Medical.

Thermal Properties of Matter

Level - 01

Q 1.

Ans.

$$\frac{C}{5} = \frac{F-32}{9}$$

$$C = \frac{5}{9}(140-32) = \frac{5}{9} \times 108$$

$$C = 60^\circ$$

fall in temp = $100^\circ - 60^\circ = 40^\circ C$

Q 2.

Ans.

$$\frac{C}{5} = \frac{F-32}{9}$$

$$C = F$$

$$\frac{C}{5} = \frac{C-32}{9}$$

$$9C - 5C = -160$$

$$C = -40^\circ$$

Q 3.

Ans. Gas thermometers are more sensitive

Q 4.

Ans. Gases expands more than liquids.

Q 5.

Ans. $360°C$

Q 6.

Ans. for 1 cm rise in pressure reading $\rightarrow \frac{100° - 0°}{90 - 50}$

$= 2.5°C$

for 10 cm ———————— $\rightarrow 2.5 \times 10$

$= 25°C$

Q 7.

Ans. $t°F = \frac{9}{5} t°C + 32°$

Q. 9.

Ans.

$A = \pi r^2$

$\frac{\Delta R}{R} = \frac{\Delta l}{l} = \frac{2}{100}$

$\frac{\Delta A}{A} = 2 \frac{\Delta R}{R}$

$100 \times \frac{\Delta A}{A} = 4\%$

Q 10.

Ans. $A = 2L^2$

$100 \times \frac{\Delta A}{A} = 2 \frac{\Delta L}{L} \times 100 = 2\%$

Q 11.

Ans.

$$\Delta L_1 = L_1 \alpha_1 \Delta T$$

$$\Delta L_2 = L_2 \alpha_2 \Delta T$$

$$\Delta L_1 = \Delta L_2$$

$$L_1' = L_1 (1 + \alpha_1 \Delta T)$$

$$L_2' = L_2 (1 + \alpha_2 \Delta T)$$

$$L_1' - L_2' = L_1 - L_2 \Rightarrow \text{constant.}$$

Q 12.

Ans.

$$\Delta V_l = V \gamma \Delta T$$

$$\Delta V_c = V \, 3\alpha \, \Delta T$$

$$\Delta V_l > \Delta V_c \Rightarrow \gamma > 3\alpha$$

Q 13.

Ans of anomalous expansion of btw. $4^\circ c$ to $0^\circ c$

Q 14.

Ans. V_{total} = 1 litre

at temp. T_1 volume of mercury in glass flask is V_1

volume of air = $1 - V_1$

at T_2 Volume of flask = $1 \left[1 + 3 \times 9 \times 10^{-6} (T_2 - T_1) \right]$

at T_2 volume of Mercury = $V_1 \left[1 + 1.8 \times 10^{-4} (T_2 - T_1) \right]$

at T_2 volume of air

$$= \left[1(1+\underbrace{3\times 9\times 10^{-6}}_{\alpha}(T_2-T_1))\right] - V_1\left[1+\underbrace{1.8\times 10^{-4}}_{\alpha}(T_2-T_1)\right]$$

$$= 1 - V_1 + (T_2-T_1)\left[27\times 10^{-6} - V_1\times 1.8\times 10^{-4}\right]$$

Initial volume of air is equal to final volume of air

$$\cancel{1-V_1} = \cancel{1-V_1} + (T_2-T_1)\left[27\times 10^{-6} - V_1\times 1.8\times 10^{-4}\right]$$

$$T_2 - T_1 \neq 0$$

$$27\times 10^{-6} = V_1 \times 1.8 \times 10^{-4}$$

$$V_1 = \frac{27\times 10^{-1}}{18} = 1.5\times 10^{-1}\ m^3$$

$$= 150\ cc$$

Q. 16.

Ans. On heating it bends towards the metal with low α because the metal with low α expands less compare to other metal.

Q 17.

Ans.

$$\sigma = Y\varepsilon$$

$$\frac{T}{A} = Y\cdot\frac{\alpha\Delta\theta}{L_0}$$

$$T = \frac{AY}{L_0}\alpha\Delta\theta$$

Q. 18.

Ans.

$$Q = c\,\Delta\theta$$

$$c = \frac{Q}{\Delta\theta}$$

Q 19.

Ans. T^3

Q 20.

Ans. $H = ml$

mass is same for both.

Q 21.

Ans.

$$\Delta Q = \Delta U + \Delta W$$

$$L = \Delta U + P(V_2 - V_1) \Rightarrow \Delta U = L - P(V_2 - V_1)$$

Q 22.

Ans.

$$\Delta Q = \Delta U + \Delta W \qquad \Delta Q = mL > 0$$

$\rho_{water} > \rho_{ice} \Rightarrow$ Volume decreases $\Rightarrow$ Work done on the system.

$$\Delta Q - \Delta W = \Delta U \qquad \Delta W(-ve) \Rightarrow \Delta U > 0$$

Q 23.

Ans.

(steam 100°c → 0°c water)

Heat loss by steam $= mL_v + ms\Delta T$

$= 540$ cal $+ 1 \times 1 \cdot 100$

$= 640$ cal.

Heat gain by ice $= mL_f = 640$ cal.

$$m = \frac{640}{80} = 8 \text{ gm.}$$

Q 24.

Ans. Temp. & Pressure both Constant.

Q 25.

Ans

100 g water at 100°c $\longrightarrow$ 100 g water at 0°c

Heat loss = $100 \times 1 \times 100$

$= 10^4$ cal.

water

100 g ice at 0°c $\rightarrow$ 100 g ~~ice~~ at 0°c

Heat gain = 100×80

= 8000 cal.

Heat loss − Heat gain = 2000 cal

~~100~~ 200 gm water at 0°c

2000 = m s ΔT

2000 = $200 \times 1 \times (T-0)$

T = 10°c

Q 26.

Ans.

1 kg water at 10°c $\rightarrow$ 1 kg water at 0°c

Heat loss = 10^3 gm $\times$ 1 $\frac{cal}{gm \times °c} \times (10-0)°c$

$= 10^4$ cal.

Heat ~~gain~~ loss = Heat gain

10^4 cal. = m Lf = m 80,

$$m = \frac{10^4}{80} = 125 \text{ gm.}$$

125 gm ice will melt. and temp. will be $0°c$

Q. 27.

~~Ans.~~

Ans. 1g ice to $100°c$ water

Heat gain $= 1 \times 80 + 1 \times 1 \times 100$

$= 180$ cal.

~~100°c~~ 1g steam. to $100°c$ water

Heat loss $= 1 \times 540$ cal.

Heat loss > Heat gain

temp. will be $100°c$.

Level - 2

Q 1.

Ans.

$$\frac{C}{5} = \frac{F-32}{9}$$

$$C = 5^\circ C$$

$$F = 41^\circ C$$

Q 3.

Ans. $1^\circ F$

Q 4.

Ans.

$$L_1 = l_1(1+\alpha_1 \Delta t)$$

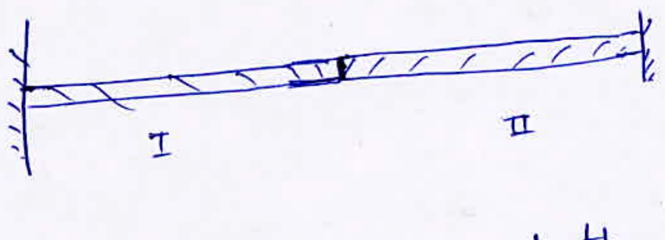
$$L_2 = l_2(1+\alpha_2 \Delta t)$$

$$L_2 - L_1 = l_1 - l_2 + (l_1\alpha_1 - l_2\alpha_2)\Delta t = \text{Const.}$$

$$l_1\alpha_1 = l_2\alpha_2 \quad \Rightarrow \quad l_2 = 60\text{ cm.}$$

Q 5.

Ans.



Tension is equal in both rods.

$$T = AY_1 \frac{l\alpha_1 \Delta t}{l} = AY_2 \frac{l\alpha_2 \Delta t}{l}$$

$$Y_1\alpha_1 = Y_2\alpha_2$$

Q 6.

Ans.

$$V_1 = L_1 L_2 L_3$$

$$V_2 = L_1(1+\alpha_1\Delta t) \cdot L_2(1+\alpha_2\Delta t) \cdot L_3(1+\alpha_2\Delta t)$$

$$= L_1L_2L_3\,(1+\alpha_1\Delta t)\,(1+\alpha_2\Delta t)^2$$

$$= V_1\,(1+\alpha_1\Delta t)\,(1+2\alpha_2\Delta t + \underbrace{\cancel{(\alpha_2\Delta t)^2}}_{\to 0})$$

$$= V_1\,(1+\alpha_1\Delta t + 2\alpha_2\Delta t + \underbrace{\cancel{2\alpha_1\alpha_2\Delta t}}_{\to 0})$$

$$= V_1\,(1+(\alpha_1+2\alpha_2)\Delta t)$$

$$\gamma = \alpha_1 + 2\alpha_2.$$

Q 7.

Ans.

$$W_1 = mg - F_B = \rho_{m_1} V_{m_1} g - \rho_{l_1} V_{m_1} g$$

$$W_2 = mg - \rho_{l_2} V_{m_2} g$$

$$= mg - \frac{\rho_{l_1} V_{m_1}(1+\gamma_m\Delta t)\,g}{(1+\gamma_l\Delta t)}$$

$$= mg - \rho_{l_1} V_{m_1} g\left(\frac{1+\gamma_m\Delta t}{1+\gamma_l\Delta t}\right)$$

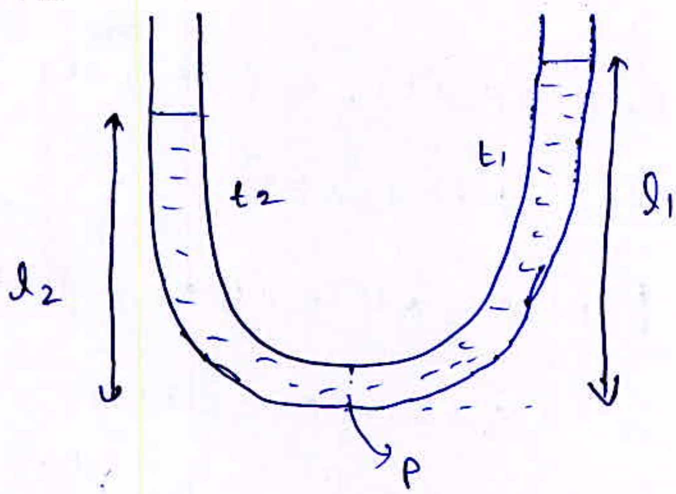
$$\gamma_m < \gamma_l \Rightarrow \left(\frac{1+\gamma_m\Delta t}{1+\gamma_l\Delta t}\right) < 1$$

$$W_2 > mg - \rho_{l_1} V_{m_1} g$$

$$W_2 > W_1$$

Q 8.

Ans.



$$P = \rho_1 l_1 g = \rho_2 l_2 g$$

$$\rho_2 = \frac{\rho_1}{[1+\gamma(t_2-t_1)]}$$

$$\rho_1 l_1 = \rho_2 l_2$$

$$\cancel{\rho_1} l_1 = \frac{\cancel{\rho_1} l_2}{[1+\gamma(t_2-t_1)]}$$

$$1+\gamma(t_2-t_1) = \frac{l_2}{l_1}$$

$$\gamma = \frac{l_2 - l_1}{l_1(t_2-t_1)}$$

Q 9.

Ans. a, b, r and l all increases

Q 10.

Ans. $\gamma = 3\alpha$

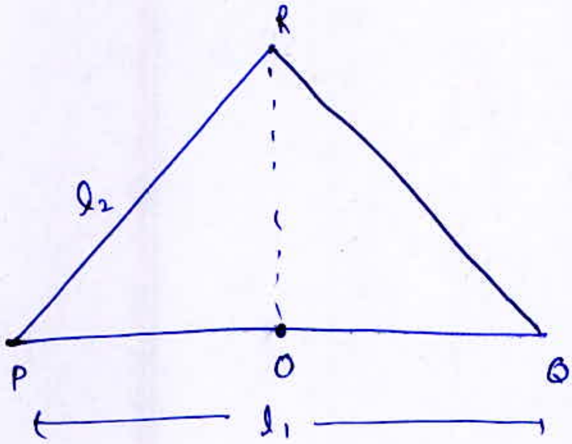
Q 11.

Ans. $T = 2\pi\sqrt{\frac{L}{g}}$ $T_2 = 2\pi\sqrt{\frac{L(1+\alpha\Delta t)}{g}}$

$T_2 > T$

Q 12.

Ans.



$$OR = \sqrt{l_2^2 - \left(\frac{l_1}{2}\right)^2}$$

$$OR = \sqrt{l_2^2 - \frac{l_1^2}{4}}$$

$$= \frac{\sqrt{3}\, l}{2}$$

$$OR = \sqrt{\{l_2(1+\alpha_2 \Delta t)\}^2 - \left\{\frac{l_1(1+\alpha_1 \Delta t)}{2}\right\}^2}$$

$$= \sqrt{l_2^2 + 2 l_2^2 \alpha_2 \Delta t - \frac{l_1^2}{4} - \frac{l_1^2}{2} \alpha_1 \Delta t}$$

$$\boxed{l_2 = l_1}$$

$$= \sqrt{l_2^2 - \frac{l_1^2}{4} + \left(\frac{l_2^2\, 4\alpha_2 \Delta t - l_1^2 \alpha_1 \Delta t}{2}\right)}$$

$$= \cancel{l_2^2 - \frac{l_1^2}{4}} \sqrt{\frac{3}{4} l^2 + \frac{l^2}{2}(4\alpha_2 - \alpha_1)\Delta t}$$

OR is independent of temp.

$$4\alpha_2 - \alpha_1 = 0 \Rightarrow \alpha_1 = 4\alpha_2$$

Q 13.

Ans.

$$Q = mc\,\Delta t$$

$$\frac{Q}{\Delta t} = mc$$

Q 14.

Ans.

$$\frac{dQ}{dt} = \sigma e A T^4$$

$$\frac{dQ}{dt} = K (T_2 - T_1)$$

$$10 = K (50-20) \Rightarrow K = \frac{1}{3}$$

$$\frac{ms \times \Delta T}{\Delta t} = K \times \left(\frac{35.1 + 34.9}{2} - 20\right).$$

$$ms = \frac{1}{3} \times \frac{60 \times 15}{0.2} = 1500 \text{ J/}^\circ\text{C}$$

Q 15.

Ans.

Heat supplied to ice $= (3.2 \times 0.5 \times 10) + (3.2 \times 80)$

$= 3.2 \times 85$

$= 272$ k cal.

$m \times 540 = 272$ k cal.

$m = 500$ gm.

Q 16.

Ans.

Heat loss $= 10 \times 110 \times 80$

$= 88$ K Cal.

$m \times 80 = 88 \times 10^3$ cal.

$m = 1100$ gm.

Q 17.

Ans.

$m \times L \times 100 = q \times 5$

$m \times L_v = q \times 28$

$$L_v = \frac{28 \times 100}{5} \text{ cal.}$$

$$= 560 \text{ cal.}$$

$$L_v = 560 \times 4.2 = 2352 \text{ J/gm}$$

Q 18.

Ans.

$$m_1 g h = m_2 L$$

$$3.5 \times 10 \times 2 \times 10^3 = m_2 \times 3.5 \times 10^5$$

$$m_2 = 2 \times 10^{-1} \text{ Kg}$$

$$= 200 \text{ gm.}$$

Q 19.

Ans.

$$q t_1 = mc (T_2 - T_1)$$

$$q t_2 = m L$$

$$L = \frac{q t_2}{m} = \frac{mc (T_2 - T_1) t_2}{m t_1}$$

Q 20.

Ans.

$$50 \times C_{iron} \times (100^\circ - 25.5) = 100 \times 1 \times (25.5^\circ - 20)$$

$$C_{iron} = \frac{100 \times 5.5}{50 \times 74.5}$$

$$= 0.148$$

Q. 21.

Ans.

Heat loss by steam = $m \times 540 + m \times 1\,(95)$

Heat gain by ice & water = $10 \times 80 + 110 \times 5 \times 1$

= 1350 Cal.

$$m \times (5.40 + 95) = 1350$$

$$m = \frac{1350}{\cancel{6}\cancel{50}35} = 2.1 \text{ gm.}$$

Q 22.

Ans.

Heat gain by vessel and the contents

$= 200 \times (40 - 10)$

Heat loss by ball = $10 \times (T - 40^\circ)$

$$10 \times (T - 40^\circ) = 200 \times 30$$

$$T - 40 = 600$$

$$T = 640^\circ c$$

Q 23.

Ans.

Heat ~~loss~~ gain by ice = $10 \times 0.5 \times 20$ = 100 Cal.

Heat ~~gain~~ loss by water = $10 \times 1 \times 10$ = 100 cal.

10 g ice and 10g water at $0^\circ C$

Q 24.

Ans.

$$m_1 s_1 (\theta_1 - \theta) + m_2 s_2 (\theta_2 - \theta) + m_3 s_3 (\theta_3 - \theta) = 0$$

$$d_1 \cancel{V} s_1 (\theta_1 - \theta) + d_2 \cancel{V} s_2 (\theta_2 - \theta) + d_3 \cancel{V} s_3 (\theta_3 - \theta) = 0$$

$$d_1 s_1 \theta_1 + d_2 s_2 \theta_2 + d_3 s_3 \theta_3 = \theta(d_1 s_1 + d_2 s_2 + d_3 s_3)$$

$$\theta = \frac{d_1 s_1 \theta_1 + d_2 s_2 \theta_2 + d_3 s_3 \theta_3}{d_1 s_1 + d_2 s_2 + d_3 s_3}$$

Q 25.

Ans.

$$\cancel{m_A} s_A (10 - T) + \cancel{m_B} s_B (25 - T) = 0$$

$$T = 15°C$$

$$10 s_A - 15 s_A + s_B 25 - s_B 15 = 0$$

$$5 s_A = 10 s_B$$

$$s_A = 2 s_B$$

$$\cancel{m_B} s_B (25 - 30°) + \cancel{m_C} s_C (40 - 30°) = 0$$

$$\cancel{25 s_B - 30} \quad 5 s_B = 10 s_C$$

$$s_B = 2 s_C$$

$$\cancel{m_A} s_A (10 - T) + \cancel{m_C} s_C (40 - T) = 0$$

$$4 \cancel{s_C} (10 - T) + \cancel{s_C} (40 - T) = 0$$

$$40 - T + 40 - 4T = 0$$

$$\frac{80}{5} = T \Rightarrow T = 16°C$$

Assertion & Reason Questions

Q 1.

Ans. density of (water > ice)

Q 2.

Ans. (c)

Q 3.

Ans.

$$mL = Q_L$$

$$L = \frac{Q_L}{m}$$

Q 5.

Ans.

$$\Delta R_{disc} = R\,\alpha_{brass}\,\Delta T$$

$$\Delta R_{hole} = R\,\alpha_{steel}\,\Delta T$$

$$\underset{(2 \times 10^{-5}\ K^{-1})}{\alpha_{brass}} > \underset{(1.2 \times 10^{-5}\ K^{-1})}{\alpha_{steel}}$$

$$\Delta R_{disc} > \Delta R_{hole}$$

Q 6.

Ans.

$$\gamma = \frac{\Delta V}{V\,\Delta T}$$

Q 7.

Ans.

$$\frac{C}{5} = \frac{F-32}{9}$$

Q 9.

Ans. density of water is minimum at 4°C

Q 10.

Ans. $L = 80 \ cal/gm$

$= 80 \times 4.2 \times 1000$

$= 336000 \ J/kg$

$$L = \frac{Q_L}{m}$$

Q 11.

Ans. $m_1 s_1 (T - T_1) + m_2 s_2 (T - T_2) = 0$

$$T = \frac{m_1 s_1 T_1 + m_2 s_2 T_2}{m_1 s_1 + m_2 s_2}$$

Q 12.

Ans. $$\text{Thermal capacity} = \frac{Q}{\Delta T}$$

Q 13.

Ans. (a)

Previous Year's Question

Q 1.

Ans.

$$\dot{Q} = \frac{mL}{t} = \frac{4.8 \times 3.36 \times 10^5}{t}$$

$$\dot{Q} = \frac{4.8 \times 3.36 \times 10^5}{3600}$$

$$\dot{Q} = KA\frac{\Delta T}{\Delta x} = \frac{4.8 \times 3.36 \times 10^5}{3600}$$

$$K = \frac{4.8 \times 3.36 \times 10^5}{3600 \times 0.36} \times \frac{0.1}{100}$$

$$K = 1.24 \ J/m.s.{}^\circ c$$

Q 2.

Ans.

$$Q = \sigma A T^4$$

$$T = \left(\frac{Q}{4\pi r^2 \sigma}\right)^{1/4}$$

Q 3.

Ans.

$$100^\circ c \longrightarrow (150 - 20) = 130^\circ$$

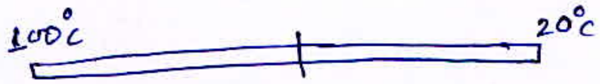
$$1^\circ c \longrightarrow 1.3^\circ$$

$$60^\circ \longrightarrow 20 + 60 \times 1.3^\circ$$

$$= 98^\circ c$$

Q 4.

Ans.



$$T_{center} = \frac{20 + 100}{2} = 60°c$$

Q 5.

Ans.

$$mg = \rho_l \frac{2}{3} V g \quad -①$$

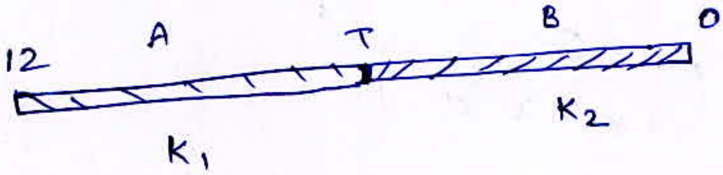
$$mg = \frac{\rho_l}{1+\gamma \Delta T} \times \frac{3}{4} V g \quad -②$$

$$\frac{9}{8} = 1 + \gamma \Delta T$$

$$\gamma = \frac{1}{8 \times 80} = 15.6 \times 10^{-4} \, {}^{\circ}c^{-1}$$

Q 6.

Ans.



$$q = K_1 A \frac{12 - T}{L}$$

$$q = K_2 A \frac{T - 0}{L}$$

$$K_1 \cancel{A} \frac{12 - T}{\cancel{L}} = K_2 \cancel{A} \frac{T - 0}{\cancel{L}}$$

$$12 - T = \frac{K_2}{K_1} (T)$$

$$12 - T = 2T \Rightarrow T = 4$$

Thermometry

Q 1.

Ans. nichrome

Q 2.

Ans. temperature coefficient of resistivity

Q 3.

Ans.

$$\frac{C}{5} = \frac{F-32}{9}$$

Q 4.

Ans. Pyrometer (by measuring intensity of radiation)

Q 5.

Ans.

$$\frac{C}{5} = \frac{F-32}{9}$$

Q 6.

Ans. $P \propto T$

Q 7.

Ans.

$$T = 39^\circ W + \frac{239-39}{100} \times 39$$

$$= 39 + 2 \times 39$$

$$= 117^\circ W$$

Q 8.

Ans. filling nitrogen gas at high pressure above the mercury column

Q 9.

Ans. Cylindrical bulb thermometer

Q 10.

Ans. pyrometer

Q 11.

Ans. 273.16 K

Q 12

Ans. $$\frac{C}{5} = \frac{F - 32}{9}$$

Q 13.

Ans. $$59^\circ = 5^\circ + T \times .9$$

$$T = \frac{54}{.9} = 60^\circ C$$

Q 14.

Ans. $$T = 20^\circ + \frac{150 - 20}{100} \times 60^\circ$$

$$= 98^\circ C$$

Q 15.

Ans.

$$\frac{C}{5} = \frac{F-32}{9}$$

$$\frac{C}{5} = \frac{140-32}{9}$$

$$C = 60^\circ \Rightarrow \text{fall } 100 - 60 = 40^\circ C$$

Q ~~..~~17.

Ans. at ~~zero~~ absolute zero ~~...~~ there is no molecular motion

Q 18.

Ans.

$$\frac{C}{5} = \frac{F-32}{9}$$

$$C = F$$

$$\frac{C}{5} = \frac{C-32}{9}$$

$$C = -40^\circ$$

Thermal expansion

Q 1.

Ans.

isothermal

$$\Delta Q = \cancel{\Delta U}^{\to 0} + \Delta W$$

150 J added to the gas

Q 2.

Ans.

$$Q = \Delta U + \Delta W$$

$$35 = \Delta U - 15$$

$$\Delta U = 50\ J$$

Q 3.

Ans.

$$I \propto l^2$$

$$\frac{\Delta I}{I} = 2\frac{\Delta l}{l} = 2\frac{\cancel{l}\alpha\Delta t}{\cancel{l}} = 2\alpha\Delta t$$

Q 4.

Any.

$$\frac{\Delta T}{T} = \frac{1}{2}\frac{\Delta L}{L} = \frac{1}{2}\frac{\cancel{L}\alpha\Delta T}{\cancel{L}}$$

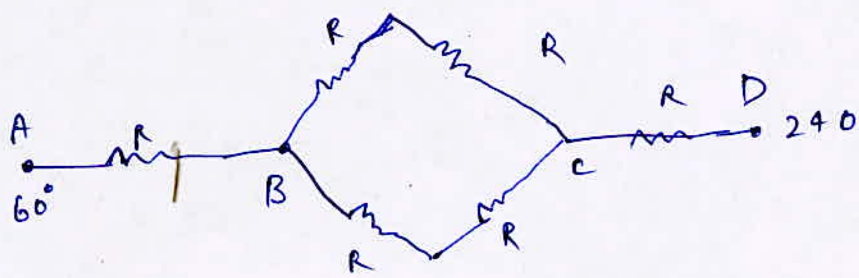
$$\frac{12.5}{86400} = \frac{\alpha}{2}\,25 \Rightarrow \alpha = \frac{1}{86400}$$

Q 5.

Ans.

$R = R_0(1+\alpha\Delta t)$ same for both.

Q 6.



T at B will be $60 + \frac{240 - 60}{3}$

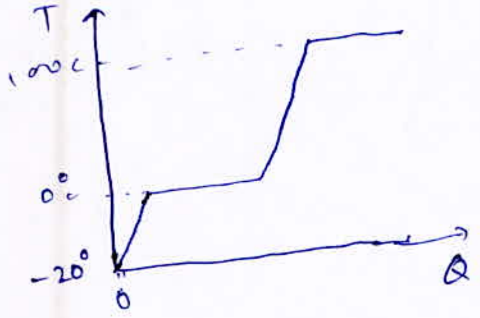
$= 120\,^\circ C$

Q. 7.

Ans. ρ_{water} is max at $4^\circ c$

Q. 8.

Ans.



Q. 9.

Ans. $420 = 10 \times 1 \times 4.2 \times \Delta T$

$\Delta T = 10$

Q. 10.

Ans. Wrong Ques.

Q. 11.

Ans. $\Delta V = V \gamma_{Hg} \Delta T = A_c \, \Delta h$

$10^{-6} \times 18 \times 10^{-5} \times 100 = 2 \times 10^{-7} \times \Delta h$

$9 \times 10^{-2} = \Delta h$

Q 12.

Ans. $\alpha_{brass} > \alpha_{iron}$

Q 13.

Ans. boiling ~~point~~ Temp. of water decreases at low pressure.

Q 14.

Ans. Initial volume of glass $= V_g$

Initial volume of Hg $= V_{Hg}$

$$V'_{glass} = V_g(1 + 3\alpha\Delta T)$$

$$V'_{Hg} = V_{Hg}(1 + \gamma_{Hg}\Delta T)$$

$$V'_{glass} - V'_{Hg} = V_g - V_H + (V_g 3\alpha\Delta T - V_{Hg}\gamma_{Hg}\Delta T)$$

$$V'_{glass} - V'_{Hg} = V_g - V_H$$

$$V_g 3\alpha \cancel{\Delta T} = V_{Hg}\gamma_{Hg}\cancel{\Delta T}$$

$$\frac{V_{Hg}}{V_g} = \frac{3\alpha}{\gamma_{Hg}} = \frac{1}{7}$$

Q 15.

Ans. $$\frac{\Delta T}{T} = \frac{1}{2}\frac{\Delta L}{L} = \frac{1}{2}\frac{K\alpha\Delta T}{K} = \frac{1}{\cancel{2}} \times 12\times10^{-6} \times \cancel{2}0$$

$$\Delta T = 86400 \times 12 \times 10^{-5}$$

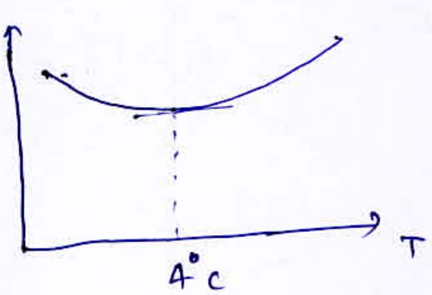
$$= 10.368 \text{ s/day}$$

Q 16.

Ans. refer. Q No 14.

Q 17.

Ans. $\dfrac{dV}{V\,dT} = \gamma$



density of water is maximum at 4° c

$\dfrac{dV}{dT} = 0$ at 4°c $\Rightarrow \gamma = 0$

Q 18.

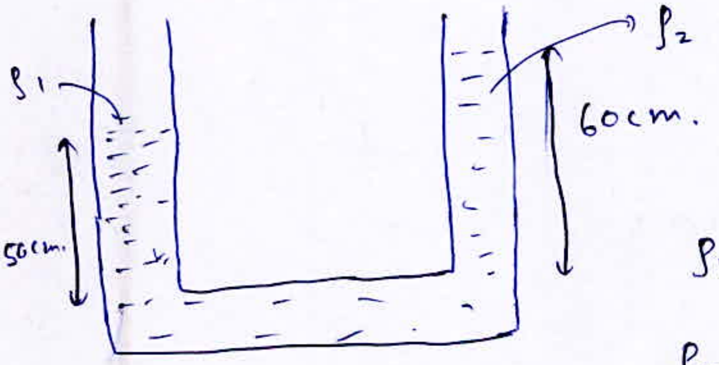
Ans. it will bend towards the metal which has higher coefficient of expansion.

Q 19.

Ans. refer Q. 17. (volume of water is minimum at 4°c)

Q 20.

Ans.



$\rho_2 = \dfrac{\rho_1}{1+\gamma\Delta T}$

$\rho_1 g h_1 = \rho_2 g h_2$

$\cancel{\rho_1 g}\, 50 = \dfrac{\cancel{\rho_1}\,\cancel{g}\,60}{1+\gamma(100-50)}$

$\gamma\, 50 = \dfrac{60}{50} - 1$

$\gamma = \dfrac{1}{250} = 4\times10^{-3}$

Q 21.

Ans.

$$\cancel{Y} + \gamma_1 \Delta T = \cancel{Y} + (\gamma - 3\alpha_1)\Delta T$$

$$\cancel{Y} + \gamma_2 \Delta T = \cancel{Y} + (\gamma - 3\alpha_2)\Delta T$$

$$\gamma_1 - \gamma_2 = 3(\alpha_2 - \alpha_1)$$

$$\alpha_2 = \frac{\gamma_1 - \gamma_2}{3} + \alpha_1$$

Q 22.

Ans. refer Q. No 17.

Q 23.

Ans.

$$l_1 \alpha_1 \cancel{\Delta T} = l_2 \alpha_2 \cancel{\Delta T}$$

$$\alpha_1 = \frac{l_2 \alpha_2}{l_1}$$

$$\frac{\alpha_2}{\alpha_1 + \alpha_2} = \frac{\cancel{\alpha_2}}{\frac{l_2 \cancel{\alpha_2}}{l_1} + \cancel{\alpha_2}} = \frac{1}{\frac{l_2}{l_1} + 1}$$

$$\frac{\alpha_2}{\alpha_1 + \alpha_2} = \frac{l_1}{l_1 + l_2}$$

Q 24.

Ans.

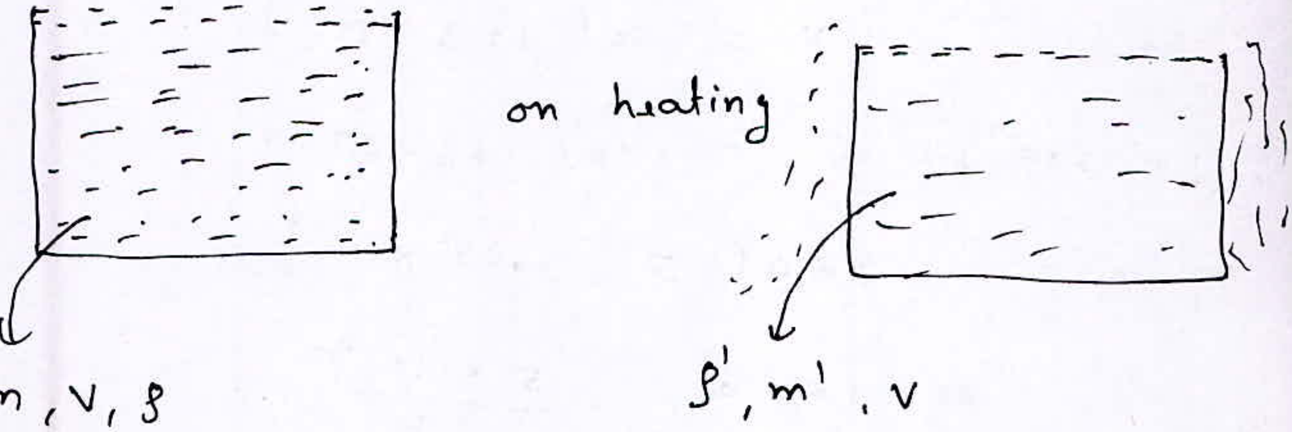
$$\rho_2' = \frac{\rho_2}{1 + 1000\gamma\Delta T} \qquad \rho_1' = \frac{\rho_1}{1 + \gamma\Delta T}$$

$$\rho_2' = \rho_1'$$

$$\frac{\rho_2}{\rho_1} = \frac{1 + 1000\gamma\Delta T}{1 + \gamma\Delta T}$$

Q 25.

Ans.



$$m' + \frac{m'}{100} = m$$

$$\frac{101\, m'}{100} = m$$

$$m' = \frac{100}{101}\, m$$

$$\rho' V = \frac{100}{101}\, \rho V$$

$$\frac{\cancel{\rho V}}{1+\gamma \Delta T} = \frac{100}{101}\, \cancel{\rho V}$$

$$\gamma = \frac{1}{100} \times \frac{1}{\Delta T}$$

$$= \frac{1}{100} \times \frac{1}{80}$$

$$= 1.25 \times 10^{-4} \ /^{\circ}C$$

Q 26.

Ans. Kinetic energy will convert in ~~the~~ internal energy

Q 27.

Ans.

$$V = V_0 (1 + 3\alpha \Delta T)$$

$$(1 + 15 \times 10^{-4}) \cancel{1.15}\, \cancel{V_0} = \cancel{V_0} (1 + 3\alpha \Delta T)$$

$$3\alpha \Delta T = 15 \times 10^{-4}$$

$$\alpha = \frac{5 \times 10^{-4}}{24}$$

$$\alpha = 2 \times 10^{-5} /^{\circ}C$$

Calorimetry

Q 1.

Ans. Heat loss by coffee $= 0.3 \times 4080 \times (70 - T)$

Heat gain by cup $= 0.12 \times 1020 \times (T - 20)$

$$0.\cancel{3} \times \cancel{4080}^{4} \times (70 - T) = 0.\cancel{12} \times \cancel{1020}^{4 \times 10^{-1}} \times (T - 20)$$

$$70 - T = \frac{(T - 20)}{10}$$

$$700 - 10T = T - 20$$

$$T = \frac{720}{11} = 65.5\ ^\circ C$$

Q2.

Ans.

$$Q = m_{cu} S \Delta T = 100 \times 10^{-3} \times 400 \times 21$$

$$Q = m_w S \Delta T = 840\ J$$

$$\Delta T = \frac{\cancel{840}\ 20}{5\cancel{0} \times \cancel{10^{-3}} \times \cancel{4200}} = 4^\circ C$$

Q 3.

Ans.

$$Q = nC_p \Delta T = 70$$

$$nC_v \Delta T = Q'$$

$$\frac{C_p}{C_v} = \gamma = \frac{70}{Q'} = 1.4 \Rightarrow Q' = 50$$

Q 4.

Ans. total internal energy

Q 5.

Ans.

$$\frac{1}{\cancel{2}} \cancel{m} v^2 \times \frac{\cancel{2}}{3} = \cancel{m} s \Delta T$$

$$\Delta T = \frac{v^2}{3s}$$

Q 7.

Ans. vaporisation of water absorbs ~~ener~~ heat from surrounding.

Q 8.

Ans.

$19 \times 1 \times 30 = 570$ (Heat loss)

$5 \times 0.5 \times 20 = 50$ gain

$5 \times 80 = 400$ (gain)

$570 - 450 = 120$

$120 = 24 \times 1 \times (T - 0)$

$T = 5^\circ C$

Q 9.

Ans.

$$\frac{0.1 \times 80 + 0.3 \times 60}{0.4} = 65^\circ c$$

Q 10.

Ans. energy conservation

potential energy $\rightarrow$ Heat

Q 11.

Ans.

$$\frac{1}{2} \times \frac{1}{2} \cancel{m} v^2 = \cancel{m} \times \cancel{200}\ 125 \times (600 - \cancel{273}\ 300) + \cancel{m} \times 2.5 \times 10^4$$

$$\frac{v^2}{4} = 125 \times 300 + 25 \times 10^3$$

$$\frac{v^2}{4} = 37.5 \times 10^3 + 25 \times 10^3$$

$$\frac{v^2}{4} = 625 \times 10^2$$

$$v = 500 \text{ m/s} = 500 \times \frac{18}{5}$$

$$v = 1800 \text{ Km/h}$$

Q 12.

Ans.

$$W = 1 \times 0.5 \times 10 + 1 \times 1 \times 100 + 1 \times 80 + 1 \times 540$$

$$= 725 \times 4.2 = 3045 \text{ J}$$

Q 13.

Ans.

$$x \times 540 = y\,(80 + 1 \times 100)$$

$$\frac{x}{y} = \frac{180}{540} = \frac{1}{3}$$

Q 14.

Ans.

$$100 \times 1 \times 50 = 5000 \quad (\text{Heat loss})$$

Heat gain by ice (0° ice to $0^\circ c$ water) $= 10 \times 80$

$= 800$

$$5000 - 800 = 110 \times 1\ (\Delta T)$$

$$\frac{420\cancel{0}}{11\cancel{0}} = T - 0$$

$$T = 38.2^\circ c$$

Q 15.

Ans.

$$\frac{1}{2} \times \left(\frac{1}{2} m v^2\right) = m L$$

$$\frac{1}{\cancel{2}} \times \frac{1}{\cancel{2}} \times 10 \times 10^{-3} \times \cancel{4}00 = m \times 80 \times 4.25$$

$$m = \frac{1}{340}$$

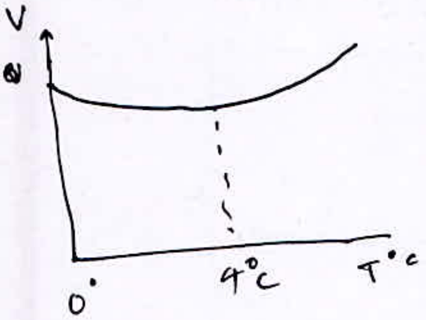
$$m = 3.3 \times 10^{-3}\ gm.$$

Q 16.

Ans. b to c and d to e (Temp. Constant)

Q 17.

Ans.



Q 18.

Ans.

heat required $= 5 \times 80 + 5 \times 1 \times 100 + 5 \times 540$

$= 5 \times 720$

$= 3600$ cal.

Q 19.

Ans.

$$mgh = \frac{1}{2} mv^2 = m' L$$

$$\frac{m'}{m} = \frac{gh}{L} = \frac{10^4}{3.34 \times 10^5} = \frac{1}{33}$$

Q 20.

Ans.

$$\frac{1}{2} mv^2 = m' L$$

$$m' = \frac{\cancel{\frac{1}{2}} \times \cancel{42}^{21} \times \cancel{16}}{0.21\ \cancel{3.36} \times 10^5} = 10^{-3} \text{ kg}$$

Q 21.

Ans.

$$2 \times L_s + 2 \times 1 (100 - 54.3) = 40 \times 1 (54.3 - 25)$$

$L_s = 20 \times 29.3 - 45.7$

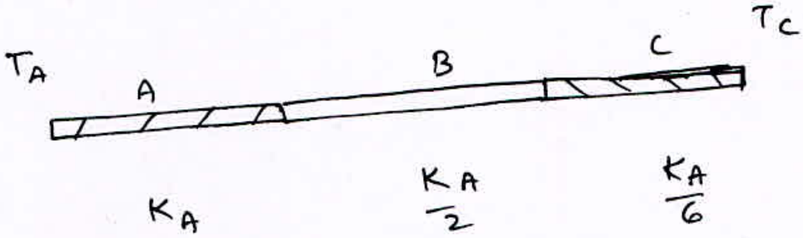
$= 586 - 45.7$

$= 540.3$ cal. g^{-1}

Thermal Conduction and Convection

Q 1.

Ans.



$$R_{eq} = \frac{L}{K_A A} + \frac{L}{\frac{K_A}{2} A} + \frac{L}{\frac{K_A}{6} A}$$

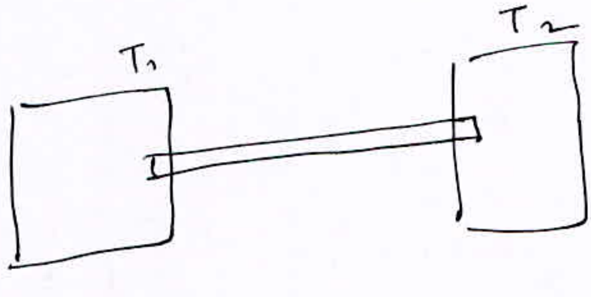
$$= \frac{9L}{K_A A}$$

$$R' = \frac{3\cancel{L}}{K_{eq} \cancel{A}} = \frac{9\cancel{L}}{K_A \cancel{A}}$$

$$\boxed{K_{eq} = \frac{1}{3} K_A}$$

Q 2.

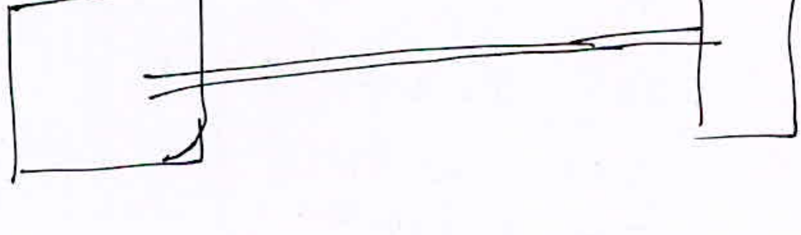
Ans.



$$\pi r^2 L_1 = \pi \left(\frac{r}{2}\right)^2 L_2$$

$$L_2 = 4L_1$$

$$\frac{Q}{t} = \frac{T_1 - T_2}{R_{th}} \qquad R_{th} = \frac{L'}{KA}$$



$$\frac{Q'}{t} = \frac{T_1 - T_2}{R_{th\ new}}$$

$$R_{th\,New} = \frac{L_2}{K A_2} = \frac{4 L_1}{K\, A/4} = 16\, R_{th}$$

$$\frac{Q'}{t} = \frac{T_1 - T_2}{16\, th}$$

$$Q' = \frac{Q}{16}$$

Q 3.

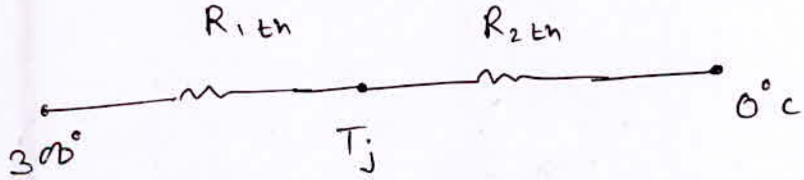
Ans.

$$\rho' = \frac{\rho}{1 + \gamma \Delta T}$$

$$\rho' = \frac{13.6}{1 + 0.18 \times (473 - 273)}$$

Q 4.

Ans.



$$q = \frac{300° - 0°}{R_1 + R_2} = \frac{300}{\frac{L}{KA} + \frac{L}{2KA}}$$

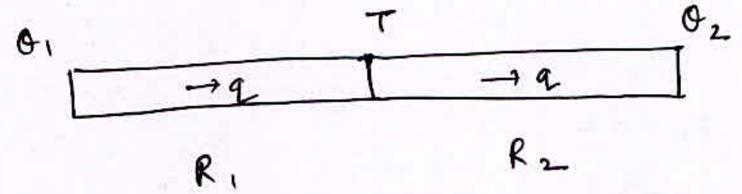
$$q = \frac{300 - T_j}{\cancel{L/KA}} = \frac{300}{\frac{3}{2}\cancel{L/KA}}$$

$$300 - T_j = 200$$

$$T_j = 100°c$$

Q 5.

Ans.



$$\dot{q} = \frac{\theta_1 - \theta_2}{R_1 + R_2} = \frac{\theta_1 - T}{R_1}$$

Q 6.

Ans.

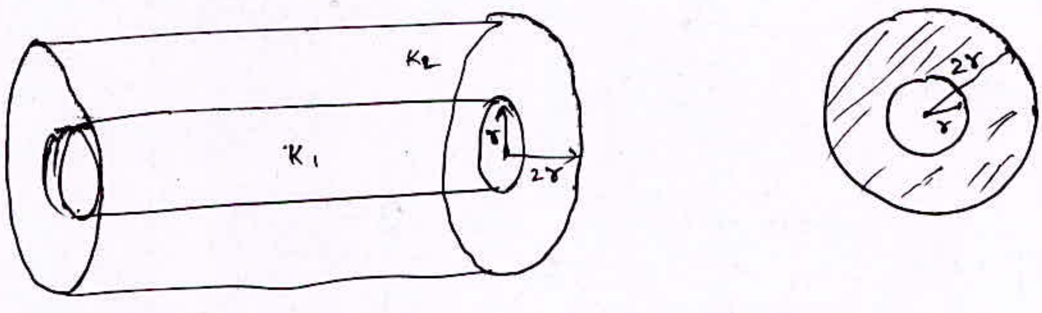
$$\dot{q} = \frac{\Delta T}{\frac{L}{KA}} \Rightarrow \Delta T = q \times \frac{L}{KA}$$

$$= 6000 \times \frac{1}{200 \times 0.75}$$

$$= 40$$

Q 7.

Ans.



Q 8.

Ans.

$$\frac{dQ}{dt} = \frac{KA(T_1 - T_2)}{L}$$

Q 9.

Ans.

$$\frac{100 - T}{\frac{L}{3KA}} = \frac{T - 50}{\frac{L}{2KA}} + \frac{T - 0}{\frac{L}{KA}}$$

$$3(100 - T) = 2(T - 50) + (T - 0)$$

$$300 - 3T = 2T - 100 + T$$

$$6T = 400$$

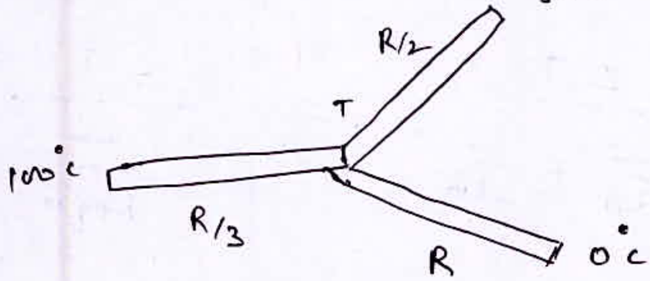
$$T = \frac{200}{3}$$

Q 10.

Ans. more than 24 min (Thermal Resistance is increasing with time)

Q 11.

Ans.



$$\frac{100 - T}{R/3} = \frac{T - 50}{R/2} + \frac{T}{R}$$

$$\Rightarrow 300 - 3T = 3T - 100$$

$$\Rightarrow T = \frac{400}{6} = \frac{200}{3}\ °C$$

Q 12.

Ans.

$$\frac{100 - T}{\frac{L_c}{K_c A}} = \frac{T - 0}{\frac{L_s}{K_s A}}$$

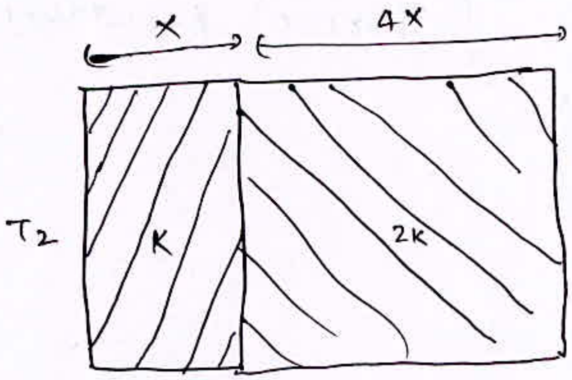
$$\frac{100 - T}{\frac{18}{9 K A}} = \frac{T - 0}{\frac{6}{K A}}$$

$$100 - T = \frac{1}{3} T$$

$$T = \frac{300}{4} = 75^{\circ} C$$

Q 13.

Ans.



$$\dot{q} = \frac{T_2 - T_1}{\frac{x}{KA} + \frac{4x}{2KA}}$$

$$= \frac{KA(T_2 - T_1)}{3x}$$

$$f = 1/3$$

Q 14.

Ans.

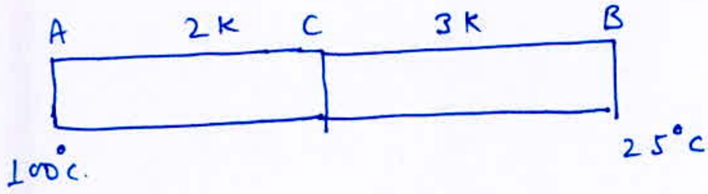
$$q = \frac{\Delta T}{\frac{L}{KA} + \frac{L}{2KA}} = \frac{\Delta T}{\frac{2L}{K_{eq} A}}$$

$$\frac{3}{2} \frac{\cancel{L}}{K\cancel{A}} = \frac{2\cancel{L}}{K_{eq} \cancel{A}}$$

$$K_{eq} = \frac{4}{3} K$$

Q 15.

Ans.



$$q = \frac{\Delta T}{\frac{L}{2KA} + \frac{L}{3KA}} = \frac{6}{5}\,\frac{\Delta T\, KA}{L} = \frac{6}{5} \times 75\,\frac{KA}{L}$$

$$q = \frac{100 - T_c}{\frac{L}{2KA}} = \cancel{2}(100 - T_c)\,\frac{\cancel{KA}}{\cancel{L}} = \frac{\overset{3}{\cancel{6}}}{\cancel{5}} \times \overset{15}{\cancel{75}}\,\frac{\cancel{KA}}{\cancel{L}}$$

$$T_c = 55^\circ C$$

Q 16.

Ans.

$$\text{thermal resistivity} = \frac{1}{\text{thermal conductivity}}$$

$$= \frac{1}{2}$$

Q 17.

Ans.

* remains unchanged

Q 18.

Ans.

$$R_{th_1} = \frac{L_1}{K_1 \cancel{A_1}} = R_{t_2} = \frac{L_2}{K_2 \cancel{A_2}}$$

$$\frac{L_1}{5K} = \frac{L_2}{3K}$$

$$\frac{L_1}{L_2} = 5/3$$

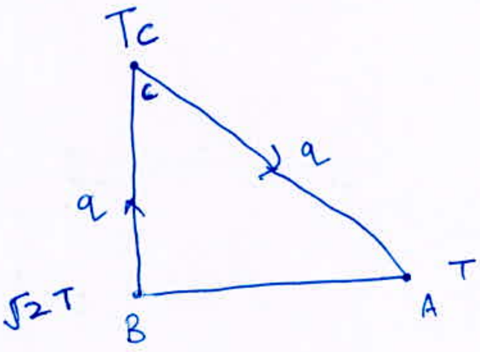
Q 19.

Ans. R_{th} should be minimum

$$R_{th} = \frac{L}{KA}$$

Q 20.

Ans.



$$\frac{\sqrt{2}T - T_c}{\frac{L}{\cancel{KA}}} = \frac{T_c - T}{\frac{\sqrt{2}L}{\cancel{KA}}}$$

$$2T - \sqrt{2}T_c = T_c - T$$

$$(1+\sqrt{2})\,T_c = 3T$$

$$\frac{T_c}{T} = \frac{3}{(1+\sqrt{2})}$$

Q 21.

Ans.

$$R_1 = \frac{L}{KA} + \frac{L}{KA} = \frac{2L}{KA}$$

$$\frac{1}{R_2} = \frac{1}{L/KA} + \frac{1}{L/KA} = \cancel{\frac{L}{2KA}}$$

$$R_2 = \frac{1}{2}\frac{L}{KA}$$

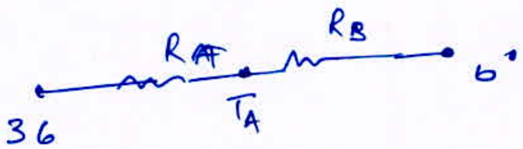
$$t \propto R$$

$$\frac{t_1}{R_1} = \frac{t_2}{R_2} \Rightarrow t_2 = 3 \text{ min}$$

Q 22.

Ans.

$$R_A = \frac{R_B}{2}$$



$$T_A = 12^\circ C$$

Q 23.

Ans. more than 14 h (thermal Resistance increases)

Q 24.

Ans.

$$\frac{F}{A} = Y \frac{\cancel{l}\alpha\Delta t}{\cancel{l}}$$

$$F = AY\alpha\Delta t$$

Radiation (Kirchoff's Law , Black Body)

Q 1.

Ans. (b)

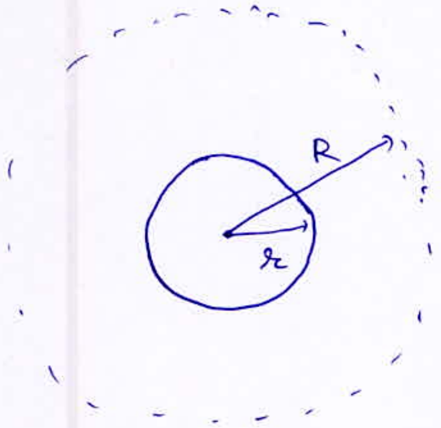
Q 2.

Ans.

$$\frac{E_1}{E_2} = \frac{\cancel{\sigma e} A_1 T_1^4}{\cancel{\sigma e} A_2 T_2^4}$$

Q 3.

Ans.



$$E = \sigma 4\pi r^2 T^4$$

$$\frac{E}{4\pi R^2} = \frac{\sigma r^2 T^4}{R^2}$$

Q 4.

Ans. electromagnetic wave (3×10^8 m/s)

Q 5.

Ans.

$$E = \sigma A \cdot (273 + 273)^4 = R$$

$$E_2 = \sigma A (273)^4 = \frac{R}{16}$$

Q 6.

Ans.

$$\lambda_{E_{max}} T = \text{Const.}$$

$$\lambda_{E_{max}} \propto \frac{1}{T}$$

Q 7.

Ans. Conduction

Q 8.

Ans.

$$\frac{E_1}{E_2} = \frac{\sigma A_1 T_1^4}{\sigma A_2 T_2^4} = \frac{8^2}{2^2} \times \frac{(400)^4}{(800)^4} = 1$$

Q 9.

Ans. (a) Zero.

Q 10.

Ans.

$$\frac{E_2}{E_1} = \frac{(1000)^4}{(500)^4} = 16$$

$$E_2 = 16 \times 7 = 112$$

Q 11.

Ans.

$$\frac{E_2}{E_1} = \frac{\sigma e A (T_2^4 - T_s^4)}{\sigma e A (T_1^4 - T_s^4)}$$

Q 12.

Ans.

$$mc \frac{dT}{dt} = \sigma A (T^4 - T_s^4)$$

$$c = \frac{\sigma \times 19.2 \times 10^{-4} \times (400^4 - 300^4)}{34.38 \times 10^{-3} \times 0.04}$$

Q. 13.

Ans.

$$\frac{\varepsilon_2}{\varepsilon_1} = \frac{(1000)^4}{(500)^4}$$

$$\varepsilon_2 = 16 \times 5 = 80 \text{ cal cm}^{-2} \text{ s}^{-1}$$

Q 14.

Ans.

$$\varepsilon_2 = R \times \frac{(273 + 273)^4}{(273)^4} = 16R$$

Q 19.

Ans.

$$\varepsilon = \sigma e A T^4 = 0$$

$$T = 0 \text{ K}$$

Q. 22.

Ans. Radiation

Q 23.

Ans. Radiation

Q 24.

Ans. $e = 1$

Q 28.

Ans. $e = 1$

Q

Wien's Law, Stefan's Law and Newton's Law of Cooling

Q 1.

Ans.

$$\sigma e A T^4 = 1134 \text{ W}$$

Q 2.

Ans.

$$\frac{d\theta}{dt} = -\lambda\theta$$

$$\ln\frac{\theta_f}{\theta_i} = -\lambda t$$

$$\ln\frac{30}{50} = -\lambda 7 \quad -(1)$$

$$\ln\frac{18}{30} = -\lambda t \quad -(2)$$

from (1) & (2) $t = 7$ min

Q 3.

Ans.

$$\frac{80-70}{5} = K\left(\frac{80+70}{2} - 40\right)$$

$$K = \frac{2}{35}$$

$$\frac{80-60}{t} = k\left(\frac{80+60}{2} - 40\right)$$

$$\frac{20}{t} = \frac{2}{35}\,(30)$$

$$t = \frac{\cancel{20}\times 35}{\cancel{2}\times 3\cancel{0}} = \frac{35}{3} = 11.66 \text{ min.}$$

Q 4.

Ans.

$$\dot{q} = \sigma e A\left(T^4 - T_s^4\right)$$

$$= \sigma e A\left(T^2 + T_s^2\right)\left(T + T_s\right)\left(T - T_s\right)$$

Q 5.

Ans.

$$\frac{10}{10} = k\left(55 - T_s\right)$$

$$\frac{8}{10} = k\left(46 - T_s\right)$$

$$\frac{5}{4} = \frac{55 - T_s}{46 - T_s}$$

$$230 - 5T_s = 220 - 4T_s$$

$$10 = T_s$$

$$T_s = 10^\circ C$$

Q 6.

Ans.

$$\lambda_{Emax} \; T = b$$

Q 7.

Ans.

$$\lambda \times 2000 = \lambda_2 \times 3000$$

$$\frac{2\lambda}{3} = \lambda_2$$

Q 9.

Ans.

$$q = ms\,(100 - 15)$$

$$= m \times 4.2 \times 85$$

$$q = 30 \times \cancel{m} \times g \times 30 \times t = \cancel{m} \times 4.2 \times 85 \times 10^3$$

$$t = \frac{4.2 \times 85 \times 10^3}{900}$$

$$= 3.96 \times 10^3$$

Q 10.

Ans.

$$P = \sigma \varepsilon A T^4$$

$$T = \left(\frac{P}{A \varepsilon \sigma} \right)^{1/4}$$

Q 11.

Ans.

$$\frac{q_1}{q_2} = \frac{\sigma e A T_1^4}{\sigma e A T_2^4} = \frac{m_1 s_1 \, dT_1/dt}{m_2 s_2 \, dT_2/dt}$$

$$\frac{\frac{dT_A}{dt}}{\frac{dT_B}{dt}} = \frac{A_A m_B}{A_B m_A} = \frac{r_B}{r_A}$$

Q 12.

Ans. $$\frac{q_2 - q_1}{q_1} = \frac{(1.3)^4 - 1}{1} = 1.85$$

Q 13.

Ans. Kirchhoffs Law

Q 14.

Ans. $$\frac{\varepsilon_2}{\varepsilon_1} = \frac{(327 + 273)^4}{(-73 + 273)^4} = 3^4$$

Q 15.

Ans. $\varepsilon \propto T^4$

Q 16.

Ans. Wien's displacement Law

Q 17.

Ans. refer Q. No. 11.

Q 18.

Ans. $P = \sigma A T^4$

Q 19.

Ans.

$$\frac{80-64}{5} = K(72 - T_s)$$

$$\frac{80-52}{10} = K(66 - T_s)$$

$$\frac{32}{28} = \frac{72 - T_s}{66 - T_s}$$

$$\cancel{4} \times (66 - T_s) = \overset{7}{\cancel{28}}(6)$$

$$66 - 42 = T_s$$

$$T_s = 24^\circ C$$

Q 20.

Ans.

$$\frac{\varepsilon_2}{\varepsilon_1} = \left(\frac{627+273}{27+273}\right)^4 = 81$$

$$\varepsilon_2 = 81 \times 0.5 = 40.5$$

Q 21.

Ans.

$$q_1 = \sigma e A\left[(75+273)^4 - (25+273)^4\right] = 200$$

$$q_2 = \sigma e A\left[(40+273)^4 - (25+273)^4\right]$$

$$q_2 = \left[\frac{(313)^4 - (298)^4}{(348)^4 - (298)^4}\right] \times 200$$

Q 22.

Ans.

$$\frac{50-T}{10} = K\left(\frac{50+T}{2} - 20\right)$$

$$\frac{20}{5} = K\,(60-20)$$

$$\frac{50-T}{40} = \left(5 + \frac{T}{2}\right)$$

$$50 - T = \cancel{200 - T = 20 T}\ 5 + T/2$$

$$45 = 3T/2$$

$$T = 30^{\circ}C$$

Q 23.

Ans. (b)

Q 24.

Ans.

$$\lambda_{E\max} T = b$$

Q 26.

Ans.

$$P = \frac{\sigma\, \cancel{4\pi}\, r^2\, (t+273)^4}{\cancel{4\pi}\, R^2}$$

Q 27.

Ans.

$$\lambda_{max} \propto \frac{1}{T}$$

Q 28.

Ans.

$$\varepsilon = \sigma e A (1000)^4$$

Q 29.

Ans. (A)

$$q = \sigma e A T^4$$

$$T_A < T_B$$

Q 30.

Ans.

$$\text{Power} = \frac{\sigma 4\pi r^2 T^4}{4\pi d^2}$$

$$q_{in} = \frac{\sigma 4\pi r^2 T^4}{4\pi d^2} \pi R^2$$

$$q_{out} = \sigma 4\pi R^2 T_0^4$$

$$q_{in} - q_{out} = ms \cancel{\frac{dT}{dt}} \to 0$$

$$q_{in} = q_{out}$$

$$T_0 \propto d^{-1/2}$$

Q 31.

Ans.

$$\lambda_{max} T = b$$

Q 32.

Ans.

$$\frac{4}{3}\pi r^3 = a^3$$

$$a = \left(\frac{4}{3}\pi\right)^{1/3} r$$

$$\frac{E_1}{E_2} = \frac{A_1}{A_2} = \frac{4\pi r^2}{6a^2} = \frac{2\cancel{4}\pi \cancel{r^2}}{3\cancel{6}\left(\frac{4}{3}\pi\right)^{2/3}\cancel{r^2}}$$

$$\frac{E_1}{E_2} = \frac{2\ \pi^{1/3}}{2^{4/3}\ 3^{1/3}} = \left(\frac{\pi}{6}\right)^{1/3}$$

Q.34.

Ans.

$$\frac{50 - 49.9}{5} = K\,(49.95 - 30)$$

$$\frac{40 - 39.9}{t} = K\,(39.95 - 30)$$

$$t = 5 \times \frac{(19.95)}{9.95} = 10 \text{ sec.}$$

Q 35.

Ans. ΔT between surrounding and body is less

Q 37.

Ans. $t_3 > t_2 > t_1$ (Newton's Law of cooling)

Q 38.

Ans. $E \propto T^4 \Rightarrow \frac{E}{16}$

Q 39.

Ans. $$\lambda_{max}\, T = \text{Const.}$$

Q ~~40~~. 42.

Ans. $$\frac{\Delta T}{t} = K\left(T_{avg} - T_s\right)$$

Q. 43.

Ans. $$\frac{q_1}{q_2} = \frac{0.2\, T_1^4}{0.8\, T_2^4} = 1$$

$$\frac{T_1}{T_2} = (4)^{1/4} = \sqrt{2}$$

Q 44.

Ans. $$E = \sigma e A\left(T^{\circ}C + 273\right)^4$$

Q 45

Ans. $$\frac{E_2}{E_1} = \left(\frac{927+273}{27+273}\right)^4 = 4^4 = 256$$

Q 46.

Ans. $$\lambda_{max}\, T = \text{Const.}$$

Q 47.

Ans. $$E \propto T^4$$

$$E_2 = (2)^4 \times E_1$$

Q 48.

Ans.

$$\frac{\varepsilon_2}{\varepsilon_1} = \frac{\sigma e A_2 T_2^4}{\sigma e A_1 T_1^4} = \frac{(100)^2 \times (\frac{1}{2})^4}{1}$$

$$= \frac{10^4}{16}$$

Q 49.

Ans.

$$\varepsilon \propto T^4$$

Q 50.

Ans.

$$\lambda_{max} \times T = b$$

Q 51.

Ans.

$$\lambda_{max\,A} T_A = \lambda_{max\,B} T_B$$

$$(\lambda_{max\,B} - 3\mu m)\, 4 \cancel{T_B} = \lambda_{max\,B} \cancel{T_B}$$

$$3 \lambda_{max\,B} = 12\ \mu m.$$

$$\lambda_{max\,B} = 4.\ \mu m.$$