DPP

DAILY PRACTICE PROBLEMS

CLASS : XITH
DATE :

Solutions

SUBJECT : PHYSICS
DPP NO. : 1

Topic :- THERMAL PROPERTIES OF MATTER

1. **(d)**

Increase of vapour pressure increases the boiling point of water.

2 **(a)**

Temperature gradient $\frac{d\theta}{dx} = \frac{(125-25)°\text{C}}{50\ cm} = 2°\text{C}/cm$

3 **(d)**

According to Wien's law

$$\lambda_m \propto \frac{1}{T}$$

And from the figure

$$(\lambda_m)_1 < (\lambda_m)_3 < (\lambda_m)_2$$

Therefore, $T_1 > T_3 > T_2$

4 **(b)**

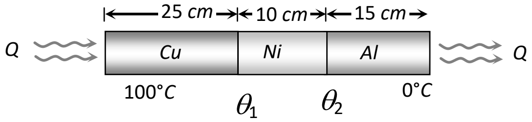
If suppose $K_{Ni} = K \Rightarrow K_{Al} = 3K$ and $K_{Cu} = 6K$

Since all metal bars are connected in series

So $\left(\frac{Q}{t}\right)_{Combination} = \left(\frac{Q}{t}\right)_{Cu} = \left(\frac{Q}{t}\right)_{Al} = \left(\frac{Q}{t}\right)_{Ni}$

and $\frac{3}{K_{eq}} = \frac{1}{K_{Cu}} + \frac{1}{K_{Al}} + \frac{1}{K_{Ni}} = \frac{1}{6K} + \frac{1}{3K} + \frac{1}{K} = \frac{9}{6K}$

$\Rightarrow K_{eq} = 2K$



Hence, it $\left(\frac{Q}{t}\right)_{Combination} = \left(\frac{Q}{t}\right)_{Cu}$

$$\Rightarrow \frac{K_{eq}A(100-0)}{l_{Combination}} = \frac{K_{Cu}A(100-\theta_1)}{l_{Cu}}$$

$$\Rightarrow \frac{2K\ A(100-0)}{(25+10+15)} = \frac{6K\ A(100-\theta_1)}{25} \Rightarrow \theta_1 = 83.33°\text{C}$$

Similar if $\left(\frac{Q}{t}\right)_{Combination} = \left(\frac{Q}{t}\right)_{Al}$

$$\Rightarrow \frac{2K\ A(100-0)}{50} = \frac{3K\ A(\theta_2-0)}{15} \Rightarrow \theta_2 = 20°\text{C}$$

5 **(b)**

If we fill nitrogen gas at high pressure above mercury level, the boiling point of mercury is increased which can extend the range upto 500°C.

6 **(c)**

Since specific heat $= 0.6 kcal/g \times °C = 0.6\ cal/g \times °C$

From graph it is clear that in a minute, the temperature is raised from 0°C to 50°C.

$\Rightarrow$ Heat required for a minute $= 50 \times 0.6 \times 50 = 1500\ cal$

Also from graph, Boiling point of wax is 200°C

7 **(d)**

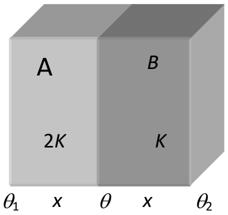
We know that when solid carbondioxide is heated, it becomes vapour directly without passing through its liquid phase. Therefore it is called dry ice

8 **(b)**

Suppose conductivity of layer B is K, then it is $2K$ for layer A. Also conductivity of combination layers A and B is $K_S = \frac{2\times 2K\times K}{(2K+K)} = \frac{4}{3}K$

Hence $\left(\frac{Q}{t}\right)_{Combination} = \left(\frac{Q}{t}\right)_A$

$$\Rightarrow \frac{4}{3}\frac{KA\times 60}{2x} = \frac{2K.A\times(\Delta\theta)_A}{x} \Rightarrow (\Delta\theta)_A = 20K$$



9 **(a)**

Boiling occurs when the vapour pressure of liquid becomes equal to the atmospheric pressure. At the surface of moon, atmospheric pressure is zero, hence boiling point decreases and water begins to boil at 30°C

10 **(a)**

Temperature of interface

$$\theta = \frac{K_1\theta_1 l_2 + K_2\theta_2 l_1}{K_1 l_2 + K_2 l_1}$$

It is given that $K_{Cu} = 9K_s$. So, if $K_s = K_1 = K$, then

$$K_{Cu} = K_2 = 9K$$

$$\Rightarrow \quad \theta = \frac{9K\times 100\times 6 + K\times 0\times 18}{9K\times 6 + K\times 18}$$

$$= \frac{5400K}{72K} = 75°C$$

11 **(b)**

Power radiated, $Q \propto AT^4$ and $\lambda_m T =$ constant. Hence, $Q \propto \frac{A}{(\lambda_m)^4}$

$$Q \propto \frac{A}{(\lambda_m)^4}$$

or $$Q \propto \frac{r^2}{(\lambda_m)^4}$$

$$Q_A\!:\!Q_B\!:\!Q_C=\frac{(2)^2}{(3)^4}\!:\!\frac{(4)^2}{(4)^4}\!:\!\frac{(6)^2}{(5)^4}$$
$$=\frac{4}{81}\!:\!\frac{1}{16}\!:\!\frac{36}{625}$$
$$= 0.05\!:\!0.0625\!:\!0.0576$$

$ie.$, Q_B is maximum.

12 **(a)**

Thermal stress is a measure of the internal distribution of force per unit area within body that is applied to the body, in the form of heat

$$\text{Thermal stress}=Y\alpha\Delta T$$

Where Y is Young's modulus, α the coefficient of linear expansion and ΔT the change in temperature

Both the rods are heated,

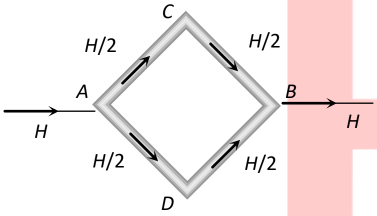
$\therefore \quad Y_1\alpha_1\Delta T_1 = Y_2\alpha_2\Delta T_2$

Since, $\quad \Delta T_1 = \Delta T_2$

$\Rightarrow \quad \frac{Y_1}{Y_2}=\frac{\alpha_2}{\alpha_1}=\frac{3}{2}$

13 **(a)**

Suppose temperature difference between A and B is 100℃ and $\theta_A > \theta_B$



Heat current will flow from A and B via path ACB and ADB. Since all the rods are identical so $(\Delta\theta)_{AC} = (\Delta\theta)_{AD}$

[Because heat current $H=\frac{\Delta\theta}{R}$; here R = same for all]

$\Rightarrow \theta_A - \theta_C = \theta_A - \theta_D \Rightarrow \theta_C - \theta_D$

$i.e.$ temperature difference between C and D will be zero

14 **(c)**

According to Wien's law, $\lambda_m T$ = constant

$\lambda_r > \lambda_y > \lambda_b \Rightarrow T_r < T_y$ or $T_A < T_C < T_B$

15 **(c)**

In first case

$$\frac{m\times s\times(61^\circ-59^\circ)}{4}=K\left[\left(\frac{(61^\circ-59^\circ)}{2}\right)-30^\circ\right] \qquad \text{...(i)}$$

In second case

$$\frac{m\times s\times(51^\circ-49)}{t}=K\left[\left(\frac{(51^\circ-49^\circ)}{2}\right)-30^\circ\right] \qquad \text{...(ii)}$$

Dividing Eq.(i) by Eq.(ii), we obtain

$$\frac{t}{4}=\frac{30}{20}=\frac{3}{2} \quad \text{or} \quad t=6\text{ min}$$

16 **(a)**

Red and green colours are complementary to each other. When red glass is heated it emits green light strongly, hence according to Kirchhoff's law, the emissive power of red glass should be maximum for green light. That's why when this heated red glass is taken in dark room it strongly emits green light and looks greenish

17 **(d)**

$$\frac{Q}{t}=\frac{KA\,\Delta\theta}{l}\Rightarrow\frac{Q}{t}\propto\frac{A}{l}\propto\frac{r^2}{l}$$

$\because \frac{r^2}{l}$ is maximum in option (d), hence it will conduct more heat

18 **(a)**

Rate of cooling $\frac{\Delta\theta}{t}=\frac{A\varepsilon\sigma(T^4-T_0^4)}{mc}\Rightarrow\frac{\Delta\theta}{t}\propto A$. Since area of plate is largest so it will cool fastest

19 **(b)**

As we know $\alpha=\frac{\Delta L}{L_0\Delta\theta}\Rightarrow\Delta\theta=\frac{\Delta L}{\alpha L_0}=\frac{5\times10^{-5}}{10\times10^{-6}\times1}=5°\mathrm{C}$

20 **(c)**

According to Wien's displacement law

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