What is Heat Transfer?

Worksheet

Heat transfer is the flow of thermal energy driven by a temperature difference, happening through conduction (direct contact), convection (fluid motion), and radiation (electromagnetic waves) until thermal equilibrium is reached.

$$Q = k A \frac{\Delta T}{d}$$

Questions

1. Which heat transfer mode can occur through a vacuum?

A) Conduction
B) Convection
C) Radiation
D) None of them

2. In Fourier's law Q/t = kA T/d, increasing thickness d...

A) Increases heat flow
B) Decreases heat flow
C) Has no effect
D) Reverses heat flow direction

3. Convection is driven mainly by...

A) Electromagnetic waves
B) Bulk motion of a fluid
C) Direct molecular contact only
D) Nuclear reactions

4. A material with high thermal conductivity k is a good...

A) Insulator
B) Conductor of heat
C) Radiator only
D) Vacuum

5. Find the heat conduction rate through a glass window (k = 0.8 W/mK, A = 2 m, T = 20 K, thickness d = 0.005 m).

6. A copper rod (k = 400 W/mK) with cross-section 0.01 m and length 0.5 m has a 50 K temperature difference. Find the heat flow rate.

7. A wall insulation layer (k = 0.04 W/mK, A = 10 m, d = 0.1 m) separates 22C indoor air from 2C outdoor air. Find the heat loss rate.

8. Define: What is heat transfer?

9. Define: What are the three modes of heat transfer?

10. Define: What is Fourier's law?

Answer Key

1. C) Radiation - Radiation travels as electromagnetic waves and needs no medium.

2. B) Decreases heat flow - Q/t is inversely proportional to thickness d - thicker material conducts less heat for the same T.

3. B) Bulk motion of a fluid - Convection transfers heat via the bulk movement of a liquid or gas.

4. B) Conductor of heat - High k means heat passes through the material easily - a good thermal conductor.

5. Q/t = kA T / d Q/t = 0.8 2 20 / 0.005 Q/t = 32 / 0.005 = 6,400 W

6. Q/t = kA T / d Q/t = 400 0.01 50 / 0.5 Q/t = 200 / 0.5 = 400 W

7. T = 22 2 = 20 K Q/t = kA T / d Q/t = 0.04 10 20 / 0.1 Q/t = 8 / 0.1 = 80 W

8. The movement of thermal energy from a hotter region to a cooler one due to a temperature difference.

9. Conduction (contact), convection (fluid motion), and radiation (electromagnetic waves).

10. Q/t = kA T/d - the rate of conductive heat flow depends on conductivity, area, temperature difference, and thickness.