

1. The temperature of a gas in a closed container is 27°C . If temperature of the gas is increased to 300°C , then pressure exerted is
 - (A) Double
 - (B) Halved
 - (C) Trebled
 - (D) Unpredictable

2. C_v of mono atomic gas is equal to
 - (A) R
 - (B) $1.5R$
 - (C) $2R$
 - (D) $3R$

3. Recycling in a chemical process facilitates
 - (A) increase yield
 - (B) enrichment of product
 - (C) heat conservation
 - (D) all (A), (B), and (C)

4. "The total volume occupied by gaseous mixture is equal to the sum of the pure component volume". This is the law of
 - (A) Dalton
 - (B) Amgat
 - (C) Gay lussac
 - (D) Avogadro

5. Kopp's rule is helpful in finding the
 - (A) heat capacity of solids
 - (B) heat capacity of gases
 - (C) molal heat capacities of gases
 - (D) activation energy

6. N_2 content in a urea sample was found to be only 42%. What is the actual urea content of the sample? (M.Wt of urea - 60)
 - (A) 80%
 - (B) 90%
 - (C) 95%
 - (D) 98%

7. S.T.P. corresponds to:

- (A) 1 atm. absolute pressure and 15.5°C
(B) 760 mm Hg gauge pressure and 15.5°C
(C) 760 torr
(D) 101.325 kPa gauge pressure and 15.5°C
8. The molar composition of a gas is 10% H₂, 10% O₂, 30% CO₂, and balance H₂O. If 50% H₂O condenses, the final mole percent of H₂ in the gas on dry basis will be
(A) 10%
(B) 5%
(C) 18.8%
(D) 20%
9. The volume occupied by 1 kmol of an ideal gas at 273.15K and 101.325 kPa is
(A) 22.414 m³
(B) 359 m³
(C) 22414 m³
(D) 35.9 m³
10. Pure A in gas phase enters a reactor, 50% of this A is converted to B through the reaction A → 3B. Mole fraction of A in the exit stream is
(A) 1/2
(B) 1/3
(C) 1/4
(D) 1/5
11. Enthalpy 'H' is defined as
(A) H = E - PV
(B) H = F - TS
(C) H - E = PV
(D) none of these
12. Joule-Thomson coefficient is defined as
(A) $\mu = \left(\frac{\partial P}{\partial T}\right)_H$
(B) $\mu = \left(\frac{\partial T}{\partial P}\right)_H$
(C) $\mu = \left(\frac{\partial E}{\partial T}\right)_H$
(D) $\mu = \left(\frac{\partial E}{\partial P}\right)_H$
13. Throttling (Joule-Thomson effect) process is a constant _____ process

- (A) Enthalpy
(B) Entropy
(C) Pressure
(D) None of these
14. $PV^\gamma = \text{constant}$ (where, $\gamma = C_p/C_v$) is valid for a/an _____ process
(A) Isothermal
(B) Isentropic
(C) Isobaric
(D) Adiabatic
15. Fugacity and pressure are numerically equal, when the gas is
(A) in standard state
(B) at high pressure
(C) at low temperature
(D) in ideal state
16. Chemical potential of i^{th} component of a system is given by
(A) $\mu_i = \left(\frac{\partial F}{\partial n_i} \right)_{T,P,n_i}$
(B) $\mu_i = \left(\frac{\partial A}{\partial n_i} \right)_{T,P,n_i}$
(C) $\mu_i = \left(\frac{\partial F}{\partial n_i} \right)_{T,P}$
(D) $\mu_i = \left(\frac{\partial A}{\partial n_i} \right)_{T,P}$
17. Work done is a
(A) property of the system
(B) path function
(C) point function
(D) state description of a system
18. The energy of activation of exothermic reaction is
(A) Zero
(B) Negative
(C) Very large compared to that for endothermic reaction
(D) Not possible to predict
19. In the reaction, $H_2 + I_2 \rightleftharpoons 2HI$, addition of an inert gas will
(A) increase the partial pressure of H_2

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- (B) increase the partial pressure of I_2
(C) increase the total pressure and hence shift the equilibrium toward right
(D) not effect on the equilibrium condition
20. At absolute zero temperature, all substances have the same
(A) Heat capacity
(B) Crystalline structure
(C) Entropy
(D) None of these
21. The operating speed of a ball mill should be _____ the critical speed
(A) much more than
(B) less than
(C) at least equal to
(D) slightly more than
22. As particle size is reduced
(A) screen become progressively more difficult
(B) screen become progressively more easier
(C) capacity and effectiveness of the screen is increased
(D) none of these
23. Froth floatation is the most suitable for treating
(A) iron ores
(B) sulphides ores
(C) quartzite
(D) none of these
24. The ratio of the actual mesh dimension of Taylor series to that of the next smaller screen is
(A) 2
(B) $\sqrt{2}$
(C) 1.5
(D) $\sqrt{3}$
25. Crushing efficiency is the ratio of the
(A) surface energy created by crushing to the energy absorbed by the solid
(B) energy absorbed by the solid to that fed to machine
(C) energy fed to the machine to the surface energy created by crushing
(D) energy absorbed by the solid to the surface energy created by crushing
26. Sphericity of a solid particle of cubical shape is
(A) π
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- (B) $\left(\frac{\pi}{6}\right)^{1/3}$
- (C) $\left(\frac{\pi}{6}\right)^{1/2}$
- (D) $\left(\frac{\pi}{3}\right)$
27. To produce talcum powder, we can use
- (A) jet mill
- (B) hammer mill
- (C) ball mill
- (D) pin mill
28. Unit of filter medium resistance is
- (A) cm^{-1}
- (B) gm/cm^{-1}
- (C) cm/gm^{-1}
- (D) gm^{-1}
29. For spheres, the specific surface shape factor is given by
- (A) D/V
- (B) AD/V
- (C) A/V
- (D) $\sqrt{AD/V}$
30. Critical speed of rotation, N (in rps-rotation per second) of trammel is equal to
- (A) $2\pi\sqrt{\frac{g}{r}}$
- (B) $\frac{1}{\pi}\sqrt{\frac{g}{r}}$
- (C) $\frac{1}{2}\sqrt{\frac{g}{r}}$
- (D) $\frac{1}{2\pi}\sqrt{\frac{g}{r}}$
31. Use of baffles in agitator helps in minimizing the _____ tendency.
- (A) Swirling
- (B) Vortexing
- (C) Both (A) and (B)
- (D) Neither (A) and (B)
32. Screen capacity is not the function of

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- (A) its opening size
(B) screen mechanism
(C) screening surface
(D) atmospheric humidity
33. Sauter mean diameter is the same as the _____ mean diameter.
(A) Mass
(B) Arithmetic
(C) volume-surface
(D) Geometric
34. Hydraulic radius is the ratio of
(A) wetted perimeter to flow area
(B) flow area to wetted perimeter
(C) flow area to square of wetted perimeter
(D) square root of flow area to wetted perimeter
35. Bernoulli's equation describes the
(A) mechanical energy balance in potential flow
(B) kinetic energy balance in laminar flow
(C) mechanical energy balance in turbulent flow
(D) mechanical energy balance in boundary layer
36. Terminal settling velocity is
(A) attained after moving one-half of total distance
(B) a fluctuating velocity
(C) a constant velocity with no acceleration
(D) none of these
37. Priming is needed in which type of pump
(A) Reciprocating
(B) Gear
(C) Centrifugal
(D) Diaphragm
38. Cavitation can be prevented by

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- (A) suitable designing the pump
(B) maintaining the suction head sufficiently greater than the vapour pressure
(C) maintain the suction head = developed head
(D) maintain the suction head lower than the vapour pressure
39. Head developed by centrifugal pump depends on its
(A) speed
(B) impeller diameter
(C) both (A) and (B)
(D) neither (A) nor (B)
40. Vena-contracta formed during flow of a liquid through an orifice meter has
(A) minimum liquid cross-section
(B) more diameter compared to orifice diameter
(C) minimum velocity of fluid stream
(D) none of these
41. The pump used for irrigation purpose is generally designed for
(A) large capacity and high head
(B) large capacity and low head
(C) small capacity and high head
(D) small capacity and low head
42. Check valve is used for _____ flow.
(A) very precise control of
(B) unidirectional
(C) multidirectional
(D) none of these
43. A streamline is
(A) a line connecting the mid-point of flow cross-sections
(B) defined for uniform flow only
(C) drawn normal to the velocity vector at every point
(D) always the path of a particle
44. Which of the following is not a dimensionless number?
(A) Pressure co-efficient
(B) Froude number
(C) Kinematic viscosity
(D) Weber number
45. Boundary layer separation occurs when the
(A) pressure reach a minimum

- (B) cross-section of the channel is reduced
(C) valve is closed in a pipeline
(D) velocity of sound is reached
46. Specific speed of centrifugal pump depends upon _____ head.
(A) Suction
(B) Delivery
(C) Manometric
(D) None of these
47. Foot valve provided in pumps are _____ valves.
(A) relief
(B) three/four way
(C) pressure reducing
(D) directional control
48. Bernoulli equation written in the form $\frac{P}{\gamma} + Z + \frac{v^2}{2g} = \text{constant}$, represents
(A) total energy per unit volume
(B) total energy per unit weight
(C) total energy per unit mass
(D) total energy per unit specific weight
49. The friction factor
(A) is dimensionless
(B) has the units of energy per unit weight of fluid
(C) appears in pressure drop relation for laminar flow through pipes
(D) is universally proportional to Reynolds number
50. Mercury is generally used in manometer for
(A) very low pressures only
(B) low pressures accurately
(C) large pressure only
(D) all pressure except the small ones
51. The Peclet number (N_{pe}) for heat transfer is given by
(A) $\frac{N_{Re}}{N_{Pr}}$

- (B) N_{Pr} / N_{Re}
- (C) $N_{Pr} N_{Re}$
- (D) $N_{Nu} / N_{Pr} N_{Re}$

52. In counter current flow compared to parallel flow,
- (A) LMTD is greater
 - (B) less surface area is required for a given heat transfer rate
 - (C) both (A) and (B)
 - (D) more surface area is required for a given rate heat transfer rate
53. Baffle spacing
- (A) is not the same as baffle pitch
 - (B) should be less than one fifth the diameter of the shell
 - (C) should be less than the inside diameter of the shell
 - (D) none of these
54. Finned tube heat exchangers
- (A) are used for smaller heat load
 - (B) use metal fins of low thermal conductivity
 - (C) facilitate very large temperature drop through tube wall
 - (D) give larger area per tube
55. Analogy between mass and heat transfer is not applicable in case of
- (A) same velocity profile or equal diffusivities
 - (B) thermal and pressure mass diffusion
 - (C) viscous heating or chemical reaction
 - (D) both (A) and (B)
56. Film wise condensation
- (A) is characterized by a thin liquid film forming over the entire surface
 - (B) is less common than dropwise condensation
 - (C) occur on non-wettable surfaces
 - (D) is characterized by high heat transfer coefficient than that for dropwise condensation
57. The peak heat flux in a boiling curve is called
- (A) the boiling point
 - (B) the Leidenfrost point

- (C) the burnout point
(D) the Nusselt point
58. 1-4 shell and tube heat exchanger means
(A) 1 shell side pass and 4 tube side passes
(B) 4 shell side pass and 1 tube side passes
(C) 4 tube per pass
(D) 4 shell side pass and 4 tube side passes
59. The value of F_T (LMTD correction factor)
(A) increases with increases in number of shell passes
(B) decrease with increases in number of shell passes
(C) remains unaffected with change in number of shell passes
(D) in always unity for multipass exchanger
60. Shell and tube heat exchanger is used for larger heat transfer area requirement because
(A) it is more economical
(B) its space requirement is small
(C) it is easy to operate and maintain
(D) all of the above (A), (B) and (C)
61. The thermal diffusivity of a material is defined as
(A) $k / \rho C_p$
(B) $\rho C_p / k$
(C) $k C_p / \rho$
(D) $k \rho / C_p$
62. If k_s , k_l , and k_g are the thermal conductivities of aluminium, water and air at the same temperature, then
(A) $k_l > k_s > k_g$
(B) $k_g > k_t > k_s$
(C) $k_s > k_g > k_l$
(D) $k_s > k_l > k_g$
63. Two parallel infinite black planes are maintained at 200°C and 300°C. If both the temperature are lowered by 100°C, the net heat transfer rate by radiation reduces approximately.

- (A) 53%
- (B) 47%
- (C) 50%
- (D) 35%

64. An equation for heat flow in the cube for constant thermal diffusivity is

$$\frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2} + \frac{\partial^2 T}{\partial z^2} = 0. \text{ This equation is known as,}$$

- (A) Newton equation
- (B) Laplace equation
- (C) Poisson equation
- (D) Fourier equation

65. Geometric mean heat transfer area for the two heat transfer areas A_1 and A_2 is given by

(A) $(A_1 - A_2) \ln \left(\frac{A_2}{A_1} \right)$

(B) $\frac{A_1 - A_2}{\ln \left(\frac{A_2}{A_1} \right)}$

(C) $\frac{A_1 - A_2}{\ln \left(\frac{A_1}{A_2} \right)}$

(D) $\frac{\ln \left(\frac{A_2}{A_1} \right)}{A_1 - A_2}$

66. The thicker the insulation the less is the total heat loss. This statement is

- (A) always true for flat insulation only
- (B) always true for curved insulation only
- (C) always true for both flat and curved insulation
- (D) not true for both flat and curved insulation

67. The Biote number is defined as

(A) $\frac{tL^2}{\alpha}$

- (B) $\frac{\alpha t}{L^2}$
- (C) $\frac{hk}{L}$
- (D) $\frac{hL}{k}$
68. The tube in a shell and tube heat exchangers vibrate due to
- (A) Fluid flow on the shell and tube sides
- (B) Oscillation in the flow of shell side or tube side fluid
- (C) Vibration due to external causes transmitted through piping and/or support
- (D) All (A), (B) and (C)
69. 25% cut segmental baffle means
- (A) A baffle plate whose height is 25% of the inside diameter of the shell
- (B) A baffle plate whose height is 75% of the inside diameter of the shell
- (C) A baffle plate whose height is 25% of the inside diameter of the tube
- (D) A baffle plate whose height is 25% of the length of tube
70. Steam economy for triple effect evaporator is
- (A) < 1
- (B) 1
- (C) > 1
- (D) $\ll 1$
71. Walls of a cubical oven are of thickness L and they are made of material of thermal conductivity k . The temperature inside the oven is 100°C and temperature outside the oven is 25°C . The inside and outside heat transfer coefficient are $3k/L$. What will be inside and outside wall temperature in $^\circ\text{C}$, respectively?
- (A) 100, 25
- (B) 81.25, 43.75
- (C) 80, 45
- (D) 85, 40
72. The non-dimensional temperature gradient in a liquid at the wall of a pipe is the
- (A) Nusselt number
- (B) Heat flux

- (C) Prandtl number
(D) Schmidt number
73. The heat flux (from outside to inside) across an insulating wall with thermal conductivity, $K = 0.04 \text{ W/m} \cdot ^\circ\text{K}$ and thickness 0.16m is 10 W/m^2 . The temperature of the inside wall is -5°C . The outside wall temperature is
(A) 25°C
(B) 30°C
(C) 35°C
(D) 40°C
74. In pipe flow, heat is transferred from hot wall to the liquid by
(A) Conduction only
(B) Forced convection only
(C) Forced convection and conduction
(D) Free and forced convection
75. For perfectly transparent surface (like gases), the
(A) Absorptivity = 0
(B) Transmissivity = 1
(C) Reflectivity = 0
(D) All (A) (B) and (C)
76. In a binary system, separation is very efficient, when the relative volatility is
(A) 1
(B) > 1
(C) < 1
(D) 0.5
77. Fick's second law of diffusion in one dimension is
(A) $J_A = -D_{AB} \frac{\partial C_A}{\partial Z}$
(B) $\frac{\partial C_A}{\partial \theta} = -D_{AB} \frac{\partial^2 C_A}{\partial Z^2}$
(C) $J_A = -D_{AB} \frac{\partial^2 C_A}{\partial Z^2}$
(D) $\frac{\partial C_A}{\partial \theta} = D_{AB} \frac{\partial^2 C_A}{\partial Z^2}$
78. Azeotropic distillation is employed to separate
(A) Constant boiling mixture
(B) High boiling mixture

- (C) Mixture with very high relative volatility
(D) Heat sensitive materials
79. Which of the following assumes constant molal vaporization and overflow?
(A) McCabe-Theiele method
(B) Ponchan-Savarit method
(C) Enthalpy concentration method
(D) Plate absorption column
80. If f is defined as moles of vapour present per mole of feed, then which of following applied to a feed at dew point?
(A) $f < 1$
(B) $f = 1$
(C) $f > 1$
(D) $0 < f < 1$
81. When the liquid over a plate is of uniform concentration, then
(A) murphee efficiency $>$ point efficiency
(B) murphee efficiency $<$ point efficiency
(C) murphee efficiency $=$ point efficiency
(D) murphee efficiency \neq point efficiency
82. If $X_D =$ overhead product molal composition and $R_D =$ reflux ration, then slope and intercept of the operating line for rectifying section are, respectively
(A) $\frac{x_D}{R_D + 1}, \frac{R_D}{R_D + 1}$
(B) $\frac{R_D}{x_D + 1}, \frac{x_D}{x_D + 1}$
(C) $\frac{x_D}{R_D + 1}, \frac{R_D + 1}{R_D}$
(D) $\frac{R_D}{R_D + 1}, \frac{x_D}{x_D + 1}$
83. At minimum reflux ratio for a given separation
(A) number of plate is zero
(B) number of plate is infinity
(C) minimum number of the theoretical plate is required
(D) separation is most efficient
84. Tea percolation employs
(A) liquid-liquid extraction
(B) absorption
(C) leaching

- (D) none of these
85. In case of gases, the binary diffusivity is proportional to pressure (P) as follows,
(A) P
(B) $1/P$
(C) $1/\sqrt{P}$
(D) \sqrt{P}
86. On addition of solute on the solvent, the _____ of the solution decreases
(A) boiling point
(B) freezing point
(C) vapour pressure
(D) both (A) and (B)
87. Pressure drop through plate tower as compared to that through packed tower, for the same duty will be
(A) less
(B) more
(C) equal
(D) either (A) and (B) ; depends on the packing height
88. Gaseous diffusion co-efficient increases with the increase in the
(A) pressure
(B) temperature
(C) both (A) and (B)
(D) neither (A) nor (B)
89. L/mG is the expression for
(A) slope of operating line in absorber
(B) brinkman number
(C) absorption factor
(D) slope of operating in stripper
90. Unit operation involved in the prilling of urea is
(A) evaporation
(B) drying
(C) crystallization

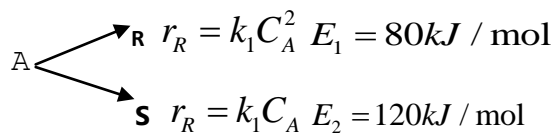
- (D) both (A) and (B)
91. According to the film theory of mass transfer, the mass transfer co-efficient is proportional molecular diffusivity (D) as
- (A) $D^{0.5}$
(B) D
(C) D^2
(D) $1/D$
92. L/G ratio of a cooling tower doesn't depend upon
- (A) outlet wet bulb temperature (WBT)
(B) enthalpy of inlet air
(C) dry bulb temperature (DBT)
(D) range
93. The lowest temperature to which water can be theoretically cooled in a cooling tower is ————— of the atmosphere air
- (A) DBT
(B) WBT
(C) average of DBT and WBT
(D) difference of DBT and WBT
94. Minimum number of ideal stages is required in a fractionating column when the reflux ratio is equal to
- (A) minimum reflux ration
(B) optimum reflux ration
(C) zero
(D) infinity
95. The dew point of a saturated gas is equal to the ————— temperature
- (A) wet bulb
(B) adiabatic saturation
(C) gas
(D) none of these
96. In distillation column design, the McCabe-Thiele procedure and a Ponchon-Savarit procedure is needed when
- (A) saturated feed is not used
(B) an azeotropic forms
(C) the latent heats of vapourization of the more and less volatile components are

- greatly different
(D) a total condenser is used
97. The humid volume (v_H) and density (ρ) of a vapour-gas mixture of mass absolute humidity (Y') are related by
- (A) $\rho = \frac{1+Y'}{v_H}$
- (B) $\rho = \frac{Y}{v_H}$
- (C) $\rho = \frac{v_H}{Y'}$
- (D) $\rho = \frac{1+v_H}{Y'}$
98. At plait point, selectivity is
- (A) 0
(B) 1
(C) 10
(D) ∞
99. A binary hydrocarbon liquid mixture of A and B ($K_A = 1.5$) containing 60 mole % A is flashed vaporized. If 40% of the feed is vaporized, the mole fraction of A in the liquid product is
- (A) 0.6
(B) 0.4
(C) 0.3
(D) 0.5
100. Air with a dry bulb temperature t_{d_1} and a wet bulb temperature t_{w_1} is passed through a heater and through an adiabatic cooler from which it emerges with dry and wet bulb temperature t_{d_2} and t_{w_2} respectively. Then
- (A) always $t_{w_1} > t_{w_2}$ and $t_{d_1} > t_{d_2}$
- (B) always $t_{w_1} < t_{w_2}$ and $t_{d_1} > t_{d_2}$
- (C) always $t_{w_1} > t_{w_2}$ and $t_{d_1} < t_{d_2}$
- (D) $t_{w_1} < t_{w_2}$ and t_{d_1} can be greater then, equal to or less than t_{d_2}
101. The reason for preferring packed towers over plate tower in distillation practice is that the packed tower operation gives
- (A) low pressure drop and high hold up
(B) high pressure drop and low hold up
(C) low pressure drop and low hold up
(D) high pressure drop and high hold up

102. Monomer of Teflon is
(A) CF_4
(B) C_2F_4
(C) C_2F_2
(D) $\text{CH}_2=\text{CHF}$
103. Natural rubber is mainly
(A) Polybutadiene
(B) Polychloroprene
(C) Polystyrene
(D) Polyisoprene
104. Sweetening Merox process for kerosene converts mercaptans into
(A) sulphur
(B) disulphides
(C) hydrogen sulphide
(D) all (A), (B) and (C)
105. The chemical formula of urea is
(A) $\text{NH}_4\text{COONH}_2$
(B) $\text{NH}_2\text{CONHCONH}_2$
(C) NH_4OH
(D) NH_2CONH_2
106. For a zero order reaction, the concentration of product increases with the
(A) increase of reaction time
(B) increase in initial concentration
(C) total pressure
(D) decrease in total pressure
107. Half-life period for a first order reaction is _____ the initial concentration of the reactant.
(A) directly proportional to
(B) inversely proportional to
(C) independent of
(D) none of these
108. Equilibrium of a chemical reaction as viewed by kinetics is _____ state.
(A) dynamic steady
(B) static steady
(C) dynamic unsteady
(D) none of these
109. The catalyst in a first order chemical reaction changes the

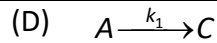
- (A) equilibrium constant
 (B) activation energy
 (C) heat of formation of the product
 (D) heat of reaction
110. The rate constant of a reaction depends on the
 (A) initial concentration of reactants
 (B) time of reaction
 (C) temperature of the system
 (D) extent of reaction

111. For the liquid phase parallel reaction



The desired product is R. A higher selectivity of R will be achieved if the reaction is conducted at

- (A) low temperature in a CSTR
 (B) high temperature in a CSTR
 (C) low temperature in a PFR
 (D) high temperature in a PFR
112. A consecutive reaction, $A \xrightarrow{c_1} B \xrightarrow{c_2} C$ is characterized by
 (A) maxima in the concentration of A
 (B) maxima in the concentration of B
 (C) maxima in the concentration of C
 (D) high exothermicity
113. Catalyst carrier
 (A) have very high selectivity
 (B) increase the selectivity of a catalyst
 (C) provide large surface area with small amount of active material
 (D) inhibit catalyst poisoning
114. For an ideal plug flow reactor, the value of Peclet number is
 (A) 0
 (B) ∞
 (C) 1
 (D) 10
115. For a series of reactions $A \xrightarrow{k_1} B \xrightarrow{k_2} C$ $k_1 \ll k_2$, the reaction system can be approximated as
 (A) $A \xrightarrow{k_1} B$
 (B) $A \xrightarrow{k_2} B$
 (C) $A \xrightarrow{k_2} C$



116. The role of catalyst in a chemical reaction is to change the

- (A) equilibrium constant
- (B) activation energy
- (C) final product
- (D) heat of reaction

117. For series reaction, the relative yield

- (A) is always greater for plug-flow reactor than for the single cstr of the same volume
- (B) statement (A) is wrong
- (C) decrease with increasing conversion
- (D) both (A) and (B) hold good

118. For the reaction, $A + B \rightarrow 2B + C$

- (A) $r_A = r_B$
- (B) $r_A = -r_B$
- (C) $r_A = 2 r_B$
- (D) $r_A = r_B/2$

119. For a reaction of the type, $V \xrightarrow{k_1} X \xrightarrow{k_2} Y \xrightarrow{k_3} Z$ the rate of reaction ($-r_x$) is given by

- (A) $(K_1 + K_2) C_x$
- (B) $(K_1 + K_2 + K_3) C_x$
- (C) $K_1 C_x - K_2 C_x$
- (D) $(K_1 - K_2) C_x$

120. What is the order of chemical reaction whose rate is determined by the variation of one concentration term only?

- (A) Zero
- (B) first
- (C) Second
- (D) third

121. The residence time distribution of an ideal CSTR is

- (A) $-\frac{1}{\tau} \exp\left(-\frac{t}{\tau}\right)$
- (B) $\tau \exp\left(-\frac{t}{\tau}\right)$
- (C) $\exp\left(-\frac{t}{\tau}\right)$

(D) $\frac{1}{\tau} \exp\left(-\frac{t}{\tau}\right)$

122. A pulse tracer is introduced in an ideal CSTR (with mean residence time τ) at time = 0. The time taken for the exit concentration of the tracer to reach half of its initial value will be
- (A) 2τ
(B) 0.5τ
(C) 0.693τ
(D) $\tau/0.693$
123. For the reaction $P + 2Q \rightarrow 3R$, molar rate of consumption of P is
- (A) double of that of Q
(B) same as that of Q
(C) half of that of Q
(D) $2/3$ of that of Q
124. Arrhenius equation describing the effect of temperature on rate constant is
- (A) $k = k_0 e^{-2E/RT}$
(B) $k = k_0 e^{-E/RT}$
(C) $k = k_0 T e^{-E/RT}$
(D) $k = k_0 e^{-E/RT}$
125. For a gas phase reaction at 400 K the rate is reported as $-\frac{dp_A}{dt} = 3.66p_A^2$. The unit of the rate constants are
- (A) $hr^{-1}(mol/l)^{-1}$
(B) $hr^{-1}(atm)^{-1}$
(C) $hr^{-1}(atm)$
(D) $hr^{-1}(atm)^3$
126. For constant-density systems, the performance equations are identical for
- (A) plug flow reactor and backmix reactor
(B) batch reactor and backmix reactor
(C) batch reactor and plug flow reactor
(D) batch reactor, plug flow reactor and backmix reactor

127. For an ideal steady-state mixed reactor the performance equation for constant-density system is

(A)
$$\tau = \frac{C_{AO} - C_A}{(-r_A)V}$$

(B)
$$\tau = \frac{C_{AO} - C_A}{(-r_A)C_{AO}}$$

(C)
$$\tau = \frac{C_{AO} - C_A}{(-r_A)}$$

(D)
$$\tau = \frac{(-r_A)}{C_{AO} - C_A}$$

128. Which one of the following statement is incorrect?

- (A) a catalyst remains unchanged at the end of a chemical reaction
- (B) a catalyst is highly specific in its action
- (C) a catalyst doesn't alter the state of equilibrium in a chemical reaction
- (D) a catalyst initiates a reaction

129. In a reaction, the threshold energy is equal to

- (A) activation energy
- (B) activation energy + normal energy of reactants
- (C) normal energy of reactants
- (D) activation energy – normal energy of reactants

130. A first-order reaction is to be treated in a series of two mixed reactors. The total volume of the two reactors is

- (A) minimum when the reactors are of different size
- (B) maximum when the reactors are equal in size
- (C) minimum when the reactor are equal in size
- (D) none of (A), (B) and (C)

131. The cumulative age distribution F is defined as

(A)
$$F(t) = 1 - \int_0^t E \cdot dt$$

(B)
$$F(t) = \int_0^t E \cdot dt$$

(C) $F(t) = 1 + \int_0^t E \cdot dt$

(D) $F(t) = \int_0^\infty E \cdot dt$

132. $\int_0^\infty E \cdot dt$ between the limits of 0 and μ is equal to

- (A) 0
- (B) 0.1
- (C) 1.0
- (D) 10

133. For packed bed reactor, the presence of a long tail in the residence time distribution curve is an indication of

- (A) Ideal plug flow
- (B) bypass
- (C) channeling
- (D) Dead zone

134. Fluidized bed reactor can be categorized as a _____ type of reactor.

- (A) plug flow
- (B) Batch
- (C) mixed flow
- (D) none of these

135. Which of the following relationship between E and F is/are correct?

(A) $F = \frac{dE}{dt}$

(B) $E = F \cdot dt$

(C) $F(t) = \int_0^t F \cdot dt$

(D) $F = \frac{dF}{dt}$

136. Dead zone is the

- (A) same as time constant
- (B) same as transportation lag
- (C) maximum change in the variable that does not change the reading of the instrument
- (D) none of these

137. Which one of the following transfer functions corresponds to an inverse response process with a positive gain?
- (A) $\frac{1}{2S+1} - \frac{1}{3S+1}$
- (B) $\frac{2}{2S+1} - \frac{5}{S+10}$
- (C) $\frac{3(0.5S-1)}{(2S+1)(S+1)}$
- (D) $\frac{5}{S+1} - \frac{3}{2S+1}$
138. The unit impulse response of a first order process is given by $2e^{-0.5t}$. The gain and time constant of the process are, respectively,
- (A) 4 and 2
- (B) 2 and 2
- (C) 2 and 0.5
- (D) 1 and 0.5
139. An example of an open-loop second order under damped system is
- (A) liquid level in a tank
- (B) U-tube manometer
- (C) Thermocouple in a thermo well
- (D) Two non-interacting first order system
140. If the time constant is _____ the dynamic lag is high for a control valve.
- (A) zero
- (B) small
- (C) large
- (D) -2
141. What is the time constant (sec) of a first order system, which require 80 seconds to reach 95% of the final response?
- (A) 53.4
- (B) 26.7
- (C) 74.5
- (D) 56.6

142. A proportional controller with a gain of K_c is used to control a first order process. The offset will increase, if
- (A) K_c is reduced
 - (B) K_c is increased
 - (C) integral control action is introduced
 - (D) derivative control action is introduced
143. The response of two tanks of same size and resistance in series is
- (A) under damped
 - (B) over damped
 - (C) critically damped
 - (D) none of the above
144. Bode diagram are generated from output response of the system subjected to which of the following input?
- (A) impulse
 - (B) step
 - (C) ramp
 - (D) sinusoidal
145. When bare thermocouple is covered by a protective sheath, the response becomes
- (A) faster and oscillatory
 - (B) faster and non-oscillatory
 - (C) slower and oscillatory
 - (D) slower and non-oscillatory
146. Which of the following is not a variable area flow meter?
- (A) piston type meter
 - (B) rotameter
 - (C) magnetic flow meter
 - (D) orifice and tapered plug meter
147. A.R. vs W plot in Bode plot is made on a/an _____ graph paper.
- (A) ordinary
 - (B) semi-log
 - (C) log-log
 - (D) triaxial

148. According to Bode stability criterion, a system is unstable, if the open loop frequency response exhibit an amplitude ratio exceeding unity at frequency for which phase lag is
- (A) 0°
 - (B) 45°
 - (C) 90°
 - (D) 180°
149. On-off control is a special case of _____ control.
- (A) proportional (P)
 - (B) proportional-integral derivative (PID)
 - (C) proportional-derivative (PD)
 - (D) proportional-integral (PI)
150. Which of the following controllers has the maximum stabilizing time?
- (A) P
 - (B) P-I
 - (C) P-D
 - (D) P-I-D
151. In a feed-back control system G and H denote open loop and close loop transfer function respectively. The output-input relationship is
- (A) $\frac{G}{1+H}$
 - (B) $\frac{H}{1+G}$
 - (C) $\frac{G}{H}$
 - (D) $\frac{H}{G}$
152. Difference at any instant between the value of controlled variable and the set point is called the
- (A) Deviation
 - (B) Derivative time
 - (C) Error ratio
 - (D) Differential gap

153. Controlled variable in an exothermic CSTR is
- (A) The inlet temperature of reactants
 - (B) The inlet concentration of reactants
 - (C) The temperature in the reactor
 - (D) The flow rate of coolant
154. Solenoid valve works like which of the following controller
- (A) proportional (P)
 - (B) proportional-integral derivative (PID)
 - (C) proportional-derivative (PD)
 - (D) on-off
155. Which of the following controller requires maximum stabilizing time?
- (A) proportional (P)
 - (B) proportional-integral derivative (PID)
 - (C) proportional-integral (PI)
 - (D) proportional-derivative (PD)
156. For n first-order non-interacting systems connected in series, the overall phase angle (ϕ) is obtained by
- (A) $\phi = \phi_1 + \phi_2 + \phi_3 + \dots + \phi_n$
 - (B) $\phi = \phi_1 \times \phi_2 \times \phi_3 \times \dots \times \phi_n$
 - (C) $\phi = (\phi_1 + \phi_2 + \phi_3 + \dots + \phi_n)/n$
 - (D) $\phi = \phi_1 \times \phi_2 \times \phi_3 \times \dots \times \phi_n)^{1/n}$
157. The open loop transfer function of a process is $K \cdot \frac{(S+1)(S+4)}{(S+2)(S+3)}$. In the root locus diagram, the pole will be at
- (A) $-1, -4$
 - (B) $1, 4$
 - (C) $-2, -3$
 - (D) $2, 3$
158. The unit step response of the transfer function $1/(S^2+2S+3)$
- (A) has a non-zero slope at origin
 - (B) has a damped oscillatory characteristics
 - (C) is overdamped
 - (D) is unstable
159. Which of the systems having following transfer function is stable?

- (A) $1/(s^2 + 2)$
(B) $1/(s^2 - 2s + 3)$
(C) $1/(s^2 + 2s + 2)$
(D) $\exp(-20s)/(s^2 + 2s - 1)$
160. A first order system with unity gain and time constant τ is subjected to a sinusoidal input of frequency $\omega = 1/\tau$. The amplitude ratio for this system is
(A) 1
(B) 0.5
(C) $1/\sqrt{2}$
(D) 0.25
161. Out of following, the depreciation calculation by which of the following method is maximum?
(A) diminishing balance
(B) straight line
(C) sum of the years digit
(D) sinking fund
162. 'Six-tenth factor' rule is used for estimating the
(A) equipment installation cost
(B) equipment cost by scaling
(C) cost of piping
(D) utilities cost
163. The cost of a distillation column in the year 2000 is x rupees. What is the cost of the column in rupees in the year 2010 given the cost indices for the years 2000 and 2010 are 480 and 520, respectively.
(A) $x(520/480)^2$
(B) $x(480/520)$
(C) $x(520/480)$
(D) $(520/480)^{0.6x}$
164. If an amount R is paid at the end of every years for ' n ' years, then the net present value of the annuity at an interest rate of ' i ' is
(A) $R \left[\frac{(1+i)^n - 1}{i} \right]$

(B) $\left[\frac{(1+i)^n - 1}{i(1+i)^n} \right]$

(C) $R(1+i)^n$

(D) $R/(1+i)^n$

165. Direct cost component of the fixed capital consist of

- (A) contingencies
- (B) onsite and offsite costs
- (C) labour costs
- (D) raw material costs

166. For a typical project, the cumulative cash flow is zero at the

- (A) end of the project life
- (B) start up
- (C) break-even point
- (D) end of design stage

167. Fixed charges for a chemical plant does not include the

- (A) interest on borrowed money
- (B) rent of land and building
- (C) property tax, insurance and depreciation
- (D) repair and maintenance charges

168. Operating profit of a chemical plant is equal to

- (A) profit before interest and tax i.e., net profit + interest + tax
- (B) profit after tax plus depreciation
- (C) net profit + tax
- (D) profit after tax

169. Book value of an equipment is equal to its original price minus

- (A) current value of the equipment
- (B) amount of money obtained from sale of the equipment
- (C) amount of money on its maintenance
- (D) total depreciation charged

170. If the effective interest rate i_{eff} is defined as the rate which, when compounded once per year, gives the same amount of money at the end of 1 year, as does the nominal interest rate r compound m times per year, then

(A) $i_{eff} = \left(1 + \frac{r}{m}\right)^m - 1$

(B) $r = (1 + i_{eff})^m - 1$

(C) $i_{eff} = e^{mr} - 1$

(D) $i_{eff} = \ln\left(1 + \frac{r}{m}\right) - 1$

171. 'P' is the investment made on an equipment, 'S' is its salvage value and 'n' is the life of the equipment in years. The depreciation for mth year by the sum-of years digit method will be

(A) $\frac{P-S}{n}$

(B) $1 - \left(\frac{P}{S}\right)^{1/m}$

(C) $\frac{m}{n} \times (P-S)$

(D) $\frac{2(n-m+1)}{n(n+1)} \times (P-S)$

172. Future value of cash flow in terms of Net Present Value (NPV) and interest rate (i) is equal to

(A) $NPV/(1+i)^n$

(B) $NPV(1+i)^n$

(C) $NPV + (1+i)^n$

(D) $NPV (1+i)^n$

173. A series of equal payments (e.g., deposits or cost) made at equal intervals of time is known as

(A) Perpetuity

(B) Capital charge factor

(C) Annuity

(D) Future worth

174. The turnover ratio method is a rapid evaluation method suitable for order of magnitude estimates. This ratio is defined by

(A) $\text{Turnover ratio} = \frac{\text{Gross annual sales}}{\text{Fixed capital investment} + \text{working capital}}$

(B) $\text{Turnover ratio} = \frac{\text{Gross annual sales}}{\text{Fixed capital investment}}$

(C) $\text{Turnover ratio} = \frac{\text{Working capital}}{\text{Fixed capital investment}}$

(D) $\text{Turnover ratio} = \frac{\text{Fixed capital investment}}{\text{Gross annual sales}}$

175. Which of the following materials is most suitable for fabrication of pressure vessels?

(A) aluminum alloy

(B) Plastic

(C) plain carbon alloy

(D) Copper

176. Hydrogenation of oil does not
- (A) remove double bond
 - (B) raise its melting point
 - (C) improve its resistance to oxidation
 - (D) none of these
177. Anti-knocking performance of a gasoline sample matches with a reference blend of 90 vol% iso-octane and 10 vol% n-heptane. What is the octane number of the gasoline sample?
- (A) 91
 - (B) 10
 - (C) 90
 - (D) 19
178. Rancidity of the fatty oil can be reduced by its
- (A) Decoloration
 - (B) Hydrogenation
 - (C) Oxidation
 - (D) Purification
179. Producer gas consists mainly of
- (A) CO, H₂
 - (B) CO, CO₂, N₂, H₂
 - (C) H₂, CH₄
 - (D) C₂H₂, CO₂, H₂
180. Fat splitting catalyst is
- (A) CaCO₃
 - (B) ZnO
 - (C) Al₂O₃
 - (D) Fe
181. Ultimate analysis of coal determines its _____ content.
- (A) C, H, N, S
 - (B) C, S, N, ash
 - (C) C, S, volatile matter and ash
 - (D) C, volatile matter, ash and moisture
182. The main product of high temperature carbonization of coal is
- (A) Tar
 - (B) Ammonia
 - (C) Coke
 - (D) Phenol

183. Nylon 6-6 is manufactured from
- (A) dimethyl terephthalate and ethylene glycol
 - (B) hexamethylene diamine and maleic anhydride
 - (C) Caprolactum
 - (D) hexamethylene diamine and adipic acid
184. The main use of the activated carbon in water treatment is to control
- (A) bacterial growth
 - (B) taste and odour
 - (C) turbidity
 - (D) none of these
185. Hydrazine (N_2H_4) is used mainly as a/an
- (A) explosive
 - (B) rocket fuel
 - (C) detergents additive
 - (D) none of these
186. Black liquor is converted into white liquor by
- (A) multi-effect evaporation only
 - (B) selective liquid extraction
 - (C) evaporation and burning the concentrated followed by causticisation of products
 - (D) extractive distillation
187. Carboxymethyl cellulose (CMC) is added in detergents to
- (A) inhibiting corrosion in washing machines made of aluminium
 - (B) act as optical brightening agent
 - (C) prevent redeposition of soil on cleaned surface
 - (D) none of these
188. Polythene is a/an _____ polymerization product
- (A) Condensation
 - (B) Addition
 - (C) Thermosetting

- (D) None of these
189. Nylon-6 is a
- (A) Polyamide
 - (B) Thermosetting resin
 - (C) Polyester
 - (D) None of these
190. Coke oven gas consists mainly of
- (A) CO and CO₂
 - (B) H₂ and CH₄
 - (C) H₂ and CO
 - (D) CH₄ and CO
191. Absorption of SO₃ in 97% H₂SO₄
- (A) Endothermic
 - (B) Exothermic
 - (C) Not possible
 - (D) None of these
192. Alkyl benzene sulphonate (ABS) is a
- (A) Pesticide
 - (B) Rubber
 - (C) Detergents
 - (D) Polyester
193. Synthesis gas meant for the synthesis of organic compound is a variable mixture of
- (A) N₂ and H₂
 - (B) CO₂ and H₂
 - (C) CO and H₂
 - (D) C and H₂
194. The most stable allotropic form of phosphorous is the _____ phosphorous.
- (A) white
 - (B) black
 - (C) yellow
 - (D) red

195. Solvay process is used for the manufacture of
(A) caustic soda
(B) caustic potash
(C) soda ash
(D) soda lime
196. The active component of catalyst used in steam reforming of methane to produce synthesis gas is
(A) Nickel
(B) Iron
(C) Platinum
(D) Palladium
197. Commercially produced nitric acid is available in concentration from _____ per cent
(A) 22 to 42
(B) 33 to 50
(C) 52 to 69
(D) 52 to 99
198. Neoprene is the trade name of
(A) Polyisoprene
(B) Polychloroprene
(C) Polyurethane
(D) Polybutadiene
199. Sulphuric acid produced by contact process is
(A) cheaper
(B) of poor quality
(C) pure and concentrated
(D) very dilute
200. Urea is formed by dehydration of
(A) biuret
(B) ammonium bicarbonate
(C) ammonium carbamate
(D) ammonium carbonate
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ROUGH WORK