c) Long range of distance
d) Very high range of distance

Answer: a
Explanation: Plastic optical cables are manufacturing for short range purposes.

8. Which of the following represents loss associated with glass fibres?
a) 3 dB/Km
b) 10 dB/Km
c) 0 dB/Km
d) 50 dB/Km

Answer: a
Explanation: Glass fibres have a net loss of 3 dB on every single kilometre.

9. Loss associated with plastic fibre is less than glass fibres.
a) True
b) False

Answer:b
Explanation: Loss associated with plastic fibre is about 100-1250 dB/Km and it is several times larger than glass fibres.

10. Cladding in glass fibre have high refractive index than the core.
a) True
b) False

Answer: b
Explanation: Cladding in glass fibre is always kept at a low refractive index than the core.

UNIT III THERMAL PHYSICS

TOPIC 3.1 TRANSFER OF HEAT ENERGY

1. The transfer of heat between two bodies in direct contact is called
a) radiation
b) convection
c) conduction
d) none of the mentioned

Answer: c
Explanation: This is the definition of conduction.

2. Heat flow into a system is taken to be ____, and heat flow out of the system is taken as ____
a) positive, positive
b) negative, negative
c) negative, positive
d) positive, negative

Answer: d
Explanation: The direction of heat transfer is taken from the high temperature system to the low temperature system.

3. In the equation, dQ=TdX
a) dQ is an inexact differential
b) dX is an exact differential
c) X is an extensive property
d) all of the mentioned

Answer: d
Explanation: This is because heat transfer is a path function.

4. The transfer of heat between a wall and a fluid system in motion is called
a) radiation
b) convection
c) conduction
d) none of the mentioned

Answer: b
Explanation: This is the definition of convection.

5. For solids and liquids, specific heat
a) depends on the process
b) is independent of the process

c) may or may not depend on the process
d) none of the mentioned

Answer: b
Explanation: It is the property of specific heat.

6. The specific heat of the substance is defined as the amount of heat required to raise a unit mass of the substance through a unit rise in temperature.
a) true
b) false

Answer: a
Explanation: c=Q/(m*Δt).

7. Heat and work are
a) path functions
b) inexact differentials
c) depend upon the path followed
d) all of the mentioned

Answer: d
Explanation: It is an important point to remember regarding heat and work transfer.

8. Latent heat is taken at
a) constant temperature
b) constant pressure
c) both of the mentioned
d) none of the mentioned

Answer: c
Explanation: The latent heat is heat transfer required to cause a phase change in a unit mass of substance at a constant pressure and temperature.

9. Which of the following is true?
a) latent heat of fusion is not much affected by pressure
b) latent heat of vaporization is highly sensitive to pressure
c) both of the mentioned
d) none of the mentioned

Answer: c
Explanation: It is a general fact about latent heat.

10. Heat transfer and work transfer are
a) boundary phenomena
b) energy interactions
c) energy in the transit
d) all of the mentioned

Answer: d
Explanation: It is an important point to remember regarding heat and work transfer.

TOPIC 3.2 THERMAL EXPANSION OF SOLIDS AND LIQUIDS

1. A faulty thermometer has its fixed points marked as 5° and 95°. The temperature of a body as measured by the faulty thermometer is 59°. Find the correct temperature of the body on a Celsius scale.
a) 60°C
b) 40°C
c) 20°C
d) 0°C

Answer: a
Explanation: $(T_C-0)/(100-0)$=(Temperature on faulty scale-Lower fixed point)/(Upper fixed point-Lower fixed point)
$(T_C-0)/100=(59-5)/(95-5)=54/90$
T_C=60°C.

2. Temperature is a microscopic concept.
a) True
b) False

Answer: b
Explanation: Temperature is a macroscopic concept. It is related to the average kinetic energy of a large number of molecules forming a system. It is not possible to define the temperature for a single molecule.

3. The thermometer bulb should have

_____

a) High heat capacity
b) No heat capacity
c) Small heat capacity
d) Varying heat capacity

Answer: c
Explanation: The thermometer bulb having small heat capacity will absorb less heat from the body whose temperature is to be measured. Hence the temperature of that body will practically remain unchanged.

4. Calorie is defined as the amount of heat required to raise the temperature of 1g of water by 1°C and it is defined under which of the following conditions?
a) From 14.5°C to 15.5°C at 760mm of Hg
b) From 98.5°C to 99.5°C at 760mm of Hg
c) From 13.5°C to 14.5°C at 76mm of Hg
d) From 3.5°C to 4.5°C at 76mm of Hg

Answer: a
Explanation: One calorie is defined as the heat required to raise the temperature of 1g of water from 14.5°C to 15.5° at 760mm of Hg.

5. Compared to burn due to air at 100°C, a burn due to steam at 100°C is _____
a) More dangerous
b) Less dangerous
c) Equally dangerous
d) Not dangerous

Answer: a
Explanation: Compared to burn due to air at 100°C, a burn due to steam at 100°C is more dangerous due to the additional heat possessed by steam.

6. 540g of ice at 0°C is mixed with 540g of water at 80°C. What is the final temperature of the mixture?
a) 0°C
b) 40°C
c) 80°C
d) Less than 0°C

Answer: a
Explanation: Heat gained by ice = Heat lost by water at 80°C
$540\times80+540\times1\times\theta=540\times1\times(80-\theta)$
$\theta=0°C$.

7. An ideal black body is thrown into a furnace. The black body is room temperature. It is observed that _____
a) Initially, it is darkest body and at later times the brightest
b) At all times it is the darkest body
c) It cannot be distinguished at all times
d) Initially, it is the darkest body and at later it cannot be distinguished

Answer: a
Explanation: Initially at lower temperature, it absorbs the entire radiations incident upon it. So, it is the darkest body. At later times, when it attains the temperature of the furnace, the black body radiates maximum energy. It appears brightest of all bodies.

8. If the sun were to increase in temperature from T to 2T and its radius from R to 2R, then the ratio of the radiant energy received on earth to what it was previously, will be _____
a) 4
b) 16
c) 32
d) 64

Answer: d
Explanation: Energy radiated by the sun per second,
$E = \sigma AT^4 = \sigma\times4\pi R^2\times T^4$
When its radius and temperature change to 2R and 2T respectively,
$E' = \sigma\times4\pi(2R)^2\times(2T)^4$
$E'/E = 64$.

9. On a hilly region, water boils at 95°C. What is the temperature expressed in Fahrenheit?
a) 100°F

b) 203°F
c) 150°F
d) 20.3°F

Answer: b
Explanation: (F-32)/9=C/5=95/5
F = 171+32 = 203°F.

10. A composite rod made of copper ($1.8\times10^{(-5)}$ $K^{(-1)}$) and steel ($\alpha=1.2\times10^{(-5)}$ $K^{(-1)}$) is heated. Then _____
a) It bends with steel on concave side
b) It bends with copper on concave side
c) It does not expand
d) Data is insufficient

Answer: a
Explanation: $\alpha_{copper}>\alpha_{steel}$
Copper expands more than steel. So rod bends with copper on convex side and steel on concave side.

11. Temperatures of two stars are in ratio 3:2. If wavelength of maximum intensity of first body is 4000 Å, what is corresponding wavelength of second body?
a) 9000 Å
b) 6000 Å
c) 2000 Å
d) 8000 Å

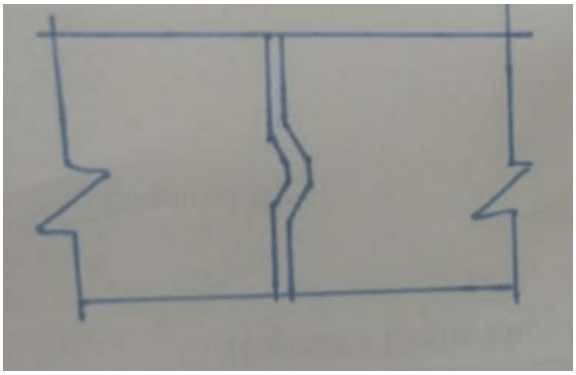
Answer: b
Explanation: $((\lambda_m)')/\lambda_m = T/T' = 3/2$
$(\lambda_m)'=3/2\ \lambda_m$
$(\lambda_m)'=3/2\times4000=6000$Å.

12. A piece of blue glass heated to a high temperature and a piece of red glass at room temperature, are taken inside a room that is dimly lit, then _____
a) The blue piece will look blue and red will look as usual
b) Red looks brighter and blue looks ordinary blue
c) Blue shines like brighter red compared to the red pieces
d) Both the pieces will look equally red

Answer: c
Explanation: According to Stefan's law, E is proportional to T^4
As the temperature of blue glass is more than that of red glass, so it will appear brighter than red glass.

TOPIC 3.3 EXPANSION JOINTS

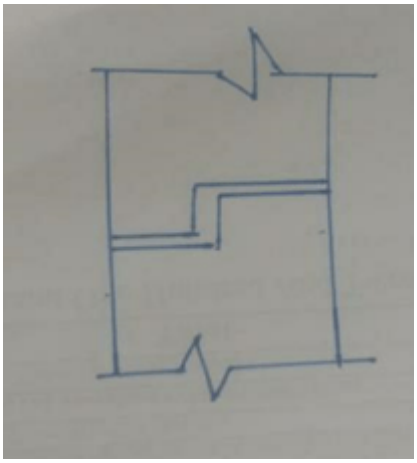
1. Identify the given joint in Concrete Structures.



a) Horizontal construction joint
b) Vertical construction joint
c) Expansion construction joint
d) Water tank joint

Answer: a
Explanation: The construction joints are provided at locations were the construction is stopped either at the end of the day or for any other reason. The provisions of the construction joint become necessary to ensure proper bond between the old work and the new work.

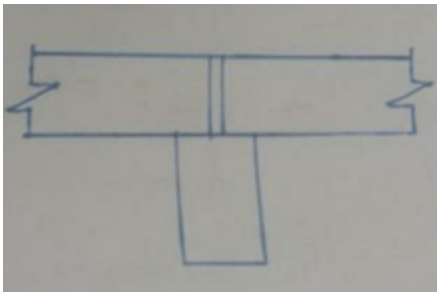
2. Identify the given joint in Concrete Structures.



a) Horizontal construction joint
b) Expansion construction joint
c) Vertical construction joint
d) Water tank joint

Answer: c
Explanation: The construction joint maybe horizontal or vertical. For an inclined or curved member of the joint should be at right angle to the axis of the member. It is necessary to determine the location of construction joints well in advance for the viewpoint of structural stability.

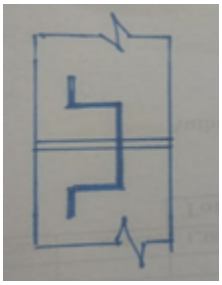
3. Identify the given type of joint in Concrete Structures.



a) L beam construction joint
b) T beam construction joint
c) Expansion joint
d) Contraction Joint

Answer: b
Explanation: In case of T-beams, the ribs should be filled with concrete first and in the slabs forming the flanges can be filled up to the centre of the ribs. If a construction joint between slab and beam becomes unavoidable especially as in the case of long and deep beams, that T beams are used.

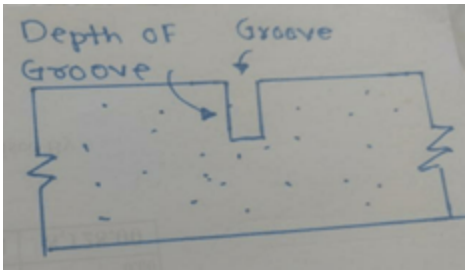
4. Identify the given joint in Concrete Structures.



a) Expansion joint
b) Contraction Joint
c) Water tank joint
d) Vertical construction joint

Answer: c
Explanation: For water tanks and other structured which store water, the strips of copper, aluminium, galvanized iron or other corrosion resistant material known as water stops or waterbars, are placed in construction joint as shown in given figure above.

5. Identify the given joint in Concrete Structures.



a) Partial contraction joint
b) Complete Contraction Joint
c) Horizontal construction joint
d) Dummy joint

Answer: d
Explanation: Above figure shows another form of contraction joint. It is also known as a dummy joint and in this case, a groove of 3 mm width is created in the concrete member to act as a joint. The groove is filled with the joint filler and its depth is about 1/3 to 1/5 of the total thickness of the member.

2. What temperature does the dark red color generally deal with?
a) 950 F
b) 1150 F
c) 1175 F
d) 1300 F

Answer: b
Explanation: Temperature of metals can be estimated by simply looking at the color of the hot body. Dark red is assigned a temperature of 1150 F, whereas for faint red, dark cherry, and cherry red it is 950 F, 1175 F, and 1300 F in that order.

3. What temperature is the dark orange color associated with?
a) 1475 F
b) 1650 F
c) 1750 F
d) 1800 F

Answer: b
Explanation: Temperature of metals can be estimated by simply looking at the color of the hot body. Dark orange is associated with a temperature of about 1150 F, while for bright cherry, orange, and yellow it is 1475 F, 1750 F, and 1800 F correspondingly.

4. Bimetallic strips are employed in _____ thermometers.
a) Vapor-pressure
b) Liquid-expansion
c) Metal-expansion
d) Resistance

Answer: c
Explanation: Bimetallic strips made by bonding of high-expansion and low-expansion metals are used in the common thermostat. When used as an industrial temperature indicator, these can be bent into a coil.

5. Bimetallic strips contain _____ as a metal.
a) Muntz metal
b) Yellow brass
c) Bronze
d) Aluminum

Answer: b
Explanation: Bimetallic strips include invar as one metal and yellow brass as another. For higher temperatures, nickel alloy can be used. These can be used in temperatures ranging from -100 F to 1000 F.

6. Why is invar used in bimetallic strips?
a) Low density
b) Low coefficient of expansion
c) High-temperature resistance
d) High abrasion resistance

Answer: b
Explanation: Most bimetallic strips are composed of invar and yellow brass as metal. Invar has the advantage of low coefficient of expansion, whereas yellow brass has the ability to be used at low temperatures.

7. _____ is commonly used in liquid-expansion thermometers.
a) Bourdon tube
b) Spinning rotor gauge
c) McLeod gauge
d) Manometer

Answer: a
Explanation: Liquid-expansion thermometers consist of a bulb and an expansible device. The bulb is exposed to the temperature that needs to be measured and usually, a Bourdon tube is used as an expansion device. These are connected by capillary tubing and are filled with a medium.

8. Resistance thermometer generally makes use of _____ for the measurement of resistance.
a) Potentiometer
b) Adruino
c) Diode bridge
d) Wheatstone bridge

Answer: d
Explanation: Resistance thermometers are based on the principle of increase in electrical resistance with increasing temperature. It consists of a resistance coil mounted in a protecting tube which is connected to a resistance measuring instrument. Generally, Wheatstone bridge is used in this process.

9. Which of these materials is not used for resistance coils?
a) Nickel
b) Copper
c) Titanium
d) Platinum

Answer: c
Explanation: Resistance coils are generally made of nickel, copper, or platinum. Nickel and copper can be used in the temperature range of 150-500 F, whereas platinum can be used between -350 to 1100 F.

10. Liquid expansion thermometers are filled with _____
a) Mercury
b) Amalgam
c) Gallium
d) Cesium

Answer: a
Explanation: The liquid-expansion thermometer has the entire system filled with an organic liquid or mercury. Mercury is used at a temperature range of -35 to 950 F. Alcohol and creosote are used at -110 to 160 F, and 20 to 400 F respectively.

TOPIC 3.5 THERMAL CONDUCTION, CONVECTION AND RADIATION

1. The sun shines on a 150 m^2 road surface so it is at 45°C. Below the 5cm thick asphalt(average conductivity of 0.06 W/m K), is a layer of rubbles at 15°C. Find the rate of heat transfer to the rubbles.
a) 5300 W
b) 5400 W
c) 5500 W
d) 5600 W

Answer: b
Explanation: There is conduction through the asphalt layer.
heat transfer rate = k A $\Delta T/\Delta x$ = 0.06 × 150 ×(45-15)/0.05
= 5400 W.

2. A pot of steel(conductivity 50 W/m K), with a 5 mm thick bottom is filled with liquid water at 15°C. The pot has a radius of 10 cm and is now placed on a stove that delivers 250 W as heat transfer. Find the temperature on the outer pot bottom surface assuming the inner surface to be at 15°C.
a) 15.8°C
b) 16.8°C
c) 18.8°C
d) 19.8°C

Answer: a
Explanation: Steady conduction, Q = k A $\Delta T/\Delta x \Rightarrow \Delta T = Q \Delta x / kA$
$\Delta T = 250 \times 0.005/(50 \times \pi/4 \times 0.2^2) = 0.796$
T = 15 + 0.796 = 15.8°C.

3. A water-heater is covered with insulation boards over a total surface area of 3 m^2. The inside board surface is at 75°C and the outside being at 20°C and the conductivity of material being 0.08 W/m K. Find the thickness of board to limit the heat transfer loss to 200 W ?
a) 0.036 m
b) 0.046 m
c) 0.056 m
d) 0.066 m

Answer: d
Explanation: Steady state conduction through board.

$Q = k\ A\ \Delta T/\Delta x \Rightarrow \Delta T = Q\ \Delta x\ /\ kA$
$\Delta x = 0.08 \times 3 \times (75 - 20)/200 = 0.066$ m.

4. On a winter day with atmospheric air at −15°C, the outside front wind-shield of a car has surface temperature of +2°C, maintained by blowing hot air on the inside surface. If the wind-shield is 0.5 m^2 and the outside convection coefficient is 250 W/Km^2, find the rate of energy loss through front wind-shield.
a) 125 W
b) 1125 W
c) 2125 W
d) 3125 W

Answer: c
Explanation: Q (conv) = h A ΔT = 250 × 0.5 × [2 − (−15)] = 250 × 0.5 × 17 = 2125 W.

5. A large heat exchanger transfers a total of 100 MW. Assume the wall separating steam and seawater is 4 mm of steel, conductivity 15 W/m K and that a maximum of 5°C difference between the two fluids is allowed. Find the required minimum area for the heat transfer.
a) 180 m^2
b) 280 m^2
c) 380 m^2
d) 480 m^2

Answer: d
Explanation: Steady conduction
$Q = k\ A\ \Delta T/\Delta x \Rightarrow A = Q\ \Delta x\ /\ k\Delta T$
A = 100 × 10^6 × 0.004 / (15 × 5) = 480 m^2.

6. The black grille on the back of a refrigerator has a surface temperature of 35°C with a surface area of 1 m^2. Heat transfer to the room air at 20°C takes place with convective heat transfer coefficient of 15 W/Km^2. How much energy is removed during 15 minutes of operation?
a) 202.5 kJ
b) 212.5 kJ
c) 222.5 kJ
d) 232.5 kJ

Answer: a
Explanation: Q = hA ΔT Δt, Q = 15 × 1 × (35-20)×15×60 = 202500 J = 202.5 kJ.

7. A small light bulb (25 W) inside a refrigerator is kept on and 50 W of energy from the outside seeps into the refrigerated space. How much of temperature difference to the ambient(at 20°C) must the refrigerator have in its heat exchanger having an area of 1 m^2 and heat transfer coefficient of 15 W/Km^2 to reject the leak of energy.
a) 0°C
b) 5°C
c) 10°C
d) 15°C

Answer: b
Explanation: Total energy that goes out = 50+25 = 75 W
75 = hAΔT = 15 × 1 × ΔT hence ΔT = 5°C.

8. As the car slows down, the brake shoe and steel drum continuously absorbs 25 W. Assume a total outside surface area of 0.1 m^2 with a convective heat transfer coefficient of 10 W/Km^2 to the air at 20°C. How hot does the outside brake and drum surface become when steady conditions are reached?
a) 25°C
b) 35°C
c) 45°C
d) 55°C

Answer: c
Explanation: ΔT = heat / hA hence ΔT = [T(BRAKE) − 20] = 25/(10 × 0.1) = 25°C
T(BRAKE) = 20 + 25 = 45°C.

9. A burning wood in the fireplace has a surface temperature of 450°C. Assume the emissivity to be 1 and find the radiant emission of energy per unit area.
a) 15.5 kW/m^2

b) 16.5 kW/m^2
c) 17.5 kW/m^2
d) 18.5 kW/m^2

Answer: a
Explanation: Q /A = 1 × σ T^4
= 5.67 × 10^{-8}×(273.15 + 450)^4
= 15505 W/m^2 = 15.5 kW/m^2.

10. A radiant heat lamp is a rod, 0.5 m long, 0.5 cm in diameter, through which 400 W of electric energy is deposited. Assume the surface emissivity to be 0.9 and neglecting incoming radiation, find the rod surface temperature?
a) 700K
b) 800K
c) 900K
d) 1000K

Answer: d
Explanation: Outgoing power equals electric power
T^4= electric energy / εσA
= 400 / (0.9 × 5.67 ×10^{-8}× 0.5 × π × 0.005)
= 9.9803 ×10^11 K^4 ⇒ T = 1000K.

11. A water-heater is covered up with insulation boards over a total surface area of 3 m^2. The inside board surface is at 75°C and the outside surface is at 20°C and the board material has a conductivity of 0.08 W/m K. How thick a board should it be to limit the heat transfer loss to 200 W ?
a) 0.066 m
b) 0.166 m
c) 0.266 m
d) 0.366 m

Answer: a
Explanation: Steady state conduction through a single layer board.
Δx = kA(ΔT)/Q
Δx = (0.08*3)*(75-20)/200 = 0.066 m.

12. Find the rate of conduction heat transfer through a 1.5 cm thick hardwood board, k = 0.16 W/m K, with a temperature difference between the two sides of 20°C.
a) 113 W/m^2
b) 213 W/m^2
c) 230 W/m^2
d) 312 W/m^2

Answer: b
Explanation: . q = .Q/A = k ΔT/Δx = 0.16 Wm /K × 20K/0.015 m = 213 W/m^2.

13. A 2 m^2 window has a surface temperature of 15°C and the outside wind is blowing air at 2°C across it with a convection heat transfer coefficient of h = 125 W/m2K. What is the total heat transfer loss?
a) 2350 W
b) 1250 W
c) 2250 W
d) 3250 W

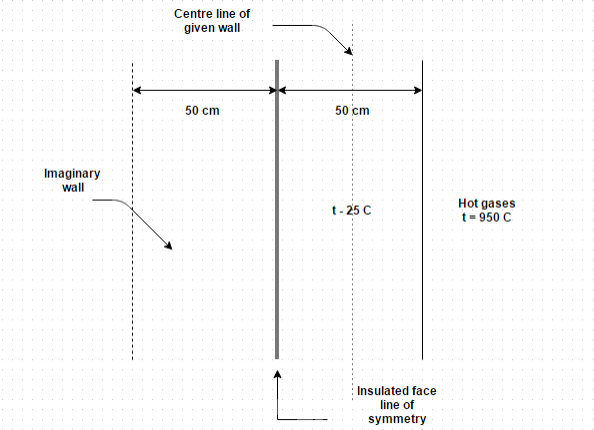
Answer: d
Explanation: .Q = h A ΔT = 125 W/m2K × 2 m2 × (15 – 2) K = 3250 W.

14. A radiant heating lamp has a surface temperature of 1000 K with ε = 0.8. How large a surface area is needed to provide 250 W of radiation heat transfer?
a) 0.0035 m2
b) 0.0045 m2
c) 0.0055 m2
d) 0.0065 m2

Answer: c
Explanation: .Q = εσAT^4
A = .Q/(εσT4) = 250/(0.8 × 5.67 × 10-8 × 10004)
= 0.0055 m^2.

TOPIC 3.6 HEAT CONDUCTIONS IN SOLIDS

1. A flat wall of fire clay, 50 cm thick and initially at 25 degree Celsius, has one of its faces suddenly exposed to a hot gas at 950 degree Celsius. If the heat transfer coefficient on the hot side is 7.5 W/m^2 K and the other face of the wall is insulated so that no heat passes out of that face, determine the time necessary to raise the center of the wall to 350 degree Celsius. For fire clay brick



Thermal conductivity = 1.12 W/m K
Thermal diffusivity = 5.16 * 10^{-7} m^2/s
a) 43.07 hours
b) 53.07 hours
c) 63.07 hours
d) 73.07 hours

Answer: a
Explanation: $t - t_a/t_0 - t_a = 0.86$. Also, $\alpha T/l^2 = 0.32$.

2. Glass spheres of 2 mm radius and at 500 degree Celsius are to be cooled by exposing them to an air stream at 25 degree Celsius. Find maximum value of convective coefficient that is permissible. Assume the following property values
Density = 2250 kg/m^3
Specific heat = 850 J/kg K
Conductivity = 1.5 W/m K
a) 245 W/m^2K
b) 235 W/m^2K
c) 225 W/m^2K
d) 215 W/m^2K

Answer: c
Explanation: l = volume/surface area = r/3. So, h = (0.1) (k) (3)/r.

3. The transient response of a solid can be determined by the equation. (Where, P is density, V is volume, c is specific heat and A is area)
a) $-4 p V c = h A (t - t_0)$
b) $-3 p V c = h A (t - t_0)$
c) $-2 p V c = h A (t - t_0)$
d) $-p V c = h A (t - t_0)$

Answer: d
Explanation: It can be determined by relating rate of change of internal energy with conductive heat exchange at the surface.

4. A 2 cm thick steel slab heated to 525 degree Celsius is held in air stream having a mean temperature of 25 degree Celsius. Estimate the time interval when the slab temperature would not depart from the mean value of 25 degree Celsius by more than 0.5 degree Celsius at any point in the slab. The steel plate has the following thermal physical properties
Density = 7950 kg/m^3
C_P = 455 J/kg K
K = 46 W/m K
a) 6548 s
b) 6941 s
c) 4876 s
d) 8760 s

Answer: b
Explanation: $t - t_a/t_I - t_a$ = exponential (- h A T/p V c). Now A/V = 100 per meter.

5. An average convective heat transfer coefficient for flow of air over a sphere has been measured by observing the temperature-time history of a 12 mm diameter copper sphere (density = 9000 kg/m^3 and c = 0.4 k J/kg K) exposed to air at 30 degree Celsius. The temperature of the sphere was measured

by two thermocouples one located at the center and the other near the surface. The initial temperature of the ball was 75 degree Celsius and it decreased by 10 degree Celsius in 1.2 minutes. Find the heat transfer coefficient

a) 27.46 W/m^2 K

b) 21.76 W/m^2 K

c) 29.37 W/m^2 K

d) 25.13 W/m^2 K

Answer: d

Explanation: $t - t_a/t_I - t_a$ = exponential (- h A T/p V c). So, h = 25.13 W/m^2 K.

6. Transient condition means

a) Conduction when temperature at a point varies with time

b) Very little heat transfer

c) Heat transfer with a very little temperature difference

d) Heat transfer for a short time

Answer: a

Explanation: The term transient or unsteady state designates a phenomenon which is time dependent.

7. Which of the following is not correct in a transient flow process?

a) The state of matter inside the control volume varies with time

b) There can be work and heat interactions across the control volume

c) There is no accumulation of energy inside the control volume

d) The rate of inflow and outflow of mass are different

Answer: c

Explanation: In transient heat conduction there is accumulation of energy inside the control volume.

8. A cylindrical stainless steel (k = 25 W/m K) ingot, 10 cm in diameter and 25 cm long, passes through a heat treatment furnace which is 5 meter in length. The initial ingot temperature is 90 degree Celsius, the furnace gas is at 1260 degree Celsius and the combined radiant and convective surface coefficient is 100 W/m^2 K. Determine the maximum speed with which the ingot moves through the furnace if it must attain 830 degree Celsius temperature. Take thermal diffusivity as 0.45 * 10^{-5} m^2/s

a) . 000116 m/s

b) .000216 m/s

c) . 000316 m/s

d) . 000416 m/s

Answer: b

Explanation: $t - t_a/t_I - t_a$ = exponential (- h A T/p V c). Now, A/V = 2(r + L)/r L = 0.48 per cm. Also, T = 1158.53 second so required velocity is 0.25/1158.53.

9. The curve for unsteady state cooling or heating of bodies is

a) Hyperbolic curve asymptotic both to time and temperature axis

b) Exponential curve asymptotic both to time and temperature axis

c) Parabolic curve asymptotic to time axis

d) Exponential curve asymptotic to time axis

Answer: d

Explanation: α/α_0 = exponential [- h A T/p c V], which represents an exponential curve.

10. What is the wavelength band for TV rays?

a) 1 * 10^3 to 34 * 10^{10} micron meter

b) 1 * 10^3 to 2 * 10^{10} micron meter

c) 1 * 10^3 to 3 * 10^{10} micron meter

d) 1 * 10^3 to 56 * 10^{10} micron meter

Answer: b

Explanation: This is the maximum and minimum wavelength for TV rays.

TOPIC 3.7 THERMAL CONDUCTIVITY

TOPIC 3.8 FORBE'S AND LEE'S DISC METHOD: THEORY AND EXPERIMENT

1. Thermal conductivity is defined as the heat flow per unit time
a) When the temperature gradient is unity
b) Across the wall with no temperature
c) Through a unit thickness of the wall
d) Across unit area where the temperature gradient is unity

Answer: d
Explanation: Thermal conductivity of a material is because of migration of free electrons and lattice vibrational waves.

2. Mark the matter with least value of thermal conductivity
a) Air
b) Water
c) Ash
d) Window glass

Answer: a
Explanation: For air, it is .024 W/ m degree i.e. lowest.

3. Which one of the following forms of water have the highest value of thermal conductivity?
a) Boiling water
b) Steam
c) Solid ice
d) Melting ice

Answer: c
Explanation: For ice, it is 2.25 W/m degree i.e. maximum.

4. The average thermal conductivities of water and air conform to the ratio
a) 50:1
b) 25:1
c) 5:1
d) 15:1

Answer: b
Explanation: For water, it is 0.55-0.7 W/m degree and for air it is .024 W/m degree.

5. Identify the very good insulator
a) Saw dust
b) Cork
c) Asbestos sheet
d) Glass wool

Answer: d
Explanation: Glass wool has a lowest thermal conductivity of 0.03 W/m degree amongst given option.

6. Most metals are good conductor of heat because of
a) Transport of energy
b) Free electrons and frequent collision of atoms
c) Lattice defects
d) Capacity to absorb energy

Answer: b
Explanation: For good conductors, there must be electrons that are free to move.

7. Heat conduction in gases is due to
a) Elastic impact of molecules
b) Movement of electrons
c) EM Waves
d) Mixing of gases

Answer: a
Explanation: If there is elastic collision then after sometime molecules regain its natural position.

8. The heat energy propagation due to conduction heat transfer will be minimum for
a) Lead
b) Water
c) Air
d) Copper

Answer: c
Explanation: It is because air has lowest

value of thermal conductivity amongst given options.

9. Cork is a good insulator because
a) It is flexible
b) It can be powdered
c) Low density
d) It is porous

Answer: d
Explanation: Cork has thermal conductivity in the range of 0.05-0.10 which is very low so it can be porous.

10. Choose the false statement
a) For pure metal thermal conductivity is more
b) Thermal conductivity decreases with increase in the density of the substance
c) Thermal conductivity of dry material is lower than that of damp material
d) Heat treatment causes variation in thermal conductivity

Answer: b
Explanation: Thermal conductivity increase with increase in the density of a substance.

TOPIC 3.9 CONDUCTION THROUGH COMPOUND MEDIA (SERIES AND PARALLEL)

1. A composite wall generally consists of
a) One homogenous layer
b) Multiple heterogeneous layers
c) One heterogeneous layer
d) Multiple homogenous layers

Answer: b
Explanation: Walls of houses where bricks are given a layer of plaster on either side.

2. Three metal walls of the same thickness and cross sectional area have thermal conductivities k, 2k and 3k respectively. The temperature drop across the walls (for same heat transfer) will be in the ratio
a) 3:2:1
b) 1:1:1
c) 1:2:3
d) Given data is insufficient

Answer: a
Explanation: As, $\delta_1 = \delta_2 = \delta_3$ and cross sectional areas are same i.e. temperature drop varies inversely with thermal conductivity.

3. A composite wall is made of two layers of thickness δ_1 and δ_2 having thermal conductivities k and 2k and equal surface area normal to the direction of heat flow. The outer surface of composite wall are at 100 degree Celsius and 200 degree Celsius. The minimum surface temperature at the junction is 150 degree Celsius. What will be the ratio of wall thickness?
a) 1:1
b) 2:1
c) 1:2
d) 2:3

Answer: c
Explanation: $Q = k_1 A_1 d t_1 / \delta_1 = k_2 A_2 d t_2 / \delta_2$ Also areas are same.

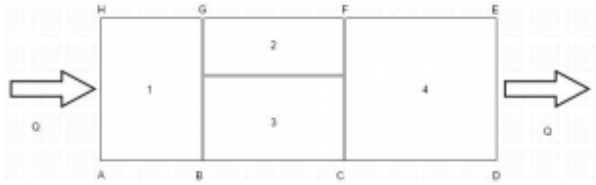
4. Let us say thermal conductivity of a wall is governed by the relation $k = k_0 (1 + \alpha t)$. In that case the temperature at the mid-plane of the heat conducting wall would be
a) Av. of the temperature at the wall faces
b) More than average of the temperature at the wall faces
c) Less than average of the temperature at the wall faces
d) Depends upon the temperature difference between the wall faces

Answer: b
Explanation: k_0 is thermal conductivity at 0 degree Celsius. Here β is positive so it is more than average of the temperature at the wall faces.

5. Heat is transferred from a hot fluid to a cold one through a plane wall of thickness (δ), surface area (A) and thermal conductivity (k). The thermal resistance is
a) $1/A\ (1/h_1 + \delta/k + 1/h_2)$
b) $A\ (1/h_1 + \delta/k + 1/h_2)$
c) $1/A\ (h_1 + \delta/k + h_2)$
d) $A\ (h_1 + \delta/k + 1/h_2)$

Answer: a
Explanation: Net thermal resistance will be summation of resistance through plane wall and from left side and right side of the wall.

6. Find the heat flow rate through the composite wall as shown in figure. Assume one dimensional flow and take



$k_1 = 150$ W/m degree
$k_2 = 30$ W/m degree
$k_3 = 65$ W/m degree
$k_4 = 50$ W/m degree
AB = 3 cm, BC = 8 cm and CD = 5 cm. The distance between middle horizontal line from the top is 3 cm and from the bottom is 7 cm
a) 1173.88 W
b) 1273.88 W
c) 1373.88 W
d) 1473.88 W

Answer: b
Explanation: $Q = d\ t/\ R_T$. $R_T = R_1 + R_{eq} + R_2 = 0.02 + 0.01469 + 0.1 = 0.2669$ degree/W.

7. A pipe carrying steam at 215.75 degree Celsius enters a room and some heat is gained by surrounding at 27.95 degree Celsius. The major effect of heat loss to surroundings will be due to
a) Conduction
b) Convection
c) Radiation
d) Both conduction and convection

Answer: c
Explanation: As there is temperature difference so radiation suits well.

8. "Radiation cannot be affected through vacuum or space devoid of any matter". True or false
a) True
b) False

Answer: b
Explanation: It can be affected only by air between molecules and vacuum of any matter.

9. A composite slab has two layers having thermal conductivities in the ratio of 1:2. If the thickness is the same for each layer then the equivalent thermal conductivity of the slab would be
a) 1/3
b) 2/3
c) 2
d) 4/3

Answer: d
Explanation: 2(1) (2)/1+2 = 4/3.

10. A composite wall of a furnace has two layers of equal thickness having thermal conductivities in the ratio 2:3. What is the ratio of the temperature drop across the two layers?
a) 2:3
b) 3:2
c) 1:2
d) $\log_e 2 : \log_e 3$

Answer: b
Explanation: We know that temperature is inversely proportional to thermal conductivity, so the ratio is 2:3.

TOPIC 3.10 THERMAL INSULATION

1. According to Indian Standards, it is recommended that the overall thermal transmittance of a roof should not be more than _____ kcal/m^2 h deg C.
a) 2.00
b) 5.00
c) 7.00
d) 9.00

Answer: a
Explanation: According to Indian Standards, it is recommended that the overall thermal transmittance of a roof should not be more than 2.00 kcal/m^2 h deg C. It is also recommended that the thermal dampness of a roof should be less than 75%.

2. The process of direct transmission of heat through a material is known as _____
a) Conduction
b) Radiation
c) Thermal insulation
d) Thermal energy

Answer: a
Explanation: The process of direct transmission of heat through a material is known as conduction. The amount of heat transfer by this process depends on various factors like temperature difference, the conductivity of the medium, the time for which the flow takes place etc.

3. Thermal insulation keeps the room cool in winters and hot in summers.
a) True
b) False

Answer: b
Explanation: Thermal insulation keeps the room hot in winters and cool in summers which results in comfortable living. It minimises heat transfer and helps in saving fuel to maintain the desired temperature in the room.

4. The amount of heat flow through a unit area of material of unit thickness in one hour, when the temperature difference is maintained at 1°C is known as _____ of the material.
a) Thermal conductivity
b) Thermal resistivity
c) Thermal conductance
d) Thermal resistance

Answer: a
Explanation: The amount of heat flow through a unit area of material of unit thickness in one hour, when the temperature difference is maintained at 1°C is known as the thermal conductivity. It is denoted by k. Its units are W/(mK).

5. The reciprocal of thermal conductivity is known as _____
a) Thermal conductance
b) Surface resistance
c) Specific conductance
d) Thermal resistivity

Answer: d
Explanation: The reciprocal of thermal conductivity is known as thermal resistivity. It is given by 1/k. Its units are (mK)/W.

6. Which of the following is the correct relationship between thermal resistance and thermal conductivity?
a) R = k/L
b) R = k.L
c) R = L/k
d) R = L^2/k

Answer: c
Explanation: Thermal resistance and thermal conductivity are related by the equation R = L/k. Here, R is the thermal resistance, k is the thermal conductivity and L is the thickness. Thermal resistance is the reciprocal of thermal conductance.

7. Surface resistance is the reciprocal of _____
a) Surface coefficient
b) Surface resistivity
c) Surface conductance
d) Surface conductivity

Answer: a
Explanation: Surface resistance is the reciprocal of the surface coefficient. It is given by 1/f where f denotes the surface coefficient. Its units are $(m^2K)/W$.

8. Thermal damping is given by the equation D = (T-t/T) x 100. Here, T denotes _____
a) Outside temperature range
b) Inside temperature range
c) Total outside and inside temperature range
d) Thickness

Answer: a
Explanation: Thermal damping is given by the equation D = (T-t/T) x 100. Here, T denotes outside temperature range and t denotes inside temperature range. Also, thermal damping is denoted by D.

9. Which of the following is the correct relation between thermal transmittance and thermal time constant?
a) T = Q x U
b) T = k/U
c) T = Q/U
d) T = U/Q

Answer: c
Explanation: Thermal transmittance and thermal time constant are related by the equation T = Q/U. Here, T denotes the thermal time constant, U is the thermal transmittance and Q is the quantity of heat stored.

10. Which of the following is not a quality of a good thermal insulating material?
a) It should be durable
b) It should have a low thermal resistance
c) It should be readily available
d) It should be fireproof

Answer: b
Explanation: A good thermal insulating material should be durable. It should have high thermal resistance. It should be fireproof and readily available.

11. Reflective sheet materials used as thermal insulating material have _____ reflectivity and _____ emissivity.
a) High, high
b) High, low
c) Low, low
d) Low, high

Answer: b
Explanation: Reflective sheet materials used as thermal insulating material have high reflectivity and low emissivity. Because of this property, it offers high heat resistance.

12. Thermal insulation of roofs can be obtained by covering the top exposed surface of the roof with _____
a) 2.5 cm thick layer of mud mortar
b) 2.5 cm thick layer of coconut pitch cement concrete
c) 7.5 cm thick layer of mud mortar
d) 7.5 m thick layer of coconut pitch cement concrete

Answer: b
Explanation: Thermal insulation of roofs can be obtained by covering the top exposed surface of the roof with 2.5 cm thick layer of coconut pitch cement concrete. Coconut pitch cement concrete is prepared by mixing coconut pitch with water and cement.

13. Presence of moisture in the thermal insulating material increases thermal insulation while the presence of air spaces decreases thermal insulation.
a) True
b) False

Answer: b
Explanation: Presence of moisture in the thermal insulating material decreases thermal insulation while the presence of air spaces increases thermal insulation. The choice of the thermal insulating material depends on various factors like cost of material, area to be covered, coat of heating or cooling, etc.

14. According to the Indian Standards, it is recommended that thermal damping of a wall should not be less than _____
a) 40%
b) 50%
c) 60%
d) 80%

Answer: c
Explanation: According to the Indian Standards, it is recommended that the thermal damping of a wall should not be less than 60%. Hence, it is also recommended that the thermal time constant should not be less than 16 h.

15. According to Indian Standards, overall thermal transmittance of a wall should not be more than _____ kcal/m^2 h deg C.
a) 1.3
b) 2.2
c) 3.7
d) 4.6

Answer: b
Explanation: According to Indian Standards, overall thermal transmittance of a wall should not be more than 2.2 kcal/m^2 h deg C. Heat insulation of exposed walls can be achieved by increasing the thickness of the wall.

TOPIC 3.11 APPLICATIONS: HEAT EXCHANGERS, REFRIGERATORS, OVENS AND SOLAR WATER HEATERS.

1. What is solar water heater?
a) Use solar energy to heat water
b) Use solar energy to generate current which is then used to heat water
c) Use water to generate heat
d) Use solar energy to generate steam

Answer: a
Explanation: Solar water heater is a system that converts sunlight into heat. This heat is then used to heat water. As the water gets heated, steam may be produced but the purpose of solar water is to heat water and not produce steam. It does not generate current.

2. Which of the following determines complexity and size of solar water heating system?
a) Food
b) Changes in ambient temperature
c) Chemicals
d) Solar radiation constant

Answer: b
Explanation: Changes in ambient temperature during day-night cycle is one of the factors that determines the complexity and size of solar water heating system. Food, chemicals and solar radiation constant does not influence the complexity and size of the system.

3. What is freeze protection in a solar water heating system?
a) Ensures that the system is frozen
b) Prevents the operation of drainback system
c) Prevents damage to system due to freezing of transfer fluid
d) Ensures that the transfer fluid is frozen

Answer: c
Explanation: Freeze protection in a solar water system prevents the system being damaged due to freezing of transfer fluid. It does not prevent the operation of drainback system.

4. What are drainback systems in solar water heating system?
a) The system that reverses the direction of flow of transfer fluid
b) The system that tracks the sun
c) The system that pumps excess transfer fluid
d) The system that drains the transfer fluid

Answer: d
Explanation: Drainback systems are systems that drain the transfer fluid particularly to ensure freeze protection. This prevents the freezing of transfer fluid and any unwanted damage to the system.

5. How does freeze-tolerance work?
a) By expansion of pipes carrying transfer fluid
b) By compression of pipes carrying transfer fluid
c) By increasing the temperature of pipes carrying transfer fluid
d) By increasing the pressure inside pipes carrying transfer fluid

Answer: a
Explanation: Freeze-tolerance works by expansion of pipes carrying the transfer fluid. The low pressure pipes are made of silicone rubber that expands on freezing.

6. Which of the following metals are used to make pipes of low cost solar water heating system?
a) Gold
b) Copper
c) Polymer
d) Silver

Answer: b
Explanation: Copper is used to make pipes of low cost solar water heating systems. Though silver and gold are good thermal conductors they are expensive. Polymer is not a metal.

7. Direct solar water heating systems _____
a) offer great overheating protection
b) are called pumped systems
c) offer no overheating protection
d) offer great freeze protection

Answer: c
Explanation: Direct solar water heating systems are also called compact systems. They offer little or no overheating protection unless they have a heat export pump.

8. How is the heat transferred from transfer fluid to potable water in indirect solar water heating systems?
a) By directly exposing the substance to sunlight
b) By using an electrical heater
c) By circulating potable water through the collector
d) By using heat exchanger

Answer: d
Explanation: An indirect solar water heating system uses a heat exchanger to transfer heat from the transfer fluid to the potable water. It does not expose the transfer fluid directly to the sunlight and does not use an electrical heater.

9. How is water heated in a direct solar water heating system?
a) By circulating potable water through the collector
b) By directly exposing water to sunlight
c) By using convection from a different transfer fluid
d) By using heat exchanger

Answer: a
Explanation: In a direct solar water heating system, the potable water is the transfer fluid. Hence, it is heated by circulating through the collector. Indirect solar water heating systems use a heat exchanger.

10. Passive systems rely on heat-driven convection.

a) False
b) True

Answer: b
Explanation: Passive systems rely on heat-driven convection. If not, they also use heat pipes to circulate the working fluid through the collector and heat it. Hence, they are cheap and are easily maintained.

11. Which of the following is an example of direct solar water heating system?
a) Pressurised antifreeze system
b) Pumped systems to circulate transfer fluid
c) Convection heat storage system
d) Drainback system

Answer: c
Explanation: Convection heat storage system is similar to an integrated collector storage system. Both these systems are examples of direct solar water heating systems.

12. How is the heat transfer fluid (HTF) heated in bubble pump systems?
a) By subjecting the closed HTF circuit to high pressure
b) By subjecting the closed HTF circuit to high pressure and by increasing the volume
c) By subjecting the closed HTF circuit to low pressure and by decreasing the volume
d) By subjecting the closed HTF circuit to low pressure

Answer: d
Explanation: In a bubble pump system, the heat transfer fluid circuit is subjected to a low pressure. This causes the liquid to boil at low temperatures as the sun heats it. The volume is not changed.

13. Batch collectors reduce heat loss by thermally insulating the storage tank.
a) True
b) False

Answer: a
Explanation: Batch collectors reduce heat loss by thermally insulating the storage tank. This is done by covering the tank in a glass-topped box that allows heat from sun to reach the water tank and traps it – greenhouse effect.

14. Overheat protection is done by passing hot water through collector during night.
a) False
b) True

Answer: b
Explanation: Overheat protection is done by passing hot water through collector during night or when there is less sunlight. This is extremely effective in direct or thermal store plumbing and ineffective in evacuated-tube collectors.

UNIT IV QUANTUM PHYSICS

TOPIC 4.1 BLACK BODY RADIATION

1. As the wavelength of the radiation decreases, the intensity of the black body radiations _____
a) Increases
b) Decreases
c) First increases then decrease
d) First decreases then increase

Answer: c
Explanation: In the case of Black Body radiations, as the body gets hotter the wavelength of the emitted radiation decreases. However, the intensity first increases up to a specific wavelength than starts decreasing, as the wavelength continues to decrease.