

Date Planned : __ / __ / __	Daily Tutorial Sheet - 10	Expected Duration : 90 Min
Actual Date of Attempt : __ / __ / __	Level - 2	Exact Duration : _____
Topics covered : <i>Radiation, Newton's law of cooling</i>		

- 121.** A long solid cylinder is radiating power. It is remolded into a number of smaller cylinders, each of which has the same length as original cylinder. Each small cylinder has the same temperature as the original cylinder. The total radiant power emitted by the pieces is twice that emitted by the original cylinder. How many smaller cylinders are there? (Neglect the energy emitted by the flat faces of cylinder.) 
- (A) 3 (B) 4 (C) 5 (D) 6
- 122.** Energy of radiation emitted by a black body at temperature 3000 K is u_1 for wavelength between 8000 Å and 9000 Å , u_2 for wavelength between 9000 Å and 10000 Å and u_3 for wavelength between 10000 Å and 11000 Å . Which of the following is true? [Wien's constant $b = 2.88 \times 10^{-3} \text{ mK}$]
- (A) $u_1 > u_2 > u_3$ (B) $u_3 > u_2 > u_1$
 (C) $u_2 > u_1$ and $u_2 > u_3$ (D) $u_2 > u_1 = u_3$
- 123.** 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) $\frac{\pi}{\sqrt{3}} : 1$
- 124.** The temperature of isolated black body falls from T_1 to T_2 in time t . Assuming Stefan's law to hold, time t is proportional to : 
- (A) $\log_e \frac{T_2}{T_1}$ (B) $\left(\frac{1}{T_2^2} - \frac{1}{T_1^2} \right)$ (C) $\left(\frac{1}{T_2^3} - \frac{1}{T_1^3} \right)$ (D) $\left(\frac{1}{T_2^4} - \frac{1}{T_1^4} \right)$
- 125.** A body with an initial temperature θ_1 is allowed to cool in a surrounding which is at a constant temperature of θ_0 ($\theta_0 < \theta_1$). Assume that Newton's law of cooling is obeyed. Let $k = \text{constant}$. The temperature of the body after time t is best expressed by : 
- (A) $(\theta_1 - \theta_0)e^{-kt}$ (B) $(\theta_1 - \theta_0)\ln(kt)$
 (C) $\theta_0 + (\theta_1 - \theta_0)e^{-kt}$ (D) $\theta_1 e^{-kt} - \theta_0$
- 126.** Solar constant is 1370 W/m^2 . 70% of the light incident on the earth is absorbed by the earth and the earth's average temperature is 288 K . The effective emissivity of the earth is : 
- (A) 0.2 (B) 0.4 (C) 0.6 (D) 1

PARAGRAPH FOR QUESTIONS 127 - 128

A thin copper rod of uniform cross section A square metres and of length L meters has a metal sphere of radius r metre at its one end symmetrically attached to the copper rod. The thermal conductivity of copper is K and the emissivity of the spherical surface of the sphere is ϵ . The free end of the copper rod is maintained at the temperature T Kelvin by supplying thermal energy from a P watt source. Steady state conditions are allowed to be established while the rod is properly insulated against heat loss from its lateral surface. Surroundings are at 0°C . Stefan's constant $= \sigma \text{ W / m}^2 \text{ K}^4$. 

127. After the steady state conditions are reached, the temperature of the spherical end of the rod, T_S is :

- (A) $T_S = T - \frac{PL}{KA}$ (B) $T_S = 0^\circ\text{C}$ (C) $T_S = \frac{PL}{KA}$ (D) $T_S = T - \frac{P(L+r)}{KA}$

128. The net power that will be radiated out, P_S , from the sphere after steady state conditions are reached is :

- (A) $P_S = P$ (B) $P_S = \frac{PA}{4\pi r^2}$ (C) $P_S = 0$ (D) $P_S = \sigma \epsilon T_S^4$

***129.** Two identical objects A and B are at temperatures T_A and T_B respectively. Both objects are placed in a room with perfectly absorbing walls maintained at a temperature T ($T_A > T > T_B$). The objects A and B attain the temperature T eventually. Select the correct statements from the following:

- (A) A only emits radiation, while B only absorbs it until both attain the temperature T
 (B) A loses more heat by radiation than it absorbs, while B absorbs more radiation than it emits, until they attain the temperature T
 (C) Both A and B only absorb radiation, but do not emit it, until they attain the temperature T
 (D) Each object continuous to emit and absorb radiation even after attaining the temperature T

***130.** A heated body emits radiations which has maximum intensity at frequency ν_m . If the temperature of the body is doubled, then:

- (A) The maximum intensity radiation will be at frequency $2\nu_m$
 (B) The maximum intensity radiation will be at frequency $(1/2)\nu_m$
 (C) The total emitted energy will increase by a factor of 16
 (D) The total emitted energy will increase by a factor of 2