel engine has length of 20 cm and diameter of 16 cm. The engine is producing power of 25 kW when it is running at 2500 r.p.m. The mean effective pressure of the engine will be nearly

(a) 5.32 bar (b) 4.54 bar
(c) 3.76 bar (d) 2.98 bar

9. A 4-stroke, 6-cylinder gas engine with a stroke volume of 1.75 litres develops 26.25 kW at 506 r.p.m. and the MEP is 600 kN/m^2. The number of misfires per minutes per cylinder will be

(a) 3 (b) 4
(c) 5 (d) 6

10. Which one of the following compressors will be used in vapour compression refrigerator for plants up to 100 tonnes capacity?

(a) Reciprocating compressor
(b) Rotary compressor
(c) Centrifugal compressor
(d0 Double-acting compressor

11. A cold storage is to be maintained at -5 °C while the surroundings are at 35 °C. The heat leakage from the surroundings into the cold storage is estimated to be 29 kW. The actual COP of the refrigeration plant used is ird that of an ideal plant working between the same temperatures. The power required to drive the plant will be

(a) 13 kW (b) 14 kW
(c) 15 kW (d) 16 kW

12. Consider the following statements:

An expansion device in a refrigeration system

1. reduces the pressure from the condenser to the evaporator
2. regulates the flow of the refrigerant to the evaporator depending on the load
3. is essentially a restriction offering resistance to flow

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

Material Science

1. The crystal structure of **Martensite** is **body-centered tetragonal**.