DPP
DAILY PRACTICE PROBLEMS

CLASS : XITH
DATE :

Solutions

SUBJECT : PHYSICS
DPP NO. : 6

Topic :- THERMAL PROPERTIES OF MATTER

1 **(c)**

$E=\sigma T^4 \Rightarrow 5.6\times 10^{-8}\times T^4=1$

$\Rightarrow T=\left[\frac{1}{5.6\times 10^{-8}}\right]^{1/4}=65\ K$

2 **(b)**

Density at 0°C, ρ_0=1.0127

Density at 100°C, ρ_{100}=1

Coefficient of real expansion of liquid

$\gamma_{\text{real}}=\frac{\rho_0-\rho_{100}}{\rho_{100}\times \Delta t}$

$=\frac{1.0127-1}{1\times 100}=0.0127\times 10^{-2}$

$=1.27\times 10^{-4}$

$\gamma_{\text{real}}=\gamma_{\text{app}}+\gamma_g$

γ_g=coefficient of volume expansion of glass=3α

$\therefore\quad 1.27\times 10^{-4}=\gamma_{\text{app}}+3\alpha$

$1.27\times 10^{-4}=\gamma_{\text{app}}+3\times 9\times 10^{-6}$

$\gamma_{\text{app}}=1.27\times 10^{-4}-27\times 10^{-6}$

$=1.27\times 10^{-4}-0.27\times 10^{-4}$

$=1\times 10^{-4}$

$\therefore\quad \gamma_{\text{app}}=\frac{\text{Mass expelled}}{\text{Remaining mass}\times\Delta t}$

$1\times 10^{-4}=\frac{m_1-m_2}{m_2\times 100}$

$\left(\frac{m_1}{m_2}-1\right)=1\times 10^{-4}\times 100=10^{-2}$

$\frac{m_1}{m_2}=1+10^{-2}=1.01$

$m_2=\frac{m_1}{1.01}=\frac{300}{1.01}$

Mass expelled=m_1-m_2

$$= 300 - \frac{300}{1.01} = \frac{3}{1.01}$$

3 **(a)**

Here, $\Delta T = 20 - 15 = 5°C$

$\alpha = 0.000012°C^{-1} = 12 \times 10^{-6}°C^{-1}$

Time lost per day $= \frac{1}{2}\alpha(\Delta T) \times 86400$ s

$= \frac{1}{2} \times 12 \times 10^{-6} \times 5 \times 86400 \text{ s} = 2.590 \text{ s}$

4 **(b)**

No, in convection the hot liquid at the bottom becomes lighter and hence it rises up. In this way the base of the convection is the difference in weight and upthrust. In the state of weightlessness this difference does not occur, so convection is not possible

5 **(a)**

Let the temperature of junction be θ.

$$\left(\frac{\Delta Q}{d_1}\right)_{\text{copper}} = \left(\frac{\Delta Q}{\Delta T}\right)_{\text{steel}}$$

$$K_1A = \frac{(100 - \theta)}{18} = \frac{K_2A(\theta - 0)}{6}$$

$$9K_2\frac{(100 - \theta)}{3} = K_2\theta$$

$$3\theta = 900 - 9\theta$$

$$12\theta = 900$$

$$\theta = 75°C$$

6 **(b)**

The wavelength corresponding to maximum emission of radiation from the sun is $\lambda_{\max} = 4753\text{Å}$ (close to the wavelength of violet colour of visible region). Hence if temperature is doubled λ_m is decreased $\left(\lambda_m \propto \frac{1}{T}\right)$, *i.e.*, mostly ultraviolet radiations are emitted

7 **(d)**

Loss of heat $\Delta Q = A\varepsilon\sigma(T^4 - T_0^4)t$

$\Rightarrow$ Rate of loss of heat $\frac{\Delta Q}{t} = A\varepsilon\sigma(T^4 - T_0^4)$

$= 10 \times 10^{-4} \times 1 \times 5.67 \times 10^{-8}\{(273 + 127)^4 - (273 + 27)^4\}$

$= 0.99\ W$

8 **(a)**

Here, $A = 1cm^2 = 10^{-4}m^2, T = 1000K, t = 1s$ and $\sigma = 5.67 \times 10^{-8}Wm^{-2}K^{-4}$

According to Stefan-Boltzmann law, energy radiated by a body is

$E = \sigma AT^4t = 5.67 \times 10^{-8} \times 10^{-4} \times (1000)^4 \times 1 = 5.67J$

10 **(c)**

$Q = A\varepsilon\sigma T^4 \Rightarrow Q \propto A \propto r^2 \quad [\because T = \text{constant}]$

$\Rightarrow \frac{Q_1}{Q_2} = \frac{r_1^2}{r_2^2} = \left(\frac{1}{2}\right)^2 = \frac{1}{4}$

12 **(b)**

Temperature gradient $= \frac{100-20}{20} = 4°\text{C}/cm$

Temperature of centre $= 100 - 4 \times 10 = 60°\text{C}$

13 **(a)**

$$\frac{dQ}{dt} = \frac{K(\pi r^2)d\theta}{dt} \Rightarrow \frac{\left(\frac{dQ}{dt}\right)_s}{\left(\frac{dQ}{dt}\right)_l} = \frac{K_s \times r_s^2 \times l_1}{K_l \times r_1^2 \times l_s} = \frac{1}{2} \times \frac{1}{4} \times \frac{2}{1}$$

$$\Rightarrow \left(\frac{dQ}{dt}\right)_s = \frac{\left(\frac{dQ}{dt}\right)_l}{4} = \frac{4}{4} = 1$$

14 **(c)**

Let θ be temperature of middle point C and in series rate of heat flow is same

$\Rightarrow K(2A)(100 - \theta) = KA(\theta - 70)$

$\Rightarrow 200 - 2\theta = \theta - 70 \Rightarrow 3\theta = 270 \Rightarrow \theta = 90°\text{C}$

15 **(c)**

Good absorbers are always good emitters of heat

16 **(b)**

According to Stefan's law radiant energy emitted by a perfectly black body per unit area per sec (ie, emissive power of black body) is directly proportional to the fourth power of its absolute temperature ie $E \propto T^4$

$$\Rightarrow \quad \frac{E_1}{E_2} = \frac{T_1^4}{T_2^4}$$

$$\frac{5}{E_2} = \frac{(273+227)^4}{(273+727)^4}$$

$$E_2 = 5 \times \left[\frac{1000}{500}\right]^4$$

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

17 **(a)**

According to Wien's displacement law $\lambda_m \propto \frac{1}{T}$. Hence, it temperature increases λ_m decreases $i.e.$, peak of the $E - \lambda$ curve shift towards left

18 **(c)**

According to Wien's law,

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

ie., it depends on the temperature of the surface.

19 **(a)**

The black spot on heating absorbs radiations and so emits them in the dark room while the polished shining part reflects radiation and absorbs nothing and so does not emit radiations and becomes invisible in the dark

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