POSTAL Study Package 2019

Mechanical Engineering

Objective Practice Sets

Heat Transfer

Contents

Sl.	Topic	Page No.
1.	Introduction and Basic Concepts	2
2.	Steady State Heat Conduction	6
3.	Steady State Conduction with Internal Heat Generation	17
4.	Heat Transfer from Extended Surfaces (FINS)	22
5.	Transient Conduction	27
6.	Forced Convection	33
7.	Natural Convection	41
8.	Heat Exchangers	45
9.	Radiation Heat Transfer	53
10.	Boiling and Condensation	64

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1 CHAPTER
Introduction and Basic Concepts

Q.1 Choose the correct statement
(a) Thermal conductivity for metals decreases with increase in temperature
(b) Thermal conductivity for gases and insulating material decreases with increase in temperature
(c) Thermal conductivity is not a function of temperature
(d) Thermal conductivity increases with increase in temperature irrespective of material

Q.2 Arrange the following substance in increasing order of thermal conductivity.
1. Copper
2. Aluminium
3. Water
4. Air

Which one of the following sequence is correct ?
(a) 4-3-2-1 (b) 4-3-1-2
(c) 3-4-2-1 (d) 3-4-1-2

Q.3 Arrangement of silver, air, aluminium and lead in order of increasing thermal conductivity at room temperature yields
(a) Air, Aluminium, Silver, Lead
(b) Air, Aluminium, Lead, Silver
(c) Lead, Air, Aluminium, Silver
(d) Air, Lead, Aluminium, Silver

[DRDO-2008]

Q.4 Consider the following materials:
1. Carbon 2. Mica
3. Bakelite 4. Fibre glass

Which of these materials are good conductors of heat, but bad conductors of electricity
(a) 1 only (b) 2 only
(c) 2 and 3 (d) 3 and 4

[UPSC JWM-2010]

Q.5 Which one of the following have a highest thermal conductivity?
(a) Boiling water (b) Steam
(c) Solid ice (d) Rain water

[UP Irrigation-2007, UPSC JWM-2010]

Q.6 Heat transmission is directly linked with the transport of medium itself, i.e., there is actual motion of heated particles during
(a) conduction only
(b) covection only
(c) radiation only
(d) conduction as well as radiation

Q.7 All the three modes of heat transmission are involved in
(a) melting of ice
(b) cooling of a small metal casting in a quenching bath
(c) heat flow through the walls of a refrigerator
(d) automobile engine equipped with a thermo-syphon cooling system

Q.8 The absorptivity of thermal radiation by a solid surface can be enhanced
(a) by polishing the surface
(b) by roughening the surface
(c) by increasing the surface area
(d) by decreasing the surface area

Q.9 Consider the following statement
1. The difference between heat transfer and thermodynamic analysis is that while former deals with rate of heat transfer and latter with transformation of energy.
2. Two isotherms can intersect each other.
3. The greatest temperature variation is in the direction tangent to the isothermal surface.

(a) All are correct
(b) 1 and 3 are correct
(c) Only 1 is correct
(d) Only 3 is correct

(a) the term (δ/KA) is called thermal resistance
(b) the term (KA/δ) is called thermal conductance
(c) the factor (Q/A) is called thermal loading
(d) the temperature gradient (dT/dx) is positive

Numerical Data Questions

N.1 A boiler furnace is made of fire brick having thickness x = 0.6 m and K = 0.8 W/mK. For the same heat loss (W/m^2) and temperature drop, another material having K = 0.16 W/mK will have its thickness _____ m.

N.2 A masonary wall (K = 0.75 W/mK) transmits 80% of heat loss through another wall (K = 0.25 W/mK, x = 100 mm). If the temperature difference across both the walls is the same, the thickness of the masonary wall would be _____ mm.

N.3 If thermal resistance of the wall is 0.058 K/W, the thermal conductance of the wall will be equal to _____ W/K.

Answers Introduction and Basic Concepts

1. (a) **2.** (a) **3.** (d) **4.** (a) **5.** (c) **6.** (b) **7.** (d) **8.** (b) **9.** (c) **10.** (d)
11. (b) **12.** (c) **13.** (c)

T.1 (b) **T.2** (c) **T.3** (d) **T.4** (c) **T.5** (c) **T.6** (d)

N.1 (0.12) **N.2** (375) **N.3** (17.24)

Explanations Introduction and Basic Concepts

1. (a)
For gases K increases with increase in temperature and decrease with increase in molecular weight.

2. (a)

Substance	K(w/m-k)
Copper	386
Aluminium	175.6
Water	0.51
Air	0.022

3. (d)
According to their thermal conductivity
for Air, K = 0.022 W/mK
for Aluminium, K = 205 W/mK
for Silver, K = 407 W/mK
Hence correct sequence is
Air, Lead, Aluminium, Silver

4. (a)
Mica, Bakelite and fibre glass are insulator material and carbon in the form of diamond is the good conductor of heat but bad conductor of electricity.

5. (c)

$$K_{water} = 0.556\ \text{W/m°C}$$
$$K_{ice} = 2.22\ \text{W/m°C}$$
$$K_{steam} = 0.0206\ \text{W/m°C}$$

10. (d)

$$q = k\frac{\Delta T}{dx} = \frac{0.51\times 25}{0.22} = 57.95\ \text{W/m}^2$$

11. (b)

$$Q = kA\frac{\Delta T}{\Delta x} = hA\Delta T$$
$$800 = 80\,(T_B - 25)$$
$$T_B = 35°\text{C}$$