Physicsaholics

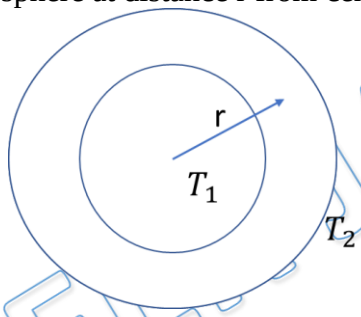
DPP – 2 (Heat Transfer)

Video Solution on Website:- https://physicsaholics.com/home/courseDetails/68

Video Solution on YouTube:- https://youtu.be/6LNeBN2m0dc

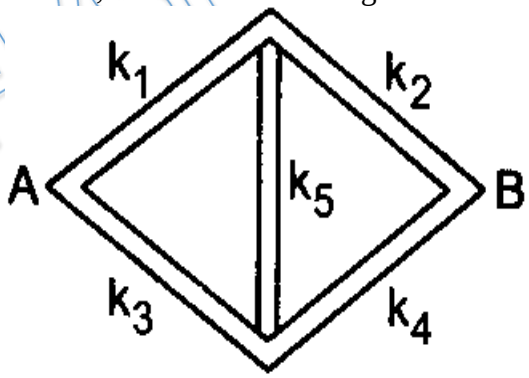
Written Solutionon Website:- https://physicsaholics.com/note/notesDetalis/83

Q 1. A hollow conducting sphere has inner radius R and outer radius 2R. Temperatures of inner cavity and surroundings are T_1 *and* T_2 ($T_2 < T_1$) respectively . These temperatures are not changing with time.
Temperature gradient in sphere at distance r from centre is directly proportional to



(a) r
(b) 1/r
(c) r^2
(d) None of the above

Q 2. Five rods of the same dimensions are arranged as shown. They have thermal conductivities k_1, k_2, k_3, k_4 and k_5. When points A and B are maintained at different temperatures, no heat flows through the central rod. It follows that



(a) $k_1 = k_4$ and $k_2 = k_3$ (b) $k_1/k_4 = k_2/k_3$
(c) $k_1k_4 = k_2k_3$ (d) $k_1k_2 = k_3k_4$

Q 3. Ice starts freezing in a lake with water at 0^0C when the atmospheric temperature is -10^0C. If the time taken for 1 cm of ice to be formed is 12 minutes the time taken for the thickness of the ice to change from 1 cm to 2 cm will be
(A) 12 minutes
(B) less than 12 minutes

PRATEEK JAIN PHYSICSAHOLICS

(C) more than 12 minutes but less than 24 minutes
(D) more than 24 minutes

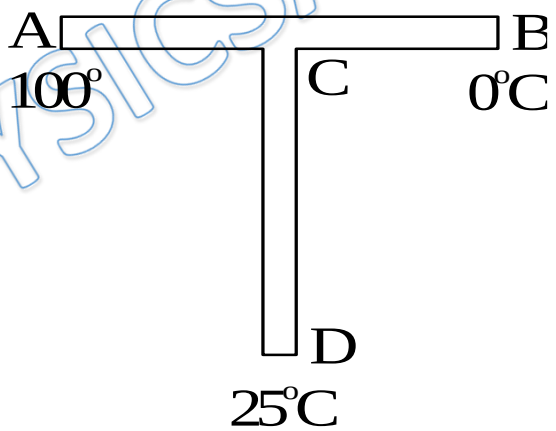
Q 4. A pond of water at 0°C is covered with layer of ice 4 cm thick if air temperature is -10°C (constant), how long it takes ice thickness to increase to 8 cm? K_{ice} = 2 W/m°C, L_f = 80 cal/gm, ρ_{ice} = 900 kg/m^3.

Q 5. Water in pond is at 0°C. The temperature of ambient air is constant at -20°C. Thickness x of ice film in centimeter increases with t in second according to relation (density of ice = 0.917 g/cc, conductivity of ice = 0.005 cgs and latent heat of ice = 80 cal/gm)
(a) $x = 2.73 \times 10^{-3}\, t$
(b) $x^2 = 2.73 \times 10^{-3}\, t$
(c) $t^2 = 2.73 \times 10^{-3} x$
(d) $t = 2.73 \times 10^{-3} x$

Q 6. A hollow metallic sphere of radius 20 cm surrounds a concentric metallic sphere of radius 5 cm. The space between the two spheres is filled with a nonmetallic material. The inner and outer spheres are maintained at 50°C and 10°C respectively and it is found that 100 J of heat passes from the inner sphere to the outer sphere per second. Find the thermal conductivity of the material between the spheres.

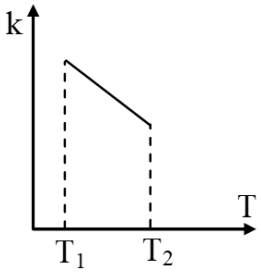
Q 7. For a solid cylinder of length L_0, area A conductivity varies with temperature Tas $k = k_0(1 + \alpha T)$. If one end is at $2T_0$ and other at T_0, find rate of heat flow?

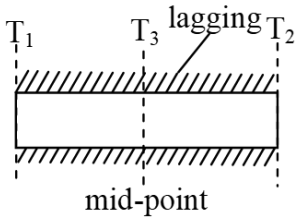
Q 8. A rod CD of thermal resistance 5.0 K/W is joined at the middle of an identical rod AB as shown in fig. The ends A, B and D are maintained at 100°C, 0°C and 25°C respectively. Find the heat current in CD in Watt.



Q 9. Over a certain temperature range, the thermal conductivity k of a metal is not constant but varies as indicated in figure. A lagged rod of the metal has its ends maintained at temperatures T_1 and $T_2 (T_2 > T_1)$ as shown in figure. Which one of the following correctly describes how T_3, the temperature at the mid-point of the rod, compares with T_1 and T_2 ?

PRATEEK JAIN PHYSICSAHOLICS





(A) $T_3 = (T_1 + T_2)/2$ (B) $T_3 = (T_1 - T_2)/2$
(C) $T_3 > (T_1 + T_2)/2$ (D) $T_3 < (T_1 + T_2)/2$

PRATEEK JAIN PHYSICSAHOLICS

Answer Key

Q.1 d	**Q.2 c**	**Q.3 d**	**Q.4 10.03 hrs.**	**Q.5 b**
Q.6 3	**Q.7** $\frac{k_0 A T_0}{L_0}\left(1+\frac{3\alpha T_0}{2}\right)$	**Q.8 4**	**Q.9 d**	