Additional Problems For Self Practice (APSP)

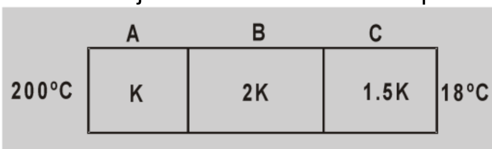
PART-I : PRACTICE TEST PAPER

Max. Marks : 120 **Max. Time : 1 Hr.**

Important Instructions :

1. The test is of **1 hour** duration and max. marks 120.
2. The test consists **30** questions, **4 marks** each.
3. Only one choice is correct **1 mark** will be deducted for incorrect response. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.
4. There is only one correct response for each question. Filling up more than one response in any question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instructions 3 above.

1. Three rods A,B and C of same length and same cross-section area are joined as shown in the figure. Their thermal conductivities are in the ratio 1 : 2 : 1.5. If the open ends of A and C are at 200°C and 18°C respectively, the temperature at the junction of A and B in equilibrium is-

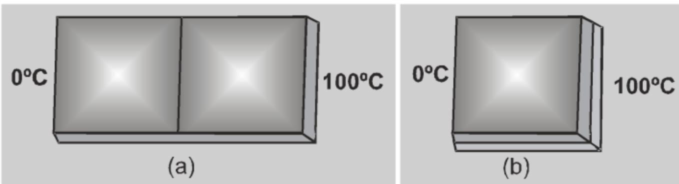


(1) 156°C (2) 116°C (3) 74°C (4) 148°C

2. In the above question, the temperature at the junction of B and C will be-
(1) 124°C (2) 124°K (3) 74°C (4) 74°K

3. The ends of the two rods of different materials with their thermal conductivities, radii of cross-section and lengths in the ratio 1 : 2 are maintained at the same temperature difference. If the rate of flow of heat in the larger rod is 4 cal/sec., that in the shorter rod will be- (in cal/sec)
(1) 1 (2) 2 (3) 8 (4) 16

4. Two identical square rods of metal are welded end to end as shown in fig. (a) 20 cal. of heat flows through it in 4 min. If the rods re welded as shown in fig. (b), the same amount of heat will flow through the rods in-



(1) 1 min. (2) 2 min. (3) 3 min. (4) 16 min.

5. The coefficients of thermal conductivity of copper, mercury and glass are respectively K_c, K_m and K_g such that $K_c > K_m > K_g$. If the same quantity of heat is to flow per second per unit area of each and corresponding temperature gradients are X_c, X_m and X_g.
(1) $X_c = X_m = K_g$ (2) $X_c > X_m > X_g$ (3) $X_c < X_m < X_g$ (4) $X_m < X_c < X_g$

6. If a liquid takes 30 sec. in cooling of 95°C to 90°C and 70 sec. in cooling of 55°C to 50°C then temp. of room is
(1) 16.5 °C (2) 22.5 °C (3) 28.5 °C (4) 32.5 °C

7. After heating two pieces of iron, they are taken in dark room. One of them appears red and another appears blue, then-
(1) The temp. of red piece will be more. (2) The temp. of blue piece will be more.
(3) The temp. of both pieces will be same. (4) Nothing can be said about their temp.

8. A body takes 2 minutes in cooling from 365K to 361K. If the room temperature is 293K, then the time taken in cooling from 344K to 342K will be-
(1) 1 min. (2) 1.2 min. (3) 1.4 min. (4) 1.8 min.

9. The rate of cooling of a sphere of thermal capacity 1000 cal/K is 400 J/s, its rate of fall of temperature is
(1) 0.095 K/min (2) 0.62 K/min (3) 2.8 K/min (4) 5.7 K/min

10. The intensity of heat radiation by a point source measured by a thermopile placed at a distance d is I, If the distance of thermopoile is doubled then the intensity of radiation will be-
(1) I (2) 2 I (3) $\frac{I}{4}$ (4) $\frac{I}{2}$

11. Prevost's theory of heat exchange tells that a body radiates thermal energy-
(1) At temperatures higher than that of surrounding only.
(2) At temperature lower than that of surroundings only.
(3) At temperature equal to that of surroundings only.
(4) At all temperature.

12. If maximum spectral emissivity at temperature T_1 K is at wavelength λ_1, then the wavelength of maximum emissivity at temperature T_2 K will be-
(1) $\frac{\lambda_1 T_2}{2}$ (2) $\lambda_1\left(\frac{T_1}{T_2}\right)^4$ (3) $\lambda_1\left(\frac{T_1}{T_2}\right)^5$ (4) $\frac{\lambda_1 T_1}{T_2}$

13. Reflection and absorption coefficients of a given surface at 0°C for a fixed wavelength are 0.5 (each). At the same temperature and wavelength the transmission (coefficient) of surface will be-
(1) 0.5 (2) 1.0 (3) zero (4) in between zero and one

14. The earth receives radiation from the sun at the rate of 1400 watt/m². The distance from the centre of the sun to the surface of the earth is 1.5×10^{11} m and the radius of the sun is 7.0×10^{8} m. Treating the sun as a black body the temperature of the sun will be-
(1) 6000K (2) 5500K (3) 5800K (4) 6200K

15. The rate of emission of energy by a unit area of a body is 10 watt and that of sun is 10^6 watt. The emissive power of the body is 0.1. If the temperature of the sun is 6000K, then the temperature of the body will be-
(1) 6000K (2) 600K (3) $\frac{600}{\sqrt{10}}$ K (4) $(600\sqrt{10})$ K

16. Equal volumes of a liquid of relative density 1.02 and water are allowed to cool from 80°C to 60°C in the same surroundings. The times taken are 8 mts and 15 mts respectively. The specific heat of the liquid in cal/gm-°C is-
(1) 0.52 (2) 0.81 (3) 1.02 (4) 1.23

17. The ratio of masses of two copper spheres of identical surfaces is 8 : 1. If their temperatures are 2000K and 1000K respectively then the ratio of energies radiated per second by the two is-
(1) 128 : 1 (2) 64 : 1 (3) 16 : 1 (4) 4 : 1

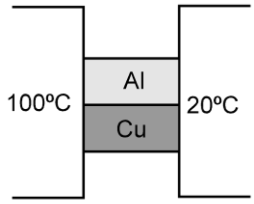
18. A solid black sphere of radius R and a solid black cylinder of same material and radius with height equal to the radius, are at the same temperature. These are allowed to cool in the same surroundings. The ratio of the rates of fall of their temperature will be-
(1) 1 : 1 (2) 4 : 3 (3) 3 : 4 (4) 2 : 3

19. Two identical calorimeters of negligible heat capacities are filled with two liquids A & B whose densities are in the ratio 4 : 3. The ratio of times taken in cooling from 80°C to 75°C is 5 : 6. The ratio of their specific heats is-
(1) 1 : 2 (2) 5 : 6 (3) 4 : 3 (4) 5 : 8

20. The temperature of a room is 30°C. A body kept in it, takes 4 minutes in cooling from 61°C to 59°C. The time taken by the body in cooling from 51°C to 49°C will be-
(1) 4 min. (2) 5 min. (3) 6 min. (4) 8 min.

21. The effective area of a black body is 0.1 m^2 and its temperature is 100 K. The amount of radiations emitted by it per min is -
(1) 1.34 cal (2) 8.1 cal (3) 5.63 cal (4) 1.34 J

22. Two metal cubes with 3 cm-edges of copper and aluminium are arranged as shown in figure



(K_{CU} =385 W/m-K, K_{AL} = 209 W/m-K)
(i) The total thermal current from one reservoir to the other is :
(1) 1.42×10^3 W (2) 2.53×10^3 W
(3) 1.53×10^4 W (4) 2.53×10^4 W

(ii) The ratio of the thermal current carried by the copper cube to that carried by the aluminium cube is : –
(1) 1.79 (2) 1.69 (3) 1.54 (4) 1.84

23. The thermal resistance of two blocks connected in series will be, if their separate thermal resistances are 2 and 3
(1) 1 (2) 6 (3) 5 (4) 1, 5

24. The temperature of a liquid drops from 365 K to 361 K in 2 minutes. Find the time during which temperature of the liquid drops from 344 K to 342 K. Temperature of room is 293 K
(1) 84 sec (2) 72 sec (3) 66 sec (4) 60 sec

25. The maximum energy in thermal radiation from a source occurs at the wavelength 4000Å. The effective temperature of the source is -
(1) 7000 K (2) 8000 K (3) 10^4 K (4) 10^6 K

26. A metallic sphere having radius 0.08 m and mass m = 10kg is heated to a temperature of 227°C and suspended inside a box whose walls are at a temperature of 27°C. The maximum rate at which its temperature will fall is : -
(Take e = 1, Stefan's constant $\sigma = 5.8 \times 10^{-8}$ Wm^{-2} K^{-4} and specific heat of the metal s = 90 cal/kg/deg J = 4.2 Joules/Calorie)
(1) .055 °C/sec (2) .066 °C/sec (3) .044 °C/sec (4) 0.03 °C/sec

27. Ventilators are provided at the top of room
(1) to bring oxygen for breathing
(2) so that sunlight may enter the room
(3) to maintain convection currents to keep the air fresh in the room
(4) To provide an outlet for carbon dioxide

28. A spherical solid black body of radius 'r' radiates power 'H' and its rate of cooling is 'C'. If density is constant then which of the following is/are true.
(1) $H \propto r$ and $c \propto r^2$ (2) $H \propto r^2$ and $c \propto \frac{1}{r}$ (3) $H \propto r$ and $c \propto \frac{1}{r^2}$ (4) $H \propto r^2$ and $c \propto r^2$

29. A wall has two layers A and B, each made of different material. Both the layers have the same thickness. The thermal conductivity for A is twice that of B. Under steady state, the temperature difference across the whole wall is 36°C. Then the temperature difference across the layer A is
(1) 6°C (2) 12°C (3) 18°C (4) 24°C

30. For a black body at temperature 727°C, its radiating power is 60 watt and temperature of surrounding is 227°C. If temperature of black body is changed to 1227°C then its radiating power will be-
(1) 304 W (2) 320 W (3) 240 W (4) 120 W

OBJECTIVE RESPONSE SHEET (ORS)

Que.	1	2	3	4	5	6	7	8	9	10
Ans.										
Que.	11	12	13	14	15	16	17	18	19	20
Ans.										
Que.	21	22	23	24	25	26	27	28	29	30
Ans.										

PART - II : PRACTICE QUESTIONS

1. If temperature of body increases by 10%, then increase in radiated energy of the body is :
(1) 10% (2) 40% (3) 46% (4) 1000%

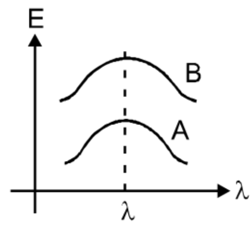
2. Choose the correct statements from the following :
(1) Good reflectors are good emitters of thermal raidations
(2) Burns caused by water at 100ºC are more severe than those caused by steam at 100ºC.
(3) All bodies emit thermal radiations at all temperatures greater than 0 K.
(4) It is possible to construct a heat engine of 100% efficiency.

3. A sphere, a cube and a thin circular plate have the same mass and are made of the same material. All of them are heated to the same temperature. The rate of cooling is :
(1) the minimum for the plate.
(2) the minimum for the cube
(3) the maximum for the plate
(4) the same for all the three.

4. A sphere and a cube of same material and same total surface area are placed in same evacuated space after they are heated to same temperature. The ratio of their initial rate of cooling in space is :
(1) 1 (2) $\sqrt{\pi}$ (3) $\sqrt{\frac{\pi}{6}}$ (4) $\frac{1}{\sqrt{6}}$

5. The temperature of an spherical isolated black body falls from T_1 to T_2 in time 't'. Then time t is :
(1) $t \propto \left(\frac{1}{T_2} - \frac{1}{T_1}\right)$ (2) $t \propto \left(\frac{1}{T_2^2} - \frac{1}{T_1^2}\right)$ (3) $t \propto \left(\frac{1}{T_2^3} - \frac{1}{T_1^3}\right)$ (4) $t \propto \left(\frac{1}{T_2^4} - \frac{1}{T_1^4}\right)$

6. Two bodies A and B have same surface area and mass. The bodies have absolute temperature T_A and T_B and emissivities e_A and e_B and specific heat capacities S_A and S_B. The intensity of radiation near a given wavelength E is plotted against wavelength λ of radiation for both bodies. Which of the following is possible option :



(1) $T_A = T_B$, $e_A \neq e_B$, $S_A = S_B$ (2) $T_A = T_B$, $e_A = e_B$, $S_A \neq S_B$
(3) $T_A \neq T_B$, $e_A = e_B$, $S_A = S_B$ (4) $T_A \neq T_B$, $e_A = e_B$, $S_A \neq S_B$

7. Two spheres of radii r_1 and r_2 have densities ρ_1 and ρ_2 and specific heats s_1 and s_2 respectively. If they are heated to the same temperature, then the ratio of their rates of coolling intially in the same surrounding will be :(assume that both surface has same emisivity)
(1) $\frac{r_2\rho_2 s_2}{r_1\rho_1 s_1}$ (2) $\frac{r_2\rho_2 s_1}{r_1\rho_1 s_2}$ (3) $\frac{r_1\rho_1 s_1}{r_2\rho_2 s_2}$ (4) $\frac{r_2\rho_1 s_1}{r_1\rho_2 s_1}$

8. In Newton's law of cooling $\frac{d\theta}{dt} = -K\,d\theta$. The proportionality constant K is K_1 and K_2 for two substances A and B having mass m_1 and m_2, surface area A_1 and A_2, specific heat S_1 and S_2, emissivity e_1 and e_2

respectively, it is given that $\frac{e_1}{e_2} = 1, \frac{A_1}{A_2} = 1, \frac{S_1}{S_2} = \frac{1}{3}$, while surrounding temperature remain constant. Then $\frac{K_1}{K_2}$:

(1) $\frac{1}{3}$ (2) $\frac{2}{9}$ (3) $\frac{3}{2}$ (4) $\frac{3}{4}$

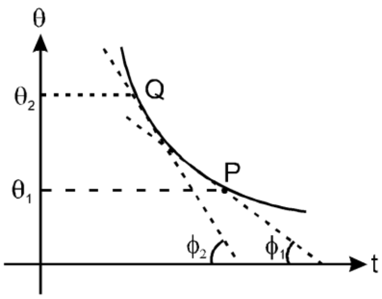
9. 3 spheres A, B and C having radii R,2R and 3R respectively are coated with carbon black on their surfaces (assume ideal blackbody). The wavelengths corresponding to maximum intensity are 3000 $\overset{0}{A}$, 4000 $\overset{0}{A}$ and 5000 $\overset{0}{A}$ respectively. The power radiated by them are Q_A, Q_B and Q_C.

(1) Q_A is maximum among all (2) Q_B is maximum among all
(3) Q_C is maximum among all (4) $Q_A = Q_B = Q_C$

10. A planet is at an average distance d from the sun, and its average surface temperature is constant and equal to T. Assume that the planet receives energy only from the sun, and loses energy only through radiation from its surface. Neglect atmospheric effects. If $T \propto d^{-n}$, the value of n is (Power of sun assumed to be constant)

(1) 2 (2) 1 (3) $\frac{1}{2}$ (4) $\frac{1}{4}$

11. A body cools in a surrounding which is at a constant temperature of θ_0. Assuming that it obeys Newton's law of cooling. Its temperature θ is plotted against time t. Tangents are drawn to the curve at the points P ($\theta = \theta_1$) and Q($\theta = \theta_2$). These tangents meets the time axis at angles φ_1 and φ_2 as shown. Then choose the correct option :



(1) $(\theta_2 - \theta_0) \tan\varphi_2 = (\theta_1 - \theta_0) \tan \varphi_1$
(2) $\theta_1 \tan \varphi_1 = \theta_2 \tan \varphi_2$
(3) $\theta_2 \tan \varphi_1 = \theta_1 \tan \varphi_2$
(4) $(\theta_1 - \theta_0) \tan \varphi_2 = (\theta_2 - \theta_0) \tan \varphi_1$

12. A slab of stone of area 0.36 m^2 and thickness 0.1 m is exposed on the lower surface to steam at 100°C. A block of ice at 0°C rests on the upper surface of the slab. In one hour 4.8 kg of ice is melted. The thermal conductivity of slab is approximately : (Given latent heat of fusion of ice = 3.36×10^5 J kg^{-1})

(1) 1.24 J/m/s/°C (2) 1.29 J/m/s/°C (3) 2.05 J/m/s/°C (4) 1.02 J/m/s/°C

13. A cubical box is used to keep drinks cold in a bus. Surface area of each face is 0.80 m^2 and each wall has thickness 2.00 cm. It is filled with ice and water which remains at 0ºC. Temperature of outside each wall is 30ºC then : (Thermal conductivity of material of box = 1×10^{-2} w/m–k) (Latent heat of fusion of ice = 3.2×10^5 J/kg)

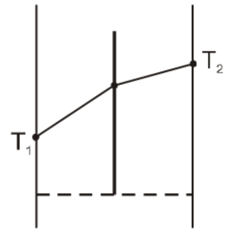
(1) Total heat current in the box is 60 J/s (2) Total heat current in the box is 72 J/s
(3) Mass of ice melted in 1 hour is 700 gm (4) Mass of ice melted in 1 hour is 690 gm

14. One day in a room a heater connected to supply maintained temperature 20ºC when outside temperature was –20ºC. Another day with the same heater, in the same room, temperature was 10ºC when outside temperature was –40ºC. If temperature of heater is same both the days. Find this value.

(use $\frac{dT}{dt} = k(T - T_0)$ and k is same for both days)

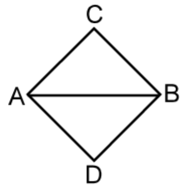
(1) 120ºC (2) 30ºC (3) 40ºC (4) 60ºC

15. The wall of a house is made of two different materials of same thickness. The temperature of the outer wall is T_2 and that of inner wall is $T_1 < T_2$. The temperature variation inside the wall as shown in the figure. Then :



(1) thermal conductivity of inner wall is greater than that of outer.
(2) thermal conductivity of outer wall is greater than that of inner
(3) thermal conductivities of the two are equal
(4) no conclusion can be drawn about thermal conductivities

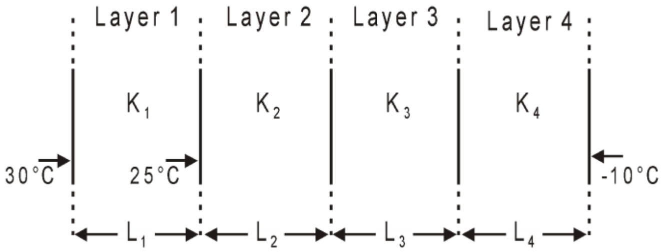
16. Two identical rectangular rods of metal are welded end to end in series between temperature 0°C and 100°C and 10 J of heat is conducted (in steady state process) through the rod in 2.00 min. If 5 such rods are taken and joined as shown in figure maintaining the same temperature difference between A and B, then the time in which 20 J heat will flow through the rods is :



(1) 30 sec. (2) 2 min. (3) 1 min. (4) 20 sec.

Comprehension # 1

Figure shows in cross section a wall consisting of four layers with thermal conductivities K_1 = 0.06 W/mK; K_3 = 0.04 W/mK and K_4 = 0.10 W/mK. The layer thicknesses are L_1 = 1.5 cm ; L_3 = 2.8 cm and L_4 = 3.5 cm. The temperature of interfaces is as shown in figure. Energy transfer through the wall is steady.



17. The temperature of the interface between layers 3 and 4 is :
(1) – 1°C (2) – 3°C (3) 2°C (4) 0°C

18. The temperature of the interface between layers 2 and 3 is :
(1) 11°C (2) 8°C (3) 7.2°C (4) 5.4°C

19. If layer thickness L_2 is 1.4 cm, then its thermal conductivity K_2 will have value (in W/mK) :
(1) 2×10^{-2} (2) 2×10^{-3} (3) 4×10^{-2} (4) 4×10^{-3}

APSP Answers

PART- I

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

PART- II

1.	(3)	**2.**	(3)	**3.**	(3)	**4.**	(3)	**5.**	(3)	**6.**	(1)	**7.**	(1)
8.	(3)	**9.**	(2)	**10.**	(3)	**11.**	(4)	**12.**	(1)	**13.**	(2)	**14.**	(4)
15.	(2)	**16.**	(3)	**17.**	(2)	**18.**	(1)	**19.**	(1)				