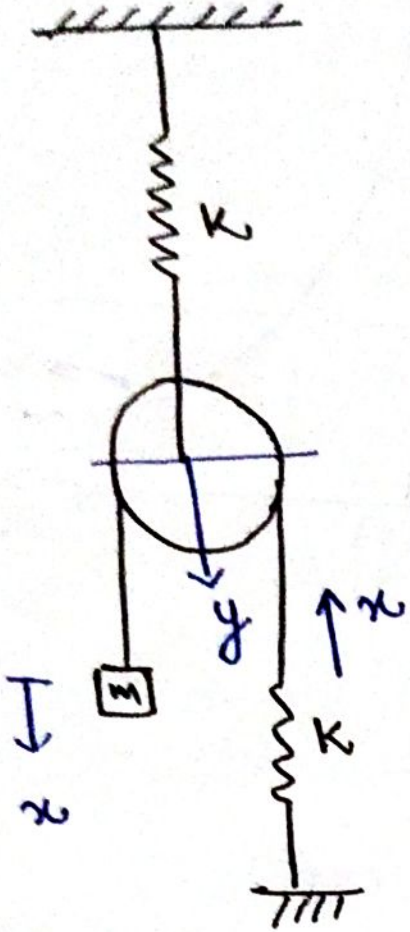
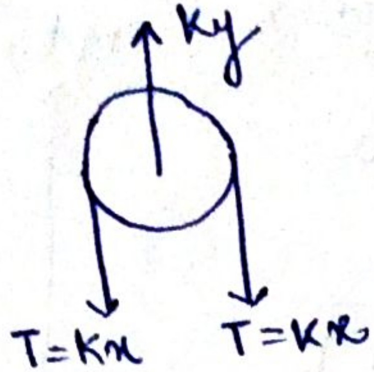
Q)





$$m\ddot{a}_y = \Sigma F_y$$

$$0 = ky - 2T$$

$$ky - 2kx = 0$$

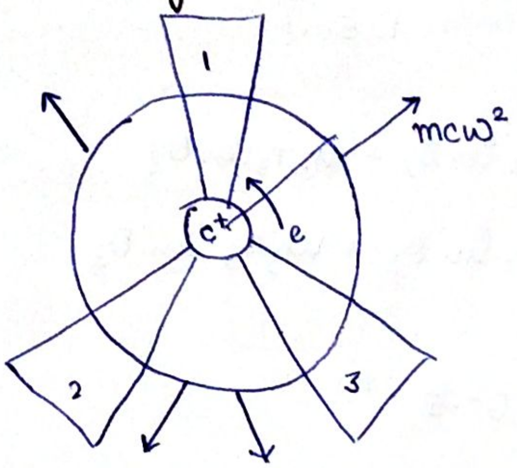
$$\boxed{y = 2x}$$

$$\frac{1}{2}mx^2 + \frac{1}{2}kx^2 + \frac{1}{2}ky^2 = \text{constant}$$

$$\frac{1}{\cancel{2}}m\cdot\cancel{2}x\cdot\dot{x}\ddot{x} + \frac{1}{\cancel{2}}k\cdot\cancel{2}x\cdot\dot{x} + \frac{1}{\cancel{2}}k\cdot\cancel{4}^{2}\cdot 2x\cdot\dot{x} = 0 .$$

DYNAMICS OF MACHINE

Balancing -



It is defined as the process of designing of machine in forces is minimum.

Balancing is the process to improve the mass distribution of a body in its bearings without unbalanced centrifugal forces.

→ Static balancing

→ Dynamic balancing

Ex. 14.1

⇒ Static balancing -

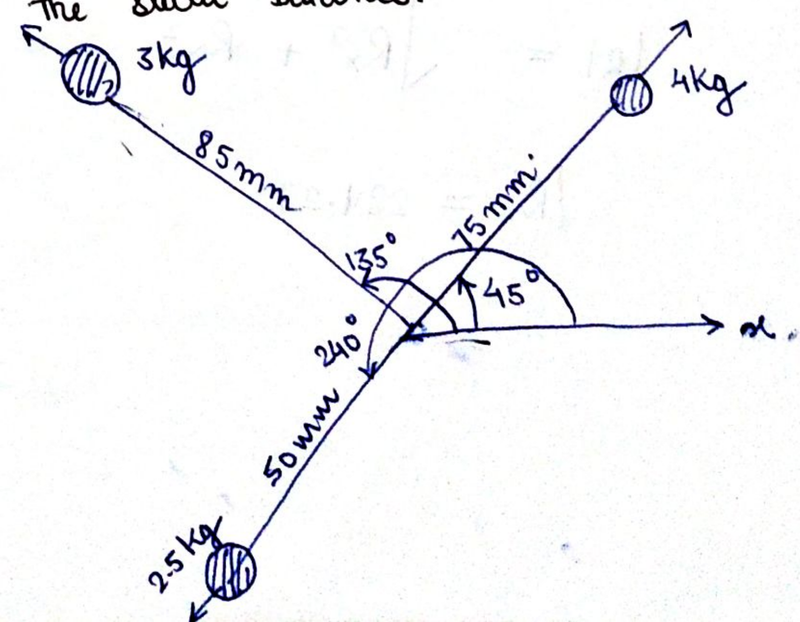
Q)

$m_1 = 4\,kg$ $\quad r_1 = 75\,mm$ $\quad \theta_1 = 45^\circ$

$m_2 = 3\,kg$ $\quad r_2 = 85\,mm$ $\quad \theta_2 = 135^\circ$

$m_3 = 2.5\,kg$ $\quad r_3 = 50\,mm$ $\quad \theta_3 = 240^\circ$

Determine the amount of countermass at a radial distance of 75 mm required to the static balance.



	m	r	θ	mr (kg-mm)
1)	4 kg	75 mm	45°	300
2)	3 kg	85 mm	135°	255
3)	2.5 kg	50 mm	240°	125

$$R_x = m_1 r_1 \cos\theta_1 + m_2 r_2 \cos\theta_2 + m_3 r_3 \cos\theta_3 .$$

$$R_y = m_1 r_1 \sin\theta_1 + m_2 r_2 \sin\theta_2 + m_3 r_3 \sin\theta_3$$

$$\Rightarrow R_x = 212.13 \cancel{*} - 180.31 - 62.5$$

$$= -30.68$$

$$\Rightarrow R_y = 212.13 + 180.31 - 108.25$$

$$= 284.19$$

$$\tan\theta = \frac{R_y}{R_x}$$

$$= \cancel{24}\ \frac{284.19}{-30.68}$$

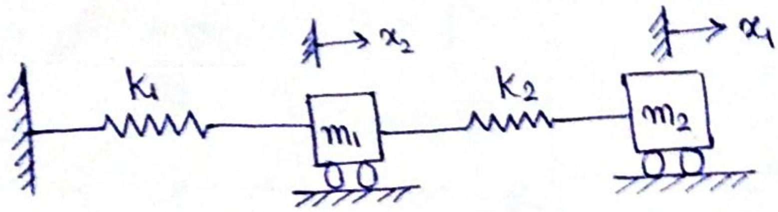
$$\tan\theta = -9.26 .$$

$$\theta = \cancel{2}\ 276.17° .$$

$$|R| = \sqrt{R_x^2 + R_y^2} = \sqrt{941.2624 + 80.7153.59}$$

$$|R| = 284.27$$

Vibration in two degree of freedom system



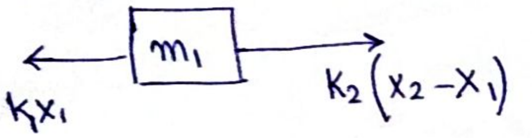
Assume –

i) $x_1 > x_2$

ii) $\boxed{x_2 \gtrless x_1}$

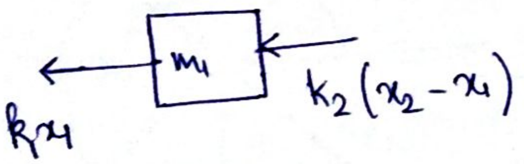
iii) $x_1 = x_2$

If $x_2 > x_1$ –



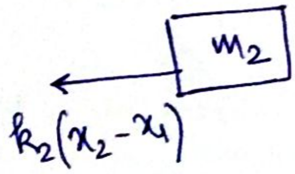
$$m_1\ddot{x}_1 = k_2(x_2 - x_1) - k_1x_1$$
$$m_1\ddot{x}_1 + (k_1 + k_2)x_1 - k_2x_2 = 0$$

If $x_2 < x_1$ –



$$m_1\ddot{x}_1 = -k_1x_1 - k_2(x_1 - x_2)$$
$$m_1\ddot{x}_1 + (k_1 + k_2)x_1 - k_2x_2 = 0 \quad \text{— (1)}$$

⇒



$$m_2\ddot{x}_2 = -k_2(x_2 - x_1)$$
$$m_2\ddot{x}_2 - k_2x_1 + k_2x_2 = 0$$

⇒ $x_1 = A_1 \sin(\omega t - \phi)$

$x_2 = A_2 \sin(\omega t - \phi)$

↳ natural frequency.

$\begin{bmatrix} A_1 \\ A_2 \end{bmatrix}$ → mode shape