JEE MAIN ANSWER KEY & SOLUTIONS

SUBJECT :- PHYSICS

CLASS :- 11th **PAPER CODE :- CWT-13**

CHAPTER :- THERMAL PHYSICS

ANSWER KEY

1.	(C)	**2.**	(A)	**3.**	(D)	**4.**	(A)	**5.**	(A)	**6.**	(D)	**7.**	(B)
8.	(B)	**9.**	(B)	**10.**	(C)	**11.**	(B)	**12.**	(B)	**13.**	(C)	**14.**	(C)
15.	(B)	**16.**	(C)	**17.**	(A)	**18.**	(B)	**19.**	(A)	**20.**	(C)	**21.**	41
22.	2	**23.**	8	**24.**	1	**25.**	30	**26.**	3	**27.**	8	**28.**	3
29.	2	**30.**	10										

SOLUTIONS

1. (C)

2. (A)

Sol. $m_1 \times 1\,(50 - 30) = m_2(80 - 50)$ ....(i)

$m_1 + m_2 = 40$ kg ....(ii)

3. (D)

Sol. Water of lake gets cooled by conduction till 4°C after that it is cooled by conduction through ice.

4. (A)

Sol. $PV = RT \Rightarrow PdV = RdT$

$\therefore$ Coefficient of volume expansion

$= \frac{1}{V}\frac{dV}{dT} = \frac{R}{PV} = \frac{1}{T}$

5. (A)

Sol. $\frac{C}{5} = \frac{F-32}{9}$

$\frac{\Delta C}{5} = \frac{\Delta F}{9}$

$\Delta F = 9 \times \frac{5}{5} = 9°$

6. (D)

Sol. Slope of ΔH vs $\Delta\theta$ graphs give 'heat capacity'.

$\therefore$ Specific heat capacity $= \frac{\text{heat capacity}}{\text{mass}}$

$= \frac{\tan 45°}{2}$ kJ/kg/°C

$= 0.5$ kJ/kg/°C

7. (B)

Sol. $\frac{mL}{t_1} = \frac{K_1A(T_1 - T_2)}{L}$

$\frac{mL}{t_2} = \frac{K_2A(T_1 - T_2)}{L}$

$\frac{K_1}{K_2} = \frac{t_2}{t_1}$

8. (B)

Sol. heat release by water = m s d θ

= 300 × 1 × 25

= 7500 Cal.

amount of Ice melts from this heat

dQ = mL

$m = \frac{dQ}{L} = \frac{7500}{80} = 93.75$ g.

9. (B)

Sol. All are in series therefore current remains same. Hence temperature difference = (current × thermal resistance) are equal for every case.

10. (C)

Sol. $\Delta L = L_l \propto \Delta t$

11. (B)

Sol. $ms_A(32 - 20) = ms_B\,(40 - 32)$

$12s_A = 8s_B$

$\frac{s_A}{s_B} = \frac{2}{3}$

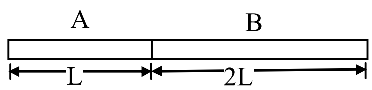
12. (B)

Sol. Half of KE is shared by each ball $\frac{1}{2}$ KE =

$m_1s_1T_1 = m_2s_2T_2$

13. (C)

Sol.



$\therefore \alpha = \frac{\Delta\ell}{L\Delta T}$

for A : $\alpha = \frac{\Delta\ell_1}{L\Delta T} \Rightarrow \Delta\ell_1 = L\,\alpha\,\Delta T$

for B : $2\alpha = \frac{\Delta\ell_2}{2L\Delta T} \Rightarrow \Delta\ell_2 = 4L\,\alpha\,\Delta T$

For composition

$\alpha_{avg.} = \frac{\Delta\ell_1 + \Delta\ell_2}{3L\Delta T} = \frac{\alpha L\Delta T + 4L\alpha\Delta T}{3L\Delta T} = \frac{5}{3}\alpha$

14. (C)

Sol. Temperature of junction A is T_A

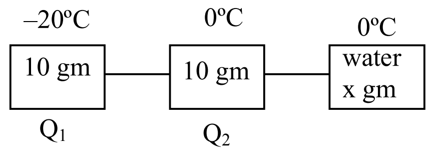
$$\frac{KA(T-T_A)}{\ell} = \frac{KA(T_A-0)}{\ell}$$

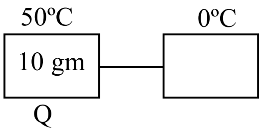
$\Rightarrow T - T_A = T_A$

$\Rightarrow T_A = \frac{T}{2}$

15. (B)

Sol.





$Q = Q_1 + Q_2$

$10 \times 50 = 10 \times 0.5 \times 20 + x \times 80$

$x = \frac{400}{80} = 5gm$

16. (C)

Sol. Thermal expansion in isotropic bodies is independent of shape size & availability of cavity.

17. (A)

Sol. $\frac{T_1-T}{x} = \frac{T-T_2}{L-x}$

$\Rightarrow T_1L - T_1x + Tx - TL = Tx - T_2x$

$TL = (T_2 - T_1)x + T_1L$

18. (B)

Sol. Amount of steam required to convert all the ice in water at 100ºC is $\frac{10}{3}$ gm.

19. (A)

Sol. The conductivity more in Cu.

20. (C)

Sol. Resistance of inner cylinder $R_1 = \frac{\ell}{k_1\pi R^2}$

Resistance of outer cylinder

$R_2 = \frac{\ell}{k_2(4\pi R^2 - \pi R^2)}$

As inner & outer cylinder in parallel

$R_{eq} = \frac{R_1R_2}{R_1+R_2}$

21. 41

Sol. Neglecting other heat losses

Heat lost by water = Heat gained by thermometer

$\therefore m_1 s_1 (\theta_1 - 40^o) = m_2s_2 (40^o - 10^o)$

m_1 = mass of water

m_2 = mass of thermometer

s_1 = specific heat of water

s_2 = specific heat of thermometer

$\Rightarrow \theta_1 = 40.6$ ºC

$\approx$ 41ºC

22. 2

Sol. $x = \ell_0\alpha t$

$x = 2$

23. 8

Sol. $-\frac{dT}{dt} = \frac{K}{100\times S_w}(T-T_0)$

$$\int_{40}^{35}\frac{-dT}{T-T_0} = \int_0^5 \frac{K}{100\times S_w}dt$$

$$\int_{40}^{35}\frac{-dT}{(T-T_0)} = \int_0^2 \frac{dt}{100\times \rho_\ell s_\ell}$$

$$\frac{5K`}{100S_w} = \frac{2K}{100\times\rho_\ell S_\ell}$$

$\rho_\ell = \frac{4}{5}$ g/cm^3 = $\frac{4\times10^{-3}kg}{5\times10^{-6}m^3} = \frac{4}{5}\times10^3$

$= \frac{40}{5}\times10^2 = 800kg/m^3$

24. 1

Sol. $\frac{40-T}{R_H/2} = \frac{T-20}{R_H/2} + \frac{T-0}{R_H/4}$

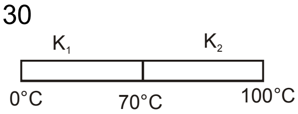
T = 15°C

$\frac{T-0}{R_H/4} = i_H \Rightarrow i_H = 6$ J/s

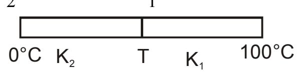
Heat supplied = $6 \times 5.6 \times 10^4 = 3.36 \times 10^5$ J In 5.6×10^4s. amount of ice $mL_f = 3.36 \times 10^5$

25. 30

Sol



Heat current is same $i_H = \frac{70-0}{R_1} = \frac{100-70}{R_2} \Rightarrow \frac{R_2}{R_1} = 3/7 \Rightarrow \frac{K_1}{K_2} = 3/7$



Heat current is same $i_H = \frac{T-0}{R_2}$

$= \dfrac{100-T}{R_1}$

$\Rightarrow \dfrac{100-T}{T} = \dfrac{R_1}{R_2} = \dfrac{K_2}{K_1} = 7/3$

$\Rightarrow 300 - 3T = 7T \Rightarrow T = 30°C$ **Ans.**

26. 3

Sol. $R = \dfrac{\ell}{KA}$

When heat is transferred from first vessel to second, temperature of first vessel decreases while that of second vessel increases. Due to both there reasons, difference between temperature of vessels decreases.

Let at an instant t, the temperature difference between two vessels be θ.

$H = \dfrac{\theta}{R} = \dfrac{KA\theta}{\ell}$

$dQ = Hdt = \dfrac{KA\theta}{\ell}dt$ ....(i)

Since gases are contained in two vessels, therefore, processes on gases in two vessels are isochoric.

Hence, decrease in temperature of gas in first vessel,

$\Delta\theta_1 = \dfrac{dQ}{nC_v} = \dfrac{dQ}{2\times\frac{5R}{2}} = \dfrac{dQ}{5R}$

Increase in temperature of gas in second vessel is

$\Delta\theta_2 = \dfrac{dQ}{4\times\frac{3R}{2}} = \dfrac{dQ}{6R}$

$\therefore$ Decrease in temperature difference

$(-d\theta) = \Delta\theta_1 + \Delta\theta_2$

$-d\theta = \dfrac{dQ}{R}\times\dfrac{11}{30}$

or $-\displaystyle\int_{50}^{25}\frac{d\theta}{\theta} = \frac{KA\times 11}{30\ell R}\int_0^t dt$

t = 3 seconds.

27. 8

Sol. $m = \dfrac{64}{8} = 8$ gm

28. 3

Sol. Let T = 100° C

& $T_0 = 50°C$

Heat $= (T - T_0)\dfrac{A}{\ell}(K_S + K_B) \times 10 \times 60$

$= (100 - 50) \times \left(\dfrac{0.2\times10^{-4}}{31\times10^{-2}}\right) \times (46 + 109)$

$\times 10 \times 60$

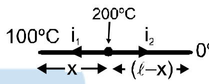
= 300 J

29. 2

Sol. $\dfrac{d\theta}{dt} = \dfrac{100-0}{R_{eq}}$; $T_B = 40°C$, $T_D = 60°C$

30. 10

Sol.



$i_1 = \dfrac{dQ_1}{dt} = \dfrac{(200-100)kA}{x}$

$= L_V \dfrac{dm_{steam}}{dt}$

$i_2 = \dfrac{dQ_2}{dt} = \dfrac{(200-0)\ \ kA}{(\ell-x)} = L_f\dfrac{dm_{fusion}}{dt}$

According to problem,

$\dfrac{dm_{steam}}{dt} = \dfrac{dm_{fusion}}{dt}$

$\dfrac{100kA}{x\,L_v} = \dfrac{200kA}{(\ell-x)L_f}$.

$\Rightarrow x = \dfrac{2\ell}{29} = 0.1$ m = 10 cm