Thermodynamics (ESC-S202)

Lecture- 7 & 8

The Zeroth Law Of Thermodynamics

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Ideal Gas

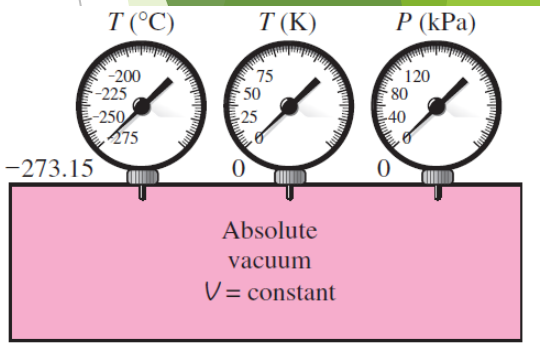
- The *p*-*v*-*T* behavior of gases at a low pressure is closely given by the following relation:

$$PV = n\bar{R}T \quad (1)$$

$$PV = mRT \quad (2)$$

$$\frac{p_1V_1}{T_1} = \frac{p_2V_2}{T_2} \quad (3)$$

Where
n= number of moles
m= mass of the gas
$\bar{R}$=the universal gas constant
R= the characteristic gas constant
Equation (3) is ideal gas equation for state.



Gas Thermometers

$\Delta T = \frac{V}{R}\Delta p$ ⟶ Constant Volume Gas Thermometer

$\Delta T = \frac{p}{R}\Delta V$ ⟶ Constant Pressure Gas Thermometer

Electrical Resistance Thermometer

- In the resistance thermometer, the change in resistance of a metal wire due to its change in temperature is the thermometric property.
- The wire frequently platinum may be incorporated in a Wheatstone bridge circuit.

$$R = R_0(1 + At + Bt^2)$$

Where

R_0= Resistance of the platinum wire when it is surrounded by melting ice

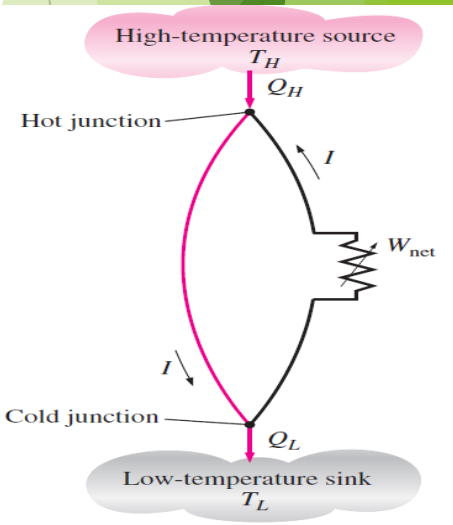
A & B are constants.

Thermocouple

- A thermocouple circuit made up from joining two wires A and B made of dissimilar metals.
- Due to the Seebeck effect, a net e.m.f. is generated in the circuit which depends on the difference in temperature between the hot and cold junctions.
- The reference junction being kept at 0^0C.

$$\varepsilon = a + bt + ct^2 + dt^3$$

Where ε is the thermal e.m.f. and constants *a*,*b*,*c*,*d* are different for each thermocouple.



Problem for Practice

Q.1 The e.m.f. in a thermocouple with the test junction at t ^{0}C on gas thermometer scale and reference junction at ice point is given by

$$\varepsilon = 0.20t - 5 \times 10^{(-4)} t^2 mV$$

The millivoltmeter is calibrated at ice and steam points. What will this thermometer read in a place where the gas thermometer reads 50 ^{0}C ?

Q.2 A platinum resistance thermometer has a resistance of 2.8 ohm at 0 ^{0}C and 3.8 ohm at 100 ^{0}C. Calculate the temperature when the resistance indicated is 5.8 ohm.

Q.3 The readings $t_{A \text{ and}}$ t_B of two ^{0}C thermometer A and B are at ice point (0^0C) and steam point (100^0C) and are related by equation

$$t_A = l + mt_B + nt_B^2$$

Where l, m and n are constants when both are emerged oil A resistor 51 ^{0}C and B resisters 50 ^{0}C.

(i)Determine the reading on A when B reads 25 ^{0}C.

(ii)Discuss the question which thermometer is correct.