Date Planned : __ / __ / __	**Daily Tutorial Sheet - 9**	**Expected Duration : 90 Min**
Actual Date of Attempt : __ / __ / __	**Level - 2**	**Exact Duration :________**
Topics covered : *Conduction*		

111. A room at 20°C is heated by a heater of resistance 20 ohm connected to 200 V mains. The temperature is uniform throughout the room and the heat is transmitted through a glass window of area $1m^2$ and thickness 0.2 cm. Calculate the temperature outside. (Thermal conductivity of glass is 0.2 cal/m C° s and mechanical equivalent of heat is 4.2 J/cal.)

(A) 13.69°C **(B)** 15.24°C **(C)** 17.85°C **(D)** 19.96°C

112. A rod of length l and cross-sectional area A has a variable conductivity given by $K = \alpha T$, where α is a positive constant and T is temperatures in Kelvin. Two ends of the rod are maintained at temperatures T_1 and $T_2 (T_1 > T_2)$. Heat current flowing through the rod will be :

(A) $\frac{A\alpha(T_1^2 - T_2^2)}{l}$ **(B)** $\frac{A\alpha(T_1^2 + T_2^2)}{l}$ **(C)** $\frac{A\alpha(T_1^2 + T_2^2)}{3l}$ **(D)** $\frac{A\alpha(T_1^2 - T_2^2)}{2l}$

113. A planet radiates heat at a rate proportional to the fourth power of its surface temperature T. If such a steady temperature of the planet is due to an exactly equal amount of heat received from the sun then which of the following statements is true?

(A) The planet's surface temperature varies inversely as the distance of the sun

(B) The planet's surface temperature varies directly as the square of its distance from the sun

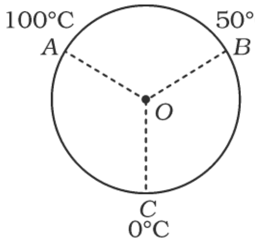
(C) The planet's surface temperature varies inversely as the square root of its distance from the sun

(D) The planet's surface temperature is proportional to the fourth power of distance from the sun

114. Inner and outer surfaces of a cylinder are maintained at temperature $4T$ and T respectively. Heat flows radially from inner surface of radius R to outer surface of radius $4R$. Radial distance from the center where temperature is $2T$.

(A) $2R$ **(B)** $2^{5/3}R$ **(C)** $2^{4/3}R$ **(D)** $3R$

***115.** A circular ring (centre O) of radius a, and of uniform cross section is made up of three different metallic rods, AB, BC and CA (joined together at the points A, B and C in pairs) of thermal conductivities α_1, α_2 and α_3, respectively (see diagram). The junctions A, B and C are maintained at the temperatures 100°C, 50°C and 0°C, respectively. All the rods are of equal lengths and cross sections. Under steady state conditions, assume that no heat is lost from the sides of the rods. Let Q_1, Q_2 and Q_3 be the rates of transmission of heat along the three rods AB, BC and CA. Then :



(A) $Q_1 = Q_2 = Q_3$ and all are transmitted in the clockwise sense

(B) Q_1 and Q_2 flow in clockwise sense and Q_3 in the anticlockwise sense

(C) $Q_1 : Q_2 : Q_3 :: \alpha_1 : \alpha_2 : 2\alpha_3$

(D) $\frac{Q_1}{\alpha_1} + \frac{Q_2}{\alpha_2} = \frac{Q_3}{\alpha_3}$

PARAGRAPH FOR QUESTIONS 116 - 118

Assume that the thermal conductivity of copper is twice that of aluminium and four times that of brass. Three metal rods made of copper, a aluminium and brass are each 15 cm long and 2 cm in diameter. These rods are placed end to end, with aluminium between the other two. The free ends of the copper and brass rods are maintained at 100°C and 0°C, respectively. the system is allowed to reach the steady state condition. Assume there is no loss of heat anywhere.

116. When steady state condition is reached everywhere, which of the following statements is true?

(A) No heat is transmitted across the copper–aluminium or aluminium–brass junctions.

(B) More heat is transmitted across the copper–aluminium junction than across the aluminium–brass junction

(C) More heat is transmitted across the aluminium–brass junction than the copper–aluminium junction

(D) Equal amount of heat is transmitted at the copper–aluminium and aluminium–brass junctions

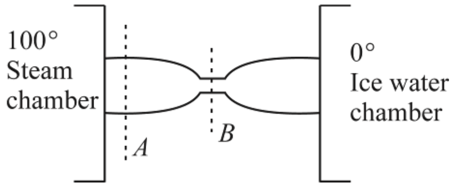
117. Under steady state condition, the equilibrium temperature of the copper–aluminium junction will be :

(A) 86°C **(B)** 18.8°C **(C)** 57°C **(D)** 73°C

118. Under steady state condition, the equilibrium temperature of the aluminium–brass junction will be :

(A) 57°C **(B)** 35°C **(C)** 18.8°C **(D)** 28.5°C

119. A copper rod (initially at room temperature $20°C$) of non-uniform cross section is placed between a steam chamber at $100°C$ and ice water chamber at $0°C$. A and B are cross sections as shown in the figure. Then match the statements in Column I with result in Column II comparing only between cross section A and B. (The mathematical expressions in Column I have their usual meanings in heat transfer)



Column I	Column II
(A) Initially rate of heat flow $\left(\frac{dQ}{dt}\right)$ will be	**(P)** Maximum at section A
(B) At steady state rate of heat flow $\left(\frac{dQ}{dt}\right)$ will be	**(Q)** Maximum at section B
(C) At steady state temperature gradient $\left\lvert\left(\frac{dT}{dx}\right)\right\rvert$ will be	**(R)** Minimum at section B
(D) At steady state rate of change of temperature $\left(\frac{dT}{dt}\right)$ will be	**(S)** Same for all section

120. 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 $36°C$. Find the temperature difference across the layer A.