DRDO 2009

Section – A

1. The thermal conductivity k of a liquid metal is predicted via the empirical equation k = Aexp(B/T), where k is in $Js^{-1}m^{-1}K^{-1}$ and T is absolute temperature in K. A and B are constants. The units of A and B are, respectively,

(A) $Js^{-1}m^{-1}K^{-1}$ and K^{-1} (B) $Js^{-1}m^{-1}K^{-1}$ and K

(C) J^{-1} smK and K^{-1} (D) J^{-1} smK and K

2. % Excess air for combustion process is defined as

(O_2 entering the process-O_2 required)

(A) *% Excess air* = ———————————— x 100

O_2 *required*

(O_2 required – O_2 entering the process)

(B) *% Excess air* = ———————————— x 100

O_2 *entering the process*

(O_2 required – O_2 entering the process)

(C) *% Excess air* = ————————————- x 100

(O_2 entering the process – O_2 required)

O_2 entering the process

(D) *% Excess air* = ———————————— x 100

(O_2 required – O_2 entering the process)

3. To prepare a solution of 50% sulfuric acid, a dilute waste acid containing 27% sulfuric acid is fortified with a fresh acid containing 96% sulfuric acid. The amount of fresh acid required for each 100 kg of dilute waste acid is

(A) 13.5 kg (B) 25 kg (C) 50 kg (D) 100 kg

4. *A* flue gas analysis gave 10% O_2, 25% CO_2 and 65% N_2 at 160 °C and 760 mm Hg. The ratio of partial pressures of CO_2 to O_2 is equal to

(A) 1 (B) 2 (C) 2.5 (D) 4

5. In the extraction of nicotine from a nicotine-water solution by kerosene, the pressure and temperature are kept constant. The available degree(s) of freedom is/are

(A) 0 (B) 1 (C) 2 (D) 3

6. The hydrostatic equation of pressure P with height *h* of an incompressible fluid of density ρ and specific weight γ is

(A) $P = \rho/h$ (B) $P = \gamma / h$

(C) $P = \rho\, h$ (D) $P = \gamma\, h$

7. A gas is being compressed from an enthalpy of 489 kJ/kg to 509 kJ/kg in a steady state open process. The entry and exit velocities of the gas are zero and 60 m/s, respectively. Assume that there is no heat loss or gain, no reaction, and potential energy change is negligible. If the load is 100 kg/h of gas, the work done on the gas is equal to

(A) 2000 kJ (B) 2180 kJ (C) 2500 kJ (D) 3000 kJ

8. The corresponding Maxwell relation for the Gibbsian equation dG = -SdT +VdP is

(A) (B)

(C) (D)

Statement for Linked Answer – Questions 9 and 10:

A system is taken from state A to state B along path ACB where 100 J of heat flows into the system and the system does 40 J of work.

9. How much heat flows into the system along path AEB if the work done by the system is 20 J?

(A) 20 J (B) 40 J (C) 60 J (D) 80 J

10. The system returns from B to A along path BDA. If the work done on the system is 30 J, what will be the amount of heat liberated/generated?

(A) -90 J (B) 90 J (C) 30 J (D) -30 J

11. Acentric factor for Argon is

(A) >1 (B) 1 (C) 0 (D) < 1

12. Wet steam at 270 °C enters a throttling calorimeter with enthalpies of 1200 kJ/kg and 2800 kJ/kg in liquid and gas phase, respectively. It leaves as supersaturated steam at 0.1 MPa and 120 °C with an enthalpy of 2700 kJ/kg. The quality of steam is

(A) 14/16 (B) 13/16 (C) 15/16 (D) 27/40

13. Superheated steam at 3 MPa and 300°C having enthalpy of 3000 kJ/kg enters a turbine at the rate of 1 kg/sec and leaves as dry saturated steam at 60 °C with an enthalpy of 2600 kJ/kg. If kinetic and potential energy changes are ignored, the power output of the turbine is

(A) 400 kW (B) 5600 kW (C) 3000 kW (D) 2600 kW

Statement for Linked Answer – Questions 14 and 15:

A reversible heat engine absorbs 800 kJ as heat from a reservoir at 600 K and rejects 100 kJ energy as heat to a reservoir at 300 K, as shown in the following figure.

Q14. The heat interaction (Q) with reservoir at 400 K is

(A) – 600 kJ (B) 400 kJ (C) – 400 kJ (D) 600 kJ

15. The work done (W) by the engine is

(A) 500 kJ (B) 400 kJ (C) 350 kJ (D) 300 kJ

16. The partial volume of component *A* in a binary mixture (A – B) *is 60 x* 10^{-6} m^3/mol. The mole% of A in the mixture is *60%*. The density of the mixture is 760 kg/m^3. What will be the partial volume (m^3/mol) of *B* in the mixture?

(Given: Molar mass of A is 50 x 10^{-3} kg/mol; molar mass of *B is* 20 x 10^{-3} kg/mol)

(A) 30 x 10^{-6} (B) 35 x 10^{-6} (C) 40 x 10^{-6} (D) 60 x 10^{-6}

17. The enthalpy of vaporization of water at 100 °C is 2300 kJ/kg. The isobaric heat capacities of liquid and vapor are, respectively, 4.0 kJ/kg-K and 2 kJ/kg-K. The enthalpy of vaporization at 150 °C will be

(A) 2400 kJ/kg (B) 2100 kJ/kg (C) 2500 kJ/kg (D) 2200 kJ/kg

18. The following equations have been proposed for an isothermal binary solution where the standard states are the pure components at the solution temperature and pressure:

$\gamma_1 = Ax_1$; $\gamma_2 = Bx_2$

What can be said about the above relation?

(A) It satisfies Gibbs-Duhem equation

(B) It does not satisfy Gibbs-Duhem equation

(C) It is thermodynamically consistent

(D) It satisfies both (A) and (C)

19. The enthalpy change of some reactions are given below:

$CO\ (g) + O_2\ (g) \rightarrow CO_2\ (g)\ \Delta H = -300$ kJ

$H_2\ (g) + O_2\ (g) \rightarrow H_2O\ (1)\ \Delta H = -320$ kJ

$H_2O(1)\ H_2O(g)$ $\Delta H = 50$ kJ

What will be the enthalpy change for the following reaction:

$CO(g) + H_2O(g)$ à $CO_2\ (g) + H_2\ (g)$

(A) -70 kJ (B) 30 kJ (C) -30 kJ (D) 70 kJ

20. The decrease in the Helmholtz Free Energy for system in a given process for which initial and final temperatures are equal to the surrounding temperature indicates.

(A) Maximum work obtained from the system

(B) Minimum work obtained from the system

(C) Minimum work which can be done on the system

(D) Both (A) and (C)

21. The vapor pressures of benzene and toluene at 70 $^{\circ}$C are 4 and 6 atm, respectively. A liquid feed of 0.6 moles of toluene at the same temperature is vaporized. Assuming Raoult's law, the vapor phase mole fraction of benzene at equilibrium is approximately.

(A) 0.30 (B) 0.40 (C) 0.50 (D) 0.60

22. An oil film of viscosity u and thickness h is sheared between a solid stationary wall and a circular disc of radius *R,* where $h << R$. The circular disc is rotating with angular speed w. For the same thickness of the film, if the radius of the disc is doubled, the angular speed remaining the same, by what factor the torque on the disc increases?

(A) 2 (B) 4 (C) 8 (D) 16

23. A circular fire hose of inner cross-sectional area 100 cm^2 is connected to a nozzle whose exit cross-sectional area is 4 cm^2. The horizontal nozzle is discharging water at 0.6 m^3/minute to the atmosphere. If a pressure gauge is connected to the hose side just before the nozzle, what would be the reading of the pressure gauge?(Density of water = 1000 kg/m^3)

(A) 312 kPa (B) 624 kPa (C) 89 kPa (D) 178 kPa

24. A reciprocating pump has a piston of cross-sectional area A and is connected to a crank of radius r which is rotating with angular velocity ω. The pump is connected to the suction and the delivery pipes whose internal cross-sectional area is A_1. The maximum velocity of the fluid element in the suction or delivery pipe is

(A) (B) (C) ωr (D)

25. Assuming that the thrust T of a propeller depends upon the diameter *D,* speed of advance V, angular velocity ω, dynamic viscosity μ, and density ρ, which of the following dimensionless parameters can be derived by dimensionless analysis?

(1) (2) (3) (4)

Select the correct answer using the codes given below:

(A) 1, 2 and 3 (B) 1, 3 and 4 (C) 2, 3 and 4 (D) 1, 2 and 4

26. The velocity profile *u* in the boundary layer over a flat plate is given by . where U is the free stream velocity, y is the vertical distance of the velocity point from the flat plate and δ is the boundary layer thickness. The displacement thickness of the boundary layer is

(A) (B) (C) (D)

27. Which of the following statements is INCORRECT about thixotropic fluids?

(A) Apparent viscosity depends on the time of shearing

(B) Thixotropy is an irreversible process

(C) Thixotropic fluid shows shear thinning behavior

(D) Thixotropic fluids are in general non-Newtonian fluids.

28. A small liquid droplet of radius 1 mm and density 900 kg/m^3 is rising up in a column of water. What is the terminal rise velocity of the drop if creeping flow conditions are assumed?(Given: viscosity of water = 1 cp, Gravitational constant g = 10 m/s^2)

(A) *m/s* (B) *m/s* (C) *m/s* (D) *m/s*

29. Which of the following is NOT RECOMMENDED to increase the collection efficiency of a cyclone separator?

(A) Increase in particle density

(B) Decrease in gas temperature

(C) Increase in particle diameter

(D) Increase in gas flow rate

Statement for Linked Answer – Questions 30 and 31:

In a fluidized bed operation, spherical particles of 1 mm diameter are packed to a height of 1.0 meter. The porosity of this bed is measured to be 0.4. At the minimum fluidization with air the bed height expands to *1.2* meter.

(Given: Particle density = *1200* kg/m^3, Gravitational constant g = 10 m/s^2).

30. The porosity of the bed at minimum fluidization is

(A) 0.4 (B) 0.3 (C) 0.5 (D) 0.6

31. The approximate value of pressure drop in the bed at minimum fluidization will be

(A) 3600 N/m^2 (B) 7200 N/m^2 (C) 6000 N/m^2 (D) 3000 N/m^2

32. In a centrifugal filter the inside radius of the filter basket is R_2 and radius of the inner surface of liquid is R_1. The centrifuge is rotating with an angular speed ω. Which of the following is true about the pressure drop ΔP from the centrifugal action?

(A) $\Delta P \mu \omega^{1/2}$ (B) $\Delta P \mu (R_2^2 + R_1^2)$

(C) $\Delta P \mu (R_2^2 - R_1^2)$ (D) $\Delta P \mu \omega$

33. In a dry crushing operation the mean diameter of the feed and product particles are 100 mm and 1 mm, respectively. The sphericity of the feed and product particles are 0.5 and 1.0, respectively. If the feed particles of 200 mm diameter with the same sphericity are handled at the same feed rate, what will be the percentage increase in power requirement assuming that the product remains the same?

(A) (B) (C) (D)

34. Which of the following is INCORRECT about the boundary layer development over flat infinite plate?

(A) The fluid velocity at solid-liquid interface is zero

(B) The shear rate inside the boundary layer is not zero

(C) The boundary layer thickness increases with distance from the leading edge

(D) The flow in the boundary layer close to the leading edge is turbulent

35. Which of the following velocity field represents an irrotational flow for x, y > 0, x ≠ y?

(A) $V = 2\,yi - 2x\,.j$

(B) $V = 2\,xi - 3y,j$

(C) $V = xy\,i - xy\,j$

(D) $V = xy\,i + xy\,j$

36. In a laminar flow between two parallel plates separated by a distance H, the head loss varies

(A) directly as H (B) inversely as H^2

(C) directly as H^2 (D) inversely as H^3

37. Two viscous liquids are to be blended by passing through a pipe. Which of the following would be the most suitable condition for axial mixing?

(A) Creeping flow (B) Low Reynolds number flow

(C) High Reynolds number flow (D) Plug flow

38. A U-tube manometer measures

(A) absolute pressure at a point

(B) local atmospheric pressure at a point

(C) difference in total energy between two points

(D) difference in pressure between two points

39. What will happen to the heat loss if foam insulation, with thermal conductivity 0.09 W/m-K is added to a 5 cm outer diameter pipe carrying hot water? (Heat transfer coefficient on the outer surface = 10 W/m^2-K)

(A) Increases (B) Decreases

(C) First increases then decreases (D) Remains constant

40. Biot number (hL/k) is important for which mode of heat transfer?

(A) Natural convection (B) Forced convection

(C) Transient heat conduction (D) Radiation

41. The temperature distribution in a 0.25 m thick wall is given as T (°C) = $250 + bx - cx^2$,

where x (in meter) is the position of a point with respect to the surface of the wall which is at higher temperature. The thermal conductivity of the wall is 5.95 W/m-°C. What will be the value of b if the surface at x = 0 is insulated?

(A) 0 (B) 1 (C) – 1 (D) 0.5

42. When momentum diffusivity is greater than the thermal diffusivity, the velocity boundary layer

(A) develops faster than the thermal boundary layer

(B) develops slower than the thermal boundary layer

(C) grows together

(D) disappears

43. An aluminium ball of area 0.5 m^2 and mass 10 kg is cooled in ambient at *25* °C. When the temperature of the ball is 125 °C, it is found to cool at the rate of 6 °C/min. What will be the surface heat transfer coefficient?

(Given, C_p = 0.5 kJ/kg-°C)

(A) 0.5 W/m^2-°C (B) 0.01 W/m^2-°C

(C) 0.05 W/m^2-°C (D) 0.1 W/m^2-°C

44. Water at 25 °C enters a pipe with internal diameter *2* cm having a constant wall heat flux of 1 KW/m^2. The flow is hydro dynamically and thermally fully developed. What will be the difference between the local wall temperature and the local mean (bulk) temperature? (Thermal conductivity of pipe = 0.4 W/m-°C; Nusselt Number = 5.0)

(A) 5 °C (B) 15 °C (C) 10 °C (D) 50 °C

45. When some liquid nitrogen spills on the floor of a laboratory, the droplets move so briskly that they appear to be dancing before they disappear. This phenomenon

(A) is related to pool boiling (B) is related to film boiling

(C) is related to nucleate boiling (D) has nothing to do with boiling

46. Consider sphere 1 enclosed by sphere 2 as shown in the following figure. The area of sphere 2 is double the area of sphere 1. What are the various view factors ($F_{11}, F_{12}, F_{21}, F_{22}$)?

(A) 0, 0.5, 0.5, 1 (B) 0.5, 1, 1, *0.5*

(C) 0.5, 0.5, 0, 1 (D) 0, 1, 0.5, 0.5

47. A triple-effect evaporator is concentrating a liquid that has no appreciable elevation in boiling point. The temperature of the steam to the first effect is 110 °C and the boiling point of the solution in the last effect is 50 °C. The ratio of the heat transfer resistance of the first effect to that of the overall heat transfer resistance is 0.2. At what temperature will the liquid boil in the first effect?

(A) 95 °C (B) 98 °C (C) 90 °C (D) 92 °C

48. Gas A is being cracked on a catalyst as per the reaction, $A \rightarrow 2B+C$ in such a way that A diffuses to the cracking surface and *B* diffuses back, while *C* is not diffusing. At steady state what will be the ratio of molar flux of A to the total molar flux?

(A) 1/3 (B) –1 (C) 2 (D) 2/3

49. The eddy momentum diffusivity, the thermal diffusivity and the mass diffusivity will be same for most of the gases when

(A) both Prandtl and Schmidt numbers are equal to 1.2

(B) both Prandtl and Schmidt numbers are equal to 10.0

(C) both Prandtl and Schmidt numbers are equal to 0.1

(D) both Prandtl and Schmidt numbers are equal to 1.0

50. According to surface renewal theory, the average mass transfer coefficient is directly proportional to

(A) D_{AB} (B) (C) (D)

51. For the flow of a fluid at right angles to a circular cylinder, the average heat transfer coefficient around the periphery is given by $Nu = a + b$ Re"' Pr", where, *Nu* is Nusselt Number, Sh is Sherwood Number, Pr is Prandtl Number, Sc is Schmidt Number and *a*, *b, m, n* are constants. The analogous expression for the mass transfer can be expressed as

(A) $Sh = a + b$ Re"' Sc" (B) $Sh = b + a$ Re"' Sc"

(C) $Nu = m + n$ Re" Sc^b (D) $Nu = n + m$ Re" Sc^v

Statement for Linked Answer – Questions 52 and 53:

A horizontal spray chamber with recirculated water is used for adiabatic humidification and cooling of air. Air with humidity of 0.01 kg water per kg of dry air is entering the unit with a flow rate of 2 kg/m^2-s. The humidity of exit stream is 0.02 kg water per kg of dry air. The active part of the chamber is 1.0 m long. The humidity at the saturated condition is 0.03 kg water per kg of dry air.

52. The volumetric gas phase mass transfer coefficient in kg/m^3-s in the operation is equal to

(A) ln 2 (B) ln 3 (C) ln 4 (D) ln 5

53. If a duplicate spray chamber operating in the same manner were to be added in series with the existing chamber, the expected humidity of the outlet air in kg water per kg of dry air is equal to

(A) 0.03 (B) 0.02 (C) 0.025 (D) 0.05

54. A saturated liquid mixture with 50% (mole basis) of more volatile component is to be separated in a continuous distillation column. The mole% of more volatile component in the distillate is 90. The constant relative volatility of more volatile component is 1.5. Assuming McCabe-Thiele method, the minimum reflux ratio for this operation is

(A) 3 (B) 2 (C) 2.5 (D) 1

55. In a perfectly mixed flow model, the ratio of the Murphree plate efficiency to the point efficiency is equal to

(A) 0 (B) 1 (C) < 1 (D) > 1

Statement for Linked Answer – Questions 56 and 57:

A waste stream of organic vapor in a gas from a process was adsorbed by solid particles in packed bed of length 20 cm. The breakpoint concentration is set at $C/C_0 = 0.10$ and the breakpoint time is 4 hours.

56. What will be the time equivalent to the unusable capacity of the bed up to the breakpoint time?

(A) 3 hours (B) 1.5 hours (C) 4 hours (D) 3.6 hours

57. The stoichiometric capacity of the bed is 7.2 hours. What will be the length of unused bed for this operation?

(A) 7.2 cm (B) 20 cm (C) 10 cm (D) 4 cm

58. In liquid-liquid extraction, the solvent B is used to separate solute C from a given solution of A and C. If A and B are completely insoluble in one another, the selectivity of B will be

(A) ∞ (B) 0 (C) < 0 (D) 1

59. A batch of wet solid is to be dried from 80% to 50% moisture (wet basis). The drying surface is 1 m^2/10 kg of dried solid. The drying takes place within the constant rate period. The constant flux of drying is 0.3 x 10^{-3} kg/m^2-s. The drying time is

(A) 10^2 s (B) 10^3 s (C) 10^4 s (D) 10^5 s

60. A gas with a flow rate of 25 mol/m^2.s is scrubbed by a pure liquid to remove a component in a counter-current packed bed column. The specific interfacial area of the packing material is 1 m^{-1}. The individual gas-film mass transfer coefficient is 25 mol/m^2.s. If the overall mass transfer resistance is 50% of the individual gas-film mass transfer resistance, the overall height of gas phase transfer unit $(HTU)_{og}$ is

(A) 0.5 m (B) 1.0 m (C) 2.0 m (D) 2.5 m

61. If L is the liquid flow rate. G is the gas flow rate and m is the slope of the equilibrium line, the absorption factor is

(A) mL / G (B) G / mL (C) L / mG (D) LG / m

62. A vessel dispersion number of zero indicates

(A) plug flow behavior (B) mixed flow behavior

(C) batch reactor behavior (D) both (B) and (C)

63. For the E curve shown below, the shaded region represents

E

tj

Time (t)

(A) fraction of inlet stream older than time t_1

(B) fraction of exit stream younger than time t_1

(C) fraction of exit stream older than time t_1

(D) fraction of inlet stream younger than time t_1

64. A first order reaction takes place in a single cylindrical pore having strong diffusion resistance. For a particle size (R), the rate of the reaction varies

(A) directly with R

(B) directly with $\sqrt{R}$

(C) inversely with $\sqrt{R}$

(D) inversely with R

65. The response curve for a step input signal from a reactor is called C curve. The variance of C curve in a `tank in series model' comprising of `n' tanks is

(A) n (B) $1/n$ (C) $n^{0.5}$ (D) n^2

66. Calculate the weight of the catalyst required for the 75% conversion of sample A (C_{AO} = 8 mol/m^3) in a mixed flow reactor at a flow rate of 1000 mole/min.

(The weight time of the operation is 4.15 kg s/m^3)

(A) 500 kg (B) 519 kg (C) 525 kg (D) 600 kg

67. In an endothermic reaction, for an increase in temperature, the equilibrium conversion

(A) rises (B) falls

(C) remains constant (D) first increases then decreases

Statement for Linked Answer – Questions 68 and 69:

Aqueous phase decomposition of A is investigated in two mixed flow reactors in series. The second reactor is having twice the volume of the first reactor. At steady state with a feed of 1 mole/litre and mean residence time of 96 seconds in first reactor, the concentration of A in the first reactor is 0.5 mol/litre and in the second 0.25 mol/litre.

68. The order of the reaction is

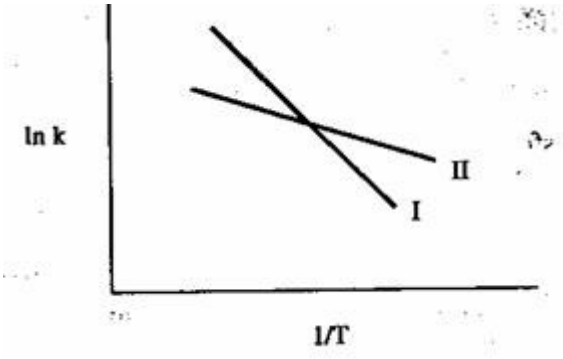
(A) 1 (B) 2 (C) 0 (D) 3

69. The rate constant (lit/mol-min) is

(A) 1.5 (B) 3 (C) 2 (D) 1.25

70. For a zero order reaction in a varying volume batch reactor, the correct equation is

71. The following figure shows the temperature dependency on the reaction rate for two sets of reactions I and II. Choose the INCORRECT statement.



(A) Reaction I is temperature sensitive

(B) Reactions I and II represent high and low activation energies respectively

(C) Reactions I and II represent low and high activation energies respectively

(D) Reaction II is temperature insensitive

72. For a particular reaction where order of the reaction is less than one, the CORRECT sequence of reactors for efficient use is

(A) Small MFR, Large MFR, PFR (B) Large MFR, Small MFR, PFR

(C) PFR, Large MFR. Small MFR (D) PFR, Small MFR, Large MFR

73. The half-life period of the reaction A → products is independent of the initial concentration of the reactant A if the order of the reaction is

(A) 0 (B) 1 (C) 2 (D) 1/2

Statement for Linked Answer – Questions 74 and 75:

Chemical A reacts to form *R* (k_1 = *8* hr^{-1}) and chemical *R* reacts to form S (k_2 = 3 hr^{-1}). In addition *R slowly* decomposes to form *T* (k_3 = 1 hr^{-1}). A solution containing 1 mol/litre of A is introduced into a batch reactor.

74. What is the maximum concentration of R (mol/lit)?

(A) 0.5 (B) 0.25 (C) 0.75 (D) 1.0

75. How long will it take (in hours) for R to reach its maximum concentration?

(A) ln 2 (B) ln 2 (C) ln 2 (D) 2 1n 2

76. Ordinary mercury-in-glass thermometer (without any covering or air gap) is an

example of

(A) zero-order system (B) first-order system

(C) second-order system (D) third-order system

77. The symbol of the type _____ denotes

(A) Pneumatic line (B) Fluid pressure line

(C) Electrical line (D) Software link

78. The Laplace transform of *sin (kt) is*

(A) $k/(s^2 + k^2)$ (B) $s/(s^2 + k^2)$

(C) $k/(s^2 - k^2)$ (D) $s/(s^2 - k^2)$

79. A control system is unstable if the open loop frequency response exhibits an amplitude ratio exceeding unity at the cross-over frequency. This is

(A) Bode stability criteria (B) Routh stability criteria

(C) Nyquist criteria (D) Root-locus criteria

80. What will be the maximum value of $K_($such that a closed loop system having the following characteristic equation is stable ?

$s^3 + 6s^2 + 11s + 6\ (1+K_C) = 0$

(A) $K_C < 10$ (B) $K_C < 15$ (C) $K_C <$ (D) $K_C <$

81. The transfer function of a proportional-integral-derivative (PID) controller is

(A) $= K_C\,(1 + \tau_D\,S + \tau_D\,S)$ (B) $= K_C + \tau_D + \tau_D\,S$

(C) $= K_C\,(D)$ =

82. For the block diagram shown below what will be the overall transfer function for the change in set point (U = 0)?

(A) = (B) =

(C) = (D) =

83. The amplitude ratio (AR) for the sinusoidal response of a first-order system is always

(A) <1 (B) >1 (C) 1 (D) 0

84. Solenoid valve works like

(A) Proportional controller (B) PD controller

(C) PID controller (D) On-off controller

85. The final product from a chemical plant is composed of two materials A and *B* with some of each being required. The total cost per unit of the finished product is

C_T = Rupees/unit.

If the amount of *A* is fixed, the amount of *B* required for minimum total cost of product is

(A) (B) (C) A/36 (D) 720A

86. Which of the following is NOT a function of baffle in the shell-and-tube heat exchanger?

(A) Direct the flow across the tube bundle

(B} Support the tube from sagging

(C) Arrest the vibration of the tubes

(D) Decrease the turbulence of the fluid

87. Match the following:

(1) Microfiltration (P) Solution/diffusion

(2) Reverse Osmosis (Q) Size exclusion

(3) Distillation (R) Vapor/liquid equilibria

(4) Stripping (S) Absorption

(A) 1-P, 2-Q, 3-R. 4-S (B) 1-Q, 2-P, 3-R, 4-S

(C) 1-S, 2-R, 3-P, 4-Q (D) 1-R, 2-Q, 3-S, 4-P

88. What is the cross-flow area in the case of a shell-and-tube heat exchanger where inside diameter of the shell is 5 m, baffle spacing 0.5 m, clearance between the tubes 5 cm, outside diameter of the tube 10 cm and pitch of the tube 2 cm?

(A) 12.5 m^2 (B) 6.25 m^2 (C) 22.5 m^2 (D) 10 m^2

89. A chemical company has purchased leaf pressure filters with 100 ft^2 for purifying an inorganic liquid stream at the cost of Rs. 15000. In a similar application the company will need

900 ft^2 leaf pressure filter. The size exponent of this type of filter is 0.5. The purchased price of the 900 ft^2 filter will be

(A) Rs.135000 (B) Rs. 67500 (C) Rs. 45000 (D) Rs. 90000

90. Which of the following results in book values greater than those obtained with the straight line method?

(A) Declining balance method (B) Sum-of-the years digit method

(C) Multiple straight line method (D) Sinking fund method

91. The Darcy's law is used to calculate

(A) heat transfer coefficient

(B) friction factor in pipe flow

(C) permeability of porous medium

(D) vapor pressure in azeotropic mixtures

92. `Total capital investment' for a chemical process plant comprises of the fixed capital investment and the

(A) working capital (B) indirect production costs

(C) direct production costs (D) overhead costs

93. Which of the following statements is INCORRECT for the manufacture of sulfuric acid by contact process?

(A) Yield is higher than the chamber process

(B) Catalyst used is vanadium pentoxide on a porous carrier

(C) Final scrubbing is done using concentrated sulfuric acid only

(D) Optimization of space velocity in catalyst chamber is a major engineering problem.

94. Match the following:

(1) Paper (P) Zeigler

(2) Soda ash (Q) Sachsse

(3) Polyethylene (R) Kraft

(4) Acetylene (S) Solvay

(A) 1-P, 2-R, 3-Q, 4-S (B) 1-P, 2-Q, 3-R, 4-S

(C) 1-S, 2-R, 3-Q, 4-P (D) 1-R, 2-S, 3-P, 4-Q

95. Match the following:

(1) Maleic anhydride (P) Ag0

(2) DDT (Q) NH_3

(3) Ethylene oxide (R) V_20_5

(4) Soda ash (S) Oleum

(A) 1-R, 2-S, 3-P, 4-Q (B) 1-S, 2-R, 3-Q, 4-P

(C) 1-R, 2-S, 3-Q, 4-P (D) 1-P, 2-Q, 3-R, 4-S

96. Match the following:

(1) Parathion (P) Lead oxide

(2) Margarine (Q) Pesticide

(3) Litharge (R) Enzyme

(4) Lipase (S) Fat

(A) 1-S, 2-P, 3-Q, 4-R (B) 1-S, 2-R, 3-Q, 4-P

(C) 1-Q, 2-S, 3-P, 4-R (D) 1-R, 2-S, 3-P, 4-Q

97. Cetane number of diesel is the measure of its

(A) smoke point (B) ignition delay

(C) viscosity (D) oxidation stability

98. Choose the CORRECT statement from the following:

(A) Aromatics have lowest octane number

(B) Paraffins are the hardest to crack

(C) Dearomatisation of kerosene increases its smoke point

(D) Aniline point is a property of LPG

99. Choose the INCORRECT statement from the following:

(A) SBR compared to natural rubber has poor tensile strength

(B) Silicone is an inorganic polymer

(C) Nylon-6 is a polyamide

(D) Neoprene is an elastomer

100. Match the following:

(1)	Permanent hardness of water	(P)	Steam distillation
(2)	Alkyl group of detergent	(Q)	Cation/anion exchanger
(3)	Rancidity of oil	(R)	Hydrogenation
(4)	Essential oil	(S)	Hydrophobic

(A) 1-Q, 2-S, 3-R, 4-P (B) 1-Q, 2-R, 3-S, 4-P

(C) 1-R, 2-P, 3-Q, 4-S (D) 1-S, 2-P, 3-R, 4-Q