Sl. No. : **30002033**

**ACFCHE**

*Register Number* | | | | | | | | | |

# 2014

# CHEMICAL ENGINEERING

**Time Allowed : 3 Hours]** **[Maximum Marks : 300**

**Read the following instructions carefully before you begin to answer the questions.**

## IMPORTANT INSTRUCTIONS

1. This Booklet has a cover (this page) which should not be opened till the invigilator gives signal to open it at the commencement of the examination. As soon as the signal is received you should tear the right side of the booklet cover carefully to open the booklet. Then proceed to answer the questions.
2. This Question Booklet contains **200** questions. Prior to attempting to answer the candidates are requested to check whether all the questions are there in series without any omission and ensure there are no blank pages in the question booklet. In case any defect in the Question Paper is noticed it shall he reported to the Invigilator within first 10 minutes.
3. Answer **all** questions. **All** questions carry equal marks.
4. You must write your Register Number in the space provided on the top right side of this page. Do not write anything else on the Question Booklet.
5. An answer sheet will be supplied to you separately by the invigilator to mark the answers.
6. You will also encode your Register Number, Subject Code, Question Booklet Sl. No. etc. with Blue or Black ink Ball point pen in the space provided on the side 2 of the Answer Sheet. If you do not encode properly or fail to encode the above information, action will be taken as per commission's notification.
7. Each question comprises *four* responses (A), (B), (C) and (D). You are to select ONLY ONE correct response and mark in your Answer Sheet. In case you feel that there are more than one correct response, mark the response which you consider the best. In any case, choose ONLY ONE response for each question. Your total marks will depend on the number of correct responses marked by you in the Answer Sheet.
8. In the Answer Sheet there are **four** circles Ⓐ, Ⓑ, Ⓒ and Ⓓ against each question. To answer the questions you are to mark with Blue or Black ink Ball point pen ONLY ONE circle of your choice for each question. Select one response for each question in the Question Booklet and mark in the Answer Sheet. If you mark more than one answer for one question, the answer will be treated as wrong. *e.g.* If for any item, Ⓑ is the correct answer, you have to mark as follows :

   Ⓐ ● Ⓒ Ⓓ

9. You should not remove or tear off any sheet from this Question Booklet. You are not allowed to take this Question Booklet and the Answer Sheet out of the Examination Hall during the examination. After the examination is concluded, you must hand over your Answer Sheet to the Invigilator. You are allowed to take the Question Booklet with you only after the Examination is over.
10. The sheet before the last page of the Question Booklet can be used for Rough Work.
11. Failure to comply with any of the above instructions will render you liable to such action or penalty as the Commission may decide at their discretion.
12. In all matters and in cases of doubt, the English Version is final.
13. Do not tick-mark or mark the answers in the Question booklet.

SPACE FOR ROUGH WORK

1. Ideal refrigeration cycle is

(A) Same as Carnot cycle

(B) Same as reverse carnot cycle

(C) Dependent on refrigerant properties

(D) The least efficient of all refrigeration processes

2. When a system consisting of several components distributed between various phases in thermodynamic equilibrium at a definite temperature and pressure, the chemical potential of each component is

(A) same in all phases

(B) different in all phases

(C) zero in all phases

(D) constant in all phases

3. The reaction coordinate measures

(A) The progress of a reaction and is defined as the degree to which a reaction has advanced

(B) The changes in reaction takes place

(C) Different species taking part in the reaction

(D) Various species converted in the reaction

4. Phase rule for reacting systems

(A) $F = C - \pi + 2$

(B) $F = C + \pi - 2$

(C) $F = C - \pi - r + 2$

(D) $F = C - \pi + r - 2$

5. For the equilibrium yield in a gas phase reaction, diluting the reaction mixture with an inert gas

(A) Has the same effect as that of an increase in pressure

(B) Has the same effect as that of a decrease in pressure

(C) Has no correlation with a change in pressure

(D) Always produces unfavourable results

6. According to Charles law, that for a given mass of an ideal gas

(A) the ratio of the volume to temperature is constant at a given pressure

(B) the ratio of the pressure to temperature is constant at a given volume

(C) the ratio of the pressure to temperature is not constant at a given volume

(D) the ratio of the volume to temperature is not constant at a given pressure

7. The critical temperature is

(A) the maximum temperature at which the gas can be liquified

(B) the maximum temperature at which the gas attained its ideality

(C) the minimum temperature at which the gas can be liquified

(D) the minimum temperature the gas attained its ideality

8. The volume basis analysis like $V = \Sigma V_i$ is known as where $V_i$ is the volume of pure component, $i$ present in the mixture and the total volume of the gas is $V$

(A) Vander Walls equation (B) Boyle's law

(C) Amagat's law (D) Charles law

9. Raoult's law provides a simple expression

(A) $\overline{P}_i = x_i P_i^S$ (B) $P_i = x^2 P_i^S$

(C) $P = x_i P_i$ (D) $P_i^S = x_i P_i$

10. Absolute pressure is equal to

(A) Atmospheric pressure only (B) Gauge pressure only

(C) Atmospheric pressure + gauge pressure (D) Atmospheric pressure – gauge pressure

11. A limiting component is defined as

(A) One which decides the conversion in the reactions

(B) One which decides the conversion in the reactants

(C) One which decides the unreacted components in the reactions

(D) One which decides the conversion in the reactants and products

12. The percentage conversion of $CH_4$ is given as, when 'a' be the K mol of $CH_4$ fed of which 'b' K mol of $CH_4$ are reacted by reaction and 'c' K mol of $CH_4$ are reacted by reaction with $H_2O$ gives Co and $H_2$

(A) Percentage conversion of $CH_4 = \left\{\frac{b+c}{a}\right\} \times 100$

(B) Percentage conversion of $CH_4 = \left(\frac{b-c}{a}\right) \times 100$

(C) Percentage conversion of $CH_4 = \left(\frac{b+a}{c}\right) \times 100$

(D) Percentage conversion of $CH_4 = \left(\frac{a-b}{c}\right) \times 100$

13. For ideal gases, the molal heat capacity of a gas mixture at a constant pressure is given by

(A) $Cp^{\circ}\ \text{mix} = \sum_{1}^{n} x_i\, Cpi^{\circ}$ (B) $Cp\ \text{mix} = x_i\, Cpi^{\circ}$

(C) $Cp\ \text{mix} = \sum_{i}^{n} x_i\, Cpi$ (D) $Cpi\ \text{mix} = \sum_{i}^{n} x_i\, Cp$

14. The relationship between vapour pressure (P) and temperature (T) is given as Antonie-equation which follows, where A, B, C are Antonie equation constants

(A) $\log_{10} P = A - \frac{B}{T+C}$ (B) $\log_{10} P = A - \frac{B}{T-C}$

(C) $\ln P = A + \frac{B}{T-C}$ (D) $\ln P = A + \frac{B}{T+C}$

15. For vapour-liquid mixture, the amounts of the phases can be calculated using

(A) Material balance equation (B) Energy balance equation

(C) Both (A) and (B) (D) Tie line method

16. When solids dissolve in a solvent, the exothermic heat of solution is given a

(A) negative sign (B) positive sign

(C) infinity (D) zero

17. The fundamental dimention of power is

(A) $[M^{\circ} L^{2} T^{-3}]$ (B) $[M^{1} L^{2} T^{-3}]$

(C) $[M L T^{-2}]$ (D) $[M L T^{-3}]$

18. $ML^2 T^{-2}$ is the fundamental unit of

(A) work (B) energy

(C) power (D) force

19. If no chemical reaction is involved, the material balances should based on

(A) chemical compounds (B) elements

(C) atomic species (D) components of fixed compositions

20. Which is true, when material balance is applied to a system ice $\rightleftharpoons$ water at steady state?
(A) Input = output, Accumulation $\neq$ 0 Consumption = 0
(B) Input $\neq$ output, Accumulation = 0 Consumption = 0
(C) Input = output, Accumulation = 0 Consumption $\neq$ 0
(D) Input = output, Accumulation = 0 Consumption = 0

21. The capacity of the screen is controlled simply by varying
(A) the rate of feed to the unit
(B) the rate of feed to the unit time
(C) the rate of time to the feed
(D) the rate of feed to the size of the screen

22. Mills that reduce solids to such fine particles are called
(A) Ball mills
(B) Tumbling mills
(C) Conical ball mills
(D) Ultra fine grinders

23. Rotary knife cutters and granulators are applied in size reduction machines for
(A) the manufacture of cement
(B) the manufacture of lime
(C) the manufacture of neither rubber nor plastics
(D) the manufacture of plastics and rubber

24. The specific cake resistance is measured by
(A) m/kg
(B) mg/m
(C) $m^2$/kg
(D) $m^2$/kg.s

25. The ratio of actual mesh dimension of Taylor series to that of the next smaller screen is
(A) 1
(B) 2
(C) $\sqrt{2}$
(D) 1.5

26. The opening of 400 mesh screen (Taylor screen) is
(A) 0.38 mm
(B) 0.038 mm
(C) 0.0038 mm
(D) 3.8 mm

27. If the solid particles being removed completely plug the pores of the filter medium and the rate of plugging is constant with time this mechanism is known as
(A) Crushing
(B) Direct sieving
(C) Screen blindness
(D) Grinding

28. In screen analysis the notation + 20 mm/–30 mm means passing through
(A) Passing 20 mm screen and retained on 30 mm screen
(B) Passing 30 mm screen and retained on 20 mm screen
(C) Passing 25 mm screen and retained on 20 mm screen
(D) Retained on 30 mm screen

29. Mesh is defined as

(A) The number of openings per linear feet of screen surface

(B) The number of openings per linear inch of screen surface

(C) The number of openings per linear metre of screen surface

(D) The number of openings per linear centimetre of screen surface

30. The specific surface of a spherical particle is

(A) $\frac{6}{\rho}$

(B) $\frac{6}{\rho \cdot D}$

(C) $\frac{\rho \cdot D}{6}$

(D) $\frac{6\rho}{D}$

31. Fibrous materials can be broken by

(A) Crushing rolls

(B) Squirrel – cage – disintegrator

(C) Tube mill

(D) Ball mill

32. Filter medium resistance is that offered by

(A) the concentration of suspension slurry to be filtered

(B) filter cloth

(C) embedded particles in the septum

(D) both (B) and (C)

33. During filteration the superficial viscosity ($\mu_c$) of filtrate is equal to where 'e' is voidage, $\Delta P$ is pressure drop 'S' is specific surface of particle, $\mu$ is viscosity of filtrate 'L' is cake resistance

(A) $\frac{5(1-e)^2}{e^3} \cdot \frac{(-\Delta P)}{S^2 \mu L}$

(B) $\frac{1}{5} \frac{e^3}{(1-e)^2} \frac{(-\Delta P)}{S^2 \mu L}$

(C) $\frac{5(1-e)^2}{e^3} \frac{S^2 \mu L}{(-\Delta P)}$

(D) $\frac{1}{5} \frac{e^3}{(1-e)^2} \frac{S^2 \mu L}{(-\Delta P)}$

34. The compressibility coefficient for incompressible sludges are

(A) 0

(B) 0.1

(C) 0.2

(D) 0.3

35. Explosive materials can be crushed by

(A) dry grinding

(B) wet grinding

(C) grinding

(D) ball mill

36. The mechanical energy supplied to the crusher is always greater, due to

(A) Power losses

(B) Gravitational forces

(C) Viscous forces

(D) Friction losses

37. During size reduction the optimum speed of ball mill must be

(A) 10 – 15% of critical speed
(B) 30 – 35% of critical speed
(C) 50 – 75% of critical speed
(D) more than 90% of critical speed

38. Which of the following is a coarse crusher?

(A) Crushing rolls
(B) Gyratory crusher
(C) Smooth roll crusher
(D) Jaw crusher

39. For a spherical particle, half of the angle of nip ($\alpha$) for a roll crusher is where $D_r$, $D_F$ and $D_P$ are the diameter of crushing rolls feed part, product part respectively

(A) $\cos\frac{\alpha}{2} = \frac{\frac{D_r}{2} + \frac{D_P}{2}}{\frac{D_r}{2} + \frac{D_F}{2}}$
(B) $\sin\frac{\alpha}{2} = \frac{\frac{D_r}{2} + \frac{D_P}{2}}{\frac{D_r}{2} + \frac{D_F}{2}}$
(C) $\cos\frac{\alpha}{2} = \frac{\frac{D_r}{2} + \frac{D_F}{2}}{\frac{D_r}{2} + \frac{D_P}{2}}$
(D) $\sin\frac{\alpha}{2} = \frac{\frac{D_r}{2} + \frac{D_F}{2}}{\frac{D_r}{2} + \frac{D_P}{2}}$

40. Epoxy resins have applied for

(A) Protective coatings
(B) Decorative coatings
(C) Injection molding
(D) Extrusion molding

41. Amatol is a mixture of

(A) TNT and ammonium nitrate
(B) Nitroglycerine and sodium chloride
(C) Ammonium chloride and sodium chloride
(D) Ammonium sulphate and Toluene

42. Wax is a

(A) Mixture of glycerides
(B) Mixture of esters of polyhydric alcohols other than glycerine
(C) Mixture of glycerides of fatty acids
(D) Mixture of fatty acids

43. Akremite is a mixture of

(A) Prilled ammonium nitrate, fuel oil and dynamite
(B) Ammonium chloride and fuel oil
(C) Ammonium sulphate and sodium chloride
(D) Ammonium chloride and sulfur

44. Hybrid propellants are available as a mixture of

(A) Solid fuel and liquid oxidizer
(B) Liquid fuel and solid oxidizer
(C) Gaseous fuel and solid coxidizer
(D) Solid fuel and solid oxidizer

45. Contamination of pure cultures used infermentation is avoided by
(A) Heat sterilization (B) Adsorption
(C) Distillation (D) Extraction

46. Enzymes used for the production of alcohol from molasses are
(A) Invertase and Zymase (B) Protease and Peroxidase
(C) Amylase and Protease (D) Oxidates and Amylase

47. During the production of alcohol from molasses, the pH is maintained as
(A) 4 to 5 (B) 8 to 10
(C) 1 to 2 (D) 11 to 12

48. Production of Vanaspathi from vegetable oil is established by
(A) Hydrogenation (B) Oxidation
(C) Reduction (D) Cracking

49. Pearl ash is called as
(A) Potassium carbonate (B) Magnesium carbonate
(C) Sodium carbonate (D) Calcium carbonate

50. To impart brown colour to the glass the addition of chemical required in sodium lead glass is
(A) Nickel oxide (B) Chromium oxide
(C) Copper oxide (D) Magnesium oxide

51. Which type of glass can be drawn into thread (or) blown into a mat for insulation?
(A) Fiber glass (B) Lead glass
(C) Borosilicate glass (D) Soda lime glass

52. To reduce strain in glass objects, it is necessary to use
(A) Annealing (B) Sintering
(C) Forming (D) Shaping

53. The three main raw materials required in making ceramic products are
(A) Clay, feldspar and sand (B) CaO, $Na_2CO_3$, NaOH
(C) $MgSO_4$, iron, magnesium (D) CaO, Magnesium, iron

54. Three common types of feldspar are
(A) Potash, soda and lime (B) Magnesium, strontium and barium
(C) Lithium, barium and magnesium (D) Barium, lithium and strontium

55. In the petroleum products, the removal of gum, colour and odour is achieved by treating with

(A) Sulfuric acid
(B) Sodium hydroxide
(C) Water
(D) Potassium hydroxide

56. Sulphuric acid saturated with $SO_3$ is called

(A) Concentrated $H_2SO_4$
(B) Sulphurous acid
(C) Oleum
(D) Sulphur oxide

57. LPG stands for

(A) Liquid Petroleum Gas
(B) Liquified Petrol Gas
(C) Liquid Petrol Gas
(D) Liquified Petroleum Gas

58. Tetra-ethyl lead is added in gasoline to

(A) Increase its smoke point
(B) Reduce gum formation
(C) Reduce the pour point
(D) Increase its octane number

59. Catalyst used in the catalytic cracking is

(A) Silica – alumina
(B) Silica gel
(C) Vanadium pentoxide
(D) Nickel

60. Catalyst used in catalytic reforming is

(A) Platinum on alumina
(B) Nickel
(C) Iron
(D) Aluminium chloride

61. The units of mass transfer coefficients could be

(A) concentration (area) / moles transferred
(B) moles transferred / time (area)
(C) moles transferred / time (area) (concentration)
(D) moles transferred / time

62. The diffusivity has the same dimensions as

(A) Absolute viscosity
(B) Kinematic viscosity
(C) Density
(D) Concentration

63. For water at 20°C, Prandtl number ($N_{Pr}$) is

(A) 0.702
(B) 7.02
(C) 70.2
(D) 702

64. The binary diffusivity of liquids varies almost as

(A) $T$ (B) $T^{1/2}$

(C) $T^2$ (D) $T^3$

65. Lewis number (Le) is

(A) Sc/Pr (B) Sh/Pr

(C) Pr/St (D) St/Sh

66. Penetration theory relates average mass transfer coefficient (K) with diffusivity (D) as

(A) $K \alpha D$ (B) $K \alpha D^{1/2}$

(C) $K \alpha D^{1.5}$ (D) $K \alpha D^2$

67. Welted wall tower experiment determines

(A) Molal diffusivity (B) Volumetric coefficient

(C) Mass transfer coefficient (D) Diffusion coefficient

68. The by-pass stream is to

(A) Control the composition of final exit stream

(B) Utilise valuable reactants

(C) Get high extent of reaction

(D) Utilise concentrated products

69. Corresponding to Prandtl number in heat transfer, the dimensionless group in Mass transfer is

(A) Schmidt number (B) Sherwood number

(C) Peclet number (D) Froude number

70. Mass transfer coefficient (K) and diffusivity (D) are related according to film theory as

(A) $K \alpha D$ (B) $K \alpha D^{1/2}$

(C) $K \alpha D^{1.5}$ (D) $K \alpha D^2$

71. Positive deviation from Raoult's law means a mixture whose total pressure is

(A) greater than that computed for ideality

(B) less than that computed for ideality

(C) less than the sum of the vapour pressure of the component

(D) such a condition cannot exist

72. Eddy momentum diffusivity, thermal diffusivity and mass diffusivity will be same for

(A) $N_{P_r} = N_{S_c} = 0.7$ (B) $N_{P_r} = N_{S_c} = 1$

(C) $N_{P_r} = N_{S_c} = 7.02$ (D) $N_{P_r} = N_{S_c} = 297$

73. Fick's second law of diffusion is

(A) $\frac{\partial C_A}{\partial t} = D_{AB}\left(\frac{\partial C_A}{\partial x} + \frac{\partial C_A}{\partial y} + \frac{\partial C_A}{\partial z}\right)$ (B) $\frac{\partial^2 C_A}{\partial t^2} = D_{AB}\left(\frac{\partial C_A}{\partial x} + \frac{\partial C_A}{\partial y} + \frac{\partial C_A}{\partial z}\right)$

(C) $\frac{\partial^2 C_A}{\partial t^2} = D_{AB}\left(\frac{\partial^2 C_A}{\partial x^2} + \frac{\partial^2 C_A}{\partial y^2} + \frac{\partial^2 C_A}{\partial z^2}\right)$ (D) $\frac{\partial C_A}{\partial t} = D_{AB}\left(\frac{\partial^2 C_A}{\partial x^2} + \frac{\partial^2 C_A}{\partial y^2} + \frac{\partial^2 C_A}{\partial z^2}\right)$

74. The transition Reynolds numbers for flow over a flat plate is $5 \times 10^5$. What is the distance from the leading edge at which transition will occur for flow of water with uniform velocity of 1 m/s? (for water kinematic viscosity = $0.858 \times 10^{-6}$ m²/s)

(A) 0.43 m (B) 1 m

(C) 43 m (D) 103 m

75. The process which transmits energy by means of electromagnetic waves is called

(A) conduction (B) convection

(C) radiation (D) isentropic

76. The effect of scaling in a heat exchanger is accounted through

(A) heat transfer coefficient (B) fouling factors

(C) insulation factors (D) diffusivity factor

77. The ratio, $\frac{\text{surface convection resistance}}{\text{internal conduction resistance}}$, is called

(A) Grashoff number (B) Priot number

(C) Stanton number (D) Prandtl number

78. Dropwise condensation usually occurs on

(A) glazed surface (B) smooth surface

(C) oil surface (D) coated surface

79. A wire is plastically deformed by supplying a force of 40 N over a distance of 0.8 m (The force moves in the direction in which the distance is measured). If the wire has a mass of 0.2 kg and a specific heat of 0.5 kJ/kg °C, the maximum increase in the average temperature of the wire will be

(A) 0.03°C (B) 0.3°C

(C) 3°C (D) 30°C

80. From a metallic wall at 100°C, a metallic rod protrudes to the ambient air. The temperature at the tip will be minimum at steady state when the rod is made of

(A) Aluminium (B) Steel

(C) Copper (D) Silver

81. In a reversible reaction, a catalyst

(A) increases the rate of the forward reaction only

(B) increases the rate of the forward reaction to a greater extent than the backward reaction

(C) increases the rate of the forward reaction and decreases the rate of the backward reaction

(D) increases the rate of the forward and the backward reaction equally

82. If a heat transfer correlation exists for a Gwen system and geometry, the mass transfer correlation may be found by replacing Nusselt number by ———————— and Prandtl number by

(A) Schmidt number, Sherwood number (B) Sherwood number, Peclet number

(C) Grashof number, Reynolds number (D) Sherwood number, Schmidt number

83. The zero parameter model for predicting conversion from RTD data are

(A) Tanks in series model (B) Axial dispersion model

(C) Segregated flow model (D) Radial dispersion model

84. Sperical particles react with gas of given composition and at a given temperature to give a solid product. If the solid follows the shrinking core model reaction controlling, the time for complete conversion is

(A) Proportional to the diameter of the particles

(B) Proportional to the square of the diameter of the particles

(C) Proportional to the diameter of the particle raised to 1.5

(D) Independent of the particle size

85. For cylindrical particles, following the shrinking care model. The time for complete conversion when reaction is the controlling mechanism is given by

(A) $T = \frac{\rho_B L}{b k_s C_{Ag}}$ (B) $T = \frac{\rho_B R}{b k_s C_{Ag}}$

(C) $T = \frac{\rho_B R}{6 b k_s C_{Ag}}$ (D) $T = \frac{\rho_B L}{6 b k_s C_{Ag}}$

86. A solid product is obtained for a spherical solid which follows the shrinking core model. If the solid particle is 7/8 converted in one hour and completely converted in 2 hours, which mechanism is rate controlling

(A) Mass transfer through the gas film (B) Diffusion through the product layer

(C) Reaction on the surface of the core (D) Reaction within the product layer

87. For the chemical reaction $A \rightarrow B$, it is found that the rate of the reaction quadruples when the concentration A is doubled. If the rate is proportional to $C_A^n$ then 'n' must be

(A) $1/4$ (B) 2

(C) 1 (D) 4

88. For a chemical reaction $A \rightarrow B$, it is found that the rate of the reaction triples when concentration of 'A' is increased 9 times. If rate is proportional to $C_A^n$ then 'n' for this reaction must be

(A) $1/2$ (B) $1/3$

(C) 3 (D) 9

89. For reactions that are externally mass transfer limited, the overall rate of reaction increases by

(A) Decreasing the gas velocity and particle size

(B) Increasing gas velocity and particle size

(C) Increasing the gas velocity and decreasing the particle size

(D) Decreasing the gas velocity and increasing the particle size

90. There is no correspondence between stoichiometry and the rate equation is the case of a/an

(A) elementary reaction (B) multiple reaction

(C) auto catalytic reaction (D) non-elementary reaction

91. When internal diffusion controls in a catalystic reaction, the true reaction order is related to the measured reaction order by

(A) $n_{true} = 2n_{apparent^{-1}}$ (B) $n_{true} = 1/(2n_{apparent^{-1}})$

(C) $n_{true} = 1 - 2n_{apparent}$ (D) $n_{true} = \dfrac{1}{1 - 2n_{apparent}}$

92. The Weisz – Prater parameter is $(C_{wp})$

(A) $-r'_A$(observed) $\rho_c R^2/D_e C_{AS}$ (B) $-r'_A$ (intrinsic) $\rho_c R^2/D_e C_{AS}$

(C) $D_e C_{AS}/-r'_A$ (observed) $\rho_c R^2$ (D) $D_e C_{AS}/-r'_A$ (intrinsic) $\rho_c R^2$

93. In certain multiphase reactors, the liquid phase in an inert medium for the gas to contract the solid catalyst, this arises when

(A) a large heat sink is required for highly exothermic reactions

(B) a large heat source is required for a highly exothermic reaction

(C) a large heat sink is required for a highly endothermic reaction

(D) a large heat source is required for a highly endothermic reaction

94. The exit ape distribution of fluid leaving a vessel is used to

(A) study the reaction mechanism

(B) study the extent of non ideal flow in the reactor

(C) to know the reaction rate constants

(D) know the activation energies of a reaction

95. A catalyst

(A) initiates a reaction

(B) lower's the activation energy of reacting molecules

(C) is capable of reacting with any one of the reactants

(D) cannot be recovered chemically uncharged at the end of a chemical reaction

96. For the unimolecular – type elementary reactions $A \xrightarrow{k_1} B \xrightarrow{k_2} C$ the fractional yield of $R$ is always

(A) same in plug flow and mixed reactors for a given conversion of A

(B) lower for plug – flow reactors than for mixed reactor for any conversion level of A

(C) higher for plug – flow reactors than for mixed reactor for any conversion level of A

(D) same in plug flow, batch and mixed reactors for a given conversion of A

97. For the unimolecular – type elementary reactions $A \xrightarrow{k_1} R \xrightarrow{k_2} S$ the fractional yield of 'R' in mixed reactor for a given conversion of A

(A) Remains constant with change in $k_2/k_1$ (B) Increases with increase in $k_2/k_1$

(C) Decreases with increase in $k_2/k_1$ (D) Increases linearly with increase in $k_2/k_1$

98. The size of a mixed flow reactor is always smaller than the size of a plug flow reactor when the order of the reaction is

(A) zero (B) first order

(C) positive orders (D) negative orders

99. For an elementary reaction $X + 2Y \rightarrow 3Z$

(A) Rate of disappearance of $Y$ is equal to the rate of appearance of $Z$

(B) The rate of disappearance of $Y$ is equal to the rate of disappearance of $X$

(C) Three times the rate of disappearance of $X$ is equal to the rate of appearance of $Z$

(D) Rate of disappearance of $X$ is equal to the rate of appearance of $Z$

100. Two small samples of solids are introduced into a constant environment over and kept there for one hour, where the 2 mm particle is completely converted, what would be the conversion for the 4 mm particle after 1 hour if reaction is controlling

(A) 0.25 (B) 0.5

(C) 0.75 (D) 0.875

101. Generally, valves are sized so that $T \equiv$ (where T : Turndown = R = Rangeability)

(A) 0.7 R (B) 20 R

(C) 30 R (D) 0.001 R

102. The rangeability is defined as

(A) maximum controllable flow / minimum controllable flow

(B) minimum controllable flow / maximum controllable flow

(C) maximum controllable flow – minimum controllable flow

(D) normal maximum flow / minimum controllable flow

103. If the difference between 180° and the phase lag at the frequency for which the gain is unity is negative, then the system

(A) is stable

(B) is unstable

(C) is critically stable

(D) insufficient information to determine the stability

104. Find out the wrong statement :

The characteristic equation for the control system.

(A) determines its stability

(B) is the same for set point and load changes

(C) depends only upon the open – loop transfer function

(D) is equal to the process transfer function

105. Local atmospheric pressure is measured by

(A) a Bourdon gauge (B) a memory Barometer

(C) a manometer (D) a hot-wire anemometer

106. Select the wrong statement :

Routh test for stability of control systems.

(A) is an algebraic method to find out the stability

(B) does not involve any plot or diagram

(C) is applicable only to systems with polynomial characteristic equations

(D) gives information about degree of stability

107. The number of poles in the open-loop transfer function $G(s) = \dfrac{1}{s^3 + 6s^2 + 11s + 6}$ are

(A) 1 (B) 3

(C) 2 (D) 0

108. The characteristic equation for the control system with a closed loop transfer function $\frac{\pi_f}{1+G}$ is

(A) $\frac{\pi_f}{1+G}=0$ (B) $1+G=0$

(C) $G=0$ (D) $\pi_f=1+G$

109. The amplitude ratio of first order system $\left(\frac{1}{\tau s+1}\right)$ is given as

(A) $\frac{1}{\sqrt{1+w^2\tau^2}}$ (B) $\frac{1}{\sqrt{1-w^2\tau^2}}$

(C) $\sqrt{1+w^2\tau^2}$ (D) $\frac{1}{1+w^2\tau^2}$

110. The roots of the characteristic equation are called

(A) zeros (B) poles

(C) eigen values (D) inflection points

111. Which of the following is the algebraic method?

(A) Routh test (B) Bode test

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

112. If the roots of characteristic equation lie on the left half of the complex plane, then the system is

(A) stable (B) unstable

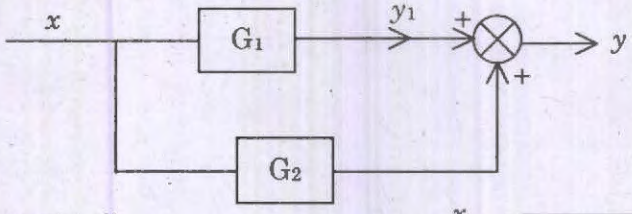
(C) critically stable (D) cannot comment about stability

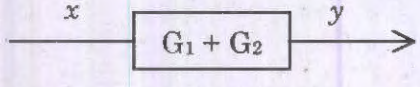
113. In Servo test

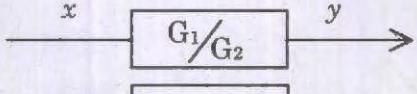
(A) No change in set point (B) Set point change occurs

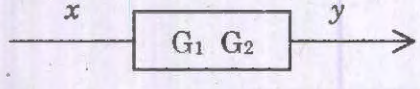
(C) Change in load occurs (D) Load increased

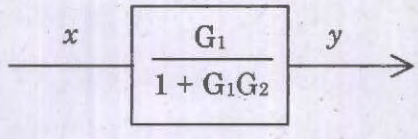
114. The reduction of following block diagram yields




(A) 


(B) 


(C) 


(D) 

115. The transfer function of first order plus dead time system is

(A) $\frac{K}{\tau_p S+1} e^{\tau S}$

(B) $\frac{K}{\tau_p S+1} e^{-\tau S}$

(C) $\frac{K}{(\tau_p S+1)} e^{-\tau S}$

(D) $\frac{K}{\tau_p S+ e^{-\tau S}}$

116. Identify the nature of the system having the following transfer function $\frac{Y(s)}{X(s)} = \frac{10}{s^2+1.6s+4}$

(A) under damped

(B) critically damped

(C) over damped

(D) undamped

117. The time required for the response to complete one cycle is known as

(A) period of oscillation

(B) rise time

(C) response time

(D) settling time

118. Critically damped response of a second order system is

(A) non-oscillatory

(B) oscillatory

(C) oscillatory with constant amplitude

(D) oscillatory with increasing amplitude

119. V-tube type mercury manometer is an example of

(A) Zero – order system

(B) First – order system

(C) Second – order system

(D) Third – order system

120. The response of an interacting system is ———————— non-interacting system response.

(A) higher than

(B) slower than

(C) equal to

(D) very much higher than

121. A second order differential equation of the form $\frac{d^2y}{dx^2} = g\left(x, y, \frac{dy}{dx}\right)$ can be solved by the Runge-Kutta method by breaking it down to the form

(A) $dx/dy = z = f(x, y);\ dz/dy = g(x, y)$

(B) $dy/dx = z = f(x, y);\ dz/dx = g(x, y)$

(C) $dy/dx = z = f(x, y, z);\ dz/dx = g(x, y, z)$

(D) $dx/dy = z = f(x, y, z);\ dz/dy = g(x, y, z)$

122. The Milne's corrector formula cannot be used as a formula of extrapolation since it requires the value of ———————— which is not known.

(A) $y'_{n+1}$ (B) $y'_n$

(C) $y'_{n-1}$ (D) $y'_{n-2}$

123. The Adam – Bashforth prediction formula is given as

(A) $y_{n+1} = y_n + \frac{h}{24}[55\ y'_n - 59\,y'_{n-1} + 37\ y'_{n-2} - 9\,y'_{n-3}]$

(B) $y_{n+1} = y_n + \frac{h}{24}[9\ y'_{n+1} + 19\,y'_n - 5\,y'_{n-1} + y'_{n-2}]$

(C) $y_{n+1} = y_{n-1} + \frac{h}{3}[y'_{n-1} + 4\,y'_n + y'_{n+1}]$

(D) $y_{n+1} = y_{n-3} + \frac{4h}{3}(2\,y'_{n-2} - y'_{n-1} + 2\,y'_n)$

124. In order to use Adam's Method for solving an ordinary differential equation and obtain the required value of $y$, what number of values of $y$ prior to the required value is needed

(A) 1 (B) 2

(C) 3 (D) 4

125. The forward first-difference quotient of $u(x,y)$ w.r.t $x$ is given as

(A) $u_x = \frac{u(x, y) - u(x-h, y)}{h}$ (B) $u_x = \frac{u(x+h, y) - u(x-h, y)}{h}$

(C) $u_x = \frac{u(x+h, y) - u(x, y)}{h}$ (D) $u_x = \frac{u(x+h, y+h) - u(x, y)}{h}$

126. Which one of the following is not an iterative method for solving algebraic equations?

(A) Gaussian elimination method (B) Gauss-Seidel method

(C) Relaxation method (D) Gauss-Jacobi method

127. Modified Euler's method is the Runge-Kutta method of

(A) first order (B) second order

(C) third order (D) fourth order

128. What is the order of error of the Euler's method?

(A) $h$ (B) $h^2$

(C) $h^3$ (D) $h^4$

129. State the condition for the equation $A u_{xx} + 2B u_{xy} + C u_{yy} = f(u_x, u_y, x, y)$ to be elliptical

(A) $B^2 - 4AC < 0$ (B) $2B^2 - 4AC < 0$

(C) $4B^2 - 4AC > 0$ (D) $B^2 - AC < 0$

130. The one dimensional wave equation of the form $\frac{\partial^2 u}{\partial x^2} = a\frac{\partial^2 u}{\partial t^2}$ is a

(A) Laplace's equation in two dimension (B) Poisson's equation

(C) Parabolic equation (D) Hyperbolic equation

131. A differential equation is said to be parabolic in a region $R$ if $B^2 - 4AC$ is

(A) positive (B) negative

(C) zero (D) infinity

132. The Schmidt relation reduces to the Bender – Schmidt when the value of $k$ is chosen such that the coefficient of $u_{i,j}$ becomes

(A) 0 (B) 1

(C) $\infty$ (D) $-1$

133. The solution obtained by using Schmidt recurrence equation for the solution of ordinary differential equation is stable only when $\lambda$ is

(A) $\geq \frac{1}{2}$ (B) $\leq \frac{1}{2}$

(C) $\leq \frac{1}{4}$ (D) $\geq \frac{1}{4}$

134. The Regula Falsi method is also known as

(A) method of tangents (B) method of chords

(C) method of lines (D) method of approximation

135. The condition for convergence of Newton – Raphson method is

(A) $|f(x) \cdot f''(x)| < |f'(x)|^2$ (B) $|f(x) \cdot f'(x)| < |f''(x)|^2$

(C) $|f'(x) \cdot f''(x)| < |f(x)|$ (D) $|f(x) \cdot f''(x)| < |f'(x)|$

136. In the solution of algebraic equations the method of tangents is also known as

(A) Bisection method
(B) Newton Raphson method
(C) Bolzano method
(D) Regula Falsi method

137. In the iteration method, if $|\phi'(x)| > 1$ the process

(A) will converge
(B) will not converge
(C) can easily be solved
(D) the reciprocal of the root can be obtained

138. The number of conditions required to solve the La Place equation is

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

139. Which one of the following method is not used to solve algebraic equations?

(A) Bolzano method
(B) Horner's method
(C) Milne's method
(D) Regula Falsi method

140. Which one of the following is a transcendental equation?

(A) $x^3 - 3x + 1 = 0$
(B) $3x + \sin x - e^x = 0$
(C) $x^4 + 2x^3 - 3x^2 + 2x + 1 = 0$
(D) $x + 4x^2 + x^3 = 5$

141. What is the reflux ratio at total reflux?

(A) zero
(B) infinity
(C) unity
(D) data insufficient

142. The reflux to a distillation column is 100 moles/hr, when the overhead product rate is 50 moles/hr, the reflux ratio is

(A) 2
(B) 0.5
(C) 50
(D) 150

143. When the feed to a distillation column is a saturated liquid, slope of the feed line is

(A) zero
(B) unity
(C) infinity
(D) less than zero

144. Desirable value of absorption factor in an absorber is

(A) 1
(B) < 1
(C) > 1
(D) 0.5

145. Dry bulb temperature of the gas is ———— the wet bulb temperature.

(A) less than
(B) more than
(C) equal to
(D) half of the

146. In extractive distillation, solvent is

(A) added to alter the relative volatility of the original constituents
(B) added to increase the viscosity of the mixture
(C) added to increase the density of the mixture
(D) to maintain the viscosity as constant

147. Rayleigh equation applies to ———— distillation.

(A) Differential
(B) Flash
(C) Evaporative
(D) Molecular

148. Selectivity of the solvent used in solvent extraction should be

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

149. Chemisorption is

(A) same as 'under waals' adsorption
(B) physical adsorption
(C) an irreversible phenomenon
(D) a reversible phenomenon

150. Physical adsorption is

(A) an irreversible phenomenon
(B) a reversible phenomenon
(C) the result of chemical interaction
(D) stronger than chemisorption

151. In adsorption, the adsorbed substance is called

(A) adsorbent
(B) adsorbate
(C) solvent
(D) sorbent

152. Bollman extraction

(A) is a static bed leaching equipment
(B) is used for extraction of oil from oil seed
(C) is a centrifugal extractor
(D) is a super critical extractor

153. Milk is dried usually in a ———— dryer.

(A) freeze
(B) spray
(C) tray
(D) rotary

154. In a paper industry, paper is dried in a ———— dryer.

(A) Tunnel
(B) Heated cylinder
(C) Conveyor
(D) Spray

155. Flights in a rotary dryer are provided to

(A) Lift and shower the solids thus exposing it thoroughly to the drying action of the gas
(B) Reduce the residence time of solid
(C) Increase the residence time of solid
(D) Increase the flow of gas

156. Rotary dryers cannot handle ———— materials.

(A) Free flowing
(B) Dry
(C) Sticky
(D) Granular

157. Refractory bricks are usually dried in a ———— dryer.

(A) Tray
(B) Tunnel
(C) Conveyor
(D) Festoon

158. Dryer widely used in a textile industry is ———————— dryer.

(A) Festoon
(B) Cylinder
(C) Conveyor
(D) Tunnel

159. Detergent solution is dried to a powder using

(A) Spray dryer
(B) Tunnel dryer
(C) Cylinder dryer
(D) Rotary dryer

160. Swenson-Walker crystalliser is a ———————— unit.

(A) Continuous
(B) Batch
(C) Semi batch
(D) Fed batch

161. The minimum concentration of oxidizer required for ignition at ambient temperature is known as

(A) Limiting oxygen index
(B) Lower flammable limit
(C) Upper flammable limit
(D) Threshold limit value

162. The Flammability limits of mixture can be estimated from the data for individual fuels by using

(A) Le Chatelier's principle
(B) Joule-Thompson principle
(C) Amagat's principle
(D) Trouton's principle

163. If the concentration of a mixture of fuel gases is known, the LFL for the mixture can be approximated from (where $P_i$ = % of fuel in the original mixture, free from air and inert gases)

(A) $(LFL)_{mix} = 100/\sum (P_i/LFL_i)$
(B) $(LFL)_{mix} = \sum (P_i/LFL_i)/100$
(C) $(LFL)_{mix} = \sum LFL_i/100$
(D) $(LFL)_{mix} = \sum \frac{100}{LFL_i}$

164. Systematic technique used for identifying all plant or equipment hazards and operability problems is

(A) Hazard and operability study
(B) Hazardous and operational study
(C) Hazard analysis study
(D) Operational analysis study

165. Which one of the following is not a formalized hazard assessment technique?

(A) Hazard and operability study
(B) Fault tree analysis
(C) Failure mode and effect analysis
(D) False tree analysis

166. The method used to estimate the likelihood of an accident by breaking it down into its contributing sequences is

(A) Fault tree analysis
(B) HAZOP
(C) Failure mode and effect analysis
(D) Safety audit

167. The method used for analyzing hazardous events after they have been identified by other techniques such as HAZOP is

(A) Fault tree analysis
(B) Failure mode and effect analysis
(C) Safety Audits
(D) Safety indexes

168. Among the following, which method uses logic diagram?

(A) HAZOP
(B) Fault tree analysis
(C) Safety analysis
(D) Failure mode and effect analysis

169. The symbol used where coincident lower-order events are necessary before a more serious higher-order event is

(A) And
(B) Or
(C) Nor
(D) Neither

170. The method that focuses only on component failure and does not consider errors in operating procedures is

(A) Failure mode and effect analysis
(B) Fault tree analysis
(C) HAZOP
(D) Safety analysis

171. With respect to Environmental protection, BAT stands for

(A) Biological Activation Treatment
(B) Best Available Technology
(C) Biological Aerobic Treatment
(D) Bioavailable Technology

172. The chemicals which upset the stability of the system by neutralizing the colloid charge are

(A) Alum and Ferric chloride
(B) Ferrous sulfate and chlorine
(C) Ozone and chlorine
(D) Hydrogen Peroxide and ferrous sulfate

173. Which of the following is not the widely used chemical oxidant in waste water treatment?

(A) Ozone
(B) Chlorine
(C) Hydrogen peroxide
(D) Hydrogen chloride

174. Among the following, which process is more difficult to control?

(A) Anaerobic treatment
(B) Aerobic treatment
(C) Trickling filter
(D) Activated sludge process

175. The temperature at which ignition will occur without the presence of a spark or flame is designated as the

(A) Ignition temperature
(B) Auto ignition temperature
(C) Lower flammable limit
(D) Upper flammable limit

176. Chloramines are used in water treatment

(A) for disinfection
(B) for taste and odour control
(C) as algicides
(D) for weed control in reservoirs

177. Which of the following devices of particulate collector is the least efficient?

(A) Cyclone separator
(B) Electro state precipitator
(C) Fabric filter
(D) Wet scrubber

178. Which of the following factors is not considered during the selection of fabric used in fabric filter?

(A) Temperature
(B) Chemical resistance
(C) Dust concentration
(D) Temperature to fabric ratio

179. Which of the following is used in cement industry for dust control?

(A) Cyclone separator
(B) Electro static precipitator
(C) Wet scrubber
(D) Fabric filter

180. The release of gases and vapour to the atmosphere cannot be controlled by

(A) Combustion
(B) Absorption
(C) Adsorption
(D) Extraction

181. The difference between the selling price of the product and the purchase cost of raw materials is known as

(A) Added value
(B) Differentiated value
(C) Undifferentiated value
(D) Subtracted value

182. Cost data are expressed as a power law of capacity and is given as

($C_E$ : Equipment cost with capacity Q

$C_B$ : Known base cost for equipment with capacity $Q_B$

M : Constant depending on equipment type)

(A) $C_E = C_B\left(Q/Q_B\right)^M$
(B) $C_E = C_B\left(\frac{Q_B}{Q}\right)^M$
(C) $C_E = Q_B\left(\frac{C_B}{Q}\right)^M$
(D) $C_E = Q\left(\frac{C_B}{Q_B}\right)^M$

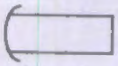
183. Which of the following is not an utility investment?

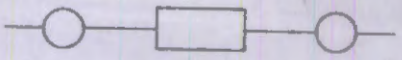
(A) Electrical generation equipments investment
(B) Steam generation equipments investment
(C) Steam distribution equipments investment
(D) Control system equipments investment

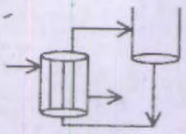
184. The cost of services includes

(A) Cost of the utilities and off sites
(B) Cost of the utilities and battery limit
(C) Cost of the off sites and battery limit
(D) Cost of the utility alone

185. The symbol of Reboiler is

(A) 

(B) 

(C) 

(D) 

186. The split fraction coefficient depends on the

(A) nature of the unit and the inlet stream composition

(B) nature of the unit and the outlet stream composition

(C) nature of the unit and the direction of stream from

(D) nature of the unit and number of processes

187. In a flow sheet, the table stream flows and other data can be placed at

(A) left hand side of the layout

(B) right hand side of the layout

(C) above or below the equipment

(D) between the equipment

188. On the detailed flow sheet representation used for design and operation, the equipment is normally provided by

(A) small in size

(B) large in size

(C) moderate in size

(D) pictorial form

189. Batch process as compared to continuous process is preferred due to when

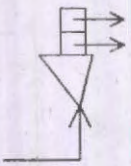
(A) sales demand is steady

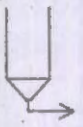
(B) same equipment can be used for several processes of this nature

(C) continuous process equipment has not been satisfactorily developed

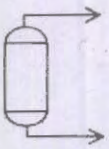
(D) service requirements is not steady

190. A centrifuge can be represented by

(A) 

(B) 

(C) 

(D) 

191. Relative roughness of the pipe can be calculated using

(A) Relative roughness = $\frac{\text{absolute roughness}}{\text{pipe inside diameter}}$

(B) Relative roughness = $\frac{\text{absolute roughness}}{\text{pipe outside diameter}}$

(C) Relative roughness = $\frac{\text{pipe roughness}}{\text{pipe inside diameter}}$

(D) Relative roughness = $\frac{\text{pipe roughness}}{\text{pipe outside diameter}}$

192. A horizontal gas liquid separator would be selected for a process when a

(A) long liquid hold-up time is required

(B) long gas hold-up time is required

(C) long residence time required

(D) long residence time is zero

193. Sometimes batch process is preferred when yield and quality of products cannot be achieved in continuous process because of

(A) high reaction rate

(B) low reaction rate

(C) short residence time

(D) long residence time

194. Hydroclones can be used for the classification of solid particles over a size range of

(A) 5 to 25 $\mu$m

(B) 5 to 45 $\mu$m

(C) 5 to 50 $\mu$m

(D) 5 to 100 $\mu$m

195. Which one of the following common problem is encountered in chemical process equipments?

(A) Rigidity of equipment

(B) Corrosion

(C) Fabricational feasibility

(D) Non-uniformity of material

196. Which one of following compensation is most efficient for the opening of a process vessel

(A) Flued in type

(B) Rim or nozzle type

(C) Ring plate

(D) Protruding type

197. Identify the flow sheet symbol of lines

(1) ————————, (2) ————————, (3) ————————, (4) ————————

(A) (1) new lines, (2) existing lines, (3) underground lines, (4) instrument lines

(B) (1) existing lines, (2) new lines, (3) instrument lines, (4) underground lines

(C) (1) instrument lines, (2) new lines, (3) existing lines, (4) underground lines

(D) (1) underground lines, (2) existing lines, (3) new lines, (4) instrument lines

198. Inventory turnover ratio is

(A) Net sales / Inventory

(B) Inventory / Net sales

(C) Profit / Net sales

(D) Net sales / Net loss

199. Equipments should be positioned in such a manner that the ———————— cost is minimum.

(A) Raw material

(B) Piping

(C) Labour

(D) Stationary

200. Pressure and temperature indicator position should be at ———————— level.

(A) eye

(B) above head

(C) chest

(D) below chest

———————

SPACE FOR ROUGH WORK

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