Self Practice Paper (SPP)

1. Heat flows radially outward through a spherical shell of outside radius R_2 and inner radius R_1. The temperature of inner surface of shell is θ_1 and that of outer is θ_2. The radial distance from centre of shell where the temperature is just half way between θ_1 and θ_2 is :

(1) $\frac{R_1+R_2}{2}$ (2) $\frac{R_1\ R_2}{R_1+R_2}$ (3) $\frac{2\ R_1\ R_2}{R_1+R_2}$ (4) $R_1 + \frac{R_2}{2}$

2. 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/degJ = 4.2 Joules/Calorie)

(1) .055 °C/sec (2) .066 °C/sec (3) .044 °C/sec (4) 0.03 °C/sec

3. Solar constant for the earth is 2.0 cal/cm²/min. Stefan's constant is $\sigma = 5.7 \times 10^{-12}$ watt/(cm² – K^4). Temperature of sun is 6000 K. Angular diameter of sun as seen from the earth is-

(1) 1.5 rad (2) 2.4° (3) 1.2° (4) 30 minutes.

4. 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.

5. Fraunhofer lines are found in-
(1) Emission spectrum of the elements present in photosphere.
(2) The absorption spectrum of the elements present in photosphere.
(3) The emission spectrum of the elements present chromosphere.
(4) The absorption spectrum of the elements present in chromosphere.

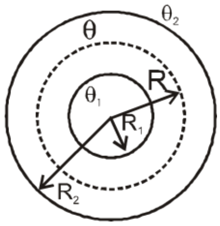
6. A solid black sphere of radius R and a solid black cylinder of same material and radius with height equal to the radius, are at the same temperature. These are allowed to cool in the same surroundings. The ratio of the rates of fall of their temperature will be-

(1) 1 : 1 (2) 4 : 3 (3) 3 : 4 (4) 2 : 3

SPP Answers

1.	(3)	**2.**	(2)	**3.**	(1)	**4.**	(4)	**5.**	(4)	**6.**	(3)

SPP Solutions

1. 

$\theta_1 - \theta_2 = \Delta\theta$

$$\frac{\theta_1 - \theta}{\int_{R_1}^{R} \frac{dr}{K4\pi r^2}} = \frac{\theta_1 - \theta_2}{\int_{R_1}^{R_2} \frac{dr}{K4\pi r^2}}$$

$$\frac{\Delta\theta/2}{\frac{1}{4\pi K}\left[\frac{1}{R_1} - \frac{1}{R}\right]} = \frac{\Delta\theta}{\frac{1}{4\pi K}\left(\frac{1}{R_1} - \frac{1}{R_2}\right)}$$

$$\Rightarrow \frac{1}{2}\left[\frac{R - R_1}{R \quad R_1}\right] = \left[\frac{R_2 - R_1}{R_1 \quad R_2}\right]$$

$$\Rightarrow R = \frac{2R_1R_2}{R_1 + R_2}$$

2. $$\left(-\frac{dT}{dt}\right) = \frac{\sigma e A}{mS}\,[T^4 - T_S^4]$$

Rate of temperature fall will be maximum when ($T^4 - T_S^4$) has maximum value i.e. T has max. value

6. $$\frac{Q_S}{Q_C} = \frac{\frac{A_s}{m_s}}{\frac{A_C}{m_C}} = \frac{A_S m_C}{A_C m_S}$$

$$= \frac{4\pi R^2 \times \rho \times \pi R^2 \times R}{(2\pi R.R + 2\pi R^2) \times \rho \times \frac{4}{3}\pi R^3}$$

$$= \frac{3}{4}$$