DPP
DAILY PRACTICE PROBLEMS

CLASS : XITH
DATE :

Solutions

SUBJECT : PHYSICS
DPP NO. : 10

Topic :- THERMAL PROPERTIES OF MATTER

1 **(b)**

$\frac{Q_2}{Q_1} = \left(\frac{T_2}{T_1}\right)^4 \Rightarrow \frac{2}{1} = \left(\frac{T_2}{T_1}\right)^4$

$\Rightarrow T_2^4 = 2 \times T_1^4 = 2 \times (273 + 727)^4 \Rightarrow T_2 = 1190K$

2 **(b)**

An ideal black body absorbs all the radiations incident upon it and has an emissivity equal to 1. If a black body and an identical another body are kept the same temperature, then the black body will radiate maximum power.
Hence, the black object at a temperature of 2000°C will glow brightest.

3 **(c)**

The boiling point of mercury is 400°C. Therefore, the mercury thermometer can be used to measure the temperature upto 360°C

4 **(c)**

Total energy radiated from a body

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

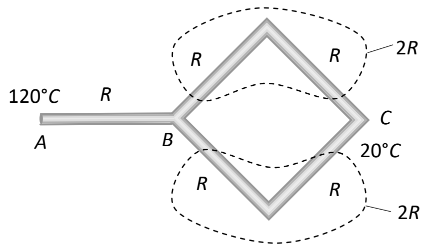
Or $\frac{Q}{t} \propto AT^4$

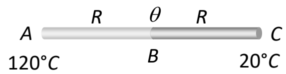
$\frac{Q}{t} \propto r^2 T^4 \qquad (\because \ A = 4\pi r^2)$

$\frac{Q_1}{Q_2} = \left(\frac{r_1}{r_2}\right)^2 \left(\frac{T_1}{T_2}\right)^4 j = \left(\frac{8}{2}\right)^2 \left[\frac{273 + 127}{273 + 527}\right]^4 = 1$

5 **(c)**

If thermal resistance of each rod is considered R then, the given combination can be redrawn as follows





(Heat current)$_{AC}$ = (Heat current)$_{AB}$

$$\frac{(120-20)}{2R} = \frac{(120-\theta)}{R} \Rightarrow \theta = 70°C$$

6 **(c)**

At boiling point saturation vapour pressure becomes equal to atmospheric pressure.

Therefore, at 100°C for water. S.V.P. = 760 mm of Hg (atm pressure)

7 **(b)**

Thermal capacity = Mass × Specific heat

Due to same material both spheres will have same specific heat. Also mass = Volume (V) × Density(ρ)

∴ Ratio of thermal capacity

$$= \frac{m_1}{m_2} = \frac{V_1\rho}{V_2\rho} = \frac{\frac{4}{3}\pi r_1^3}{\frac{4}{3}\pi r_2^3} = \left(\frac{r_1}{r_2}\right)^3 = \left(\frac{1}{2}\right)^3 = 1:8$$

8 **(d)**

$\frac{A_T}{A_{2000}} = \frac{16}{1}$ [Given]

Area under $e_\lambda - \lambda$ curve represents the emissive power of body and emissive power $\propto T^4$

[Hence area under $e_\lambda - \lambda$ curve) $\propto T^4$

$$\Rightarrow \frac{A_T}{A_{2000}} = \left(\frac{T}{2000}\right)^4 \Rightarrow \frac{16}{1} = \left(\frac{T}{2000}\right)^4 \Rightarrow T = 4000K$$

9 **(c)**

Initial volume $V_1 = 47.5$ units

Temperature of ice cold water $T_1 = 0°C = 273\ K$

Final volume of $V_2 = 67$ units

Applying Charle's law, we have $\frac{V_1}{T_1} = \frac{V_2}{T_2}$

(where temperature T_2 is the boiling point)

or $T_2 = \frac{V_2}{V_1} \times T_1 = \frac{67 \times 273}{47.5} = 385\ K = 112°C$

10 **(a)**

$$W = JQ \Rightarrow \frac{1}{2}\left(\frac{1}{2}Mv^2\right) = J(m.c.\Delta\theta)$$

$$\Rightarrow \frac{1}{4} \times 1 \times (50)^2 = 4.2[200 \times 0.105 \times \Delta\theta] \Rightarrow \Delta\theta = 7.1°C$$

11 **(a)**

According to Stefan's law

$$E \propto T^4$$

$$\frac{E_1}{E_2} = \left[\frac{T_1}{T_2}\right]^4$$

$$\frac{E_1}{0.5} = \left[\frac{273+627}{273+27}\right]^4$$

$$E_1 = 0.5\left(\frac{900}{300}\right)^4$$

$$\Rightarrow \quad E_1 = 40.5 \text{ J}$$

12 **(d)**

Rate of cooling (here it is rate of loss of heat)

$$\frac{dQ}{dt} = (mc + W)\frac{d\theta}{dt} = (m_l c_l + m_c c_c)\frac{d\theta}{dt}$$

$$\Rightarrow \frac{dQ}{dt} = (0.5 \times 2400 + 0.2 \times 900)\left(\frac{60-55}{60}\right) = 115\,\frac{J}{s}$$

13 **(c)**

With rise of altitude pressure decreases and boiling point decreases

14 **(d)**

Let final temperature of water be θ

Heat taken = Heat given

$$100 \times 1 \times (\theta - 10) + 10(\theta - 10) = 220 \times 1(70 - \theta)$$

$$\Rightarrow \quad \theta = 48.8°\text{C} = 50°\text{C}$$

15 **(c)**

$$E \propto T^4 \Rightarrow \frac{E_1}{E_2} = \left(\frac{T_1}{T_2}\right)^4 \Rightarrow \frac{7}{E_2} = \left(\frac{273+227}{273+727}\right)^4 = \frac{1}{16}$$

$$\Rightarrow E_2 = 112\frac{cal}{cm^2 \times \text{sec}}$$

16 **(b)**

According to Newton's law of cooling t_1 will be less than t_2.

17 **(b)**

Liquid having more specific heat has slow rate of cooling because for equal masses rate of cooling $\frac{d\theta}{dt} \propto \frac{1}{c}$

18 **(c)**

We know that $P = P_0(1 + \gamma t)$ and $V = V_0(1 + \gamma t)$

And $\gamma = (1/273)/°\text{C}$ for $t = -273°\text{C}$, we have $P = 0$ and $V = 0$

Hence, at absolute zero, the volume and pressure of the gas become zero

19 **(b)**

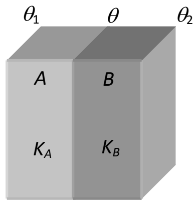
In series rate of flow of heat is same

$$\Rightarrow \frac{K_A A(\theta_1 - \theta)}{l} = \frac{K_B A(\theta - \theta_2)}{l}$$

$$\Rightarrow 3K_B(\theta_1 - \theta) = K_B(\theta - \theta_2)$$

$$\Rightarrow 3(\theta_1 - \theta) = (\theta - \theta_2)$$

$\Rightarrow 3\theta_1 - 3\theta = \theta - \theta_2 \Rightarrow 4\theta_1 - 4\theta = \theta_1 - \theta_2$
$\Rightarrow 4(\theta_1 - \theta) = (\theta_1 - \theta_2)$
$\Rightarrow 4(\theta_1 - \theta) = 20 \Rightarrow (\theta_1 - \theta) = 5°\text{C}$



20 **(b)**

$\gamma_r = \gamma_a + \gamma_v$; where γ_r = coefficient of real expansion,
γ_a = coefficient of apparent expansion and
γ_v = coefficient of expansion of vessel.
For copper $\gamma_r = C + 3\alpha_{Cu} = C + 3A$
For silver $\gamma_r = S + 3\alpha_{Ag}$

$$= C + 3A = S + 3\alpha_{Ag} \Rightarrow \alpha_{Ag} = \frac{C - S + 3A}{3}$$

PE

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