Unit 9 - Week 7

Assignment 7

The due date for submitting this assignment has passed.
As per our records you have not submitted this assignment.

Due on 2019-09-18, 23:59 IST.

1) For heat to flow down the thermal gradient, the entropy change should be — *1 point*

- ≤ 0
- =0
- ≥ 0
- > 0

No, the answer is incorrect.
Score: 0
Accepted Answers:
≥ 0

2) One-dimensional steady state heat conduction takes place through a solid whose cross-sectional area varies linearly in the direction of heat transfer. Assume there is no heat generation in the solid and the thermal conductivity of the material is constant and independent of temperature. The temperature distribution in the solid is — *1 point*

- Quadratic
- Exponential
- Logarithmic
- Linear

No, the answer is incorrect.
Score: 0
Accepted Answers:
Logarithmic

3) The dimensions of thermal diffusivity is given by — *1 point*

- $[MLT^{-3}K^{-1}]$
- $[L^2T^{-1}]$
- $[ML^2T^{-1}]$
- $[ML^2T^{-2}]$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$[L^2T^{-1}]$

4) Steady one-dimensional heat conduction takes place across the faces 1 and 3 of a composite slab consisting of slabs A and B in perfect contact as shown in the figure, where k_A, k_B denote the respective thermal conductivities. Using the data as given in the figure,the interface temperature T_2 (in °C).....

Figure 1: Composite Slab

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 67,68

5) Find the thermal conductivity of a sheet of area 150mmx150mm and 10 mm thick, if during a four-hour period $5.2 \times 10^7 J$ heat is conducted through the thickness of the sheet when the two faces are at 298 K and 308 K..... — *1 point*

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 0.16,0.17

6) The temperature profile (T in Kelvin) of an arc weld across its width is given as $T = 2000exp(0.3x^2)$ where x (in mm) is the distance from the weld centre. The melting point of the base material is 1500 K. The width of the fusion zone is..... (in mm correct to 2 decimal places) — *1 point*

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 0,8.1

7) The lining of a box-type furnace is made up of a refractory layer and steel plate as shown in the figure. Steady state temperature at the surface of the refractory is $1273 K$ and that at the outer steel surface is $473 K$. If the steady-state heat flux through the refractory-steel plate composite is $16000 W.m^{-2}$,and heat flow is along x-direction, the thermal contact resistance ($W^{-1}.m^2.K$) between refractory and steel is given by ..... — *1 point*

Given data: Thermal conductivity of refractory = $1.2 W.m^{-1}K^{-1}$,Thickness of refractory lining = 80 mm, Thermal conductivity of steel = $32 W.m^{-1}K^{-1}$, Thickness of steel plate = 4 mm

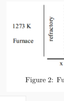

Figure 2: Furnace Wall

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 0.42,0.44

8) At the mould exit of a continuous caster, the metal consisting of a solidified shell with a liquid metal core exits at the rate of $35 kg s^{-1}$. Given that the latent heat of fusion is $3 \times 10^5 J kg^{-1}$ and the total rate of heat removal by the mould is $4.2 \times 10^6 W$, the mass fraction of solid at the mould exit is ....(correct upto 2 decimal points).Assume that both solid and liquid remain at the melting point while they are in the mould. — *1 point*

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 0.38,0.41

9) A brick wall $k = 0.59 W m^{-1} K^{-1}$ of thickness 0.18 m separates the warm air in a room from the cold ambient air. On a particular winter day, the outside air temperature is $-5°C$ and the room needs to be maintained at $27°C$. The heat transfer coefficient associated with outside air is $20 W m^{-2} K^{-1}$. Neglecting the convective resistance of the air inside the room, the heat loss, in ($W m^{-2}$), is ... — *1 point*

- 88
- 110
- 128
- 160

No, the answer is incorrect.
Score: 0
Accepted Answers:
128

10) Steady-state radial heat conduction. through a hollow infinitely long zirconia cylinder is governed by the following ordinary differential equation

$$\frac{1}{r}\frac{d}{dr}\left(kr\frac{dT}{dr}\right) = 0$$

where T and r are the temperature and radial distance. The inner surface of the hollow cylinder is maintained at $1473 K$, and outer surface is at $973 K$. The rate of heat loss per unit length through the outer surface of the hollow cylinder (in $W m^{-1}$ rounded off to the nearest integer) is .... Given: Inner radius is 0.05 m , outer radius is 0.07 m and the thermal conductivity of zirconia is $k = 2 W m^{-1} m^{-1}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 18660,18690

11) A slender rod of length L, diameter d, ($L >> d$) with a thermal conductivity k_1 is joined with another rod of identical dimensions but with a different thermal conductivity K_2 , to form a composite cylindrical rod of length $2L$. The heat transfer in radial direction and contact resistance are negligible.The effective thermal conductivity of the composite rod is — *1 point*

- $k_1 + k_2$
- $\sqrt{k_1 k_2}$
- $\frac{k_1 k_2}{k_1 + k_2}$
- $\frac{2k_1 k_2}{k_1 + k_2}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\frac{2k_1 k_2}{k_1 + k_2}$

12) In a composite slab, the temperature at the interface (T_{inter}) between two materials is equal to the average of the temperatures at the two ends. Assuming steady one-dimensional heat conduction, which of the following statements is true about the respective thermal conductivities? — *1 point*

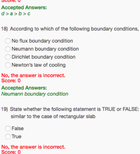

Figure 3: Composite Slab

- $k_1 = k_2$
- $k_2 = 2k_1$
- $k_1 = 2k_2$
- $2k_1 = 3k_2$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$k_1 = 2k_2$

13) Two insulting materials of thermal conductivity K and 2K are available for lagging a pipe carrying a hot fluid. If the radial thickness of each material is same — *1 point*

- Material with higher thermal conductivity should be used for inner layer and the material with lower thermal conductivity for outer layer
- Material with lower thermal conductivity should be used for inner layer and the material with higher thermal conductivity for outer layer
- It is immaterial in the sequence which the layer is made
- It is not possible to judge unless numerical examples are given

No, the answer is incorrect.
Score: 0
Accepted Answers:
Material with lower thermal conductivity should be used for inner layer and the material with higher thermal conductivity for outer layer

14) For a given heat flow and for the same thickness, the temp drop across the material will be maximum for — *1 point*

- Copper
- Steel
- Glass wool
- Refractory brick

No, the answer is incorrect.
Score: 0
Accepted Answers:
Glass wool

15) In case of one dimensional heat conduction in a medium with constant properties, T is the temperature at position x, at time t. Then $\frac{\partial T}{\partial t}$ is proportional to — *1 point*

- T/x
- $\frac{\partial T}{\partial x}$
- $\frac{\partial^2 T}{\partial x^2}$
- $\frac{\partial^2 T}{\partial t^2}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\frac{\partial^2 T}{\partial x^2}$

16) One dimensional unsteady state heat transfer equation for a sphere with heat generation at the rate q'_gcan be written as — *1 point*

- $\frac{1}{r}\frac{\partial}{\partial r}\left(r^2\frac{\partial T}{\partial r}\right) + \frac{q'_g}{k} = \frac{1}{\alpha}\frac{\partial T}{\partial t}$
- $\frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2\frac{\partial T}{\partial r}\right) + \frac{q'_g}{k} = \frac{1}{\alpha}\frac{\partial T}{\partial t}$
- $\frac{\partial^2 T}{\partial r^2} + \frac{q'_g}{k} = \frac{1}{\alpha}\frac{\partial T}{\partial t}$
- $\frac{\partial^2 (rT)}{\partial r^2} + \frac{q'_g}{k} = \frac{1}{\alpha}\frac{\partial T}{\partial t}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2\frac{\partial T}{\partial r}\right) + \frac{q'_g}{k} = \frac{1}{\alpha}\frac{\partial T}{\partial t}$

17) In descending order of magnitude, the thermal conductivity of (a) Pure iron, (b) liquid water, (c)saturated water vapour, and (d) aluminium can be arranged as — *1 point*

- a > b > c > d
- b > c > a > d
- d > a > b > c
- d > c > b > a

No, the answer is incorrect.
Score: 0
Accepted Answers:
d > a > b > c

18) According to which of the following boundary conditions, the heat flux at the boundary is constant. — *1 point*

- No flux boundary condition
- Neumann boundary condition
- Dirichlet boundary condition
- Newton's law of cooling

No, the answer is incorrect.
Score: 0
Accepted Answers:
Neumann boundary condition

19) State whether the following statement is TRUE or FALSE: As the radius of the cylinder/sphere increases, the thermal resistance will look similar to the case of rectangular slab — *1 point*

- False
- True

No, the answer is incorrect.
Score: 0
Accepted Answers:
True

20) **Assertion(A):**During casting, solidification is faster in sharp corners. — *1 point*
Reason(R): The thermal resistance increases with increase in radius of curvature.

- Both A and R are true but R is NOT the correct explanation of A
- Both A and R are true and R is the correct explanation of A
- A is true but R is false
- Both A and R are false

No, the answer is incorrect.
Score: 0
Accepted Answers:
Both A and R are true and R is the correct explanation of A