DPP
DAILY PRACTICE PROBLEMS

CLASS : XITH
DATE :

Solutions

SUBJECT : PHYSICS
DPP NO. : 5

Topic :- THERMAL PROPERTIES OF MATTER

1 **(b)**

According to Stefan's law of radiation

$U \propto T^4$ (∵ U is the energy)

$\Rightarrow \quad \frac{U_1}{U_2} = \left(\frac{T_1}{T_2}\right)^4$

$\frac{U_1}{U_2} = \left(\frac{T}{T/2}\right)^4$ (∵ $T_2 = \frac{T}{2}$)

Or $\quad \frac{U_1}{U_2} = \left(\frac{2}{1}\right)^4$

Or $\quad \frac{U_1}{U_2} = \left(\frac{16}{1}\right)$

Or $\quad U_2 = \frac{U_1}{16}$

$\Rightarrow \quad U_2 = \frac{U}{16}$ (∵ $U_1 = U$)

2 **(b)**

In series, $R_{eq} = R_1 + R_2 \Rightarrow \frac{2l}{K_{eq}A} = \frac{l}{K_1 A} + \frac{l}{K_2 A}$

$$\Rightarrow \frac{2}{K_{eq}} = \frac{1}{K_1} + \frac{1}{K_2} \Rightarrow K_{eq} = \frac{2K_1K_2}{K_1 + K_2}$$

3 **(d)**

From Stefan law, the energy radiated by sun is given by. $P = \sigma e A T^4$, assuming e=1 for sun.

In Ist case, $\quad P_1 = \sigma e \times 4\pi R^2 \times T^4$

In 2nd case, $\quad P_2 = \sigma e \times 4\pi(2R^2) \times (2T^4)$

$= \sigma e \times 4\pi R^2 \times T^4 \times 64 = 64P_1$

The rate at which energy is received by earth is,

$$E = \frac{P}{4\pi R_{SE}^2} \times A_E$$

where A_E = area of earth

R_{SE} = distance between sun and earth

So, In Ist case, $\quad E_1 = \frac{P_1}{4\pi R_{SE}^2} \times A_E$

$$E_2 = \frac{P_2}{4\pi R_{SE}^2} \times A_E = 64E_1$$

4 **(a)**

For gases γ is more

5 **(d)**

Suppose $m\ gm$ ice melted, then heat required for its melting $= mL = m \times 80\ cal$

Heat available with steam for being condensed and then brought to 0°C

$= 1 \times 540 + 1 \times 1 \times (100 - 0) = 640\ cal$

⇒ Heat lost = Heat taken

$\Rightarrow 640 = m \times 80 \Rightarrow m = 8\ gm$

Short trick : You can remember that amount of steam (m') at 100°C required to melt $m\ gm$ ice at 0°C is

$$m' = \frac{m}{8}$$

Here, $m = 8 \times m' = 8 \times 1 = 8\ gm$

6 **(c)**

Rate of energy $\frac{Q}{t} = P = A\varepsilon\sigma T^4 \Rightarrow P \propto T^4$

$$\Rightarrow \frac{P_2}{P_1} = \left(\frac{T_2}{T_1}\right)^4 = \left(\frac{927 + 273}{127 + 273}\right)^4 \Rightarrow P_1 = 405\ W$$

8 **(d)**

$\frac{Q}{t} = \frac{KA\Delta\theta}{l} \Rightarrow \frac{Q}{t} \propto \frac{A}{l} \propto \frac{d^2}{l}$ [d = diameter of rod]

$$\Rightarrow \frac{(Q/t)_1}{(Q/t)_2} = \left(\frac{d_1}{d_2}\right)^2 \times \frac{l_2}{l_1} = \left(\frac{1}{2}\right)^2 \times \left(\frac{1}{2}\right) = \frac{1}{8}$$

9 **(c)**

Heat required is proportional to square of radius

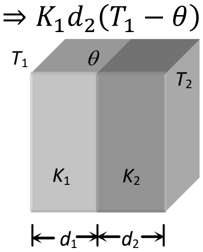
$$\frac{Q_1}{Q_2} = \frac{r_1^2}{r_2^2} = \frac{(1.5)^2}{(1)^2} = \frac{9}{4}$$

11 **(a)**

In series both walls have same rate of heat flow. Therefore

$$\frac{dQ}{dt} = \frac{K_1 A(T_1 - \theta)}{d_1} = \frac{K_2 A(\theta - T_2)}{d_2}$$

$\Rightarrow K_1 d_2 (T_1 - \theta) = K_2 d_1 (\theta - T_2)$



$$\Rightarrow \theta = \frac{K_1 d_2 T_1 + K_2 d_1 T_2}{K_1 d_2 + K_2 d_1}$$

13 **(c)**

Due to evaporation cooling is caused which lowers the temperature of bulb wrapped in wet hanky

14 **(c)**

$$t = \frac{Ql}{KA(\theta_1 - \theta_2)} = \frac{mLl}{KA(\theta_1 - \theta_2)} = \frac{V\rho Ll}{KA(\theta_1 - \theta_2)}$$

$$= \frac{5 \times A \times 0.92 \times \frac{5+10}{2}}{0.004 \times A \times 10 \times 3600} = 19.1 hours$$

15 **(a)**

If $m\ gm$ ice melts then

Heat lost = Heat gain

$80 \times 1 \times (30 - 0) = m \times 80 \Rightarrow m = 30\ gm$

16 **(b)**

Substances are classified into two categories

(i) water like substances which expand on solidification.

(ii) CO_2 like (Wax, Ghee *etc*.) substances which contract on solidification.

Their behaviour regarding solidification is opposite.

Melting point of ice decreases with rise of pressure but that of wax etc increases with increase in pressure. Similarly ice starts forming from top to downwards whereas wax starts its formation from bottom to upwards

17 **(d)**

According to Stefan's law

$E \propto T^4$ or $E = \sigma T^4$

Where σ is Stefan's constant. It's value is

$= 5.67 \times 10^{-8}\ \mathrm{Wm^{-2}K^{-4}}$

Here, $T_1 = 27 + 273 = 300$ K

$T_2 = 927 + 273 = 1200$ K

$\therefore \quad \frac{E_1}{E_2} = \left(\frac{300}{1200}\right)^4 = 1:256$

18 **(a)**

The equivalent electrical circuit, figure in these cases is of Wheatstone bridge. No current would flow through central rod CD when the bridge is balanced. The condition for balanced Wheatstone bridge is $\frac{P}{Q} = \frac{R}{S}$ (in terms of resistances)

$\frac{1/K_1}{1.K_2} = \frac{1/K_3}{1/K_4}$ or $\frac{K_2}{K_1} = \frac{K_4}{K_3}$

Or $K_1K_4 = K_2K_3$

19 **(a)**

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

$= \frac{1}{2} = 0.5$

20 **(d)**

Because steady state has been reached

ANSWER-KEY										
Q.	1	2	3	4	5	6	7	8	9	10
A.	B	B	D	A	D	C	D	D	C	C
Q.	11	12	13	14	15	16	17	18	19	20
A.	A	C	C	C	A	B	D	A	A	D