Q1. In a cylindrical shaped body of 30 cm diameter and 30 cm length heat is generated at a rate of 1.5 MW/m^3. The surface temperature is 400^{0}C. The convection coefficient is 200 W/m^{2}K. Heat is convected and radiated to the surroundings at 100^{0}C. The radiation factor is 1. The solid has a density of 19000 kg/m^3 and a specific heat of 0.118 kJ/ kgK. Determine the rate of change of temperature of the body at that instant in ^{0}C/s.

Ans: 0.03985 ^{0}C/s

Q2. The outside surface of a cylindrical cryogenic container is at -10^{0}C. The outside radius is 8cm. There is a heat flow of 65.5 W/m, which is dissipated to the surroundings both by radiation and convection. The convection coefficient is 4.35 W/m^{2}K and the radiation factor is 1. Determine the surrounding temperature.

Ans: 355.4 K

Q3. A solid receives heat by radiation over its surfaces at 4 kW and the heat convection rate over the surface of the solid to the surroundings is 5.2 kW, and heat is generated at a rate of 1.7 kW over the volume of the solid, determine the heat capacity of the solid if the time rate of change of the average temperature of the solid is 0.5^{0}C/s.

Ans: 1000 J/^{0}C

Q4. Air at 120^{0}C flows over a plate 20 mm thick and the temperatures in the middle 10 mm layer of the plate was measured using thermos couples and were found to be 42^{0}C and 30^{0}C. The thermal conductivity of the material is known to be 22.5 W/mK. Determine the average convection coefficient over the plate.

Ans: 375 W/m^{2}K

Q5. A circular pipe of OD 20 cm is enclosed centrally in a square section insulation of 36 cm side. The thermal conductivity of the material is 8.5 W/mK. The inside surface is at 200^{0}C. The outside is exposed at 30^{0}C with h = 35 W/m^{2}K. Determine the heat flow per a length of 5 m.

Ans: 67219 W

Q6. An insulating wall 16 cm thick has one face at 600^{0}C while the other is at 100^{0}C. The thermal conductivity of the material is given by $k = 0.078(1 + 17.95 \times 10^{-4}T) W/mK$ and T is in ^{0}C. Determine the heat loss per unit area and the mid plane temperature.

Ans: 396.9 W/m^2 and 383.8^{0}C

Q7. The thermal conductivity of an insulating material used to reduce heat gain into a cryogenic spherical shaped container varies a $k = 0.028(1 + 50 \times 10^{-4}T)$. Where T is in ^{0}C and k is in W/mK. The inner radius is 16cm and the insulation thickness is 12 cm. The inner surface is at -190^{0}C while the outer surface is at 10^{0}C. Determine the heat loss, the temperature at mid radius and the radius at which the temperature is -40^{0}C.

Ans: 14.45 W, -32.37^{0}C and 0.21287 m

Q8. A truncated conelike solid has its circumferential surface insulated. The base is at 300°C and the area along the flow direction at x is given by A = 1.3 (1 – 1.5x). Where x is

measured from the base in the direction of flow in m and A is in m^2. If the thermal conductivity is 2.6 W/mK and the plane at x = 0.2 m is maintained at 100°C, determine the heat flow and also the temperature at x = 0.1 m. Calculate the temperature gradients at the three sections.

Ans: -841.09 ^{0}C/m, -989.52 ^{0}C/m and -1201.6 ^{0}C/m