### Uka Tarsadia University(Diwaliba Polytechnic) Diploma in Chemical Engineering Objective Type Questions (Heat Transfer)

### UNIT 1

### Heat Transfer by Conduction

- 1. Your finger sticks to an ice tray just taken from refrigerator. Which factor have more effect on this phenomenon
  - A) The inside temperature of the freezer
  - B) The humidity of the air
  - C) The heat capacity of your finger and the tray
  - D) The thermal conductivity of the tray
- 2. The thermal drop through each layer of two layered furnace wall is shown in the figure. Assume the external temperature  $T_1$  and  $T_3$  are maintained constant and that  $T_1 > T_3$ . If the thickness of the layer  $x_1$  and  $x_2$  are the same which of the following statement is correct



- A)  $K_1 > k_2$  where k is thermal conductivity of the layer
- B)  $K_1 < k_2$
- C)  $K_1 = k_2$  but the heat flow through material 1 is larger than heat flow from material 2
- D)  $K_1 = k_2$  but the heat flow through material 2 is larger than heat flow from material 1
- 3. A wire is plastically deformed by supplying a force of 40 N over a distance of 0.8 m in the direction of force. If the wire has amass of 0.2 kg and specific heat of 0.5 kJ/kg °C, the maximum increase in average temperature of wire will be
  - A) 0.03 °C
  - B) 0.3 °C
  - C) 3 °C
  - D) 30 °C

- 4. Wet clothes are hung on a clothesline outdoor in a sub zero temperature. After a day the clothes are brought into the house and observed to be dry. The process of drying is best explained as
  - A) Vaporization
  - B) Sublimation
  - C) Melting
  - D) Condensation
- 5. Which of the following would not increase the rate of heat transfer from a heater pipe
  - A) Insulating with material whose thickness is below that of critical thickness for insulation
  - B) Blowing air over it
  - C) Providing fins
  - D) Putting the heater pipe into another whose thermal conductivity is smaller in number and is 2 inches thick
- 6. The measurement of specific heat of a material relates the quantity of heat required to change the temperature of a given mass to the mass of that material. At ordinary temperature range (or for a small temperature range) the specific heat C, may be considered constant. If aluminum has a specific heat of 0.217 cal/gm °C than copper 0.093 cal/ gm °C, then
  - A) Copper is less massive than aluminum
  - B) It take more energy in form of heat to change the temperature of aluminum than copper of equal mass
  - C) Aluminum can be kept at higher temperature than copper of equal mass
  - D)  $C_{Al} / C_{Cu}$  is higher at higher temperature than lower temperature
- 7. A 10 kg solid at 100°C with a specific heat of 0.8 KJ/Kg °C is immersed in 40 kg of 20 °C liquid with a specific heat of 4.0 KJ/Kg °C. the temperature after a long time if the container is insulated will be
  - A) 30 °C
  - B) 28 °C
  - C) 26 °C
  - D) 24 °C
- 8. A 1000 Kg vehicle travelling at 80 m/sec impacts a plunger attached to system piston arrangement. If all of the energy of vehicle is absorbed by the 20 Kg of liquid contained in the cylinder, what is the maximum temperature rise of the liquid (Specific heat of the liquid is 4.0 KJ/Kg °C)
  - A) 55 °C
  - B) 50 °C
  - C) 45 °C
  - D) 40 °C

- 9. A solid sphere and a hollow sphere of the same material and size are heated to same temperature and allowed to cool in the same surrounding. If the temperature difference between the body and that of surrounding is T, then
  - A) Bothe the sphere will cool at the same rate for small value of T
  - B) Bothe the sphere will cool at the large rate for small value of T
  - C) Hollow sphere will cool at faster rate for all value of T
  - D) Solid sphere will cool at faster rate for all value of T
- 10. From a metallic wall at 100 °C, a metallic rod protrudes to an ambient air. The temperature at the tip will be minimum when the rod is made up of
  - A) Aluminum
  - B) Steel
  - C) Copper
  - D) Silver
- 11. A block of material is heated from well above the room temperature and left to cool in the room. Which of the graphs shown in the figure below correctly explain the rate of cooling





D) None of these

- 12. A furnace is made up of red brick wall of thickness 0.5 m and conductivity 0.7 W/mK. For the same heat loss and the temperature drop, this can be replaced by a layer of diatomite earth of conductivity 0.14 W/m.K and the thickness
  - A) 0.5 m
  - B) 0.1 m
  - C) 0.2 m
  - D) 0.15 m
- 13. Upto critical radius of insulation
  - A) Added insulation will increase heat loss
  - B) Added insulation will decrease heat loss
  - C) Convective heat loss will be less than conduction heat loss
  - D) Heat flux will decrease
- 14. The temperature distribution at a certain instant of time in a concrete slab during curing is given by

 $T = 3 x^2 + 3x + 16$ , Where x is in cm and T in K.

The rate of change of temperature with time is given by (assume diffusivity to be 0.0003  $\rm cm^2/s$ 

- A) +0.0009 K/s
- B) +0.0048 K/s
- C) -0.0012 K/s
- D) -0.0018 K/s

15. Which of the following would lead to reduction in thermal resistance

- A) increasing the thermal conductivity
- B) decrease the length of conductor

- C) Both A) and B)
- D) None
- 16. Heat pipe is widely used now a days because it act as
  - A) An insulator
  - B) Conductor and insulator
  - C) A superconductor
  - D) A fin
- 17. In the current carrying conductors, if the radius of conductor is less than the critical radius,

Then addition of electrical insulation is desirable as it

- A) Reduces the heat loss from the conductor and thereby enables the conductor to carry higher current
- B) Increases the heat loss from the conductor and thereby enables the conductor to carry higher current
- C) Increases the thermal resistance of the insulation thereby enables the conductor to carry higher current
- D) Reduce the thermal resistance of the insulation thereby enables the conductor to carry higher current
- 18. The heat flux from composite cylinder is given by equation

A) 
$$Q = \frac{(T1 - Tn - 1)2\pi L}{\sum_{n=1}^{n=n} \frac{1}{Kn} \log \frac{rn + 1}{rn}}$$
  
B)  $Q = \frac{4\pi (T1 - Tn - 1)2\pi L}{\sum_{n=1}^{n=n} \frac{1}{Kn} (\frac{rn + 1 - rn}{Knrn.rn + 1})}$ 

C) 
$$\mathbf{Q} = \frac{(T1 - Tn + 1)}{\sum_{n=1}^{n=n} \frac{1}{Kn} log \frac{Ln}{Kn}}$$

### D) None of these

- 19. The heat transfer Q and the work done W and change in internal energy delta U all are zero in case of
  - A) Rigid vessel containing steam at 150 °C left in atmosphere which is at 25°C
  - B) Rigid vessel containing ammonia gas connected through a valve to a evacuated rigid vessel, the valve and the connecting pipe is well insulated and the valve being opened and after a time, conditions though the two vessel becoming uniform
  - C) 1 kg gas contained in a insulated cylinder expanding as the piston moves slowly outwards
  - D) 1 kg or air flowing adiabatically from the atmosphere into a previously evacuated bottle
- 20. Heat transfer taking place according to

- A) Zeroth law of thermodynamics
- B) First law of thermodynamics
- C) Second law of thermodynamics
- D) Third law of thermodynamics
- 21. Consider the following statements
  - 1. Under certain condition increase in thickness of insulation may increase the heat loss from a heated pipe
  - 2. The heat flux from a insulated pipe reaches a maximum when the outside radius insulation is equal to radius of thermal conductivity to the surface coefficient
  - 3. Smaller diameter tube are invariably insulated
  - 4. Economic insulation is based on minimum heat loss from pipe Of these statement
  - A) 1 and 3 are correct
  - B) 2 and 4 are correct
  - C) 1 and 2 are correct
  - D) 3 and 4 are correct
- 22. Consider the following statements:

The Fourier heat conduction equation

$$\mathbf{Q} = -\mathbf{K}\mathbf{A}\,\frac{dT}{dx}$$

Presumes

- 1 Steady state condition
- 2 Constant value of thermal conductivity
- 3 Uniform temperature at the wall surface
- 4 One dimensional heat flow Of these statements
- A) 1, 2 and 3 are correct
- B) 1,2 and 4 are correct
- C) 2,3 and 4 are correct
- D) 1,3 and 4 are correct
- 23. In a long cylindrical rod of radius R and the surface heat flux of  $q_0$ , the uniform internal heat generation rate is
  - A)  $2 q_0/R$
  - B) 2 q<sub>0</sub>
  - C)  $q_0/R$
  - D)  $q_0/R^2$
- 24. Heat is mainly transferred by conduction, convection and radiation in
  - A) insulating pipe carrying hot water
  - B) refrigerator freezer oil
  - C) boiler furnace
  - D) condensation of steam in a condenser



25. A furnace wall is constructed as shown in figure. The interfacial temperature  $T_1$  will be 1000°C

- A) 560 °C
- B) 200 °C
- C) 920 °C
- D) 1120 °C
- 26. For a current carrying wire of 20 mm diameter exposed to air ( h= 25 W/mK), the maximum heat distribution occurs when the thickness of insulation (K = 0.5 W/mK), is
  - A) 20 mm
  - B) 10 mm
  - C) 1.5mm
  - D) 0 mm
- 27. Two insulating material of thermal conductivity k and 2 k are available of lagging a pipe carrying hot fluid. If the radial thickness of each material is same
  - A) Material with higher thermal conductivity should be used for inner layer and one with layer and one with lower thermal conductivity for the outer
  - B) Material with lower thermal conductivity should be used for inner layer and one with layer and one with higher thermal conductivity for the outer
  - C) It is immaterial in which sequence the insulating material are used
  - D) It is not possible to judge unless numerical value of dimension are given
- 28. For a given heat flow and for the same thickness, the temperature drop across the material will be maximum for
  - A) Copper
  - B) Steel
  - C) Glass- wool
  - D) Refractory brick

- 29. The temperature field in a body varies accordingly to equation  $\mathbf{T}(\mathbf{x},\mathbf{y}) = \mathbf{x}^3 + 4\mathbf{x}\mathbf{y}$ The direction of the fastest variation in temperature at the point (1, 0) is given by
  - A) 3i + 8j
  - B) i
  - C) 0.6 i + 0.8 j
  - D) 0.5 **i** + 0.866 **j**
- 30. The temperature variation under steady state condition of a composite slab of two materials with thermal conductivity  $k_1$  and  $k_2$  is shown in the figure, which of the following statements holds?



The temperature drop through a two layered furnace wall shown above is maintained at 550 °C. Each layer is of equal thickness. Which of the following action will result in lowering the temperature at the interface between the two layers?

- A) Increasing thermal conductivity of outer layer
- B) Increasing thermal conductivity of inner layer
- C) Increasing thickness of outer layer
- D) Reducing thickness of inner layer
- 32. Which of the following is a unit of thermal conductivity

- A) W/m K
- B) J/m K
- C)  $W/m^2 K$
- D) None of these
- 33. Heat transfer from electric bulb by
  - A) Conduction
  - B) Convection
  - C) Radiation
  - D) All of these
- 34. Basic law of heat conduction is
  - A) Fourier's law
  - B) Newton's law
  - C) Stefan's law
  - D) First law of thermodynamics
- 35. Assumption made in Fourier's law is that the heat flow
  - A) Is in steady state
  - B) Through a solid in one dimension
  - C) Both A) and B)
  - D) None of these
- 36. Metals are good conductor because
  - A) Of free electron present
  - B) There atoms are relatively far away
  - C) Their atoms collide frequently
  - D) All of these
- 37. If the thermal conductivity of wall varies as  $K_0(1 + \alpha t)$ , then the temperature at the centre of the wall as compared to that in case of constant thermal conductivity, will be
  - A) More
  - B) Less
  - C) Same
  - D) Depends on the other factor
- 38. With increase in temperature the thermal conductivity of solid material
  - A) Increases
  - B) Decreases
  - C) Remain same
  - D) None of these
- 39. With increase in temperature the thermal conductivity of air
  - A) Increases
  - B) Decreases
  - C) Remain same
  - D) None of these

- 40. Highest thermal conductivity is of
  - A) Air
  - B) Water
  - C) Oxygen
  - D) Hydrogen
- 41. Highest thermal conductivity is of
  - A) Solid ice
  - B) Melting ice
  - C) Water
  - D) Steam
- 42. If  $\ell$  is the density of a substance, S is the specific heat and K is thermal conductivity, then thermal diffusivity (h) is equal to
  - A) S/ ℓK
  - B) \(\empty K/S\)
  - C) K/ {S
  - D) {S/K
- 43. Unit of thermal diffusivity is
  - A) m/hr °C
  - B)  $m^2/hr$
  - C) m/hr
  - D) m<sup>2</sup>/hr °C
- 44. Thermal diffusivity is
  - A) Function of temperature
  - B) Physical property of substance
  - C) A dimensionless parameter
  - D) All of these
- 45. The rate of heat conduction (Q) through a thick sphere of radius  $r_1$  and  $r_2$  is equal to
  - A) 4  $\ell$  K(t<sub>1</sub>-t<sub>2</sub>)/(r<sub>2</sub>-r<sub>1</sub>)
  - B) 4  $\ell Kr_1 \cdot r_2 / (r_2 r_1)$
  - C)  $4\ell Kr_1 r_2(t_1-t_2)/(r_2-r_1)$
  - D) None of these
- 46. Highest thermal conductivity is of
  - A) Iron
  - B) Lead
  - C) Concrete
  - D) Wood
- 47. The rate of heat transfer through a body is given by  $Q = KA(T_1-T_2)/(X)$ , the term X/KA is called
  - A) Thermal resistance
  - B) Thermal conductivity

- C) Temperature gradient
- D) Thermal loading
- 48. The term,  $(T_1-T_2)/(X)$  is called
  - A) Thermal resistance
  - B) Thermal conductivity
  - C) Temperature gradient
  - D) Thermal loading
- 49. The term KA/X is called
  - A) Thermal resistance
  - B) Thermal conductivity
  - C) Temperature gradient
  - D) Thermal loading

# UNIT 2

### Heat Transfer by Convection

- 1. If a body has large thermal conductivity and a corresponding low film heat transfer coefficient, the heat flow to or from the body is controlled principally by
  - A) Conductive resistance
  - B) Convective resistance
  - C) Radiation resistance
  - D) Temperature gradient
- 2. Overall coefficient of heat transfer is used in case of heat transfer by
  - A) Convection and radiation
  - B) Radiation and conduction
  - C) Conduction and convection
  - D) Radiation, conduction and convection
- 3. The effect of scaling in heat exchanger is accounted through
  - A) Heat transfer coefficient
  - B) Fouling factor
  - C) Insulation factor
  - D) Diffusivity factor
- 4. Unit of convective heat transfer coefficient is
  - A) Kcal/m<sup>2</sup>hr
  - B)  $J/m^2hr K$
  - C) cal/cm<sup>2</sup>sec K
  - D) all of these

- 5. the heat transfer from one particle of a fluid to another by actual motion (which is caused by the difference in density due to temperature) of the particle is called
  - A) forced convection
  - B) free convection
  - C) artificial convection
  - D) none of these
- 6. forced convection is caused due to difference in
  - A) density
  - B) pressure
  - C) viscosity
  - D) none of these
- 7. free convection is caused due to difference in
  - A) Density
  - B) pressure
  - C) viscosity
  - D) none of these
- 8. Fouling factor is used
  - A) in heat exchanger design as safety factor
  - B) in case of Newtonian fluid
  - C) when a liquid exchanges heat with a gas
  - D) none of these
- 9. The value of overall heat transfer coefficient is highest in process of heat exchange
  - A) Air to carbon dioxide
  - B) Air to heavy tar
  - C) From steam to oil
  - D) In steam condensers
- 10. The value of overall heat transfer coefficient is least in fluid combinations
  - E) Air to carbon dioxide
  - F) Air to heavy tar
  - G) Air condensers
  - H) Alcohol condensers
- 11. The unit of overall heat transfer coefficient is
  - A) Kcal/m hr °C
  - B) Kcal/m<sup>2</sup>hr<sup>o</sup>C
  - C) Kcal/hr °C
  - D) None of these
- 12. Overall coefficient of heat transfer is used in case of
  - A) Conduction
  - B) Convection
  - C) Radiation

- D) Conduction and convection
- 13. Heat transfer from one particle of a fluid to another by the actual motion caused by same mechanical means, is called
  - A) Free convection
  - B) Forced convection
  - C) Conduction
  - D) Radiation
- 14. Heat transfer from one particle of a fluid to another by the actual motion is due to difference of density caused by temperature of the particle is called
  - A) Free convection
  - B) Conduction
  - C) Forced convection
  - D) Radiation
- 15. It is desired to increase the heat dissipation rate over the surface of an electronic device of spherical shape of 5mm radius exposed to convection with  $h = 10 \text{ W/m}^2\text{K}$  by encasing it in s spherical sheath of conductivity 0.04 W/m K. For the maximum heat flow the diameter of sheath should be
  - A) 18 mm
  - B) 16 mm
  - C) 12 mm
  - D) 8 mm
- 16. According to Newton's law of cooling the amount of heat transfer through a solid surface of area A at a temperature  $T_S$  to a fluid at temperature  $T_f$  is ( h is film heat transfer coefficient)
  - A)  $Q = hA/(T_s T_f)$
  - B)  $Q = h/A (T_s T_f)$
  - C)  $Q = hA (T_s T_f)$
  - D)  $Q = (T_s T_f)/hA$
- 17. A wall of surface area ( of thickness  $\Delta x$  and conductivity k) contains hot fluid at temperature  $T_1$  to one side and cold fluid at temperature  $T_2$  to other side. The rate of heat transfer from hot fluid to cold fluid id equals to
  - A)  $(T_1 T_2) / (1/h_1A + \Delta x/kA + 1/h_2A)$
  - B)  $(T_1 T_2)(h_1 + h_2 / (A \Delta x))$
  - C)  $(T_1 T_2)(1/h_1 + 1/h_2)A$
  - D)  $(1/h_1A + \Delta x/kA + 1/h_2A)/(T_1 T_2)$
- 18. A thin copper wire at 300 °C is suddenly immersed in water at 30 °C. it cools down to 150 °C in 70 seconds. It is then reheated to initial temperature of 300 °C and suddenly exposed to air at 30 °C where it cools down to 150 °C in 200 seconds. The difference in cooling time is due to
  - A) Large specific heat of water

- B) Large heat transfer coefficient in water
- C) Small heat transfer coefficient in water
- D) None of these
- 19. The overall heat transfer coefficient (U) for a composite wall of thickness x<sub>1</sub>, x<sub>2</sub>, x<sub>3</sub> and the correspondingly thermal conductivity k<sub>1</sub>, k<sub>2</sub>, k<sub>3</sub> is given by the equation
  - A)  $1/U = k_1 / x_1 + k_2 / x_2 + k_3 / x_3$
  - B)  $U = k_1 / x_1 + k_2 / x_2 + k_3 / x_3$
  - C)  $1/U = x_1/k_1/+x_2/k_2 + x_3/k_3$
  - D) U =  $x_1/k_1/ + x_2/k_2 + x_3/k_3$
- 20. In free convection, motion of fluid is caused by
  - A) The weight of the fluid element
  - B) The hydrostatic force on the element
  - C) The buoyancy force arising from variation in density of the fluid with the temperature
  - D) None of these
- 21. Air at 20 °C blows over a plate of 50 cm \* 75 cm maintained at 250 °C, if the convective heat transfer coefficient is 25 W/  $m^2$  °C the heat transfer rate is
  - A) 215.6 kW
  - B) 2156 kW
  - C) 2.156 kW
  - D) 21.56 kW
- 22. In natural convection, Nusslet number is function of
  - A) Reylonds number
  - B) Grashoff's number
  - C) Prandtl number
  - D) Both B) and C)
- 23. A dimensionless number associated with convective heat transfer is
  - A) Reylond's number
  - B) Nusslet number
  - C) Froude number
  - D) All of these
- 24. Film coefficient is the ration of
  - A) Thickness of the film of fluid to thermal conductivity
  - B) Thickness of the film of fluid to the temperature drop through the film of the fluid
  - C) Thermal conductivity to the temperature drop through the film of the fluid
  - D) Thermal conductivity to the equivalent thickness of the film of fluid
- 25. Heat is transferred from pipe to the surrounding air is maximum by
  - A) Conduction
  - B) Convection
  - C) Both A) and B)
  - D) None of these

- 26. The process of heat transfer from one particles of fluid to another with actual motion of fluid is called
  - A) Conduction
  - B) Convection
  - C) Radiation
  - D) All of these
- 27. On a summer day a scooter rider feels more comfortable while on the move while at the stop light because
  - A) An object in motion captures less solar radiation
  - B) Air is transparent to radiation and hence it is cooler than body
  - C) More heat is lost by convection and radiation while in motion
  - D) Air has low specific heat hence it is cooler
- 28. A 20 cm diameter, 1.2 m long cylinder losses heat from its peripheral surface by convection. Surface temperature of cylinder is constant at 100 °C and the fluid temperature is constant at 20 °C. the average convective heat transfer coefficient over the surface of cylinder is 25 W/m<sup>2</sup> K. the heat transfer rate is
  - A) 120 π W
  - B) 240 π W
  - C) 320  $\pi$  W
  - D) 480 π W
- 29. Free convection flow depend on all of the following except
  - A) Density
  - B) Coefficient of viscosity
  - C) Gravitational force
  - D) Velocity
- 30. Conduction plus fluid flow in motion is known as
  - A) Radiation
  - B) Conduction
  - C) Convection
  - D) heat exchanger
- 31. How many types of convection are there
  - A) 4
  - B) 3
  - C) 2
  - D) 1
- 32. Which of the following heat flow situation pertains to free or natural convection
  - A) Air conditioning installation and nuclear reactor
  - B) Flow of water inside the condenser tube
  - C) Cooling of internal combustion engine
  - D) Cooling of billets in atmosphere

- 33. Mark the system where the heat transfer is given by force convection
  - A) Chilling effect of cold wind on warm body
  - B) Fluid passing through the tubes of condenser
  - C) Heat flow from hot pavement to surrounding atmosphere
  - D) Heat exchange on the outside of cold and warm pipes
- 34. Forced convection in liquid bath is caused by
  - A) Intense stirring by external agency
  - B) Molecular energy interactions
  - C) Density difference brought about by temperature gradient
  - D) Flow of electrons in random fashion
- 35. A finned tube hot water radiator with a fan blowing over it is kept in room during winter. The major portion of heat transfer from radiator is due to
  - A) Combined conduction and radiation
  - B) Radiation to the surrounding
  - C) Better conduction
  - D) Convection to the air
- 36. Which one of the following having highest value of overall heat transfer coefficient
  - A) Steam condenser
  - B) Feed water heater
  - C) Alcohol heater
  - D) Steam
- 37. Which one is having lowest value of overall heat transfer coefficient
  - A) Steam
  - B) Air condensers
  - C) Air to heavy tars
  - D) Ammonia condenser
- 38. Newton's law of cooling is given by
  - A)  $Q = hA(t_s t_f)$
  - B)  $Q = 2hA(t_s t_f)$
  - C)  $Q = 3 hA(t_s t_f)$
  - D)  $Q = 4hA(t_s t_f)$
- 39. The value of film coefficient is dependent upon
  - A) Boundary layer configuration
  - B) Geometry and orientation of the surface
  - C) Surface conditions
  - D) All of these
- 40. A region of fluid motion near a plate in which temperature gradient exists is
  - A) Thermal boundary layer
  - B) Diathermic boundary layer
  - C) Turbulent flow

D) Laminar flow

- 41. Thermo physical property of the fluid is represented by
  - A) Density
  - B) Specific heat
  - C) Thermal conductivity
  - D) All of these
- 42. In the equation  $Q = hA \Delta T$ ;  $\Delta T$  is
  - A) Geometric mean temperature difference
  - B) Arithmetic mean temperature difference
  - C) Logarithmic mean temperature difference
  - D) The difference of average bulk temperature of hot and cold fluids
- 43. Fouling factor is
  - A) A dimensionless quantity
  - B) Does not provide a safety factor for design
  - C) Accounts for additional resistance to heat flow
  - D) All of these
- 44. Convective heat transfer coefficient in case of fluid flowing in tubes is not affected by the tube length/ diameter ratio, if the flow is in the \_\_\_\_\_ zone
  - A) Laminar
  - B) Transition
  - C) Both A) and B)
  - D) Highly turbulent
- 45. Controlling heat transfer film coefficients is the one, which offers\_\_\_\_\_ resistance to the heat transfer
  - A) No
  - B) The least
  - C) The largest
  - D) Lower
- 46. The unit of heat transfer coefficient in SI unit is
  - A)  $J/m^2K$
  - B)  $W/m^2K$
  - C) w/m K
  - D) j/m k
- 47. in forced convection heat transfer depends on
  - A) Re, Pr
  - B) Re, Gr
  - C) Mainly Gr
  - D) Re only
- 48. The film coefficient is decreased due to presence of non condensing gases in the vapor. The film coefficient of super heated vapor as compared to that of saturated vapor is

- A) More
- B) Less
- C) Same
- D) Either less or more, depend upon the nature of vapor
- 49. Newton's law of cooling holds good when
  - A) The temperature of surrounding is constant
  - B) Temperature of surrounding changes appreciably
  - C) Does not depend on surrounding temperature
  - D) None of these
- 50. Newton's law of cooling holds good when
  - A) Temperature difference between surrounding and body is very large
  - B) Temperature difference between surrounding and body is very small
  - C) Does not depend on temperature difference
  - D) None of these

# UNIT 3

### HEAT EXCHANGERS

- 1. In a parallel flow gas turbine recuperator, the maximum effectiveness is
  - A) 100 %
  - B) 75 %
  - C) 50 %
  - D) Between 25 % and 45 %
- 2. When  $t_{c1}$  and  $t_{c2}$  are the temperature of cold fluid at entry and exit respectively and  $t_{h1}$  and  $t_{h2}$  are the temperature of hot fluid at the entry and exit point, and the cold fluid have lower heat capacity rate as compared to hot fluid, the effectiveness of heat exchanger is given by
  - A)  $(t_{c1} t_{c2}) / (t_{h1} t_{c1})$
  - B)  $(t_{h2} t_{c2})/(th_1 t_{c1})$
  - C)  $(t_{h1} t_{h2})/(t_{h1} t_{c1})$
  - D)  $(t_{c2} t_{c1})/(t_{h1} t_{c1})$
- 3. Provision of fins on a given heat transfer surface will be more if there are
  - A) Less number of thin fins
  - B) Less number of thick fins
  - C) Larger number of thin fins
  - D) Larger number of thick fins
- 4. A designer chooses the value of fluid flow rate and specific heat in such a manner that the heat capacities of two fluids are equal. A hot fluid enters the counter current heat exchanger at 100 °C And leaves at 60 °C. the cold fluid enters at40 °C. the mean temperature difference between the two fluid is
  - A) (100+60+40)/3 °C

- B) 60 °C
- C) 45 °C
- D) 20 °C
- 5. €-NTU method is practically useful in thermal design heat exchanger when
  - A) Outlet temperature of fluid stream is not called priori
  - B) Outlet temperature of fluid stream is called priori
  - C) Outlet temperature of hot fluid stream is known but that of cold stream is not called a priori
  - D) Inlet temperature of fluid stream is called priori
- 6. In shell and tube heat exchanger, baffles are provided to shell side to
  - A) Prevent the stagnation of shell side tube
  - B) Improve heat transfer
  - C) Provide support for tube
  - D) All of these
- 7. A counter flow shell and tube exchanger is used to heat water with hot exhaust gases. The water (C = 4180 J/Kg °C) flows at a rate of 2 Kg/s while the exhaust gas (C = 1030 J/Kg °C) flows at the rate of 5.25 Kg/s. if the heat transfer area is 32.5 m<sup>2</sup> and overall heat transfer coefficient is 200 W/m<sup>2</sup> °C, what is the NTU for heat exchanger
  - A) 1.2
  - B) 2.4
  - C) 4.5
  - D) 8.6

#### 8. Match list I with list II select the correct answer using the code given below

list I	list II
	1. Water cooling tower
A) Regenrative heat exchanger	
	2. Lungstorm air heater
B) Direct contact heat exchanger	
	3. Hyperbolic curve
C) Conduction through a cylindrical	
wall	
	4. Loagrithemic curve
D) Conduction through a spherical	
shell	

Codes

	Α	В	С	D
A)	1	4	2	3
B)	3	1	4	2
C)	2	1	3	4

D) 2 1 4 3

- 9. A counter flow heat exchanger is used to heat water from 20 °C to 80 °C by using hot exhaust gas entering at 140 °C and leaving at 80 °C. The LMTD of this exchanger is
  - A) 80°C
  - B) 60 °C
  - C) 110 °C
  - D) Not determinable
- 10. Addition of fin to the surface increases the heat transfer if  $(\eta A/KP)^{1/2}$  is
  - A) Equal to one
  - B) Greater than 1
  - C) Less than 1
  - D) Greater than 1 but less than 2
- 11. In certain heat exchanger both the fluid have identical mass flow rate- specific heat product. The hot fluid enters at 76 °C and leaves at 47 °C, the cold fluid enters at 26 °C and leaves at 55 °C. the effectiveness of heat exchanger is
  - A) 0.16
  - B) 0.58
  - C) 0.72
  - D) 1.0
- 12. Heat exchanger are used in
  - A) Condensers and boilers in steam plant
  - B) Intercooler and preheater
  - C) Condenser and evaporator in refrigerator
  - D) All of these
- 13. In heat exchanger the value of logarithmic mean temperature difference should be
  - A) Maximum possible
  - B) Minimum possible
  - C) Zero constant
  - D) None of the above
- 14. Value of logarithmic mean temperature difference for counter flow as compared to parallel flow heat exchanger is
  - A) More
  - B) Less
  - C) Same
  - D) None of these
- 15. In counter flow heat exchanger, both the fluids
  - A) At inlet are in their hottest state
  - B) At inlet are in their coldest state
  - C) At outlet are in their hottest state
  - D) At outlet are in their coldest state

- 16. Automobile radiator is heat exchanger of
  - A) Counter flow type
  - B) Parallel flow type
  - C) Cross flow type
  - D) Regenerator type
- 17. In design of heat exchanger one transfer unit means
  - A) Condition when change in temperature of one steam numerically equals the average driving force
  - B) Section heat exchanger having surface area 1 m<sup>2</sup>
  - C) Section heat exchanger having temperature drop by °C
  - D) None of these
- 18. Floating heads are provided in heat exchangers to
  - A) Increase pressure drop
  - B) Decrease pressure drop
  - C) Regulate the flow rate
  - D) Avoid deformation of tubes due to thermal expansion
- 19. Fin efficiency deals with
  - A) Thermal performance
  - B) Economical material requirement
  - C) Cost of manufacturing
  - D) All of these
- 20. An exchanger in which hot and cold fluid flow over heat transfer surface alternately is
  - A) Direct contact exchanger
  - B) Regenerator
  - C) Parallel flow exchanger
  - D) All of these
- 21. The equation of effectiveness  $\sum = 1 e^{-NTU}$  of heat exchanger is valid in the case of ( NTU is number of transfer unit)
  - A) Boiler and condenser for parallel flow
  - B) Boiler and condenser for counter flow
  - C) Boiler and condenser for both parallel and counter flow
  - D) Gas turbine for both parallel and counter flow
- 22. In parallel flow heat exchanger, the rate of
  - A) Flow heat is maximum
  - B) Decrease of temperature is maximum
  - C) Decrease pressure drop
  - D) Decrease vibration
- 23. Multiple pass heat exchanger is used to
  - A) Increase pressure drop
  - B) Increase rate of heat transfer

- C) Decrease pressure drop
- D) Decrease vibrators
- 24. Baffles are provided in heat exchangers to
  - A) Increase pressure drop
  - B) Decrease pressure drop
  - C) Increase rate of heat transfer
  - D) Decrease vibrations
- 25. In shell and tube heat exchanger, the corrosive liquid is generally passed from
  - A) Tube side
  - B) Shell side
  - C) Both A) and B)
  - D) None of these
- 26. In counter current flow heat exchanger
  - A) Both the fluid at inlet are in their hottest state
  - B) Both the fluid at inlet are in their coldest state
  - C) Both the fluid at exit are in their hottest state
  - D) Both the fluid at exit are in their hottest state
- 27. The effect of scaling in a heat exchanger is accounted through
  - A) Heat transfer coefficient
  - B) Fouling factor
  - C) Insulation factors
  - D) Diffusivity factor
- 28. NTU is calculated by the equation.
  - A) UA/C<sub>min</sub>
  - B) UA  $C_{min}$
  - C)  $C_{min}/UA$
  - D)  $C_{min}/C_{max}$
- 29. In a heat exchanger, the temperature difference between the hot medium at inlet and cold medium at inlet is
  - A) LMTD
  - B) Mean temperature difference
  - C) Degree of approach
  - D) All of these
- 30. In cross flow heat exchanger
  - A) Both the fluid flow in same direction
  - B) Both the fluid flow in opposite direction
  - C) Bothe the fluid flow perpendicular to each other
  - D) None of these
- 31. If in a double pipe heat exchanger, we require to have a constant wall temperature, we use it in a counter flow direction

- A) True
- B) False
- C) Depend on situation
- D) Data insufficient
- 32. Which is the major mean of heat transfer in double pipe heat exchanger
  - A) Convection
  - B) Conduction
  - C) Radiation
  - D) Combined convection and conduction
- 33. How many times do we have to calculate Nusslet number in double pipe heat exchanger
  - A) 1
  - B) 2
  - C) 3
  - D) 4
- 34. In an operation when we want to heat a stream of liquid by steam, we usually keep the steam on the annular side and fluid in the inner side
  - A) True
  - B) False
  - C) Depend on situation
  - D) Data insufficient
- 35. Which of the following is not a subset of tubular heat exchanger
  - A) Double pipe
  - B) Finned tube
  - C) Shell and tube
  - D) Spiral tube
- 36. In a double pipe heat exchanger, in the inner side fluid enters at 20 °C and leaves at 45 °C. the annulus has steam condensing at 1atm. What is the value of LMTD
  - A) 39 °C
  - B) 66.7 °C
  - C) 70 °C
  - D) 40.5 °C
- 37. Plate type heat exchanger which are made from thin plates, can handle high pressure and temperature difference
  - A) True
  - B) False
- 38. Which of the following is not a plate type heat exchanger
  - A) Welded
  - B) Gasketed
  - C) Agitated
  - D) Brazed

- 39. Why do we use counter flow operation on gasketed type heat exchanger
  - A) It provide better ease of operation
  - B) Applied pressure difference required is low
  - C) A large and uniform temperature difference is achieved
  - D) It reduces corrosion
- 40. Shell and tube heat exchanger are not used in industry because of their inability to handle high pressure and temperature
  - A) True
  - B) False
- 41. How many times do we have to calculate pressure drop in shell and tube heat exchanger
  - A) 1
  - B) 2
  - C) 3
  - D) 4
- 42. When we want to heat a stream of liquid by steam, we usually keep steam on the shell side and fluid in the tube
  - A) True
  - B) False
- 43. Which of the following is not a type of reboiler
  - A) Double pipe reboilers
  - B) Thermosyphon reboilers
  - C) Kettle reboilers
  - D) Internal reboilers
- 44. Which one of the following is not a working property of reboiler
  - A) Generate a flux of vapor to feed to a distillation tower
  - B) Boil water at film boiling temperature
  - C) Flash boiling
  - D) Boil water at a bubble formation region
- 45. The reboiler which has its heating system mounted directly to the distillation column is
  - A) Flash reboilers
  - B) Internal reboilers
  - C) Kettle reboilers
  - D) Horizontal thermosyphon reboilers
- 46. Heat transfer in agitated vessels can be carried out by two methods they are
  - A) Jacketed and plates
  - B) Plates and coils
  - C) Jacketed and internal coil
  - D) Semi coils and internal coils
- 47. Which one of the following is not a type of jacket
  - A) Full conventional jacket

- B) Dimpled jacket
- C) Coiled jacket
- D) Half pipe jacket
- 48. Which jacket is used to provide better mechanical strength
  - A) Full conventional jacket
  - B) Dimpled jacket
  - C) Coiled jacket
  - D) Half pipe jacket
- 49. Heat exchangers are classified into how many category
  - A) 1
  - B) 2
  - C) 3
  - D) 4
- 50. Based upon nature of heat exchanger, the heat exchanger are classified into how many category
  - A) 1
  - B) 2
  - C) 3
  - D) 4

### UNIT 4

### HEAT TRANSFER WITH PHASE CHANGE

- 1. Boiling refers to a change from the
  - A) solid to a liquid phase
  - B) vapor to a liquid phase
  - C) liquid to a solid phase
  - D) liquid to a vapor phase
- 2. The boiling process has wide-spread applications in
  - (i) Production of steam in nuclear and steam power plants for generation and for industrial processes and space heating
  - (ii) Absorption of heat in refrigeration and air-conditioning systems
  - (iii) Concentration, dehydration and drying of foods and materials
  - Identify the correct statements
  - A) i and ii
  - B) ii and iii
  - C) i, ii and iii
  - D) i and iii
- 3. Maximum heat transfer rate in a modern boiler is about A)  $2 * 10^5$  W/m<sup>2</sup>

B) 3 \* 10 <sup>5</sup> W/m<sup>2</sup> C) 4 \* 10 <sup>5</sup> W/m<sup>2</sup> D) 5 \* 10 <sup>5</sup> W/m<sup>2</sup>

- **4.** Which type of boiling occurs in steam boilers employing natural convection? A) Forced convection
  - B) Pool
  - C) Local
  - D) Saturated
- 5. In which type of boiling the fluid motion is induced by external means?
  - A) Pool
  - B) Local
  - C) Forced convection
  - D) Subcooled
- **6.** The temperature of the liquid is below the saturation temperature and boiling takes place only in vicinity of the heated surface. This type of boiling is known as
  - A) Subcooled
  - B) Forces
  - C) Saturated
  - D) Pool
- **7.** In which type of boiling the temperature of the liquid exceeds the saturation temperature?
  - A) Forced
  - B) Saturated
  - C) Pool
  - D) Saturated
- 8. The phenomenon of stable film boiling is referred to as
  - A) Nucleate effect
  - B) Boiling regimes
  - C) Leiden frost effect
  - D) Von karma effect
- **9.** For water evaporating at atmospheric pressure, the burnout occurs at temperature excess slightly above
  - A) 25 K
  - B) 55 K
  - C) 75 K
  - D) 105 K

10. The boiling phenomenon is known to occur in how many forms?

- A) 1
- B) 2

C) 3

D) 4

11. The nucleate pool boiling is influenced by the following factors

(i) Pressure

(ii) Liquid properties

(iii) Material

Identify the correct statements

A) i, ii and iii

- B) ii only
- C) i and ii
- D) ii and iii
- 12. Consider the following phenomena
  - (i) Boiling
  - (ii) Free convection in air
  - (iii) Forced convection in air
  - (iv) Conduction in air

Identify the correct sequence (heat transfer coefficient)

A) iii - iv - i - ii

- B) iv i iii ii
- C) iv iii ii i
- D) iv ii iii i
- **13.** In spite of large heat transfer coefficient in boiling liquids, fins are used advantageously when the entire surface is exposed to
  - A) Film boiling
  - B) Transition boiling
  - C) Nucleate boiling
  - D) All modes of boiling

### 14. With increase in excess temperature, the heat flux in boiling

- A) Increases continuously
- B) Decreases and then increases
- C) Decreases, then increases and again decreases
- D) Increases, then decreases and again increases

15. Heat flux increases with temperature excess beyond the Leiden-frost point due to

- A) Radiation effect becomes predominant
- B) Occurrence of subcooled boiling
- C) Vapor space become large
- D) Promotion of nucleate boiling
- **16.** Leiden-frost expansion is related to
  - A) Condensation of vapor on a cold surface
  - B) Exchange of heat between two solids

C) Evaporation of a solution

- D) Boiling of liquid on a hot surface
- 17. Consider the following statements regarding nucleate boiling
  - (i) The temperature of the surface is greater than the saturation temperature of the liquid

(ii) Bubbles are created by the expansion of entrapped gas oil vapor at small cavities in the surface

(iii) The temperature is greater than that in film boiling

(iv) The heat transfer from the surface to the liquid is greater than that in the film boiling Which of these statements are correct?

A) i and iii

- B) i, ii and iv
- C) ii, iii and iv
- D) i, ii and iii

# **18.** Which of the following parameters affect burnout heat flux in the nucleate boiling region

- (i) Heat of evaporation
- (ii) Temperature difference
- (iii) Density of vapor
- (iv) Density of liquid
- (v) Surface tension at the vapor-liquid interface
- Mark the correct answer from the codes indicated below
- A) i, ii, iii and v
- B) i, iii, iv and v
- C) i, ii, iii and iv
- D) i, iii and  $\boldsymbol{v}$
- **19.** Condensation refers to a change from the
  - A) Solid to a liquid phase
  - B) Vapor to a liquid phase
  - C) Liquid to a solid phase
  - D) Liquid to a vapor phase

20. Condensation process is very common in

- (i) Boilers
- (ii) Condensers
- (iii) Evaporators
- Identify the correct statements
- A) i and ii
- B) ii and iii
- C) i, ii and iii
- D) i and iii

- 21. The convective coefficients for condensation usually lie in the range
  - A) 30-300 W/m<sup>2</sup> K
  - B) 60-3000 W/m<sup>2</sup> K
  - C) 300-10000 W/m<sup>2</sup> K
  - D) 2500-10000 W/m<sup>2</sup> K
- 22. Drop wise condensation usually occurs on
  - A) Oily surface
  - B) Glazed surface
  - C) Smooth surface
  - D) Coated surface
- **23.** Consider the following statements

(i) If a condensing liquid does not wet a surface, then drop wise condensation will not take place on it

- (ii) Drop wise condensation gives a higher transfer rate than film wise condensation
- (iii) Reynolds number of condensing liquid is based on its mass flow rate
- (iv) Suitable coating or vapor additive is used to promote film wise condensation Identify the correct statement

A) i and ii

- B) ii, iii and iv
- C) iv only
- D) i, ii and iii
- **24.** Depending upon the behavior of condensate up on the cooled surface, the condensation process are classified into how many distinct modes?
  - A) 1
  - B) 2
  - C) 3
  - D) 4
- **25.** Saturated steam is allowed to condense over a vertical flat surface and the condensate film flows down the surface. The local coefficient of heat transfer for condensation
  - A) Remains constant at all heights of the surface
  - B) Decreases with increasing distance from the top of the surface
  - C) Increases with increasing thickness of film
  - D) Increases with increasing temperature differential between the surface and vapour
- **26.** For film wise condensation on a vertical plane, the film thickness  $\delta$  and heat transfer coefficient h vary with distance x from the leading edge as
  - A)  $\delta$  decreases, h increases
  - B) Both  $\delta$  and h increases
  - C)  $\delta$  increases, h decreases
  - D) Both  $\delta$  and h decreases

- 27. Which field is set up when a fluid flows past a heated or cold surface?
  - A) Energy
  - B) Temperature
  - C) Mass
  - D) Time
- **28.** The velocity profile of the hydrodynamic boundary layer is dependent upon
  - A) Time
  - B) Viscosity
  - C) Temperature
  - D) Mass
- **29.** The relationship between the thermal and hydrodynamic boundary layer thickness is governed by the
  - A) Peclet number
  - B) Prandtl number
  - C) Stanton number
  - D) Fourier number
- **30.** Which quantity signifies the ratio of temperature gradient at the surface to a reference temperature gradient?
  - a) Reynolds number
  - b) Nusselt number
  - c) Fourier number
  - d) Stanton number
- **31.** Nusselt number is given by
  - A) h l/k
  - B) 2 h l/k
  - C) 3 h l/k
  - D) 4 h l/k
- **32.** For a given value of Nusselt number, the convective surface coefficient h is directly proportional to
  - A) Length
  - B) Mass
  - C) Thermal conductivity
  - D) Density
- **33.** The value of film coefficient is dependent upon
  - (i) Boundary layer configuration
  - (ii) Geometry and orientation of the surface
  - (iii) Surface conditions
  - A) i and ii
  - B) ii and iii

C) i and ii

D) i, ii and iii

**34.** Which of the following dimensionless number gives an indication of the ratio of internal (conduction) resistance to the surface (convective) resistance?

A) Biot number

- B) Fourier number
- C) Stanton number
- D) Nusselt number

35. In the non-dimensional Biot number, the characteristics length is the ratio of

- A) Perimeter to surface area of solid
- B) Surface area to perimeter of solid
- C) Surface area to volume of solid
- D) Volume of solid to its surface are
- **36.** The quantity  $h L_C/k$  is known as
  - A) Biot number
  - B) Fourier number
  - C) Stanton number
  - D) Nusselt number
- **37.** The Prandtl Number approximates \_\_\_\_\_
  - A) Momentum diffusivity to thermal diffusivity
  - B) Thermal diffusivity to momentum diffusivity
  - C) Shear stress to thermal diffusivity
  - D) Thermal diffusivity to kinematic viscosity
- 38. The ratio of inertia force to viscous force is known as
  - A) Grashof number
  - B) Reynolds number
  - C) Fourier number
  - D) Nusselt number
- **39.** Velocity within the given fields would be similar in magnitude, direction and turbulence pattern when
  - A) Nusselt number are different
  - B) Nusselt number are same
  - C) Reynolds number are different
  - D) Reynolds number are same
- **40.** Reynolds number is given by the quantity
  - A) p V l/δ
  - B) 2 p V l/ $\delta$
  - C) 3 p V l/δ
  - D) 4 p V l/δ

- 41. For laminar flow, Reynolds number should be
  - A) Less than 2300
  - B) Equal to 2300
  - C) Greater than 2300
  - D) Less than 4300
- **42.** For transient flow, the value of Reynolds number may vary between
  - A) 1450-9870
  - B) 1200-4500
  - C) 2300-6000
  - D) 6000-9000
- 43. The ratio of heat flow rate by convection to flow rate by conduction is known as
  - A) Stanton number
  - B) Graetz number
  - C) Fourier number
  - D) Peclet number
- **44.** The ratio of heat capacity of fluid flowing through the pipe per unit of length to the conductivity of pipe material is known as
  - A) Graetz number
  - B) Reynolds number
  - C) Peclet number
  - D) Fourier number
- **45.** The product of buoyant force and inertia force to the square of the viscous force is known as
  - A) Stanton number
  - B) Grashof number
  - C) Fourier number
  - D) Peclet number
- **46.** The ratio of heat transfer coefficient to the flow of heat per unit temperature rise due to the velocity of the fluid is known as
  - A) Fourier number
  - B) Grashof number
  - C) Peclet number
  - D) Stanton number
- **47.** When Biot number exceeds 0.1 but is less than 100, use is made of Heislers charts for the solution of transient heat conduction.
  - A) True
  - B) False
- **48.** In transient heat conduction, the two significant dimensionless parameters are
  - A) Reynolds number and Fourier number
  - B) Reynolds number and Biot number

- C) Reynolds number and Prandtl number
- D) Biot number and Fourier number

49. In the lumped system parameter model, the variation of temperature with time is

- A) Linear
- B) Exponential
- C) Sinusoidal
- D) Cube
- 50. Boiling occurs at
  - A) Atmospheric pressure
  - B) Any temperature
  - C) Both A) and B)
  - D) None of these

### UNIT-5

### THERMAL RADIATION

- 1. Aluminum foil used for cooking and storage sometimes has one side shiny surface and one dull surface. Should the shiny side or the dull side be on the outside when the food is wrapped for baking and freezing, respectively?
  - A) Shiny side, shiny side
  - B) Dull side, dull side
  - C) Shiny side, dull side
  - D) Dull side, shiny side
- 2. A small body at 100 °F is replaced in a large heating oven whose wall are the maintained at 2000 °F. the average absorptivity of the body varies with the temperature of the emitter as follows;

Temperature( °F)	100 °F	1000 °F	2000
			٥F
	0.8	0.6	0.5
Absorptivity, α			

What is the rate at which radiant energy is absorbed by the body per unit area? Stefan's boltzmaan constant =  $0.1714 * 10^{-8}$  Btu/hr ft<sup>2</sup>°F<sup>4</sup>

- A)  $2.11 * 10^{-4}$  Btu/hr ft<sup>2</sup>
- B)  $3.38 * 10^{-4}$  Btu/hr ft<sup>2</sup>13.7 Btu/hr ft<sup>2</sup>
- C)  $3.16 * 10^{-4}$  Btu/hr ft<sup>2</sup>
- D) None of the above
- 3. According to stefan's law which must be modified by Quantum physics, the total radiant intensity of a black body over all wavelength is given as

# $\int_0^\infty R d\lambda = \sigma T^4$

if radiant intensity is measured as  $R(\lambda) = \{8 \pi kT(C/4)\} / (\lambda^4)$ 

What are the units of the Stefan-Boltzmann constant k in MKS SYSTEM?

A)  $J/k^4$ 

- A)  $W/m^4k^4$
- B) W/m<sup>2</sup>
- C)  $W/m^2k^4$
- D) None of the above
- 4. Energy transferred by means of electromagnetic in
  - A) Conduction process
  - B) Convection process
  - C) Radiation process
  - D) None of these
- 5. A perfect black body is
  - A) Black in color
  - B) Reflect all the incident radiation
  - C) Absorbs all the incident radiation
  - D) Transmit all the incident radiation
- 6. If a body reflects all the incident radiation it is called
  - A) Black body
  - B) White body
  - C) Grey body
  - D) Transparent body
- 7. If a body transmit all the incident radiation on it, then it is called
  - A) Black body
  - B) White body
  - C) Grey body
  - D) Transparent body
- 8. As a result of absorption of all radiations incident on a black body, the black body
  - A) Becomes good conductor of heat
  - B) Shines
  - C) Temperature increases
  - D) All of these
- 9. Wavelength of radiation emitted depends on
  - A) Temperature of body
  - B) Material of the body
  - C) Both A) and B
  - D) None of these
- 10. Temperature of the sun can be measured with the help of
  - A) Mercury thermometer

- B) Standard thermometer
- C) Radiation pyrometer
- D) None of these
- 11. Heat transfer by radiation between two surface can be decreased by
  - A) Bringing the surface together
  - B) Polishing the surface
  - C) Providing a radiation shield between the surfaces
  - D) All of these
- 12. Radiation emitted by black body is called
  - A) Total radiation
  - B) Full radiation
  - C) Black radiation
  - D) All of these
- 13. All body above absolute zero temperature emits radiation. This statement is
  - A) Wein's law
  - B) Stefan's law
  - C) Planck's law
  - D) Prevost theory
- 14. Ratio of energy absorbed by body to the total energy incident on it is called
  - A) Emissive power
  - B) Absorptive power
  - C) Emissivity
  - D) Transmissibility
- 15. Ratio of emissive power of a body to the perfectly black body is called
  - A) Emissivity
  - B) Absorptivity
  - C) Transmissivity
  - D) Reflectivity
- 16. Ratio of energy transmitted by the body to the total radiation energy incident on the body is called
  - A) Emissivity
  - B) Absorptivity
  - C) Transmissivity
  - D) Reflectivity
- 17. Ratio of energy reflected by the body to the total radiation energy incident on the body is called
  - A) Emissivity
  - B) Absorptivity
  - C) Transmissivity
  - D) Reflectivity

- 18. Emissive power of a body depends upon
  - A) Wavelenght
  - B) Temperature
  - C) Physical nature
  - D) All of these
- 19. Emissivity of a body is equal to absorpitivity if the body is
  - A) In thermal equilibrium
  - B) At low temperature
  - C) At high temperature
  - D) None of these
- 20. Emissivity of a body is equal to absorpitivity for radiation
  - A) With equal wavelength and temperature
  - B) In radio frequency range
  - C) In infrared region
  - D) All of these
- 21. In grey body emissivity is
  - A) Less than 1
  - B) Equal to 1
  - C) More than 1
  - D) None of these
- 22. A body whose absorptivity does not vary with temperature and wavelength of the incident ray is called
  - A) Black body
  - B) White body
  - C) Gray body
  - D) Opaque body
- 23. A radiation shield should have
  - A) Zero reflectivity
  - B) Low reflectivity
  - C) High reflectivity
  - D) None of these
- 24. Absorptivity of all the body must lie between
  - A) 0 and 0.1
  - B) -1 and +1
  - C) 0 and 1.0
  - D) None of these

25. Absorptivity and reflectivity of a white body respectively are

- 0 and 0
- 1 and 0
- $0 \ and \ 1$

1 and 1

- 26. Absorptivity and reflectivity of a black body respectively are
  - A) 0 and 0
  - B) 1 and 0
  - C) 0 and 1
  - D) 1 and 1

# 27. Absorptivity and reflectivity of a transparent body respectively are

- A) 0 and 0
- B) 1 and 0
- C) 0 and 1
- D) -1 and 1

# 28. Wavelength for the maximum emissive power is given by

- A) Wein's law
- B) Stefan's law
- C) Planck's law
- D) Prevost theory
- 29. Relation between the emissive power and absorptive power is given by
  - A) Wein's law
  - B) Stefan's law
  - C) Planck's law
  - D) Kirchoff's law
- 30. Wavelenght corresponding to maximum energy is inversely proportional to absolute temperature. Above statement is
  - A) Wein's law
  - B) Stefan's law
  - C) Planck's law
  - D) Kirchoff's law
- 31. Planck's law of radiation is applicable to
  - A) Thermal radiation
  - B) Temperature radiation
  - C) Monochromatic radiation
  - D) None of these
- 32. Planck's law hold good for
  - A) All coloured bodies
  - B) Black bodies
  - C) White bodies
  - D) Both A) and B)
- 33. Stefan boltzman equation is
  - A) Q = Pat
  - B)  $Q = pAT^2$

C)  $Q = pAT^3$ 

- D)  $Q = pAT^4$
- 34. Unit of stefan- boltzman constant is
  - A) Watt/cm<sup>2</sup> k<sup>4</sup>
  - B) Kcal/  $m^2 hr k^4$
  - C) Cal/ cm<sup>2</sup> sec  $k^4$
  - D) All of these

# 35. Value of stefan boltzman constant in Kcal/ $m^2$ hr $k^4$

- A) 4.87\* 10<sup>-6</sup>
- B) 4.87\* 10<sup>-8</sup>
- C)  $5.67 * 10^{-6}$
- D) 5.67 \* 10<sup>-8</sup>
- 36. Amount of radiation from a body depends upon
  - A) Nature of the body
  - B) Temperature of the body
  - C) Surface area of the body
  - D) All of these
- 37. Radiation energy requires
  - A) A medium for its propagation
  - B) No medium for its propagation
  - C) Heating for its propagation
  - D) None of these
- 38. Radiation of heat is large in
  - A) Black polished surface
  - B) Black rough surface
  - C) White rough surface
  - D) White polished surface
- 39. Radiation from flame contain
  - A) Continious radiation from burning shoot particles of microscopic and submicroscopic dimensions
  - B) Radiation from suspended larger particles of coal trash causing flame luminosity
  - C) Infrared radiation from water vapor and carbon dioxide
  - D) All of the above
- 40. As a result of absorption of all the radiation incident on a black body, the black body
  - A) Becomes good conductor of heat
  - B) Shines
  - C) Temperature increases
  - D) All of these
- 41. A hollow sphere of uniform interior temperature and a small hole behaves as a
  - A) Black body

- B) White body
- C) Grey body
- D) Opaque body
- 42. As compared to the white surface, black surface are
  - A) Better radiators
  - B) Better absorber
  - C) Both A) and B)
  - D) None of these
- 43. Reflectance of a black body is
  - A) Zero
  - B) Less than unity
  - C) Equal to unity
  - D) Infinite
- 44. Heating effect caused by wavelenfth having range
  - A) 0.1 m to 100 m
  - B) 100 m to 200 m
  - C) 200 m to 300 m
  - D) None of these
- 45. A surface diffusely reflecting and emitting the same amount of energy which it receives by radiation is called
  - A) Perfect black body
  - B) Perfect white body
  - C) Perfect grey body
  - D) Perfect radiating body
- 46. When metallic surface get oxidized, the emissivity
  - A) Increases
  - B) Decreases
  - C) Remain same
  - D) None of these
- 47. Highest value of emissivity is of
  - A) Ice
  - B) Carbon
  - C) Rubber
  - D) Paper
- 48. Emissivity of polished silver body as compared to perfect black body is
  - A) Very high
  - B) High
  - C) Low
  - D) Very low
- 49. If the absorptivity plus reflectivity of a body is equal to 1, then the body is called

- A) Black body
- B) White body
- C) Grey body
- D) Opaque body
- 50. The process which transmits energy by mean of electromagnetic waves is called
  - A) Convection
  - B) Radiation
  - C) Conduction
  - D) None of these

# UNIT 6

# **EVAPORATION**

- 1. Statement related to the process of evaporation that is incorrect is?
  - A) Evaporation occurs at any temperature
  - B) Evaporation takes place within liquid not on the surface
  - C) Temperature may change during evaporation
  - D) No bubbles are formed in liquid during evaporation
- 2. Rate of evaporation is\_\_\_\_\_
  - A) directly proportional to temperature of liquid
  - B) inversely proportional to temperature of liquid
  - C) independent of temperature of liquid
  - D) directly proportional to humidity of surrounding air
- 3. Rate of evaporation increases as?
  - A) exposed surface area of liquid increases
  - B) exposed surface area of liquid decreases
  - C) movement of air above surface of liquid decreases
  - D) atmospheric pressure increases
- 4. Rate of evaporation decreases as?
  - A) temperature increases
  - B) humidity of surrounding air increases
  - C) movement of air above surface of liquid increases
  - D) atmospheric pressure decreases
- 5. Which of the following factors do not affect the rate of evaporation?
  - A) Temperature of liquid
  - B) Humidity of surrounding air
  - C) Depth of liquid
  - D) Surface of liquid
- 6. Evaporation occurs only \_\_\_\_\_
  - A) after boiling

- B) after extreme cooling
- C) at surface of a liquid
- D) if boiling occurs at atmospheric pressure
- 7. Compounds evaporating easily and giving off a smell are?
  - A) ionic compounds
  - B) covalent bonds
  - C) metallic bonds
  - D) dative bonds
- 8. When heating begins in miscible solutions, vapors formed will be?
  - A) of liquid lower in boiling point
  - B) of liquid higher in boiling point
  - C) vapors will be of both liquids with a higher concentration of liquid having low boiling point
  - D) collected in a gas syringe
- 9. Evaporation of solution of CuSO<sub>4</sub> helps in?
  - A) making it concentrated
  - B) crystallization of CuSO<sub>4</sub>
  - C) evaporation of salt CuSO<sub>4</sub>
  - D) concentration and crystallization
- 10. Evaporation in dairy industry is a preliminary step to which of the following process?
  - A) Drying
  - B) Flavoring
  - C) Watering
  - D) Pasteurization
- 11. Evaporation in dairy industry is done under \_\_\_\_\_
  - A) Vacuum
  - B) Heater
  - C) Dryer
  - D) Pasteurizer
- 12. Which evaporators can be used when a low degree of concentration is required?
  - A) Falling film evaporator
  - B) Circular type evaporator
  - C) Tubular type evaporator
  - D) Plate type evaporator
- 13. The evaporator in which the material to be evaporated boils outside the horizontal tube and steam condenses inside the tubes is called \_\_\_\_\_
  - A) Horizontal tube evaporator
  - B) Vertical tube evaporator
  - C) Vacuum pan evaporator
  - D) Forced circulation evaporator

- 14. Evaporator which promotes natural circulation is?
  - A) Horizontal tube evaporator
  - B) Vertical tube evaporator
  - C) Vacuum pan evaporator
  - D) Forced circulation evaporator
- 15. Evaporators in which pumps are used to force the evaporating liquid through the tubes are called?
  - A) Horizontal tube evaporator
  - B) Vertical tube evaporator
  - C) Vacuum pan evaporator
  - D) Forced circulation evaporator
- 16. Name of the evaporator which consists of one pass vertical shell and tube heat exchanger discharging the product to be evaporated into a relatively small vapor head?
  - A) Horizontal tube evaporator
  - B) Long tube vertical evaporator
  - C) Vacuum pan evaporator
  - D) Forced circulation evaporator
- 17. Which of the following is the disadvantage of climbing film evaporator?
  - A) Severe scale formation
  - B) Over heating
  - C) Small concentration
  - D) Low pressure
- 18. Which of the following is not the advantage of falling film evaporator?
  - A) Short residence time of liquid
  - B) Good performance with small temperature difference across heating surfaces
  - C) Operates at lower temperature difference than rising film evaporator
  - D) Long residence time of liquid
- 19. As the film rises further evaporation occurs until they reach the top of the tubes. The mixture of vapor and milk then passes into a separate chamber from which the vapor passes to a condenser. Name the evaporator.
  - A) Climbing film evaporator
  - B) Falling film evaporator
  - C) Plate evaporator
  - D) Forced circulation evaporato
- 20. Great economies of operation may be made in large installations with \_\_\_\_\_
  - A) Multiple effect evaporator
  - B) Centri-therm evaporator
  - C) Falling film evaporator
  - D) Rising film evaporator

- 21. Device used to improve thermal efficiency of an evaporator is called?
  - A) Thermo compressor
  - B) Deareater
  - C) Dryer
  - D) Pasteurizer
- 22. Ratio of capacity to economy is known as \_\_\_\_\_
  - A) Water consumption per hour
  - B) Steam consumption per hour
  - C) Sediment consumption per hour
  - D) Milk consumption per hour
- 23. \_\_\_\_\_ is the total mass of water vaporized per unit mass of steam input to the evaporator.
  - A) Efficiency of evaporator
  - B) Economy of evaporator
  - C) Rate of evaporator
  - D) Capacity of evaporator
- 24. Single effect evaporation is simple and steam effective.
  - A) True
  - B) False
- 25. \_\_\_\_\_ Rule is often used to compare a pure liquid and a solution at a given concentration.
  - A) Duhring's rule
  - B) Plank rule
  - C) Friction rule
  - D) Doppler rule
- 26. What is defined by the term Evaporator Capacity?
  - A) Kg of fluid supplied in one day
  - B) Kg of water evaporated in one day
  - C) Kg of fluid supplied in 1hr
  - D) Kg of water evaporated in 1hr
- 27. What are the parameters to determine the evaporator economy?
  - A) Evaporator Capacity
  - B) Evaporator temperature
  - C) Evaporator pressure
  - D) Evaporator Fluid supply
- 28. What is the steam consumption of an evaporator if the evaporator capacity is 30kg/her and the steam consumption is 45kg/hr?
  - A) 67%
  - B) 70%

- C) 80%
- D) 65%
- 29. What is the Evaporator Consumption if we evaporate 10 kg of water from a feed of 50kg at a temperature of 25°C to a final temperature of 100°C in an hour?
  - Latent heat of vaporization of water = 2,260 kJ/kg
  - Specific heat capacity = 6 KJ/Kg K
  - A) 21kg/hr
  - B) 22kg/hr
  - C) 20kg/hr
  - D) 19kg/hr
- 30. Find the value of Evaporator Capacity if we have a feed of 30kg at 25°C and with evaporator consumption as 10kg/hr?
  - Latent heat of vaporization of water = 2,260 kJ/kg

Specific heat capacity = 6 KJ/Kg K

- A) 2kg/hr
- B) 3kg/hr
- C) 4kg/hr
- D) 5kg/hr
- 31. What do we mean by the term Evaporator Consumption?
  - A) Steam consumed in 1hr
  - B) Steam produced in 1hr
  - C) Feed supplied in 1hr
  - D) Feed supplied in 1day
- 32. Find one among the following which does not measure evaporator performance.
  - A) Steam Consumption
  - B) Amount of Vapour Produced
  - C) Economy
  - D) Amount of feed supplied
- 33. The capacity of an evaporator depends upon the temperature of the feed solution.
  - A) True

B) False

- 34. Which one of the following method can be adopted to increase the capacity of the evaporator?
  - A) Increase pressure in calandria
  - B) Using multiple effect evaporator
  - C) Getting the temperature of the feed close to boiling temperature
  - D) Reducing the temperature of the feed
- 35. In a multiple effect evaporator, the pressure \_\_\_\_\_\_ as we move to subsequent effects.

A) Decreases

- B) Increases
- C) Remains same
- D) Doubles
- 36. What is the reason for using decreasing pressure on every subsequent effects in a multiple effect evaporator?
  - A) To be able to reuse the vapour from previous effect
  - B) To decrease the vapour pressure
  - C) To increase the boiling point
  - D) To decrease the boiling point
- 37. What is the number of effects used in the following setup?



- A) Triple effect evaporator
- B) Single effect evaporator
- C) Quadruple effect evaporator
- D) Double effect evaporator

38. In a multiple effect evaporator with more than one effects, the size of each effect should

### A) Decrease if pressure decreases

- B) Increase if pressure decreases
- C) Remain same
- D) Should increase if pressure increases
- 39. The multiple effect evaporators usually use \_\_\_\_\_\_ system of evaporation.
  - A) Flash
  - B) Natural convection
  - C) Forced convection
  - D) Bubble boiling
- 40. Which one of the following is not an assumption in multiple effect evaporator's calculations?
  - A) There is no sub cooling of the condensate from different steam chests
  - B) Heat transfer surface does not undergo fouling

- C) The entering steam is at their boiling point
- D) Pressure is same in every effect

41. For the given problem, What is the mass fraction for H<sub>2</sub>O in feed and NaOH in product?



- A) 0.50 and 0.50
- B) 0.65 and 0.50
- C) 0.65 and 0.65
- D) 0.50 and 0.95
- 42. What do we mean by types of feeding in an evaporator?
  - A) Total number of different types of feed available
  - B) Types of steam temperature applied
  - C) Types of recycle feed applied
  - D) Types of product extracted
- 43. Which one of the following is not a type of feeding in an evaporator?
  - A) Forward feed
  - B) Backward feed
  - C) Convoluted feed
  - D) Mixed feed
- 44. What is the name of the following evaporator? Recognize the type of feed
  - A) Forward feed
  - B) Backward feed
  - C) convoluted feed
  - D) Mixed feed



- 45. How can boiling point elevation be achieved in Evaporators?
  - A) Increasing pressure
  - B) Decreasing pressure
  - C) Increasing concentration
  - D) Increasing
- 46. Boiling point of the solution \_\_\_\_\_\_ as the evaporation process proceeds.
  - A) Increases
  - B) Decreases
  - C) remains same
  - D) Becomes half
- 47. Boiling point of a solution is a colligative property.
  - A) True
  - B) False
- 48. Boiling point elevation causes the driving force of evaporation in the fluid to \_\_\_\_\_
  - A) Decrease
  - B) Increase
  - C) Remain same
  - D) Increase tenfold
- 49. The Boiling point elevation as the evaporation in an evaporator proceeds can be approximately measured by \_\_\_\_\_
  - A) Duhring's rule
  - B) Arrhenius rule
  - C) Kozeny Carman rule
  - D) Sieder tate rule
- 50. The vapour released from the feed after being considerably concentrated is superheated steam.
  - A) True
  - B) False