Chapter: 09

Transfer of Heat

Exercise MCQs

1. **In solids, heat is transferred by:**

   (A) radiation (B) conduction (C) convection (D) absorption

2. **What happens to the thermal conductivity of a wall if its thickness is doubled?**

   (A) becomes double (B) remains the same
   (C) becomes half (D) becomes one-fourth

3. **Metals are good conductor of heat due to the:**

   (A) free electrons (B) big size of their molecules
   (C) small size of their molecules (D) rapid vibrations of their atoms

4. **In gases, heat is mainly transferred by:**

   (A) molecular collision (B) Conduction (C) convection (D) radiation

5. **Convection of heat is the process of heat transfer due to the molecules:**

   (A) random motion (B) downward movement
   (C) upward movement (D) free movement

6. **False ceiling is done to:**

   (A) lower the height of the ceiling (B) keep the roof clean
   (C) cool the room (D) insulate the ceiling

7. **Rooms are heated using gas heaters by:**

   (A) conduction only (B) convection and radiation
   (C) radiation only (D) convection only

8. **Land breeze blows from:**

   (A) sea to land during night (B) sea to land during the day
   (C) land to sea during night (D) land to sea during the day

9. **Which of the following is a good radiator of heat?**

Ⓐ a shining silvered surface
Ⓑ a dull black surface
Ⓒ a white surface
Ⓓ a green coloured surface

10. Styrofoam is a :

Ⓐ Conductor Ⓑ Semiconductor Ⓒ Bad conductor Ⓓ None of them

11. Unit of thermal conductivity is :

Ⓐ $Wm^{-1}K^{-1}$ Ⓑ $Wm^{-1}K^{-2}$ Ⓒ $Wm^{-2}K^{-1}$ Ⓓ $Wm^{2}K^{-1}$

Answer Key:

1	Ⓑ	7	Ⓑ
2	Ⓒ	8	Ⓒ
3	Ⓐ	9	Ⓑ
4	Ⓑ	10	Ⓒ
5	Ⓒ	11	Ⓐ
6	Ⓓ		

Short Questions

1. Why metals are good conductors of heat?

Ans: Metals are good conductors of heat because they possess freely moving electrons.

2. Explain why.

(a) A metal feels colder to touch than wood kept in a cold place!

(b) Land breeze blows from land towards sea!

(c) Double-walled glass vessel is used in thermos flask!

(d) Deserts soon get hot during the day and soon get cold after sunset!?

Ans:

(a) A metal feels colder to touch than wood because it is a good conductor due to free electrons. So it cools down more rapidly as compared to wood. Wood is an example of an insulator.

(b) At night, the land cools faster than the sea. Therefore, air above the sea is warmer, rises up and colder air from the land begins to move towards the sea.

(c) A double-walled glass vessel is used in a thermos flask because a double-walled glass vessel has air between two glass walls that provide insulation.

(d) Deserts soon get hot during the day and soon get cold after sunset because the sand in the deserts has a very low value of specific heat. It cools down and warms up fastly.

3. Why transfer of heat in fluids take place by convection?

Ans: Transfer of heat in fluids takes place by convection because fluids are not good conductors of heat. As, molecules of fluids are able to move freely, hence heat transfer takes place by convection.

4. Why conduction of heat does not take place in gases?

Ans: Conduction of heat does not take place in gases because gases are bad conductors of heat.

5. What measures do you suggest to conserve energy in houses?

Ans: Measures to conserve energy:

- Hot water tanks are insulated by plastic or foam lagging.
- The bottoms of cooking pots are made black to increase the absorption of heat from the fire.
- Solar energy is used by solar panels in houses. The solar energy is converted into electric energy.
- Switch off the electric appliances when these are not used by humans.
- Energy in houses can be conserved by using energy savers instead of bulbs.

6. What is meant by convection current?

Ans: Convection current:

Hot air rises up creating a gap which is filled by colder air, this air also gets warm and rises up. That is how convection currents are produced.

7. How does heat reach us from the sun?

Ans: Heat reaches us from the sun through the radiation process.

8. Suggest a simple activity to show the convection of heat in gases not given in the book.

Ans: An example of convection in daily life is when we use a fireplace of heat in our home, as the fire heats up the air in front of it, the hot air rises up as it is less dense and then, in turn, pushes the cool air down so that it is heated and then rises, this motion is called convection currents and in the reaction fireplace air effective to heat us.

9. How various surfaces can be compared by a Leslie cube?

Ans: The rate at which various surfaces absorb heat is different from one another. So, on the basis of their ability to absorb heat through different surfaces can be compared to Leslie's cube.

10. Explain the impact of the greenhouse effect on global warming.

Ans: During the recent years, the percentage of carbon dioxide has been increased considerably. This has caused an increase in the average temperature of the earth by trapping more heat due to the greenhouse effect. This phenomenon is known as global warming. This is serious implications for global climate.

11. What is the greenhouse effect?

Ans: **Greenhouse effect:**

Greenhouse effect is the result of infrared light not being able to transmit it back through the atmosphere into space after it has been radiated to the earth from the sun.

Important Formulas

- $\frac{Q}{t} = \frac{kA\Delta T}{t}$ or $Q = \frac{tkA\Delta T}{L}$
- Rate of flow of heat $= \frac{Q}{t}$
- Rate of flow of heat $= k = Wm^{-1}K^{-1}$

Numerical

1. The concrete roof of a house of thickness 20cm has an area 200m². The temperature inside the house is 15°C and outside is 35°C. Find the rate at which thermal energy will be conducted through the roof. The value of k for concrete is $0.65Wm^{-1}K^{-1}$.

Ans: Given data:

Thickness of the roof $= V = 20cm = 0.2m$

Area of the roof $= A = 200m^2$

Temperature outside the house $= T_1 = 35^0\ C$

Temperature outside the house = (35 + 273)K = 308K

Temperature inside the house = T_2 = 15^0 C

Temperature inside the house = (15 + 273)K = 288K

Coefficient of thermal conductivity = k = 0.65 $Wm^{-1}K^{-1}$

Required:

Rate of conduction of energy through the roof = W = ?

Solution:

As we know that,

$$\text{Rate of flow of heat} = \frac{Q}{t} = \frac{kA\,(T_1 - T_2)}{L}$$

$$\text{Rate of flow of heat} = \frac{Q}{t} = \frac{0.65 \times 200 \times (308 - 288)}{0.2}$$

$$\text{Rate of flow of heat} = \frac{Q}{t} = \frac{130 \times 20}{0.2}$$

$$\text{Rate of flow of heat} = \frac{Q}{t} = \frac{2600}{0.2}$$

$$\text{Rate of flow of heat} = \frac{Q}{t} = 13000 Js^{-1}$$

Result:

Rate of conduction of energy through the roof = $\frac{Q}{t}$ = 13000Js^{-1}

2. How much heat is lost in an hour through a glass window measuring 2.0m by 2.5m when the inside temperature is 25^oC and that of the outside is 5^oC. The thickness of glass is 0.8cm and the value of k for glass is 0.8Wm-1K^{-1}?

Ans: Given data:

Area of the window = A = 2.0m × 2.5m = 5.0m^2

Temperature inside the window = T_1 = 25^0 C

Temperature inside the window = (25 + 273)K = 298K

Temperature outside the window = T_2 = 5^0 C

Temperature outside the window = (5 + 273)K = 278K

Coefficient of thermal conductivity = k = 0.8 $Wm^{-1}K^{-1}$

Required:

Heat lost through the glass = Q = ?

Solution:

As we know that,

$$Q = \frac{kA\,(T_1 - T_2)t}{L}$$

$$Q = \frac{0.8 \times 5 \times (298 - 278) \times 3600}{0.008}$$

$$Q = \frac{4 \times 20 \times 3600}{0.008}$$

$$Q = \frac{288000}{0.008}$$

$$Q = 36000000\text{J}$$

$$Q = 3.6 \times 10^7\text{J}$$

Result:

Heat lost through the glass = Q = 3.6×10^7J