Q. 1 The temperature of a liquid drops from 365K to 361K in 2 minute. The time during which temperature of the liquid drops from 344K to 342 K is (temperature of room is 293K) -

(A) 84 sec (B) 72 sec

(C) 66 sec (D) 60 sec **[A]**

Sol. From newton's law of cooling

$$\frac{365-361}{2} = K\left(\frac{365+361}{2}-293\right) \quad .....(1)$$

$$\frac{344-342}{t} = K\left(\frac{344+342}{2}-293\right) \quad ......(2)$$

(1) / (2)

$$t = \frac{365+361-586}{344+342-586} = \frac{140}{100} \text{ min.}$$

$$= \frac{140\times 60}{100} \text{ sec} = 84 \text{ sec}$$

Q. 2 The radiation emitted by a star A is 10000 times that of the sun. If the surface temperatures of the sun and star A are 6000 K and 2000 K respectively, the ratio of the radii of the star A and the sun is -

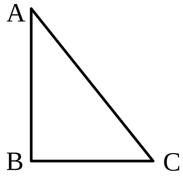
(A) 300 : 1 (B) 600 : 1 (C) 900 : 1 (D) 1200 : 1

Sol. [C] $\varepsilon \propto AT^4$; $\varepsilon \propto R^2\, T^4$ or $R \propto \sqrt{\frac{\varepsilon}{T^4}}$

$$\frac{R_2}{R_1} = \sqrt{\frac{\varepsilon_2}{\varepsilon_1}\cdot\frac{T_1^4}{T_2^4}} = \sqrt{\frac{10000}{1}\times\left(\frac{6000}{2000}\right)^4}$$

$$= 10^2 \times \left(\frac{3}{1}\right)^2 = 900 : 1$$

Q. 3 Three rods of identical cross-sectional area and made from the same metal form the sides of an isosceles triangle ABC right angled at B. The points A and B are maintained at temperatures T and $\sqrt{2}T$ respectively in the steady state. Assuming that only heat conduction takes place, temperature of point C will be -



(A) $\frac{3T}{\sqrt{2}+1}$ (B) $\frac{T}{\sqrt{2}+1}$

(C) $\frac{T}{\sqrt{3}(\sqrt{2}-1)}$ (D) $\frac{T}{\sqrt{2}-1}$

Sol. [A] $\frac{kA(\sqrt{2}T-\theta)}{\ell} = \frac{kA(\theta-T)}{\sqrt{2}\ell}$

$\Rightarrow 2T - \sqrt{2}\,\theta = \theta - T$

$3T = (1+\sqrt{2})\,\theta$

$\theta = \frac{3T}{1+\sqrt{2}}$ **[B]**

Q. 4 A sphere and a cube of same material and same total surface area are placed in the same evacuated space turn by turn after they are heated to the same temperature. Find the ratio of their initial rates of cooling in the enclosure -

(A) $\sqrt{\frac{\pi}{6}}:1$ (B) $\sqrt{\frac{\pi}{3}}:1$ (C) $\frac{\pi}{\sqrt{6}}:1$ (D) $\frac{\pi}{\sqrt{3}}:1$

Sol. [A] $S_S = S_C \Rightarrow m_S > m_C$; $\frac{dQ}{dt} = \frac{4\sigma AT_0^3}{ms}\Delta T$

Given $6a^2 = 4\pi r^2$ or $\frac{a}{r} = \sqrt{\frac{4\pi}{6}} = \sqrt{\frac{2\pi}{3}}$

$$\frac{dQ}{dt} \propto \frac{A}{m} \;;\; \frac{\left(\frac{dQ}{dt}\right)_S}{\left(\frac{dQ}{dt}\right)_C} = \frac{\frac{4\pi r^2}{\frac{4}{3}\pi r^3\rho}}{\frac{6a^2}{a^3\rho}} = \frac{3/r}{6/a} = \frac{a}{2r}$$

$$= \frac{1}{2}\sqrt{\frac{2\pi}{3}} = \sqrt{\frac{\pi}{6}} : 1$$

Q. 5 A steel ball of mass 0.1 kg falls freely from a height of 10 m and bounces to a height of 5.4 m from the ground. If the dissipated energy in this process is absorbed by the ball, the rise in its temperature is - (Specific heat of steel = 460 J/kg/ºC, g = 10 m s^{-2})

(A) 0.01ºC (B) 0.1ºC (C) 1ºC (D) 1.1ºC

Sol. [B] $mg(h_1 - h_2) = ms\Delta\theta$

$$\Delta\theta = \frac{g(h_1-h_2)}{5} = \frac{10\times 4.4}{460} = \frac{44}{460} = 0.1\ ºC$$

Q. 6 In a room where the temperature is 30°C, a body cools from 61°C to 59°C in 4 minute. The time taken by the body to cool from 51°C to 49°C is -

(A) 4 minutes (B) 6 minutes

(C) 5 minutes (D) 8 minutes

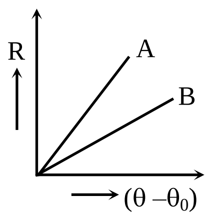
Sol.[B] In first case:

$$\frac{61-59}{4} = k\left[\frac{61+59}{2} - 30\right] \therefore \frac{1}{2} = k \times 30 \Rightarrow k = \frac{1}{60}$$

In second case $\frac{51-49}{t} = \frac{1}{60}\left[\frac{51+49}{2} - 30\right]$

$$\therefore \frac{2}{t} = \frac{1}{60} \times 20 \Rightarrow t = 6 \text{ min.}$$

Q. 7 Two circular discs A and B with equal radii are blackened. They are heated to same temperature and are cooled under identical conditions. What inference do you draw from their cooling curves ?



(A) A and B have same specific heats

(B) Specific heat of A is less

(C) Specific heat of B is less

(D) Nothing can be said

Sol. [B] $R \propto (\theta - \theta_0)$ cooling is poster for A than B, so specific heat of A is smaller than B

Q. 8 Fraunhofer lines in the solar spectrum correspond to radiation -

(A) emitted by the inner part of the sun but absorbed by its outer atmosphere

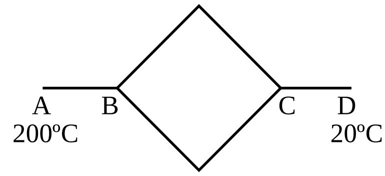
(B) not absorbed due to imperfect instrument

(C) not emitted by the sun

(D) emitted by the sun but absorbed by the earth's atmosphere

Sol. **[A]** Fraunhafer line are found in atmosphere because some wavelength are absorbed by chromsphere of the sun.

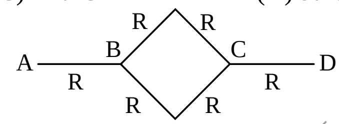
Q. 9 Six identical conducting rods are joined as shown in figure. Points A and D are maintained at temperatures 200ºC and 20ºC respectively. The temperature of junction B will be -

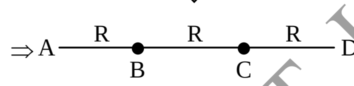


(A) 120ºC (B) 100ºC

(C) 140ºC (D) 80ºC

Sol. [C]





$$\left(\frac{dQ}{dt}\right)_1 = \left(\frac{dQ}{dt}\right)_2$$

$$\frac{kA(200-\theta)}{\ell} = \frac{kA(\theta-20)}{2\ell}$$

$400 - 2\theta = \theta - 20$; $\theta = \frac{420}{3} = 140ºC$

Q. 10 The sun radiates energy in all directions. The average radiations received on the earth surface from the sun is 1.4 kilowatt/m^2. The averager earth-sun distance is 1.5×10^{11} metres. The mass lost by the sun per day is (1 day = 86400 seconds)

(A) 4.4×10^9 kg (B) 7.6×10^{14} kg

(C) 3.8×10^{12} kg (D) 3.8×10^{14} kg

Sol. **[D]**

E = IAt

$E = I(4\pi d^2)t$

$E = mc^2$ $m = \frac{I(4\pi d^2)t}{c^2}$

Q. 11 Two copper spheres, one of large size and the other small, are heated to the same temperature. Which will cool first ?

(A) Bigger

(B) Smaller

(C) Both in equal time

(D) Insufficient data to reply

Sol. [B] Smaller sphere (cooling) $\propto \frac{1}{\text{mass}}$

Q. 12 If Wien's constant b = 0.3 cm K, then the temperature of the sun having maximum intensity of radiation at 5000 Å wavelength is -

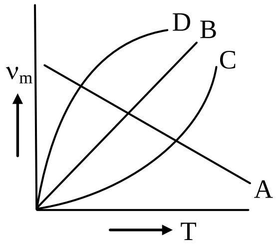
(A) 5000 K (B) 6000 K

(C) 4000 K (D) 7000 K

Sol. **[B]**

$\lambda_m T = b \Rightarrow T \times 5000 = 0.3 \times 10^8$

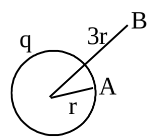
Q. 13 Which of the following is the $\nu_m - T$ graph for a perfectly black body ?



(A) A (B) B

(C) C (D) D

Sol. **[B]** $\because \nu_m = \dfrac{c}{\lambda_m}$ & $\lambda_m = \dfrac{b}{T}$



Q.14 We consider the radiation emitted by the human body. Which of the following statements is true

(A) The radiation is emitted only during the day

(B) The radiation is emitted during the summers and absorbed during the winters

(C) The radiation emitted lies in the ultraviolet region and hence is not visible

(D) The radiation emitted is in the infra-red region **[D]**

Q.15 A black body emits radiations of maximum intensity for the wavelength of 5000 Å when the temperature of the body is 1227ºC. If the temperature of the body is increased by 1000ºC, the maximum intensity would be observed at -

(A) 1000Å (B) 2000Å

(C) 5000 Å (D) 3000Å

Sol. [D] $\lambda = \dfrac{b}{t}$; $\dfrac{\lambda_2}{\lambda_1} = \dfrac{T_1}{T_2} = \dfrac{1500}{2500} = \dfrac{3}{5}$

$\lambda_2 = \dfrac{3}{5}\lambda_1 = 3000$Å

Q.16 Solar radiation emitted by sun resembles that emitted by a black body at a temperature of 6000 K. Maximum intensity is emitted at wavelength of about 4800 Å. If the sun were to cool down from 6000 K to 3000 K, then the peak intensity would occur at a wavelength -

(A) 4800 (B) 9600

(C) 2400 (D) 19200 **[B]**

Sol. $\dfrac{\lambda_{m_2}}{\lambda_{m_1}} = \dfrac{T_1}{T_2} \Rightarrow \lambda_{m_2} = 9600$ Å

Q.17 In a room where the temperature is 30ºC a body cools from 61ºC to 59ºC in 4 minute. The time taken by the body to cool from 51ºC to 49ºC will be :

(A) 4 minute (B) 6 minute

(C) 5 minute (D) 8 minute **[B]**

Sol. Use $\dfrac{\theta_1 - \theta_2}{t} = K'\left(\dfrac{\theta_1 + \theta_2}{2} - \theta_0\right)$

Q.18 A bucket full of hot water cools from 75ºC to 70ºC in time T_1, from 70ºC to 65ºC in time T_2 and from 65ºC to 60ºC in time T_3, then -

(A) $T_1 = T_2 = T_3$ (B) $T_1 > T_2 > T_3$

(C) $T_1 < T_2 < T_3$ (D) $T_1 > T_2 < T_3$ **[C]**

Q.19 An object is cooled from 75ºC to 65ºC in 2 minutes in a room at 30ºC. The time taken to cool another object from 55ºC to 45ºC in the same room in minutes is -

(A) 4 (B) 5

(C) 6 (D) 7 **[A]**

Q.20 A polished surface -

(A) Reflect radiation (B) Emit radiation

(C) Absorb radiation (D) All **[D]**

Sol. A polished is good reflector, hence bad absorber and consequently a bad radiator.

Q.21 A body is heated to temperature 40 degree and kept in a chamber maintained at 20º. If temperature decreases to 36º in 2 minutes. Time after it will further decrease by 4 degree is -

(A) 2 min (B) 2 min 33 sec

(C) 2 min 55 sec (D) 3 min **[B]**

Sol. $\frac{d\theta}{dt} = -k(\theta - \theta_0)$

From 40º to 36º : $\theta = \frac{40+36}{2} = 38$

$\frac{d\theta}{dt} = \frac{4}{2} = 2$ degree/min

From 36º to 32º : $\theta = 14$

$\frac{d\theta}{dt} = \frac{4}{t}$

$\Rightarrow \frac{4/2}{4/t} = \frac{38}{34}$

$\Rightarrow$ t = 2 min 33 sec

Q.22 Two bodies P and Q have thermal emissivities of E_P and E_Q respectively. Surface area of these bodies is same and the total radiant power is also emitted at the same rate. If the temperature of P in Kelvin is T_P, then the temperature of Q in Kelvin is -

(A) $\left(\frac{E_Q}{E_P}\right)^{\frac{1}{4}} \times T_P$ (B) $\left(\frac{E_P}{E_Q}\right)^{\frac{1}{4}} \times T_P$

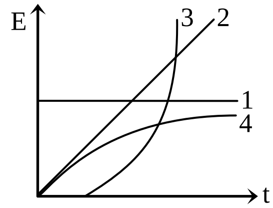
(C) $\left(\frac{E_Q}{E_P}\right)^{\frac{1}{2}} \times T_P$ (D) $\left(\frac{E_P}{E_Q}\right)^{\frac{1}{2}} \times T_P$ **[B]**

Sol. Intensity of radiation = $eA\sigma T^4$

$\therefore \quad 1 = \frac{E_P}{E_Q} \times \left(\frac{T_P}{T_Q}\right)^4$

$\therefore \quad T_Q = \left(\frac{E_P}{E_Q}\right)^{1/4} \times T_P$

Q.23 A sphere of surface temperature T is in thermal equilibrium with its environment. Which of the following curves gives the energy radiated by sphere versus time 't' –



(A) 1 (B) 2

(C) 3 (D) 4 **[A]**

Sol. As sphere is in thermal equilibrium with its surrounding.

Q.24 Two bodies A and B are placed in an evacuated vessel maintained at a temperature of 27ºC. The temperature of A is 327ºC and that of B is 227ºC. The ratio of heat loss from A and B is about -

(A) 2 : 1 (B) 1 : 2

(C) 4 : 1 (D) 1 : 4 **[A]**

Sol. $\frac{E_1}{E_2} = \frac{T_1^4 - T_0^4}{T_2^4 - T_0^4} = \frac{(600)^4 - (300)^4}{(500)^4 - (300)^4}$

Q.25 Wein's constant is 2892 × 10^{-6} SI unit and the value of λ_m for moon is 14.46 micron. The surface temperature of moon is –

(A) 100 K (B) 300 K

(C) 400 K (D) 200 K **[D]**

Sol. Wein's law

$\lambda_m T = b$

$T = \frac{b}{\lambda_m} = \frac{2892 \times 10^{-6}}{14.46 \times 10^{-6}}$

= 200 K

Q.26 Three discs, A, B and C having radii 2 m, 4 m and 6 m respectively are coated with carbon black on their outer surfaces. The wavelengths corresponding to maximum intensity are 300 nm, 400 nm and 500 nm, respectively. The power radiated by them are Q_A, Q_B and Q_C respectively –

(A) Q_A is maximum (B) Q_B is maximum (C) Q_C is maximum (D) $Q_A = Q_B = Q_C$

[B]

Sol. $Q \propto AT^4$ and $\lambda_m T$ = constant. Hence,

$$Q \propto \frac{A}{(\lambda_m)^4} \qquad \text{or} \; Q \propto \frac{r^2}{(\lambda_m)^4}$$

$$Q_A : Q_B : Q_C = \frac{(2)^2}{(3)^4} : \frac{(4)^2}{(4)^4} : \frac{(6)^2}{(5)^4}$$

$$= \frac{4}{81} : \frac{1}{16} : \frac{36}{625}$$

= 0.05 : 0.0625 : 0.0576

i.e., Q_B is maximum.

Q.27 A body cools from 80°C to 50°C in 5 minute. Calculate the time it takes to cool from 60°C to 30°C. The temperature of surroundings is 20°C –

(A) 6 min (B) 4.5 min
(C) 9 min (D) 12 min **[C]**

Sol. In first case:

Average temperature of liquid

$$= \frac{80+50}{2} = 65^\circ C$$

Excess temp = $(65 - 20)^\circ C = 45^\circ C$

$$\frac{d\theta_1}{dt} = \frac{50-80}{5} = -6^\circ C/\text{min}.$$

$$-6 = K \times 45 \qquad \ldots (1)$$

In second case:

Average temperature of liquid $= \frac{60+30}{2} = 45^\circ C$.

Excess temp = $(45 - 20)^\circ C = 25^\circ C$.

Rate of fall of temp $\frac{d\theta_2}{dt}$

$$\frac{d\theta_2}{dt} = -\frac{60-30}{t_{min}}$$

$$-\frac{30}{t_{min}} = K \times 25 \qquad \ldots (2)$$

Divide (1) by (2) t = 9 min.

$$\frac{-6}{\frac{-30}{t_{min}}} = \frac{K \times 45}{K \times 25}$$

$$t_{min} = \frac{45}{25} \times \frac{5}{1} = 9 \text{ min.}$$

Q.28 The spectral energy distribution of the Sun (temp = 6050 K) has a maximum at 4753 Å. The temperature of a Star for which this maximum is at 9506 Å is –

(A) 6050 K (B) 3025 K
(C) 12100 K (D) 24200 K **[B]**

Sol. From Wien's law

$\lambda_{max} T = b$ where b = Wien's constant.

$b = 2.89 \times 10^{-3}$ m K.

Let For Sun λ_{m1} = 4753 Å and T_1 = 6050 K.

For Starb λ_{m2} = 9506 Å and T_2 = ?

or $\lambda_{m2} T_2 = \lambda_{m1} T_1$

$$T_2 = \frac{\lambda_{m_1}}{\lambda_{m_2}} \times T_1$$

$$= \frac{4753}{9506} \times 6050 = 3025 \text{ K}.$$

Temperature of Star = $\boxed{3025\,\text{K.}}$

Q.29 Rate of heat loss of a body is 'K' time temperature difference between body and environment. Time taken by body in losing $\frac{3}{4}$rth of the maximum heat it can lose is –

(A) $\frac{2}{K}$ (B) $\frac{2\,\ell n\,2}{K}$
(C) $\frac{\ell n 2}{K}$ (D) $\frac{\ell n 4}{K}$ **[B]**

Sol. Let θ_0 = Temperature of environment

θ_1 = Initial temperature of body

θ = Temperature of body at any instant t

$\therefore$ Maximum heat body can lose = $ms(\theta_1 - \theta_0)$

[m = mass of body
s= specific heat of body]

$$\frac{d\theta}{dt} = -K(\theta - \theta_0)$$

$$\frac{\theta - \theta_0}{\theta_1 - \theta_0} = e^{-Kt}$$

$$t = \frac{1}{K}\,\ell n\left(\frac{\theta_1 - \theta_0}{\theta - \theta_0}\right)$$

Body will lose $\frac{3}{4}$ its maximum heat when

$$\theta = \frac{\theta_1 + 3\theta_0}{4}$$

$$\therefore t = \frac{2\ell n2}{K}$$

Q.30 If the temperature of the sun were to increase from T to 2T and its radius from R to 2R, then the ratio of the radiant energy received on earth to what it was previously will be -

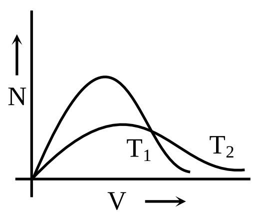
(A) 32 (B) 16

(C) 4 (D) 64 **[D]**

Sol. $T_2 = 2T$, $T_1 = T$, $R_1 = R$, $R_2 = 2R$

$$\frac{E_2}{E_1} = \left(\frac{R_2}{R_1}\right)^2 \left(\frac{T_2}{T_1}\right)^4 = \frac{64}{1}$$

Q.31 Maxwell's velocity distribution curve is given for two different temperatures. For the given curves -



(A) $T_1 > T_2$ (B) $T_1 < T_2$

(C) $T_1 \le T_2$ (D) $T_1 = T_2$ **[B]**

Sol. Higher is the temperature greater is the most probable velocity.

Q.32 The energy spectrum of a black body exhibits a maximum around a wavelength λ_0. The temperature of the black body is now changed such that the energy is maximum around a wavelength $3\lambda_0/4$. The power radiated by the black body will now increase by a factor of -

(A) 64/27 (B) 256/81

(C) 4/3 (D) 16/9 **[B]**

Sol. $\lambda_0 T_1 = \frac{3\lambda_0}{4} T_2 \Rightarrow T_2 = \frac{4T_1}{3}$

Power = Energy per unit time and $E \propto T^4$

$$\frac{P_2}{P_1} = \left(\frac{T_2}{T_1}\right)^4 = \left(\frac{4}{3}\right)^4 = \frac{256}{81}$$

Q.33 A black body at high temperature T K radiates energy at the rate of E W/m^2. When the temperature falls to (T/2) K, the radiated energy will be -

(A) E/4 (B) E/2 (C) 2E (D) E/16

Sol. [D] $\frac{E_2}{E_1} = \frac{\left(\frac{T}{2}\right)^4}{T^4} = \frac{1}{16}$

Q.34 A sphere, a cube and a thin circular plate all made of the same mass and finish are heated to a temperature of 200ºC; which of these objects will cool slowest when left in air at room temperature -

(A) The sphere

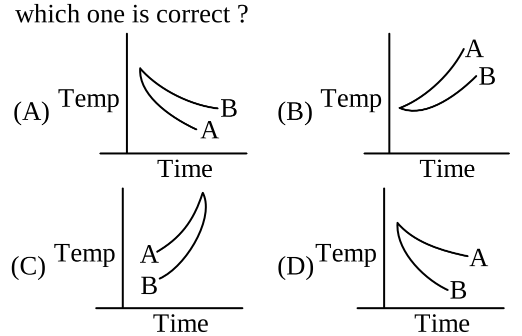
(B) The cube

(C) The circular plate

(D) All will cool at the same rate **[A]**

Sol. Sphere is having minimum area so, $d\theta/dt$ will also be minimum

Q.35 Two identical sphere A & B of radius 2 cm & 3 cm are heated to the same temperature and then left to cool. Their cooling is shown by graph which one is correct ?



[A]

Sol. Rate of cooling is $\propto \frac{1}{\text{radius}}$ so A is faster.

Q.36 There are two thin spheres A and B of the same material and same thickness. They emit like black bodies. Radius of A is double that of B. A and B of same temperature T. When A and B are kept in a room of temperature T_0 (< T), the ratio of their rates of cooling (rate of fall of temperature) is (assume negligible heat exchange between A and B) -

(A) 2 : 1 (B) 1 : 1

(C) 4 : 1 (D) 8 : 1 **[B]**

Sol. The rate of heat loss by a thin hollow sphere of thickness 'Δx', mean radius 'r' and made of density 'ρ' is given by

$$mS\frac{dT}{dt} = -\in \sigma A(T^4 - T_0^4)$$

$$(\rho\, 4\pi\pi^2\, \Delta x)\, S\frac{dT}{dt} = -\in \sigma\, 4\pi r^2 (T^4 - T_0^4)$$

$$\Rightarrow \frac{dT}{dt} = -\frac{\in \sigma(T^4 - T_0^4)}{S\Delta x}$$ is independent of radius.

Hence rate of cooling is same for both spheres.

Q.37 A thin square steel plate with each side equal to 10 cms is heated by a blacksmith. The rate of radiated energy by the heated plate is 1134 watts. The temperature of the hot steel plate is – (Stefan's constant $\sigma = 5.67 \times 10^{-8}$ watts $m^{-2}K^{-4}$ emissivity of the plate = 1)

(A) 1000K (B) 1189K

(C) 2000K (D) 2378K **[B]**

Q.38 Two sphere made of same substance have radii 1m and 4m, and temperatures 4000ºK and 2000ºK respectively. The ratio of power radiated by two spheres is –

(A) 1/2 (B) 1/4

(C) 4 (D) 1 **[D]**

Q.39 The rate of emission of radiation of a body at temperature 27ºC is 20 watt. If the temperature of a body is increased to 327ºC, the rate of emission of radiation will be –

(A) 20 watt (B) 160 watt

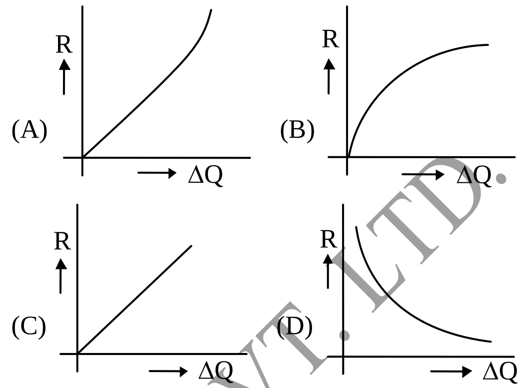
(C) 320 watt (D) 327 watt **[C]**

Q.40 A body cools from 50ºC to 40ºC in 5 min. If temperature of the surroundings is 20ºC, the temperature of the body after 5 min would be –

(A) 36ºC (B) 35ºC

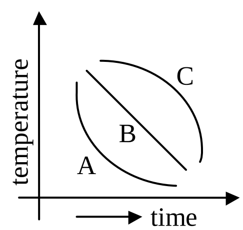
(C) 33.33ºC (D) 30ºC **[A]**

Q.41 The rate of cooling R with excess of temperature $\Delta\theta$ varies according to the graph-



[A]

Q.42 A block of steel heated to 100ºC is left in a room to cool. Which of the curves shown in fig., represents the correct behavior –



(A) A (B) B

(C) C (D) None of these **[C]**

Q.43 If T is the absolute temperature of a blackbody and λ_m is the peak wavelength of its radiation, then –

(A) $\lambda_m T$ = 2898m.K (B) $\lambda_m T$ = 2898 μm.K

(C) $\lambda_m T$ = 2.898 m.K (D) $\lambda_m T$ = 2.898 cm.K

[B]

Q.44 Two stars A and B radiate maximum energy at wavelength 4000Aº and 5000Aº respectively. The ratio of their temperatures will be –

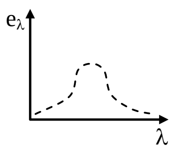
(A) 1 : 2 (B) 2 : 1

(C) 4 : 5 (D) 5 : 4 **[D]**

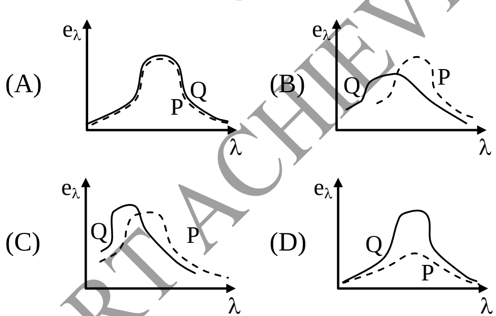
Q.45 An aluminium sphere 10 cm in diameter is suspended by a fine thread inside an evacuated jar, so that it can lose heat only by radiation. The sphere is initially at temperature 127ºC. Then the initial net rate of heat loss of the sphere is (given density of aluminium 2.7 g/cm^3, emissivity $\in$ = 0.1 and specific heat s = 0.92 J/gK) – (Surrounding temperature = 27ºC)

(A) 3.13 W (B) 6.13 W
(C) 31.3 W (D) 997 W **[A]**

Q.46 Light from an electric lamp P has spectral distribution shown below.



Which one of the graphs below best represents the spectral distribution of light from a lamp Q which takes the same input power as lamp P but operate at a higher temperature. (In the graphs below the dotted curves relates to lamp P and the solid curve to lamp Q.)



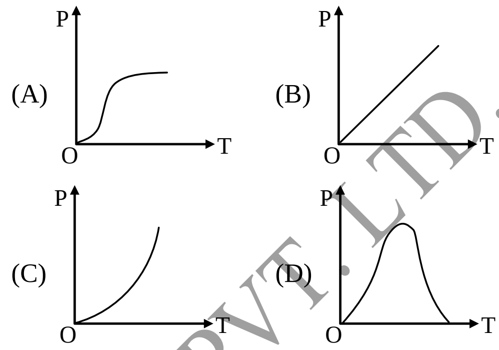
[C]

Q.47 How much energy from the sun impinges on the top of the earth's atmosphere per unit time per unit area –

(A) 1.38×10^3 J/m^{2}s (B) 1.38 J/m^{2}s
(C) 3.91×10^{26} J/m^{2}s (D) 1.4×10^{-3}J/m^{2}s

[A]

Q.48 Which one of the following graphs best represents the way in which the total power P radiated by a black body depends upon the thermodynamic temperature T of the body –



[C]

Q.49 A thin spherical shell and a thin cylindrical shell (closed a both ends) have same volume. Both the shells are filled with water at the same temperature and are exposed to the same atmosphere. Initial temperature of water is slightly greater than that of surrounding. Then at initial moment -

(A) rate of heat radiation from two shells will be same
(B) rate of fall of temperature in both the shells will be same
(C) rate of heat radiation and rate of fall of temperature, both, in cylindrical shell are less than those in spherical shell
(D) none of these

Sol. **[D]**
Use the expression of rate of cooling by radiation.

Q.50 Two spheres of the same material have radii 1 m and 4 m and temperatures 4000 K and 2000 K respectively. The ratio of the energy radiated per second by the first sphere to that by second is -

(A) 1 : 1 (B) 16 : 1
(C) 4 : 1 (D) 1 : 9 **[A]**

Sol. $$\frac{P_1}{P_2} = \left(\frac{T_1}{T_2}\right)^4 \times \left(\frac{r_1}{r_2}\right)^2$$

Q.1 The emissive power of a black body at T = 300 K is 10 watt/m^2. Consider a body B of area A = 10m^2, coefficient of reflectivity r = 0.3 and coefficient of transmission t = 0.5. Its temperature is 300K. Then emissive power of B is W/m^2.

Sol. e = a = 0.2

since a = 1 – r – t = 0.2 for the body B

E = (10) (0.2) = 2 W/m^2

Q.2 The emissivity of tungsten is approximately 0.35. A tungsten sphere 1 cm in radius is suspended within a large evacuated enclosure whose walls are at 300 K. What power input is required to maintain the sphere at a temperature of 3000 K if heat conduction along the supports is neglected ? Express your answer in kW after rounding off the nearest integer. Take $\sigma = \frac{17}{3} \times 10^{-8}$ S.I. units and $\pi = \frac{213}{68}$.

Sol. **[2]**

$P = \sigma A e (3000^4 - 300^4) = 2kW$