DPP
DAILY PRACTICE PROBLEMS

CLASS : XITH
DATE :

Solutions

SUBJECT : PHYSICS
DPP NO. : 8

Topic :- THERMAL PROPERTIES OF MATTER

1 **(c)**

Since specific heat of lead is given in $Joules$, hence use $W = Q$ instead of $W = JQ$.

$\Rightarrow \frac{1}{2} \times \left(\frac{1}{2}mv^2\right) = m.c.\Delta\theta \Rightarrow \Delta\theta = \frac{v^2}{4c} = \frac{(300)^2}{4 \times 150} = 150°C$

2 **(a)**

Anomalous density of water is given by (a). It has maximum density at 4°C.

3 **(d)**

Area under given curve represents emissive power and emissive power $\propto T^4 \Rightarrow A \propto T^4$

$\Rightarrow \frac{A_2}{A_1} = \frac{T_2^4}{T_1^4} = \frac{(273+327)^4}{(273+27)^4} = \left(\frac{600}{300}\right)^4 = \frac{16}{1}$

4 **(b)**

When length of the liquid column remains constant, then the level of liquid moves down with respect to the container, thus γ must be less than 3α

Now we can write $V = V_0(1 + \gamma\Delta T)$

Since $V = Al_0 = [A_0(1 + 2\alpha\Delta T)]l_0 = V_0(1 + 2\alpha\Delta T)$

Hence $V_0(1 + \gamma\Delta T) = V_0(1 + 2\alpha\Delta T) \Rightarrow \gamma = 2\alpha$

5 **(b)**

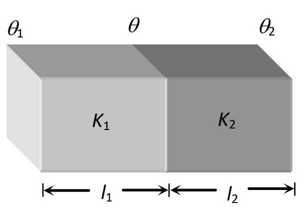
Highly polished mirror like surfaces are good reflectors, but not good radiators

6 **(c)**

At steady state, rate of heat flow for both blocks will be same,

$i.e., \frac{K_1A(\theta_1 - \theta)}{l_1} = \frac{K_2A(\theta - \theta_2)}{l_2}$ [Given $l_1 - l_2$]

$\Rightarrow K_1A(\theta_1 - \theta) = K_2A(\theta - \theta_2) \Rightarrow \theta = \frac{K_1\theta_1 + K_2\theta_2}{K_1 + K_2}$

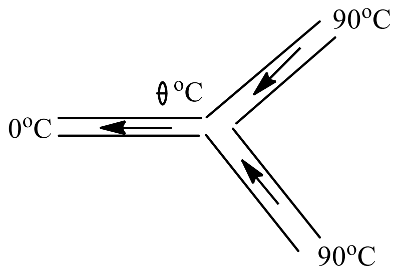


7 **(d)**

Let the temperature of function be θ, then

$$H = H_1 + H_2$$

$$\Rightarrow \quad \frac{KA(\theta-0)}{L} = \frac{KA(90-\theta)}{L} + \frac{KA(90-\theta)}{L}$$



Or $\theta = 90 - \theta + 90 - \theta$

Or $\theta = 180 - 2\theta$

Or $3\theta = 180$

Or $\theta = 60°C$

8 **(d)**

Amount of energy radiated ∝ $(\text{Temperature})^4$

9 **(a)**

Convection is not possible in weightlessness. So the liquid will be heated through conduction

10 **(a)**

Luminosity of a star depends upon the total radiations emitted by the star.

The star emits 17000 times the radiations emitted by the sun.

∴ $E = \sigma T^4$

Hence, $\frac{E_1}{E} = \left(\frac{T_1}{T}\right)^4$

So, $(17000)^{1/4} = \frac{T_1}{T}$ (Given, $E_1 = 17000E$)

$$T_1 = 6000 \times 11.4 = 68400 \text{ K}$$

11 **(b)**

Intensity is directly proportional to energy.

12 **(b)**

Heat current $\frac{Q}{t} \propto \frac{r^2}{l}$, from the given options, option (b) has higher value of $\frac{r^2}{l}$.

13 **(c)**

Stress $= Y\alpha\Delta\theta$; hence it is independent of length

14 **(a)**

Heat required to raise the temperature of 40 g of water from 25°C to 54.3°C, is equivalent to sum of heat required to condense the steam.

∴ Heat required to raise the temperature of water by t°C is

$= m_1 c\Delta t_1$ ...(i)

Where c is specific heat of water and m the mass. Heat required to condense steam

$$= m_2L + m_2c\Delta t_2 \qquad \text{...(ii)}$$

Equating eqs. (i) and (ii), we get

$$m_2L + m_2c\Delta t_2 = m_1c\Delta t_1$$

Given, $m_2 = 2$ g

$\Delta t_2 = (100 - 54.3)°\text{C} = 45.7°\text{C}$

$m_1 = 40$ g

$\Delta t_1 = (54.3 - 25)°\text{C} = 29.3°\text{C}$

$c = 1\ \text{calg}^{-1}$

$\Rightarrow 2 \times L + 2 \times 1 \times 45.7 = 40 \times 1 \times 29.3$

$\Rightarrow \quad 2L + 91.4 = 1172$

$\Rightarrow \quad 2L = 1080.6$

$\Rightarrow \quad L = 540.3\ \text{calg}^{-1}$

15 **(a)**

Rate of cooling $\propto (T^4 - T_0^4)$

$$\Rightarrow \frac{H}{H'} = \frac{(T_1^4 - T_0^4)}{(T_2^4 - T_0^4)} = \frac{600^4 - 200^4}{400^4 - 200^4}$$

Or $H' = \frac{(16+4)(16-4)H}{(36+4)(36-4)} = \frac{3}{16}H$

16 **(d)**

$$\theta_{\text{mix}} = \frac{m_W\theta_W - \frac{m_iL_i}{c_W}}{m_i + m_W} = \frac{100 \times 50 - 10 \times \frac{80}{1}}{10 + 100} = 38.2°\text{C}$$

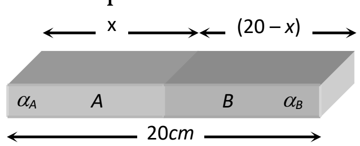
17 **(b)**

$\Delta L = L_0\, \alpha\Delta\theta$

Rod A: $0.075 = 20 \times \alpha_A \times 100 \Rightarrow \alpha_A = \frac{75}{2} \times 10^{-6}/°\text{C}$

rod B: $0.045 = 20 \times \alpha_B \times 100 \Rightarrow \alpha_B = \frac{45}{2} \times 10^{-6}/°\text{C}$

For composite rod : $x\ cm$ of A and $(20 - x)cm$ of B we have



$0.060 = x\, \alpha_A \times 100 + (20 - x)\alpha_B \times 100$

$$= x\left[\frac{75}{2} \times 10^{-6} \times 100 + (20 - x) \times \frac{45}{2} \times 10^{-6} \times 100\right]$$

On solving we get $x = 10\ cm$

18 **(b)**

Suppose thickness of each wall is x then

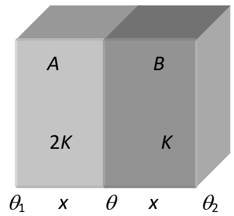
$$\left(\frac{Q}{t}\right)_{combination} = \left(\frac{Q}{t}\right)_A \Rightarrow \frac{K_SA(\theta_1 - \theta_2)}{2x} = \frac{2KA(\theta_1 - \theta)}{x}$$

$\because K_S = \frac{2\times 2K\times K}{(2K+K)} = \frac{4}{3}K$ and $(\theta_1 - \theta_2) = 36°$

$$\Rightarrow \frac{\frac{4}{3}KA \times 36}{2x} = \frac{2KA(\theta_1 - \theta)}{x}$$

Hence temperature difference across will A is

$(\theta_1 - \theta) = 12°C$



19 **(c)**

As the coefficient expansion of metal is less as compared to the coefficient of cubical expansion of liquid, we may neglect the expansion of metal ball. So when the ball is immersed in alcohol at 0°C, it displaces some volume V of alcohol at 0°C, and has weight W_1

$\therefore\ W_1 = W_0 - V\rho_0 g$

Where W_0 = weight of ball in air

similarly, $W_2 = W_0 - V\rho_{59} g$

where ρ_0 = density of alcohol at 0°C

and ρ_{59} = density of alcohol at 59°C

As $\rho_{59} < \rho_0, \Rightarrow W_2 > W_1$ or $W_1 < W_2$

20 **(a)**

Water has maximum specific heat

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

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