

CHEMICAL ENGINEERING

(Final)

- In a combustion process at steady state, 1 mole of carbon and 1 mole of oxygen is fed to the system and 1 mole of carbon dioxide is obtained per unit time. The accumulation in this process is
 - 12
 - 32
 - 0
 - 44
- In a test, 20kg of propane was burnt with 40kg of air to produce 44kg of CO₂ and 12 kg CO. What was the percent excess air?
 - 2.27
 - 28
 - 13.79
 - 2.8
- Calculate the molality of 1 litre solution of 93% sulphuric acid (weight /volume)
 - 0.91
 - 10.43
 - 9.30
 - None of the above
- Weight of 56 litres of ammonia at N.T.P. is _____ gram.
 - 2.5
 - 8600
 - 42.5
 - 4.56
- A gas at 0°C is cooled at constant pressure until its volume becomes half the original volume. The temperature of the gas at this state will be
 - 273°C
 - 136.5°K
 - 136.5°C
 - 0°K
- Number of gram moles of solute dissolved in 1 kg of solvent is called its
 - normality
 - molality
 - molarity
 - formality
- The value of gas constant 'R' is _____ kcal/kg.mole.°C.
 - 2.79
 - 1.987
 - 3.99
 - None of the above
- The vapor pressures of benzene and toluene are 3 and 4/3 atmospheres respectively. A liquid feed of 0.4 moles of benzene and 0.6 moles of toluene is vapourised. Assuming that the products are in equilibrium, the vapor phase mole fraction of benzene is
 - 0.8
 - 0.6
 - 0.2
 - 0.4

9. 1 torr is equal to _____ mm Hg column.
- (A) 1000 (B) 1
(C) 10 (D) 100
10. Which of the following ratios defines the recycle ratio in a chemical process?
- (A) Recycle stream/fresh feed stream
(B) Recycle stream/gross feed stream
(C) Gross feed stream/recycle feed stream
(D) None of the above
11. What is the total pressure exerted by a mixture of 0.45 kg mole of benzene, 0.44 kg mole of toluene and 0.23 kg mole of o-xylene at 100°C, if their vapor pressures at 100°C are 1340, 560 and 210 mmHg respectively ?
- (A) 801.5 (B) 780.5
(C) 756.2 (D) 880.5
12. An azeotropic solution of two liquids has boiling point lower than either of them, when it
- (A) is unsaturated
(B) is saturated
(C) shows negative deviation from Raoult's law
(D) shows positive deviation from Raoult's law
13. Sometimes, in chemical processes, a part of the outlet stream is rejected as waste in order to keep the impurity level in the system within limits. This phenomenon is termed as the
- (A) bypassing (B) recycling
(C) purging (D) recirculation
14. A vapor whose partial pressure is less than its equilibrium vapor pressure is called a _____ vapour.
- (A) superheated (B) saturated
(C) supersaturated (D) None of the above
15. A gas occupies a volume of 283c.c at 10°C. If it is heated to 20°C at constant pressure, the new volume of the gas will be _____ c.c.
- (A) 566 (B) 283
(C) 141.5 (D) 293
16. Brix is a unit for
- (A) viscosity (B) specific gravity
(C) solubility (D) Pressure

17. The maximum adiabatic flame temperature of fuels in air is _____ the maximum flame temperature in pure oxygen.
- (A) lower than (B) same as
(C) not related to (D) higher than
18. For water evaporating into unsaturated air under adiabatic conditions and at constant pressure, the _____ remains constant throughout the period of vaporisation.
- (A) wet bulb temperature (B) dry bulb temperature
(C) relative saturation (D) humidity
19. A butane isomerisation process produces 70 kmole/hr of pure isobutane. A purge stream removed continuously, contains 85% n-butane and 15% impurity (mole%). The feed stream is n-butane containing 1% impurity (mole%). The flow rate of the purge stream will be
- (A) 5 kmole/hr (B) 4 kmole/hr
(C) 3 kmole/hr (D) 6 kmole/hr
20. The equilibrium value of the mole fraction of the gas dissolved in a liquid is directly proportional to the partial pressure of that gas above the liquid surface". This statement pertaining to the solubility of gases in liquid is the _____ law.
- (A) Henry's (B) Amgat's
(C) Raoult's (D) None of the above
21. The ratio of the actual mesh dimension of any screen to that of the next smaller screen in the Taylor series is
- (A) 2 (B) $\sqrt{2}$
(C) 102 (D) $1/\sqrt{2}$
22. Mesh number is number of openings per
- (A) square inch of screen surface
(B) square cm of screen surface
(C) linear inch of screen surface
(D) linear centimeter of screen surface
23. _____ law is applicable to fine grinding.
- (A) Kicks law (B) Rittingers law
(C) Bonds law (D) Newtons law
24. A material which passes the 100mesh screen but was retained on 150 mesh screen can be represented as
- (A) - 100+150 (B) +100-150
(C) either (A) or (B) (D) None of the above

25. For settling in the stoke's range ,the value of Reynold's number is
- (A) $2 < \text{Rep} < 200$ (B) $200 < \text{Rep} < 500$
(C) $500 < \text{Rep} < 2100$ (D) $0 < \text{Rep} < 2$
26. Kynch Theory is applicable for the design of
- (A) Ball Mill
(B) Continuous thickener
(C) Distillation column
(D) Packed Bed
27. Which of the following is not categorised as a “mechanical operation”?
- (A) Size enlargement (B) Filtration
(C) Agitation (D) Humidification
28. Two particles are called to be equal settling, if they are having the same.
- (A) size
(B) terminal velocities in the same fluid & in the same field of force.
(C) specific gravity
(D) None of the above
29. Diatomaceous earth is a/an
- (A) explosive (B) filter aid
(C) filter medium (D) catalyst
30. For a non-spherical particle, the sphericity
- (A) has the dimension of length.
(B) is always less than 1.
(C) is the ratio of volume of a sphere having the same surface area as the particle to the actual volume of the particle.
(D) is defined as the ratio of surface area of a sphere having the same volume as the particle to the actual surface area of the particle.
31. Froth floatation is the most suitable for treating
- (A) sulphide ores (B) quartzite
(C) iron ores (D) None of the above
32. The main size reduction operation in ultrafine grinders is
- (A) compression (B) attrition
(C) impact (D) cutting
33. Trommels separate a mixture of particles depending on their
- (A) size (B) density
(C) electrical and magnetic properties (D) wettability

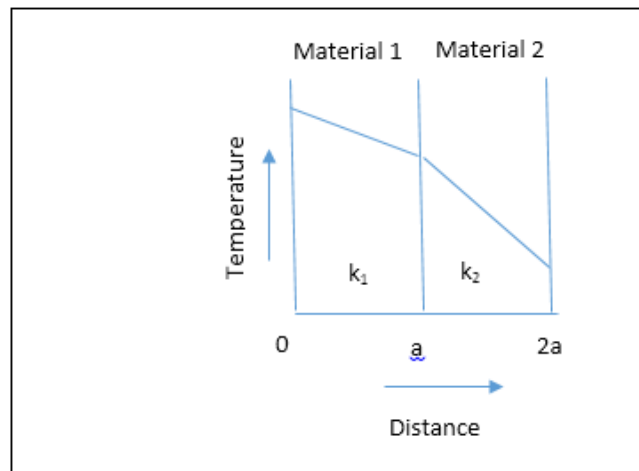
34. Shape factor for a cylinder whose length equals its diameter is
- (A) 1.5 (B) 0.5
(C) 1.0 (D) 2.0
35. Equivalent diameter of a particle is the diameter of the sphere having the same
- (A) ratio of surface to volume as the actual volume.
(B) ratio of volume to surface as the particle.
(C) volume as the particle.
(D) None of the above
36. The average velocity of a Newtonian fluid in a straight tube under viscous flow conditions equals to
- (A) the maximum velocity
(B) 2/3rd the maximum velocity
(C) 50% of the maximum velocity
(D) 1/3rd the maximum velocity
37. Wall thickness for schedule 80 pipe is
- (A) same as that for schedule 40 pipe
(B) less than that for schedule 40 pipe
(C) more than that for schedule 40 pipe
(D) None of the above
38. Equivalent length of a wide open globe valve is _____ the equivalent length of a half open globe valve of the same nominal size.
- (A) greater than (B) lesser than
(C) same as (D) cannot say
39. For a rotameter as the flow rate increases, pressure drop
- (A) increases (B) decreases
(C) remains constant (D) None of the above
40. The predominant fluid property associated with cavitations phenomenon is
- (A) Surface tension (B) Vapor pressure
(C) Density (D) Viscosity
41. Newton's law of viscosity states that the shear stress is directly proportional to the
- (A) velocity (B) velocity gradient
(C) square of velocity (D) square of velocity gradient

42. Poise is the unit of
- (A) kinematic viscosity (B) dynamic viscosity
(C) pressure (D) power
43. Which of the following fluid is essentially a non-Newtonian fluid under normal working conditions?
- (A) Human blood (B) Thin lubricating oils
(C) Water (D) Air
44. The plot below corresponds to
- (A) pseudo plastic fluid (B) real fluid
(C) bingham plastic (D) None of the above.
45. Gauge pressure at a point is equal to
- (A) absolute pressure minus absolute zero pressure
(B) absolute pressure minus atmospheric pressure
(C) absolute zero pressure plus absolute pressure
(D) absolute zero pressure plus atmospheric pressure
46. Laminar flow of a Newtonian fluid ceases to exist, when the Reynolds number exceeds
- (A) 3000 (B) 4000
(C) 2100 (D) 1500
47. The net positive suction head (NPSH) of a centrifugal pump is defined as the sum of the velocity head and the pressure head at the
- (A) suction
(B) discharge minus vapor pressure of the liquid at the discharge temperature
(C) discharge
(D) suction minus vapor pressure of the liquid at suction temperature
48. Which of the following denotes the effect of compressibility in fluid flow?
- (A) Mach number (B) Weber number
(C) Euler number (D) Reynolds number
49. Power loss in an orificemeter is _____ that in a venturimeter.
- (A) same as (B) more than
(C) data insufficient, cannot be predicted (D) less than

50. At high Reynolds number
- (A) viscous forces predominate.
 - (B) inertial forces control and viscous forces are unimportant.
 - (C) inertial forces are unimportant and viscous forces control.
 - (D) None of the above
51. For a particle settling in water at its terminal settling velocity, which of the following is true?
- (A) Weight = buoyancy + drag
 - (B) Buoyancy = weight + drag
 - (C) Drag = buoyancy + weight
 - (D) Drag = weight
52. Very small pressure difference (< 5 mm water column) can be most conveniently measured by a/an _____ manometer.
- (A) inclined tube water
 - (B) U-tube water
 - (C) U-tube mercury
 - (D) inclined tube mercury
53. Priming is needed in a _____ pump.
- (A) diaphragm
 - (B) centrifugal
 - (C) reciprocating
 - (D) gear
54. Where does the maximum stress occur in case of laminar flow of incompressible fluid in a closed conduit of diameter 'd'?
- (A) At $d/8$ from the wall
 - (B) At the wall
 - (C) At $d/4$ from the wall
 - (D) At the centre
55. Boundary layer separation is caused by the
- (A) reduction of pressure to vapour pressure
 - (B) boundary layer thickness reducing to zero
 - (C) adverse pressure gradient
 - (D) reduction of pressure gradient to zero
56. When a small quantity of water evaporates into large quantity of unsaturated air, the steady-state temperature attained is referred to as
- (A) Dew point
 - (B) Bubble point
 - (C) Wet-bulb temperature
 - (D) Dry-bulb temperature

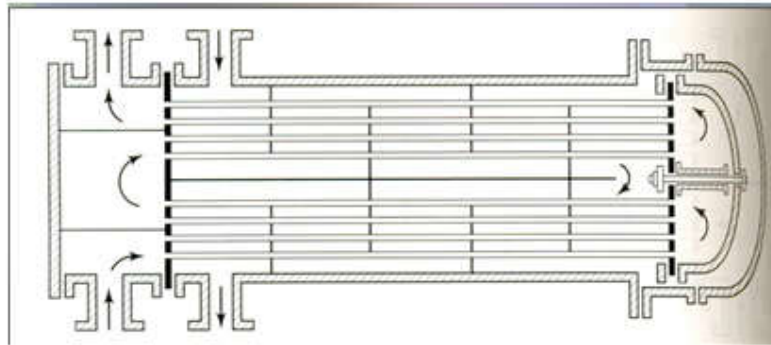
57. The maximum heat loss from a heated pipe occurs when the thickness of thermal insulation is
- (A) less than critical radius (B) equal to critical radius
(C) more than critical radius (D) Both (B) and (C)
58. A cold fluid is heated from 100°C to 150°C by steam at 200°C. The LMTD in counter flow is
- (A) equal to the LMTD in parallel flow
(B) greater than the LMTD in parallel flow
(C) lower than the LMTD in parallel flow
(D) None of the above
59. Typically dropwise condensation occurs on cold surfaces which are
- (A) smooth and clean (B) polished
(C) slightly rough and dirty (D) made of only specific materials
60. Film boiling is not usually desired in commercial equipment because
- (A) it is very difficult to maintain
(B) it is not economical
(C) it is possible only in certain situations
(D) heat transfer rate is low
61. A preferred heat exchanger for gas-gas service is
- (A) multi pass shell and tube (B) double pipe
(C) plate type (D) finned tube
62. For concentrating fruit juice, the recommended evaporator to be used is
- (A) falling film evaporator (B) short tube vertical evaporator
(C) long tube vertical evaporator (D) agitated film evaporator
63. The cooling effect in a cooling tower can be speeded up by
- (A) increasing the area of exposed wet surface
(B) decreasing the air velocity
(C) increasing the barometric pressure
(D) increasing the humidity of air

64. In a cooling tower water is cooled from 95°C to 80°C by exposure to air with a wet bulb temperature of 70°C . The approach would be
- (A) 15°C (B) 10°C
 (C) 25°C (D) None of the above
65. In a heat exchanger with steam outside the tubes, a liquid gets heated to 45°C , when its flow velocity in the tubes is 2 m/s . If the flow velocity is reduced to 1 m/s , other things remaining the same, the temperature of the exit liquid will be
- (A) equal to 45°C
 (B) initially decreases and remains constant thereafter
 (C) less than 45°C
 (D) more than 45°C
66. Function of baffles on the shell side of a heat exchanger is to
- (A) decrease pressure drop (B) reduce scale deposit
 (C) hold the tubes in position (D) create turbulence
67. The heat required (in kJ, up to 1 digit after the decimal point) to raise the temperature of 1 mole of a solid material from 100°C to 1000°C is _____. The specific heat of the material (in J/mol-K) is expressed as $C_p = 20 + 0.005T$, where T is in K. Assume no phase change.
- (A) 14 kJ (B) 21.703kJ
 (C) 19kJ (D) 12 kJ
68. In the Figure below showing the temperature profile, which of the following relationship is correct. k_1 and k_2 are the thermal conductivities of Material 1 and Material 2 respectively.



- (A) $k_2 = 0$ (B) $k_2 > k_1$
 (C) $k_2 = k_1$ (D) $k_2 < k_1$

69. The ratio of kinematic viscosity to thermal diffusivity is known as
- (A) Stanton Number (B) Mach number
(C) Nusselt Number (D) Prandtl number
70. When Biot number approached towards zero, then
- (A) no surface resistance (B) high surface resistance
(C) no conductive resistance (D) None of the above
71. According to Stefan Boltzmann's law, the emissive power of a black body is proportional to
- (A) $T^{3/2}$ (B) T
(C) T^4 (D) T^3
72. The shell and tube heat exchanger shown in the figure below is a



- (A) 2-4 shell and tube heat exchanger
(B) 4-2 shell and tube heat exchanger
(C) 2-2 shell and tube heat exchanger
(D) 4-4 shell and tube heat exchanger
73. Which one of the following heat exchanger is used for evaporating viscous or heat sensitive material under high vacuum?
- (A) Plate and frame exchanger (B) Scraped surface heat exchanger
(C) Shell and tube heat exchanger (D) Finned tube heat exchanger
74. For strong solutions, the boiling point elevation is best found by empirical rule known as
- (A) Lambert rule (B) Duhring rule
(C) Kirchoff's rule (D) Fourier's rule
75. The LMTD correction factor (FT) is to be applied for
- (A) counter flow exchanger (B) co-current flow exchanger
(C) cross flow exchanger (D) All of the above

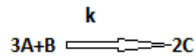
76. In a heat exchanger shell, with tube size and pitch remaining same
- (A) more number of tubes can be accommodated in triangular pitch arrangement.
 - (B) more number of tubes can be accommodated in square pitch arrangement.
 - (C) equal number of tubes can be accommodated in both the cases
 - (D) cannot say
77. In a packed tower, the gas velocity must be about
- (A) 0.9 times the flooding velocity
 - (B) 0.5 times the flooding velocity
 - (C) 0.3 times the flooding velocity
 - (D) 0.2 times the flooding velocity
78. For gas liquid contact the pressure drop is the least in the following equipment
- (A) bubble cap tower
 - (B) wetted wall tower
 - (C) perforated tray tower
 - (D) grid tray tower
79. Langmuir equation is used in
- (A) absorption
 - (B) distillation
 - (C) adsorption
 - (D) extraction
80. Which of the following methods for the design of distillation column assume constant molal vaporization and overflow?
- (A) Ponchon Savarit method
 - (B) Mc Cabe Thiele method
 - (C) Ellis method
 - (D) Enthalpy concentration method
81. The ratio of flux to concentration gradient is known as
- (A) thermal diffusivity
 - (B) eddy diffusivity
 - (C) mass transfer coefficient
 - (D) volumetric diffusivity
82. Channeling is most severe in
- (A) stacked packings
 - (B) dumped packings of crushed solids
 - (C) dumped packings of regular units
 - (D) any one of the above
83. Cox chart is used to find
- (A) vapour pressure
 - (B) viscosity
 - (C) specific gravity
 - (D) diffusivity
84. In an azeotropic mixture, the equilibrium liquid composition is
- (A) more than vapor composition
 - (B) same as vapor composition
 - (C) less than vapor composition
 - (D) independent of pressure

85. For a binary mixture at constant temperature, with the increase of total pressure, the relative volatility
- (A) decreases (B) increases
(C) remains constant (D) None of the above
86. If q is the moles of liquid flow per unit mole of feed in stripping section of a distillation column, then which one of the following is true when the feed is in the form of partially vapour and partially liquid.
- (A) $q > 1$ (B) $q < 1$
(C) $0 < q < 1$ (D) $q = 1$
87. Extraction utilizes differences in the
- (A) relative volatilities of their components
(B) vapour pressure of their components
(C) solubilities of their components
(D) boiling point of their components
88. For a ternary mixture in extraction, a pure component can be represented by
- (A) sides of equilateral triangular coordinates
(B) apex of an equilateral triangular coordinates
(C) a point inside the binodal curve in the equilateral triangle
(D) a point outside the binodal curve in the equilateral triangle
89. Drying operation under vacuum is used to
- (A) reduce drying temperature
(B) increase drying temperature
(C) maintain drying at the same temperature as in the case of atmospheric pressure
(D) None of the above
90. Which one of the following dryer is used for the drying of highly heat sensitive materials?
- (A) Spray dryer (B) Tray dryer
(C) Screen conveyer dryer (D) Screw conveyor dryer
91. In the formation of a crystal the driving potential is
- (A) super saturation (B) saturation
(C) nucleation (D) None of the above
92. Shanks system is used for
- (A) size reduction (B) counter current leaching
(C) counter current absorption (D) adsorption

93. Rayleigh's equation is applicable for
- (A) continuous fractionation (B) continuous absorption
(C) simple distillation (D) continuous extraction
94. Phenomenon of liquid passing through the perforations in the tray column is called
- (A) flooding (B) loading
(C) coning (D) weeping
95. A spherical storage vessel is quarter-filled with toluene. The diameter of the vent at the top of the vessel is 1/20th of the diameter of the vessel. Under the steady state condition, the diffusive flux of toluene is maximum at
- (A) the surface of the liquid
(B) the mid-plane of the vessel
(C) the vent
(D) a distance 20 times the diameter of the vent away from the vent
96. Diffusivity of solute gas A in a gaseous mixture is (where T is the temperature)
- (A) Proportional to $T^{1/2}$ (B) Proportional to T
(C) Proportional to $T^{3/2}$ (D) Independent of T
97. For a ternary mixture in extraction, a pure component can be represented by
- (A) sides of equilateral triangular coordinates
(B) apex of an equilateral triangular coordinates
(C) a point inside the binodal curve in the equilateral triangle
(D) a point outside the binodal curve in the equilateral triangle
98. Drying operation under vacuum is used to
- (A) reduce drying temperature
(B) increase drying temperature
(C) maintain drying at the same temperature as in the case of atmospheric pressure
(D) None of the above
99. The riser in bubble cap trays conduct the flow of
- (A) liquid (B) vapour
(C) both liquid and vapour (D) None of the above
100. An ideal plug flow reactor has
- (A) uniform mixing (B) axial dispersion
(C) flat velocity profile (D) None of the above

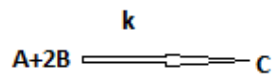
101. For any given duty and for all positive reaction orders, the size of mixed reactor is
- (A) higher than plug flow reactor (B) smaller than plug flow reactor
(C) same as plug flow reactor (D) cannot say
102. For an increase in pressure in gas reactions, when the number of moles decreases conversion
- (A) decreases (B) increases
(C) unaffected (D) cannot say
103. The response curve for a step input signal from a reactor is called
- (A) E-curve (B) C-curve
(C) F-curve (D) I-curve
104. In a zero order reaction, the rate of chemical reaction
- (A) increases with the increase of concentration of reactants
(B) decreases with the increase of concentration of reactants
(C) is independent of the concentration of reactants
(D) None of the above
105. For a gas phase reaction at 298 K, the rate is reported as $\frac{-dp_A}{dt} = 3.20p_A^3$, atm/h
The unit of rate constant is
- (A) atm.h⁻¹ (B) atm⁻¹h⁻¹
(C) atm⁻²h⁻¹ (D) atm⁻³h⁻¹

106. For a chemical reaction,



the rate of formation of product is 0.4 mole/(litre.h). The rate of disappearance of A must be equal to

- (A) 0.4 mole/(litre.h) (B) 0.6 moles/(litre.h)
(C) 0.2 moles/(litre.h) (D) None of the above
107. For a reaction



The experimental data suggests that rate=k[A][B]. The molecularity and order of reaction for this reaction is

- (A) 3 and 2 respectively (B) 2 and 3 respectively
(C) 3 and 3 respectively (D) 2 and 2 respectively

108. In a chemical reaction, the time required to reduce the concentration of reactant from 1 mole /litre to 0.5 mole/litre, is same as that required to reduce it from 50 moles/litre to 25 mole/litre in the same volume. Then the reaction is of
- (A) Zero order (B) first order
(C) second order (D) third order
109. Which one of the following reaction will be favoured by low pressure?
- (A) $N_2 + 3H_2 \leftrightarrow 2NH_3$ (B) $2SO_2 + O_2 \leftrightarrow 2SO_3$
(C) $2H_2 + O_2 \leftrightarrow 2H_2O$ (D) $N_2O_4 \leftrightarrow 2NO_2$
110. With the increase in temperature the equilibrium conversion of a reversible endothermic reaction $A \leftrightarrow R$
- (A) decreases (B) increases
(C) remains unaffected (D) cannot say
111. A catalyst increases the rate of a reaction, because it
- (A) increases the activation energy of the reactants
(B) decreases the activation energy of the reactants
(C) brings together the reactant molecules
(D) increases the temperature
112. For mixed flow systems, the Dispersion number
- (A) Tends to infinity (B) tends to zero
(C) tends to 1 (D) None of the above
113. A first order reaction requires two equal sized CSTR. The conversion is
- (A) more when they are connected in series
(B) less when they are connected in series
(C) same whether they are connected in series or in parallel
(D) more when they are connected in parallel
114. The most unsuitable reactor for carrying out reactions in which high reactant concentration favours high yields is
- (A) plug flow reactor (B) series of CSTR
(C) PFR in series (D) backmix reactor
115. For every 10°C rise in temperature, the rate of chemical reaction doubles. When the temperature is increased from 30 to 70°C, the rate of reaction increases _____ times.
- (A) 12 (B) 8
(C) 16 (D) 32

116. _____ is the response curve for a step input signal from a reactor.
- (A) I-curve (B) C-curve
(C) S-curve (D) None of the above
117. A reversible liquid phase endothermic reaction is to be carried out in a plug flow reactor. For minimum reactor volume, it should be operated such that the temperature along the length
- (A) decreases
(B) increases
(C) first increases and then decreases.
(D) is at the highest allowable temperature throughout.
118. In an exothermic chemical reaction, the reactants compared to the products have
- (A) higher temperature (B) more energy
(C) same energy (D) less energy
119. 'N' plug flow reactors in series with a total volume 'V' gives the same conversion as a single plug flow reactor of volume 'V' for _____ order reactions.
- (A) second (B) three
(C) first (D) any
120. Pick out the wrong statement.
- (A) The vessel dispersion number (D/UL) for plug flow and mixed flow approaches zero and infinity respectively.
(B) Space time in a flow reactor is a measure of its capacity and is equal to the residence time when the density of reaction mixture is constant.
(C) In an ideal tubular flow reactor, mixing takes place in radial direction and there is no mixing in longitudinal direction.
(D) Mixed reactor is always smaller than the plug flow reactor for all positive reaction orders for a particular duty
121. Which of the following will favour the reverse reaction in a chemical equilibrium reaction?
- (A) Removal of at least one of the products at regular interval
(B) Increasing the concentration of one of the reactants
(C) Increasing the concentration of one or more of the products
(D) None of the above
122. The ratio of volume of mixed reactor to the volume of P.F.R. (for identical flow rate, feed composition and conversion) for zero order reaction is
- (A) ∞ (B) >1
(C) 1 (D) 0

123. Quick opening valves are generally of the type of
- (A) needle valve (B) globe valve
(C) diaphragm valve (D) gate valve
124. For measuring the temperature of a furnace which is the most suitable instrument
- (A) thermocouple (B) optical pyrometer
(C) bimetallic thermometer (D) resistance thermometer
125. In process control it is desirable to anticipate the effect of large load changes and reduce the maximum error; a possible control action to achieve this is
- (A) proportional (B) integral
(C) derivative (D) PI control
126. When $\zeta = 0$, the nature of step response is
- (A) underdamped (B) critically damped
(C) overdamped (D) undamped
127. The band width of an on-off controller is
- (A) one (B) 100
(C) zero (D) infinite
128. Rheometer is used to measure
- (A) density (B) viscosity
(C) molecular diffusivity (D) velocity
129. In an underdamped second order response, the value of decay ratio is equal to
- (A) overshoot (B) overshoot²
(C) overshoot⁻² (D) overshoot⁻¹
130. A special case of proportional control is on-off control, when its gain K_c is
- (A) zero (B) infinity
(C) 1 (D) None of the above
131. Servo problem is encountered when there is a change in
- (A) set point (B) load variable
(C) manipulated variable (D) None of the above
132. Consider a system with $G(s) = \frac{1}{s^2 + s + 1}$. The percentage overshoot for this system for a step change is
- (A) 63.5% (B) 16.6%
(C) 32% (D) 83%

133. Consider a pure capacitance system with P-controller in a closed loop. If there is a unit step change in set point for the system, the offset is
- (A) zero (B) one
(C) infinity (D) no sufficient information to determine
134. Air to open type control valve
- (A) opens when air pressure fails (B) closes when air pressure fails
(C) Both of the above (D) None of the above
135. A P controller gives an offset. We would like to have zero offset. You recommend
- (A) adding integral action (B) adding derivative action
(C) use large K_C (D) set $K_c=0$
136. A gain margin of less than one means
- (A) unstable system (B) stable system
(C) critically stable system (D) underdamped system
137. Thermistor, which has high temperature co-efficient of resistivity, is used as the sensing element in resistance thermometer. It is a/an
- (A) liquid semi-conductor (B) insulator
(C) solid semi-conductor (D) conductor
138. Flapper nozzle is used in a/an _____ controller.
- (A) electronic (B) pneumatic
(C) hydraulic (D) None of the above
139. Typical specifications for design stipulates the gain margin and phase margin to be respectively
- (A) > 1.7 and $> 30^\circ$ (B) < 1.7 and $> 30^\circ$
(C) < 1.7 and $< 30^\circ$ (D) > 1.7 and $< 30^\circ$
140. Response of a system to a sinusoidal input is called _____ response.
- (A) unit step (B) impulse
(C) frequency (D) None of the above
141. The operation of a rotameter is based on
- (A) pressure drop across a nozzle (B) pressure at a stagnation point
(C) rotation of a turbine (D) variable flow area

142. The closed loop pole of a stable second order system could be
- (A) complex conjugate with positive real parts
 - (B) both real and negative
 - (C) both real and positive
 - (D) one real positive and the other real negative
143. The Laplace transform of $f'(t)$ is
- (A) $s^2 f(s) - s f(0) - f'(0)$
 - (B) $s f(s) - s f(0) - f'(0)$
 - (C) $s f(s) - f(0)$
 - (D) $s^2 f'(s) - f(0)$
144. Which of the following second order systems are equivalent to two first order systems in series?
- (A) $G(s) = \frac{1}{s^2 + 2s + 2}$
 - (B) $G(s) = \frac{1}{s^2 + 1.9s + 0.7}$
 - (C) $G(s) = \frac{1}{s^2 + 5}$
 - (D) $G(s) = \frac{1}{s^2 + s + 2}$
145. If the absolute temperature of an ideal gas is doubled and pressure is reduced to one half, the volume of gas will
- (A) increase two fold
 - (B) increase four fold
 - (C) decrease two fold
 - (D) remains unchanged
146. For a reversible adiabatic process ΔS is
- (A) < 0
 - (B) > 0
 - (C) $= 0$
 - (D) None of the above
147. The expansion of a gas into vacuum is
- (A) reversible process
 - (B) irreversible process
 - (C) Both of the above
 - (D) None of the above
148. Five moles of an ideal gas are compressed isothermally at 400°K from 1 atm to 5atm. Calculate the free energy change for the process.
- (A) $- 5116.7 \text{ cal}$
 - (B) 5116.7 cal
 - (C) 21409.39 cal
 - (D) $- 21409.39 \text{ cal}$
149. Pore diffusion resistance in a catalyst is considered negligible if Thiele modulus is
- (A) > 1
 - (B) < 1
 - (C) < 0.5
 - (D) > 0.5

150. An adiabatic system can exchange energy with its surroundings

- (A) only in the form of work
- (B) either in the form of heat or work
- (C) in the form of only heat
- (D) both in the form of heat and work
