

Question Booklet No. :

CECH/2022

Register
Number

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2022
PAPER – I
CHEMICAL ENGINEERING
(Degree Standard)

Duration : Three Hours]

[Total Marks : 300

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

IMPORTANT INSTRUCTIONS

1. You will be supplied with this question booklet 15 minutes prior to the commencement of the examination.
2. This question booklet contains 200 questions. Before answering the questions, you shall check whether all the questions are printed serially and ensure that there are no blank pages in the question booklet. **If any defect is noticed in the question booklet, it shall be reported to the invigilator within the first 10 minutes and get it replaced with a complete question booklet. If the defect is reported after the commencement of the examination, it will not be replaced.**
3. Answer all the questions. All the 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 room invigilator to shade the answers. Instructions regarding filling of answers etc., which are to be followed mandatorily, are provided in the answer sheet and in the memorandum of admission (Hall Ticket).
6. You shall write and shade your question booklet number in the space provided on page one of the answer sheet with **BLACK INK BALL POINT PEN**. If you do not shade correctly or fail to shade the question booklet number, your answer sheet will be invalidated.
7. Each question comprises of five responses (answers) : i.e. (A), (B), (C), (D) and (E). You have to select **ONLY ONE** correct answer from (A) or (B) or (C) or (D) and shade the same in your answer sheet. If you feel that there are more than one correct answer, shade the one which you consider the best. **If you do not know the answer, you have to mandatorily shade (E).** In any case, choose **ONLY ONE** answer for each question. If you shade more than one answer for a question, it will be treated as a wrong answer even if one of the given answers happens to be correct.
8. 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 room during the time of the examination. After the examination, 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.
9. You should not make any marking in the question booklet except in the sheets before the last page of the question booklet, which can be used for rough work. This should be strictly adhered to.
10. Failure to comply with any of the above instructions will render you liable for such action as the Commission may decide at their discretion.

SEAL

SPACE FOR ROUGH WORK

1. The Total Cost Of Production (TCOP) is calculated by

Where

TCOP = Total Cost Of Production

CCOP = Cash Cost of Production

VCOP = Sum of all the Variable Costs of Production minus by product revenues

FCOP = Sum of all the Fixed Cost Of Production

ACC = Annual Capital Charge

(A) $TCOP = (VCOP - FCOP) + ACC$

(B) $TCOP = (VCOP + FCOP) + ACC$

(C) $TCOP = (VCOP + FCOP) - ACC$

(D) $TCOP = FCOP - ACC - VCOP$

(E) Answer not known

2. An optimization problem of locating oil-wells to identify better production rate can be solved by

(A) Quadratic programming

(B) Integer programming

(C) Geometric programming

(D) Linear programming

(E) Answer not known

3. In an optimization problem, the ratio of the partial derivative of objective function to the partial derivative of constraints with respect to any one independent variable is termed as

(A) Newton's multiplier

(B) Kuhn-Tucker multiplier

(C) Lagrange multiplier

(D) Reynolds multiplier

(E) Answer not known

4. Formulation of a design problem for specialty product requires
- (A) Physical properties
 - (B) Chemical properties
 - (C) Surface properties
 - (D) Functional properties
 - (E) Answer not known
5. Choose the following condition which is to be satisfied for the local minimum (x_{\min}) to be called as Global minimum (x^*)
- (A) $x^* > x_{\min}$
 - (B) $x^* < x_{\min}$
 - (C) $x^* = x_{\min} = 0$
 - (D) $x^* = x_{\min}$
 - (E) Answer not known
6. Optimization of one phase of an operation while ignoring some factors that have an effect on the process of plant is known as
- (A) Constrained optimization
 - (B) Linear optimization
 - (C) Sub optimization
 - (D) Quadratic programming optimization
 - (E) Answer not known
7. When the model is non linear in the coefficients, they can be estimated by
- (A) Least square method
 - (B) Non Linear progression
 - (C) Linear regression
 - (D) Non Linear regression
 - (E) Answer not known

8. The technique used in recovery of sensitive biological products is
- (A) permeation technique (B) per vaporation
 (C) super critical fluid extraction (D) dialysis
(E) Answer not known
9. Identify the process from the following, one which could not be done by pervaporation technique?
- (A) Removal of water from organic solvents
 (B) Adjustment of H_2/CO ratio in synthesis gas
(C) Removal of organics from water
(D) Dehydration of ethanol-water azeotrope
(E) Answer not known
10. Cation exchange resins include
- (A) weak base resins with Ammonium groups
(B) strong base resins with Ammonium groups
 (C) strong acid resins with Sulphuric acid groups
(D) weak acid resins with Sulphuric acid groups
(E) Answer not known
11. The method used in recovery of metals from dilute solutions is
- (A) crystallization (B) permeation
(C) osmosis (D) ion exchange
(E) Answer not known

12. The difference in permeabilities through membranes is used to separate solutions containing large molecules or colloids in the process of

- (A) Gas Permeation (B) Ultrafiltration
(C) Electrolysis (D) Osmosis
(E) Answer not known

13. Typically, microfiltration retains matters of diameter between _____ and _____ microns.

- (A) 0.02 and 10 microns (B) 10 and 50 microns
(C) 0.001 and 0.01 microns (D) 51 and 100 microns
(E) Answer not known

14. The complete rejection of solute by the membrane which leads to a higher concentration at membrane surface than in bulk solution is known as

- (A) Osmosis (B) Dialysis
 (C) Concentration polarization (D) Diffusion
(E) Answer not known

15. Recovery of salts or sugars from natural products or colloidal solutions can be achieved by

- (A) Chromatography (B) Micro filtration
 (C) Ultra filtration (D) Reverse osmosis
(E) Answer not known

16. The sequence of stages in the evolution of a crystal is
- (A) Embryo → Cluster → Nucleus → Crystal
 - (B) Cluster → Embryo → Nucleus → Crystal
 - (C) Nucleus → Cluster → Embryo → Crystal
 - (D) Nucleus → Embryo → Cluster → Crystal
 - (E) Answer not known
17. A continuous crystallizer produces 2000 kg/hr of $\text{Al}_2(\text{SO}_4)_3 \cdot 18\text{H}_2\text{O}$ (density = 100 kg/m³) and residence time of magma in crystallizer is 2 hours. What would be volume of crystals in crystallizer?
- (A) 20 m³
 - (B) 20 Litres
 - (C) 2 m³
 - (D) 40 m³
 - (E) Answer not known
18. The systems for which the output response is bounded for all bounded input is defined as
- (A) Unstable system
 - (B) Stable system
 - (C) Lag system
 - (D) Feed forward system
 - (E) Answer not known
19. The process that contain a large transport lag ($\exp[-\tau_d S]$) is often used the control strategy by
- (A) First order process
 - (B) Dead time compensation
 - (C) Second order process
 - (D) IMC
 - (E) Answer not known

20. The ratio of output amplitude to input amplitude in sinusoidal response is

Where τ = Time Constant

(A) $\sqrt{\tau^2 \omega^2 + 1}$

(B) $\sqrt{\tau^2 \omega^2 - 1}$

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

(D) $\frac{1}{\sqrt{\tau^2 \omega^2 - 1}}$

(E) Answer not known

21. The time constant (τ) of a mixing process first order system is

(A) $\tau = mc/hA$

(B) $\tau = AR$

(C) $\tau = V/q$

(D) $\tau = R \cdot C$

(E) Answer not known

22. In second order under damped system which of the following is correct?

(A) Overshoot = (Decay ratio)³

(B) Overshoot = $\frac{1}{\text{Decay ratio}}$

(C) Decay ratio = $\sqrt{\text{overshoot}}$

(D) Decay ratio = (overshoot)²

(E) Answer not known

23. U-tube manometer is an example for _____ order system.

(A) 1st

(B) 2nd

(C) 3rd

(D) zero order

(E) Answer not known

24. The Laplace transform of $e^{-at} \cos Kt$ is

(A) $\frac{s-a}{(s+a)^2 + K^2}$

(B) $\frac{s+a}{(s+a)^2 + K^2}$

(C) $\frac{s-a}{(s+a)^2 - K^2}$

(D) $\frac{s+a}{(s+a)^2 - K^2}$

(E) Answer not known

25. The Laplace transform of unit step function is

(A) 1

(B) 0

(C) $\frac{1}{s}$

(D) s

(E) Answer not known

26. The flow sensors are usually modeled by simple algebraic equation, where α is a constant determined by the construction characteristics of flow sensor and ΔP is the pressure difference between a point at the flow constriction and a point with fully developed flow

(A) flow = $\alpha^2 + \Delta P$

(B) flow = $\frac{\alpha}{\Delta P}$

(C) flow = $\alpha \Delta P^3$

(D) flow = $\alpha \sqrt{\Delta P}$

(E) Answer not known

27. The largest range of values of a measured variables to which the instrument does not respond is called as

(A) Dead zone

(B) Drift

(C) Sensitivity

(D) Accuracy

(E) Answer not known

28. When hysteresis is observed, the desorption equilibrium pressure
- (A) is always equal to that obtained by adsorption
 - (B) is always higher than that obtained by adsorption
 - (C) is always lower than that obtained by adsorption
 - (D) may be equal to or higher than that obtained by adsorption
 - (E) Answer not known
29. The letter 'a' in individual coefficients $k_y a$ and $k_x a$ and the overall coefficients $K_y a$ and $K_x a$ used in the design of adsorption column refers to
- (A) interfacial area per unit volume
 - (B) unit volume per interfacial area
 - (C) cross-sectional area
 - (D) specific surface area
 - (E) Answer not known
30. The condition at which the liquid hold up starts to increase, as judged by a change in the slope of the pressure drop line, is called
- (A) Channeling
 - (B) Loading point
 - (C) Flooding
 - (D) Short-circuiting
 - (E) Answer not known
31. Which of the following extractors are especially useful for liquids with very small density difference and very short residence time?
- (A) Centrifugal Extractors
 - (B) Mixer-Settler Extractors
 - (C) Pulsed Extractors
 - (D) Packed Extraction tower
 - (E) Answer not known

32. The equation used for diffusion process for a smaller pore size which is less than the normal mean free path is
- (A) Chapman-Enskog equation
 - (B) Stokes-Einstein equation
 - (C) Knudsen diffusion equation
 - (D) Lennard-Jones potential
 - (E) Answer not known
33. Which type of evaporator is preferred for the materials with heat sensitive products and liquids with suspended solids?
- (A) Long tube vertical
 - (B) Horizontal tube
 - (C) Reboiler
 - (D) Agitated thin film
 - (E) Answer not known
34. Which one states that the boiling point of a given solution is a linear function of the boiling point of pure water at the same pressure
- (A) Boiling point elevation
 - (B) Charle's law
 - (C) Boyle's law
 - (D) Duhring's rule
 - (E) Answer not known

35. Thermal diffusivity is defined as the ratio of

- (A) Thermal conductivity to thermal capacity
- (B) Thermal capacity to thermal conductivity
- (C) Thermal capacity to diffusivity
- (D) Mass diffusivity to thermal capacity
- (E) Answer not known

36. Find out the correct statement of the Colburn analogy between heat transfer and fluid friction

- (A) $jH = (St)^{2/3} (Pr)^{1/3} \phi_v^{-1} = \frac{f}{2}$
- (B) $jH = (St)(Pr)^{1/3} \phi_v^{-1} = \frac{f}{2}$
- (C) $jH = (St)(Pr)^{2/3} \phi_v^{-1} = \frac{f}{2}$
- (D) $jH = (St)^{2/3} (Pr)^{1/3} \phi_v^{-1} = \frac{f}{2}$
- (E) Answer not known

37. To discharge large quantities of liquid in multistage centrifugal pump, the impellers are connected

- (A) in parallel
- (B) in series
- (C) in both parallel and series
- (D) tangentially
- (E) Answer not known

38. What is flowing under laminar conditions is a pipe of length L . If the diameter of the pipe is doubled for a constant volumetric flow rate, the pressure drop across the pipe
- (A) decreases 2 times (B) decreases 16 times
 (C) increases 2 times (D) increases 16 times
 (E) Answer not known
39. A Newtonian fluid (with ρ -density, μ -viscosity) is flowing with velocity 'v' in a circular tube of diameter D and length L . For Laminar flow ΔP is proportional to
- (A) $\frac{L\mu v^2}{D}$ (B) $L\mu v / D^2$
 (C) $D\mu v^2 / L$ (D) $\mu v / L$
 (E) Answer not known
40. The hydrostatic law states that the rate of increase of pressure in a vertical direction is equal to
- (A) density of the fluid
 (B) specific weight of the fluid
 (C) viscosity
 (D) surface tension
 (E) Answer not known
41. Pressure of Cobalt in steel improves is
- (A) Corrosion resistance (B) Tensile strength
 (C) Cutting ability (D) Refractory resistance
 (E) Answer not known

42. To remove very small amount of tiny solid impurities from liquid, we use
- (A) Pressure filter (B) Vacuum filter
(C) Centrifugal filter (D) Flocculation
(E) Answer not known

43. Sorting classifiers used to separate the particles based on differing
- (A) densities (B) sizes
(C) shapers (D) viscosities
(E) Answer not known

44. Among the following _____ is called Heavy Fluid Separation.
- (A) Filtration
(B) Thickness
 (C) Sink and float method classifiers
(D) Clarifiers
(E) Answer not known

45. In the Empirical Equation for Custer resistance $\alpha = \alpha_0(\Delta P)^S$

Where α = Specific cake resistance

α_0 = Constant

ΔP = Pressure drop

S = Compressibility coefficient

Compressibility coefficient value falls between

- (A) 0.2 and 0.8 (B) 2 and 8
(C) 0.02 and 0.08 (D) 1 and 10
(E) Answer not known

46. Among the following, choose an equation relating flow in an agitated vessel (q) to agitator diameter (D_a)

(A) $q \propto nD_a$

(B) $q \propto nD_a^{1.5}$

(C) $q \propto nD_a^2$

(D) $q \propto nD_a^3$

(E) Answer not known

47. Power number is used in the design of

(A) Pumps

(B) Agitated vessel

(C) Crusher

(D) Grinder

(E) Answer not known

48. In agitator, at Reynolds number less than 300, the power number for baffled tank is _____ unbaffled tank.

(A) greater than

(B) lesser than

(C) independent of

(D) equal to

(E) Answer not known

49. The sphericity is defined as

Where

V_p = Volume of particle

D_p = Diameter of particle

S_p = Surface area of particle

(A) $\frac{6V_p}{D_p S_p}$

(B) $\frac{6D_p}{V_p S_p}$

(C) $\frac{6S_p}{D_p \cdot V_p}$

(D) $\frac{6V_p}{S_p}$

(E) Answer not known

50. Mohr stress diagram is a graph of
- (A) shear stress versus angle of repose
 - (B) shear stress versus pressure
 - (C) angle of repose versus angle of internal friction
 - (D) shear stress versus shear rate
 - (E) Answer not known
51. Which of the following operation is not dependent on the vapour-liquid equilibrium data?
- (A) Distillation
 - (B) Absorption
 - (C) Extraction
 - (D) Sublimation
 - (E) Answer not known
52. The Coefficient Of Performance (COP) of a refrigerator is defined as
- (A) Quantity of heat absorbed per unit of work
 - (B) Quantity of heat desorbed per unit of work
 - (C) Quantity of heat radiated per unit of time
 - (D) Quantity of heat transmitted per unit of time
 - (E) Answer not known
53. Entropy change for an irreversible process accounting both system and surroundings together, is
- (A) Positive
 - (B) Negative
 - (C) Zero
 - (D) Undefinable
 - (E) Answer not known

54. For an exothermic reaction, the equilibrium constant
- (A) remains unaffected with change in temperature
 - (B) decrease with increase in temperature
 - (C) increase with increase in temperature
 - (D) increase linearly with increase in temperature
 - (E) Answer not known
55. Clayperon Equation deals with the
- (A) effect of an inert gas on vapour pressure
 - (B) rate of change of vapour pressure with temperature
 - (C) temperature dependence of heat of phase transition
 - (D) calculation of ΔF for spontaneous phase change
 - (E) Answer not known
56. In _____, both mass and energy can flow across the boundary.
- (A) open system
 - (B) closed system
 - (C) insulated system
 - (D) isolated system
 - (E) Answer not known
57. The logarithm of the vapor pressure of the substance is plotted as the ordinate against the logarithm of the vapor pressure of the reference at the same temperature as the abscissa in
- (A) Hausbrandt Chart
 - (B) Duhring Plot
 - (C) Cox Chart
 - (D) Psychrometric Chart
 - (E) Answer not known

58. If 30g of NaOH is present in a litre of solution, then the molarity of the solution is

- (A) 30 M (B) 1 M
 (C) 0.75 M (D) 40 M
(E) Answer not known

59. pH of 0.098 M HCl solution is

- (A) $\log(0.098)$ (B) $-\log(0.098)$
(C) -0.012 (D) $-\log(0.012)$
(E) Answer not known

60. Raoult's Law is given by

- (A) $P = p_1 + p_2 + p_3$
 (B) $p_A = p_A^\circ x_A$ ($p_A^\circ = \text{vap. } p_r, p_A = \text{par. } p_r$)
(C) $V = V_1 + V_2 + V_3$
(D) $p_A = y_A \cdot P$ ($P = \text{Tot. } p_r$)
(E) Answer not known

61. For an ideal gas, the compressibility factor

- (A) decreases with pressure raise
 (B) is unity at all temperatures
(C) is unity at all concentration
(D) is infinity
(E) Answer not known

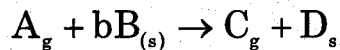
62. Any one of the following is partially depolymerised and contains a high percentage of carbon black, ash and solvent oils
- (A) Reclaimed rubber (B) Hypalon
(C) Urethane rubber (D) Butyl rubber
(E) Answer not known
63. Sucrose is a
- (A) monosaccharide (B) disaccharide
(C) trisaccharide (D) polysaccharide
(E) Answer not known
64. Sugar beet contains _____ of sucrose.
- (A) 3 to 6 % (B) 7 to 12 %
 (C) 13 to 17 % (D) 20 to 25 %
(E) Answer not known
65. Turkey red is a
- (A) sulphur dye (B) mordant dye
(C) solvent dye (D) natural dye
(E) Answer not known
66. Colour of the pulp obtained from K raft process is
- (A) Brown (B) White
(C) Black (D) Yellow
(E) Answer not known

67. In beer production, the regiment after maturing process, contains yeast, precipitated proteins and tannis is known as
- (A) lager (B) chill
 (C) draff (D) hops
(E) Answer not known
68. Identify the separation method based on the relative solubilities in different solvents that are used in the manufacture of lube oil
- (A) Distillation
(B) Absorption
 (C) Extraction
(D) Adsorption
(E) Answer not known
69. Which of the following is more suitable for the construction of refractories?
- (A) High porosity bricks
 (B) Low porosity bricks
(C) Bricks with high thermal expansion
(D) Bricks with low thermal conductivity
(E) Answer not known
70. Cement manufactured by fusing lime stone and bauxite is
- (A) Portland cement (B) Hydraulic lime cement
(C) Pozzolana cement (D) High alumina cement
(E) Answer not known

71. For gas-solid non catalytic reactions, of change in size, which resistance will not be considered

- (A) film resistance
- (B) reaction resistance
- (C) ash resistance
- (D) overall resistance
- (E) Answer not known

72. For ash layer control, time required for complete conversion (τ), consider



Where ρ_B = molar density

R = Radius of particle

b = Stiochiometric coefficient

D_e = Diffusivity

CAg = Concentration

(A) $\frac{\rho_B R^2}{6bD_e CAg}$

(B) $\frac{\rho_B^2 R^2}{12bD_e CAg}$

(C) $\frac{R^2}{6bD_e CAg}$

(D) $\frac{\rho_B^2 R^2}{12bD_e}$

(E) Answer not known

73. For large value of Thiele Modulus $\left(L\sqrt{\frac{K}{D}}\right)$ of a solid catalyzed first order reaction, the effectiveness factor (η) is equal to

(A) 1

(B) $L\sqrt{\frac{K}{D}}$

(C) $1 + L\sqrt{\frac{K}{D}}$

(D) $1/\left(L\sqrt{\frac{K}{D}}\right)$

(E) Answer not known

74. If Thiele Modulus is large, _____ limits the reaction.

(A) External diffusion

(B) Internal diffusion

(C) Surface reaction

(D) Adsorption

(E) Answer not known

75. BET apparatus is used to determine the

(A) specific surface area of a catalyst

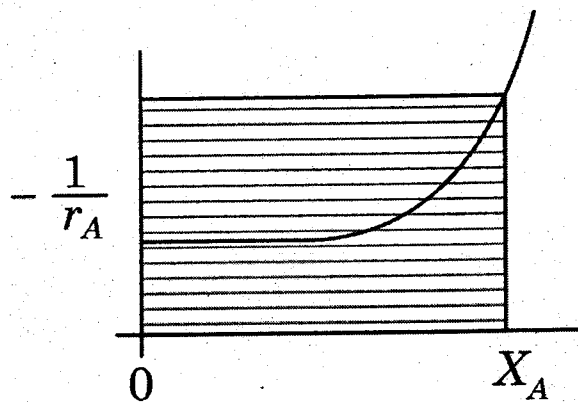
(B) activity of the catalyst

(C) pore diameter

(D) porosity of the catalyst

(E) Answer not known

76. The shaded area is the representation of the following equation.



(A) $\tau = C_{A_0} \int_0^{X_A} \frac{dX_A}{-r_A}$

(B) $\tau = \frac{V}{V_0}$

(C) $\frac{\tau}{C_{A_0}} = \frac{X_A}{-V_A}$

(D) $\tau = \frac{C_{A_0} \cdot V}{FA_0}$

(E) Answer not known

77. To maximize the formation of R in the simultaneous reactions



We should have

(A) Low C_A , low C_B

(B) Low C_A , high C_B

(C) High C_A , low C_B

(D) High C_A , high C_B

(E) Answer not known

78. The fractional volume change between no conversion and complete conversion for the isothermal gas phase reaction $2A \rightarrow R$, is

- (A) 0.5
(B) -0.5
(C) 1
(D) 1.5
(E) Answer not known

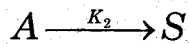
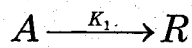
79. For a reaction $A + 3B \rightarrow 5C + 7D$ which one of the following relation is correct?

- (A) $-r_A = -\frac{1}{3}r_B = \frac{1}{5}r_C = \frac{1}{7}r_D$
(B) $-r_A = -3r_B = 5r_C = 7r_D$
(C) $-r_A = -\frac{1}{3}r_B = 5r_C = 7r_D$
(D) $-r_A = \frac{1}{3}r_B = -\frac{1}{5}r_C = -\frac{1}{7}r_D$
(E) Answer not known

80. The half life time ($t^{1/2}$) of the reaction, is defined as _____.

- (A) $\frac{(0.5)^{1-n} - 1}{K(n-1)} C_{A_0}^{1-n}$
(B) $\frac{(0.5)^{n-1} - 1}{K(n-1)}$
(C) $\frac{(n)^{1-n} - 1}{K(n-1)}$
(D) $\frac{(n)^{n-1} - 1}{K(n-1)}$
(E) Answer not known

81. Substance A in a liquid reacts to produce R and S as follows :



$-r_A$ for the above elementary reaction is

(A) $K_1 C_A$

(B) $K_2 C_A$

(C) $(K_1 + K_2) C_A$

(D) $\frac{K_1}{K_2} C_A$

(E) Answer not known

82. The rank of matrix $\begin{pmatrix} 2 & 0 & 3 \\ 4 & 2 & 1 \\ 6 & 2 & 4 \end{pmatrix}$

(A) 0

(B) 1

(C) 2

(D) 3

(E) Answer not known

83. The eigen values of a hermitian matrix are

(A) Complex

(B) Purely imaginary

(C) Real

(D) None of the above

(E) Answer not known

84. The inverse of the matrix $\begin{bmatrix} 0.2 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0.5 \end{bmatrix}$ is

(A) $\begin{bmatrix} 2 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 5 \end{bmatrix}$

(B) $\begin{bmatrix} -0.2 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -0.5 \end{bmatrix}$

(C) $\begin{bmatrix} 5 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 2 \end{bmatrix}$

(D) $\begin{bmatrix} 0.5 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0.2 \end{bmatrix}$

(E) Answer not known

85. In the Gauss Elimination method for solving a system of algebraic equation triangularization leads to

(A) Diagonal matrix

(B) Lower triangular matrix

(C) Upper triangular matrix

(D) Singular matrix

(E) Answer not known

86. By Newton-Raphson method, the value of 'x' for $x^2 - 29 = 0$, to five decimal places is

- (A) 5.38516 (B) 5.85361
(C) 5.35816 (D) 5.40216
(E) Answer not known

87. In Bisection method, at each iteration, the Length of the interval is reduced by a factor of

- (A) 0.2 (B) 4
(C) 1.5 (D) 2
(E) Answer not known

88. Gauss-seidal is an _____ method.

- (A) Discrete (B) Iterative
(C) Indirect (D) Partial
(E) Answer not known

89. The Newton Raphson method is also called as

- (A) Tangent method (B) Serant method
(C) Chord method (D) Diameter method
(E) Answer not known

90. Yellow colour in the chemical Hazard NFPA diamond indicates
- (A) Hazard warming
 - (B) Health hazard
 - (C) Fire hazard
 - (D) Reactivity hazard
 - (E) Answer not known
91. Identify the following chemical that will combust on exposure to air
- (A) Barium cyanide
 - (B) Lead amide
 - (C) Sodium borohydride
 - (D) Phenyl sodium
 - (E) Answer not known
92. Any liquid, whenever the temperature of the liquid is as little as 1 degree less than 100°F. Would be releasing vapour at a rate sufficient to be ignitable, is a
- (A) Flammable liquid
 - (B) Non-Flammable liquid
 - (C) Combustible liquid
 - (D) Organic liquid
 - (E) Answer not known

93. The Oxidation ponds which have a mixture of both aerobic and anaerobic conditions are called as

- (A) Faculative ponds
- (B) Lagoons
- (C) Polishing ponds
- (D) Aerated ponds
- (E) Answer not known

94. The area required for sludge thickening in activated sludge setting tank can be estimated using the following equation.

A – Area required

Q – Flow rate

t_w – Time to reach desired underflow concentration

H_0 – Initial height of interface in column

(A) $A = \frac{Q^2 t_w}{H_0}$

(B) $A = \frac{Q t_w^2}{H_0}$

(C) $A = \frac{Q^2 t_w^2}{H_0}$

(D) $A = \frac{Q t_w}{H_0}$

(E) Answer not known

95. Particle aggregation is brought about by inducing velocity gradients is known as

- (A) Ortho kinetic flocculation
- (B) Peri kinetic flocculation
- (C) Micro flocculation
- (D) Kinetic flocculation
- (E) Answer not known

96. The Bhopal Gas Tragedy was mainly due to

- (A) Methyl iso butyl carbamate
- (B) Methyl iso cyanite
- (C) Methyl iso butyl cyanite
- (D) Methyl carbamate
- (E) Answer not known

97. Aerosols are suspension of particles in air with an effective diameter

- (A) Greater than $100 \mu\text{m}$
- (B) Less than 1 mm
- (C) Between $10 \mu\text{m} - 100 \mu\text{m}$
- (D) Less than $10 \mu\text{m}$
- (E) Answer not known

98. Minamata disease is caused due to

- (A) Mercury
- (B) Lead
- (C) Phosphorus
- (D) Arsenic
- (E) Answer not known

99. Dimensionless number used to estimate the dispersion in mechanically agitated lagoons is

- (A) Peclet number
- (B) Reynolds number
- (C) Froude number
- (D) Grashof number
- (E) Answer not known

100. In the context of chemical process industries, the term BOD is normally associated with the

- (A) Characterization of solids
- (B) Characterization of gaseous effluents
- (C) Characterization of liquid effluents
- (D) Characterization of boiler feed water
- (E) Answer not known

101. Which of the following is used to find energy target for heating and cooling using heat exchanger?
(ΔT = Temperature difference)

(A) $(\Delta T)_{\max}$

(B) $(\Delta T_1 + \Delta T_2)/2$

(C) $\Delta T_1 - \Delta T_2$

(D) $(\Delta T)_{\min}$

(E) Answer not known

102. Quadratic programming is concerned with the non-linear program of optimizing the quadratic objective function subject to

(A) Linear equality constraints

(B) Linear inequality constraints

(C) Linear equality or inequality constraints

(D) Non-Linear equality or inequality constraints

(E) Answer not known

103. A suitable tool to understand the interface between the process and utility system is

(A) Composite curve

(B) Grand composite curve

(C) Areas of integrity

(D) Stochastic curve

(E) Answer not known

104. Hessian Matrix of an objective function is positive-definite, then stationary point can be called as

- (A) Minimum
- (B) Maximum
- (C) Global minimum
- (D) Global maximum
- (E) Answer not known

105. Simplex method begins at when

- (A) all the points are in feasible region
- (B) the corner points are only at feasible region
- (C) the intermediate points are within the feasible region
- (D) an interior points are in the feasible region
- (E) Answer not known

106. In the relationship between the character of $f(x)$ and the state of $H(x)$.
If $f(x)$ is concave, then $H(x)$ is

- (A) Positive - definite
- (B) Positive - indefinite
- (C) Negative - semidefinite
- (D) Negative - definite
- (E) Answer not known

107. The general form of a constrained optimization problem does not involve

- (A) objective function to be optimized
- (B) equality constraints
- (C) inequality constraints
- (D) auxiliary information of the process
- (E) Answer not known

108. The value of X_2 for the minimization problem $f(X) = 4X_1^2 + 5X_2^2$ subject to $2X_1 + 3X_2 = 6$ by direct substitution is
- (A) 1.286 (B) 1.071
(C) 1.52 (D) 1.77
(E) Answer not known
109. The quadratic model is obtained from
- (A) Truncated Taylor series expansion
(B) Runge Kutta method
(C) Newton Raphson method
(D) Euler's method
(E) Answer not known
110. The total _____ depends on the number of charged functional groups per gram of dry ion exchanger (or) per ml of swollen gel.
- (A) ionic capacity (B) non-ionic capacity
(C) concentration (D) metallic capacity
(E) Answer not known
111. Solutes can be recovered from a super critical fluid by changing
- (A) ion exchange properties (B) temperature
(C) permeability (D) diffusivities
(E) Answer not known

112. The charge on the Ion-exchanger depends on the _____ of the solvent.

- (A) pH
(B) concentration
(C) temperature
(D) solubility
(E) Answer not known

113. Which of the following membrane materials is used for Reverse Osmosis applications?

- (A) Polybenzimidazole
(B) Polypropylene
(C) Polyimide
(D) Polysulphone
(E) Answer not known

114. In dialysis, the flux of each solute is proportional to the

- (A) Temperature gradient
(B) Velocity gradient
 (C) Concentration gradient
(D) Momentum gradient
(E) Answer not known

115. Which one is not a zeolite based membrane?

- (A) Alumina supported silicate
(B) Rare earth doped silicate
(C) ZSM 5
 (D) Graphene oxide
(E) Answer not known

116. The membranes which are generally made with the skin on the outside, and a bundle with thousands closely packed fibres sealed in a metal cylinder is
- (A) Frame – fiber membrane
 - (B) Tubular – fiber membrane
 - (C) Spiral wound fiber membrane
 - (D) Hollow - fiber membrane
 - (E) Answer not known
117. A process for selectively removing low molecular weight solutes from a solution by allowing them to diffuse into a region of lower concentration is
- (A) Filtration
 - (B) Dialysis
 - (C) Pervaporation
 - (D) Permeation
 - (E) Answer not known
118. Which among the following does not relate to solubility and crystal size of super saturation process?
- (A) Kelvin Equation
 - (B) Gibbs-Thompson Equation
 - (C) Ostwald Equation
 - (D) Pinsky- Randall Equation
 - (E) Answer not known

119. Overall Amplitude Ratio (AR) is given by $\log AR =$

- (A) $\log AR_1 + \log AR_2 + \dots + \log AR_n$
- (B) $\log AR_1 \cdot \log AR_2 \dots \log AR_n$
- (C) $\log AR_1 - \log AR_2 \dots - \log AR_n$
- (D) $\log AR_1 - \log AR_2 + \log AR_3 \dots - \log AR_n$
- (E) Answer not known

120. The controller used for injection of a fuel-air mixture into furnace is

- (A) Cascade Controller
- (B) IMC – Internal Modern Controller
- (C) MPC – Model Predictive Controller
- (D) Ratio Controller
- (E) Answer not known

121. The important features of Bode Plot for the open loop transfer function of a feed back system is

- (A) ϕ is -180° , where $AR = 1$
- (B) ϕ is $+180^\circ$, where $AR = 1$
- (C) ϕ is -90° , where $AR = 1$
- (D) ϕ is $+90^\circ$, where $AR = 1$
- (E) Answer not known

122. The system to provide an algebraic method for determining the stability of a simple feed back control system is called as

- (A) Routh criterion
- (B) Rout-Locus
- (C) Bude-Stability
- (D) Nyquist-Stability
- (E) Answer not known

123. 1st order pade approximation for Transportation lag is given by

(A) $1 - \tau s/2$

(B) $1 + \frac{\tau s}{2}$

(C) $\frac{1 + \frac{\tau s}{2}}{1 - \frac{\tau s}{2}}$

(D) $\frac{1 - \frac{\tau s}{2}}{1 + \frac{\tau s}{2}}$

(E) Answer not known

124. The correct expression among the following is

(A) Decay ratio = (Overshoot)

(B) Decay ratio = (Overshoot)²

(C) Decay ratio = $\frac{1}{\text{Overshoot}}$

(D) Decay ratio = $\frac{1}{(\text{Overshoot})^2}$

(E) Answer not known

125. The Laplace transform of $\sin t$ is

(A) $\frac{1}{S^2 + 1}$

(B) $\frac{S}{1 + S^2}$

(C) $\frac{1}{S^2 - 1}$

(D) $\frac{S}{S^2 - 1}$

(E) Answer not known

126. The relationship between flow (q) and head (h) is applicable for flow through a rectangular-shaped weir is

(A) $q \propto h$

(B) $q \propto h^{1/2}$

(C) $q \propto h^{2/3}$

(D) $q \propto h^{3/2}$

(E) Answer not known

127. Zero pressure on the gauge scale equals

(A) 14.7 kg/cm^2

(B) 10^{-5} KPa

(C) 76 cm Hg

(D) 10^{-5} N/m^2

(E) Answer not known

128. The device used for velocity measurement is

(A) Barometer

(B) Thermometer

(C) Bolometer

(D) Hotwire Anemometer

(E) Answer not known

129. The degree of closeness with which an instrument responds to change in the measured variable is known as

(A) precision

(B) drift

(C) fidelity

(D) sensitivity

(E) Answer not known

130. A batch rectifier is usually operated under _____ conditions for an initial period of time prior to withdrawal of distillate product.

- (A) Sub-cooled (B) Partial-reflux
 (C) Total-reflux (D) Super saturated
(E) Answer not known

131. Flash vapourization is carried out by

- (A) cooling the feed at constant pressure
(B) increasing the pressure on the feed stream
 (C) reducing the pressure on the feed stream
(D) increasing the temperature on the feed stream
(E) Answer not known

132. The Stanton number (St) for mass transfer is defined as

Where

Sh – Sherwood number

Re – Reynold's number

Sc – Schmidt number

(A) $\frac{Sh}{Re \cdot Sc}$

(B) $\frac{Sh}{ReSc^{1/3}}$

(C) $\frac{Re}{Sc}$

(D) $Re \cdot Sc$

(E) Answer not known

133. TEMA standards specify a minimum pitch of _____ times the outside diameter of tubes for triangular pitch.

- (A) 1.25 (B) 1.50
(C) 1.75 (D) 2.0
(E) Answer not known

134. The turbulent flow through conduits, the velocity gradient is

- (A) small near the wall (B) large near the wall
(C) large in the turbulent core (D) small in the buffer zone
(E) Answer not known

135. The ratio of heat transfer area to the volume of heat exchanger for a compact heat exchanger should be

- (A) $> 200 \text{ ft}^{-1}$ (B) $= 200 \text{ ft}^{-1}$
(C) Between 101 ft^{-1} and 199 ft^{-1} (D) $< 100 \text{ ft}^{-1}$
(E) Answer not known

136. The presence of even small amounts of noncondensing gas in a condensing vapor will

- (A) increase the rate of condensation
(B) not affect the rate of condensation
 (C) reduce the rate of condensation
(D) indirectly affect the rate of condensation
(E) Answer not known

137. Identify the pump used for leak proof towards handling dangerous liquids

- (A) Piston pump
- (B) Plunger pump
- (C) Canned-rotor centrifugal pump
- (D) Gear pump
- (E) Answer not known

138. The Mechanical efficiency of a Reciprocating Pump varies from _____ to _____ for small pumps.

- (A) 70 to 90%
- (B) 50 to 70%
- (C) 40 to 50%
- (D) 30 to 40%
- (E) Answer not known

139. In transient heat conduction, the two significant dimensionless parameters are _____ number and _____ number.

- (A) Reynolds, Fourier
- (B) Reynolds, Sherwood
- (C) Sherwood, Fourier
- (D) Bior, Fourier
- (E) Answer not known

140. Annealing is carried out in order to

- (A) relieve stress
- (B) decrease softness
- (C) decrease ductility
- (D) increase stress
- (E) Answer not known

141. The corrosion occurring at the contact area between materials under load subjected to vibration and slip is known as

- (A) Galvanic corrosion
- (B) Crevice corrosion
- (C) Fretting corrosion
- (D) Intergranular corrosion
- (E) Answer not known

142. Fibre composite used for replacing screws for bone fracture and joint replacement is made of

- (A) Carbon
- (B) Polymer
- (C) Fiberglass
- (D) Aramid
- (E) Answer not known

143. The raw materials for steel manufacture are

- (A) cast iron, wrought iron and air/oxygen
- (B) cast iron and air/oxygen
- (C) pig iron and air/oxygen
- (D) wrought iron and air/oxygen
- (E) Answer not known

144. Separation factor in cyclone separator is ratio of

Where

F_C = Centrifugal force

F_g = Gravity force

- (A) $F_C - F_g$
- (B) $F_C + F_g$
- (C) F_C / F_g
- (D) F_g / F_C
- (E) Answer not known

145. Filter aid is used to

- (A) increase the rate of pressure drop
- (B) decrease the porosity of the cake
- (C) increase the porosity of the cake
- (D) act as a support base for septum
- (E) Answer not known

146. Choose a relationship among the following for calculating power requirement in Agitated Vessels

Where

Re – Reynold's Number

Sh – Sherwood Number

Fr – Froude Number

Sc – Schmidt Number

- (A) $N_p = \psi(\text{Re}, \text{Sh})$
- (B) $N_p = \psi(\text{Fr}, \text{Sh})$
- (C) $N_p = \psi(\text{Re}, \text{Sc})$
- (D) $N_p = \psi(\text{Re}, \text{Fr})$
- (E) Answer not known

147. The expression $\frac{1}{\sum_{i=1}^n (x_i / \bar{D}_p)}$ represents

Where x_i = mass fraction in given increment

\bar{D}_p = average particle diameter

- (A) mass mean diameter
- (B) volume mean diameter
- (C) arithmetic mean diameter
- (D) volume-surface mean diameter
- (E) Answer not known

148. Tumbling mills operates at the critical speed in percentage of

- (A) 0–20%
- (B) 20–40%
- (C) 65–80%
- (D) 80–95%
- (E) Answer not known

149. In a cumulative screen analysis $x_F = 0.5$, $x_D = 0.8$ and $x_B = 0.2$. What is the ratio of overflow to feed? Where x_F , x_D and x_B are cumulative mass fraction of feed, overflow and underflow?

- (A) 0.1
- (B) 0.3
- (C) 0.5
- (D) 0.7
- (E) Answer not known

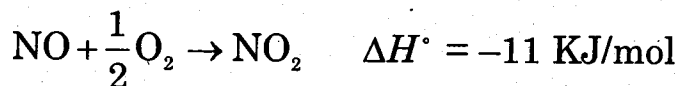
150. According to second law of thermodynamics, the total entropy change associated with any process must be _____.

- (A) zero (B) infinite
(C) negative (D) positive
(E) Answer not known

151. The two phases of a pure substance are in equilibrium when each phase has the

- (A) same value of specific gibbs function
(B) same value of driving force
(C) different value of specific gibbs function
(D) different value of mass fraction
(E) Answer not known

152. At standard conditions



The standard heat of formation of NO in KJ/mol is

- (A) -78 (B) 78
 (C) -34 (D) -101
(E) Answer not known

153. In the equation $f_i = \phi_i^{sat} P_i^{sat} \exp\left[V_i^l \frac{(P - P_i)^{sat}}{RT}\right]$, exponential is known as the _____ factor.

- (A) Pressure (B) Poynting
(C) Volume (D) Equilibrium
(E) Answer not known

154. The heat required to raise the temperature of one kg of a substance by 1k is defined as

- (A) Heat capacity (B) Heat of mixing
(C) Heat of crystallization (D) Specific heat
(E) Answer not known

155. "Recycle ratio" refers to

- (A) Gross feed stream / recycle feed stream
 (B) Recycle stream / fresh feed stream
(C) Fresh feed stream / recycle stream
(D) Recycle stream / net product outlet stream
(E) Answer not known

156. $\left(P + \frac{a}{v^2}\right)(v - b) = RT$ is given by

- (A) Virial equation (B) Vander-Walls equation
(C) Ideal Gas law (D) Compressibility factor
(E) Answer not known

157. _____ is the volume of a mixture of air and accompanying water vapor per kg of dry air.

- (A) Relative humidity (B) Absolute humidity
 (C) Psychrometric volume (D) Humid heat
(E) Answer not known

158. The measure of the deviation of Gases from the Ideal behaviour is given by

- (A) Daltons law
(B) Compressibility factor
(C) Amagat's law
(D) Avagadro's constant
(E) Answer not known

159. By appropriate conversion processes, biomass can be converted into

- (A) LPG
(B) Producer gas
(C) Ammonia
(D) Urea
(E) Answer not known

160. The equilibrium temperature reached by the absorber plate when no heat is being extracted from the collector is called

- (A) Saturation temperature
(B) Stagnation temperature
(C) Eutetic temperature
(D) Collecting temperature
(E) Answer not known

161. Nitrile rubber is produced by polymerization of

- (A) acrylonitrile and butadiene
(B) acrylonitrile and styrene
(C) arylonitrile and isoprene
(D) isoprene and isobutylene
(E) Answer not known

162. The main raw material for paper and pulp manufacture

- (A) Starch (B) Fatty acids
(C) Sugars (D) Cellulose
(E) Answer not known

163. Most commonly used fillers in the paper making process is

- (A) Talc and TiO_2 (B) Talc and SiO_2
(C) Talc and CaO (D) Talc and MnO_2
(E) Answer not known

164. Oil is

- (A) a mixture of glycerides of alcohols
 (B) a mixture of glycerides of fatty acids
(C) a solid at normal temperature
(D) a ester of alcohols other than glycerine
(E) Answer not known

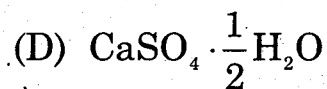
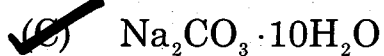
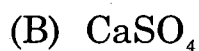
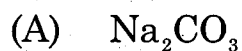
165. Mixtures of glycerides of fatty acids are called as

- (A) Fats and Oils (B) Paints
(C) Pulp (D) Waxes
(E) Answer not known

166. Mixed esters of polyhydric alcohols other than glycerin are called

- (A) Waxes (B) Fats
(C) Oils (D) Detergents
(E) Answer not known

167. Washing Soda is



(E) Answer not known

168. Undesirable side reaction in the product of urea is the formation of

(A) Ammonium Carbonate

(B) Biuret

(C) Tetrauret

(D) Water

(E) Answer not known

169. Vanadium pentoxide is used as catalyst for manufacture of

(A) Sulphuric acid

(B) Nitric acid

(C) Hydrochloric acid

(D) Phosphoric acid

(E) Answer not known

170. Choose Heterogenous non catalytic reaction among following

(A) Ammonia Synthesis

(B) Nitric acid Production

(C) Burning of coal Particle

(D) Oxidation of SO_2 to SO_3

(E) Answer not known

171. For a first order chemical reaction in a porous catalyst the thick modulus is 10. The effectiveness factor is approximately equal to

- (A) 1
- (B) 0.5
- (C) 0.1
- (D) 0
- (E) Answer not known

172. If the value of equilibrium constant is very much large ($k \gg 1.0$) then it means _____ is possible and the reaction is _____.

- (A) 100% conversion and irreversible reaction
- (B) 50% conversion and reversible reaction
- (C) 100% conversion and reversible reaction
- (D) 50% conversion and autocatalytic reaction
- (E) Answer not known

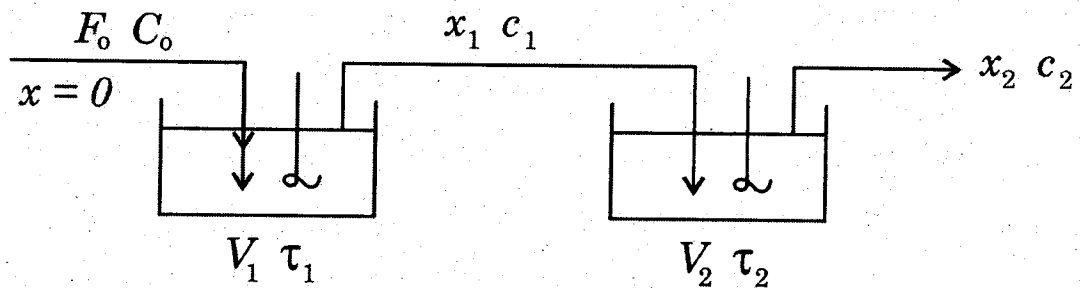
173. The rate of a catalytic chemical reaction can be increased by

- (A) increasing the size of non-porous pellet
- (B) decreasing the temperature
- (C) decreasing the concentration
- (D) increasing the internal surface area
- (E) Answer not known

174. For an elementary reaction $A + 2B \xrightarrow{k} 3C$

- (A) rate of appearance of $C =$ rate of disappearance of A
- (B) rate of disappearance of $A =$ rate of disappearance of B
- (C) rate of appearance of $C =$ rate of disappearance of B
- (D) rate of appearance of $C = 3 \times$ rate of disappearance of A
- (E) Answer not known

175. The CSTR in series connection



the $\left(\frac{C_2}{C_0}\right)$ for a first order reaction is

where V_1 and V_2 are the volumes of reactor 1 + 2

τ_1 and τ_2 are the space times of reactor 1 + 2

- (A) $\frac{C_2}{C_0} = \frac{1}{(1 + \tau_2 K)}$
- (B) $\frac{C_2}{C_0} = \frac{1}{(1 + \tau_1 K)}$
- (C) $\frac{C_2}{C_0} = \frac{1}{(1 + \tau_1 K)(1 + \tau_2 K)}$
- (D) $\frac{C_2}{C_0} = (1 + \tau_1 K)(1 + \tau_2 K)$
- (E) Answer not known

176. For a gas phase first order reaction $A \rightarrow 2B$ carried out in a mixed flow reactor. Which one of the following relation is correct?

Where τ = Space Time

C_{A_0} = Initial concentration

X_A = Conversion

E_A = Fractional volume change

K = Rate constant

(A) $\tau = \frac{C_{A_0} X_A}{(1 - X_A)}$

(B) $\tau = \frac{(1 + \sum_A X_A) X_A}{K(1 - X_A)}$

(C) $\tau = C_{A_0} (1 - X_A)$

(D) $\tau = \frac{C_{A_0} X_A \sum_A}{(1 + X_A)}$

(E) Answer not known

177. For a given duty and for all positive reaction orders, the size of a mixed reactor is

(A) smaller than that of PFR

(B) same as that of PFR

(C) larger than that of PFR

(D) insufficient information

(E) Answer not known

178. A reaction $A \rightarrow 3B$ is conducted in a constant pressure vessel. Starting with pure A , the volume of the reaction mixture increases 3 times in 6 minutes. The fractional conversion is

- (A) 0.33
- (B) 0.5
- (C) 1
- (D) data insufficient, cannot be predicted
- (E) Answer not known

179. The reaction rate constant at two different temperature T_1 and T_2 are related by

- (A) $\ln\left(\frac{K_2}{K_1}\right) = \frac{E}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$
- (B) $\ln\left(\frac{K_2}{K_1}\right) = \frac{E}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$
- (C) $\exp\left(\frac{K_2}{K_1}\right) = \frac{E}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$
- (D) $\exp\left(\frac{K_2}{K_1}\right) = \frac{E}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$
- (E) Answer not known

180. The governing equation to determine the conversion time in a batch reactor for a first order irreversible reaction

- (A) $C_A = \frac{C_{A_0}}{1 + C_{A_0} Kt}$
- (B) $C_A = C_{A_0} - Kt$
- (C) $C_A = C_{A_0} + Kt$
- (D) $C_A = C_{A_0} \cdot e^{-Kt}$
- (E) Answer not known

181. If $A = \begin{bmatrix} 1 & 3 \\ 2 & 2 \\ 3 & 1 \end{bmatrix}$ and $B = \begin{bmatrix} -4 & -6 \\ -5 & -5 \\ -6 & -4 \end{bmatrix}$ then $A + 2B =$

(A) $\begin{bmatrix} -3 & -3 \\ -3 & -3 \\ -3 & -3 \end{bmatrix}$

(B) $\begin{bmatrix} 1 & -1 & 2 \\ 0 & 2 & -3 \end{bmatrix}$

(C) $\begin{bmatrix} -8 & -12 \\ -10 & -10 \\ -12 & -8 \end{bmatrix}$

(D) $\begin{bmatrix} -7 & -9 \\ -8 & -8 \\ -9 & -7 \end{bmatrix}$

(E) Answer not known

182. If the function involved in the equation depends upon only _____ variable and its derivatives are ordinary derivatives, then the equation is called ordinary differential equation

(A) 2

(B) 4

(C) 1

(D) 3

(E) Answer not known

183. Identify the exact solution for following ODE with initial condition as

$$C_A(t=0) = C_{A_0} = 5 \text{ mol/litre} \quad \frac{dC_A}{dt} = -7C_A$$

(A) $\{7e^{-5t} + e^{5t}\}$

(B) $5e^{-7t}$

(C) $7e^{-5t}$

(D) $e^{-5t} + e^{-7t}$

(E) Answer not known

184. The sum of Eigen values is called _____ of matrix

- (A) Determinant
- (B) Trace
- (C) Spectrum
- (D) norm
- (E) Answer not known

185. In order to solve differential equations, the algorithm of fourth order Runge-Kutta method is

- (A) $y_{K+1} = y_K + \frac{h}{2}(fK_1 + 2fK_2 + 2f_3)$
- (B) $y_{K+1} = y_K - \frac{h}{6}(fK_1 + 2fK_2 + 2fK_3 + fK_4)$
- (C) $y_{K+1} = y_K + \frac{h}{6}(fK_1 + 2fK_2 + 2fK_3 + fK_4)$
- (D) $y_K = y_K + h(fK_1)$
- (E) Answer not known

186. The stiffness of a differential equation is a matter of its

- (A) Initial state
- (B) Degree
- (C) Final state
- (D) Boundary condition
- (E) Answer not known

187. The Quadratic Equation in one variable is expressed in the form.

- (A) $ax + b = 0$
- (B) $a + bx^2 + cx^4 = 0$
- (C) $ax^2 + bx + c = 0$
- (D) $ax^3 + bx + cx^2 = 0$
- (E) Answer not known

Where a, b, c are coefficients

188. An approximate function that describes the datapoints as a whole with smallest error can be solved using

- (A) Curve fitting
- (B) z -transform
- (C) Laplace transform
- (D) Fourier transform
- (E) Answer not known

189. The data points that are used for estimating the expected values between the known points are termed as

- (A) Extrapolation
- (B) Interpolation
- (C) Trapezoidal roots
- (D) Transcript method
- (E) Answer not known

190. During industrial hygiene, in order to determine the study of toxic chemicals _____ data sheet is used.

- (A) Mass safety
- (B) Material safety
- (C) Operation safety
- (D) Risk
- (E) Answer not known

191. Class – A fire consists of fire due to

- (A) Wood
- (B) Oil
- (C) Transformer
- (D) Chemicals
- (E) Answer not known

192. _____ is best suited to extinguish oil or Flammable liquid fire.

- (A) Soda acid
- (B) Vaporizing liquid
- (C) Foam
- (D) Dry Chemical
- (E) Answer not known

193. USHA regards an atmosphere of more than _____% as oxygen enriched atmosphere.

- (A) 16.4
- (B) 17.5
- (C) 23.5
- (D) 27.6
- (E) Answer not known

194. In wastewater treatment process, when the reaction is independent of concentration of the reactants, it is called

- (A) Second order reaction
- (B) First order reaction
- (C) Zero order reaction
- (D) Pseudo First order reaction
- (E) Answer not known

195. In wastewater treatment during preliminary treatment,

- (A) oil and grease are removed
- (B) 50% of total solids are removed
- (C) 50% of pathogens are removed
- (D) 80% of BOD is removed
- (E) Answer not known

196. The removal of phosphorus in water is generally done by

- (A) Dephosphorification
- (B) Eutrophication
- (C) Coagulation
- (D) Oxidation
- (E) Answer not known

197. Sounds with a very high frequency of _____ is called 'ultrasound'.

- (A) above 20,000 Hz
- (B) 10,000 Hz
- (C) 15,000 Hz
- (D) 5,000 Hz
- (E) Answer not known

198. Spray ponds are employed for the control of _____ pollution.

- (A) Air
- (B) Thermal
- (C) Noise
- (D) Water
- (E) Answer not known

199. The optimum dissolved oxygen in natural waters is

- (A) 1 – 2 ppm
- (B) 9 – 10 ppm
- (C) 4 – 6 ppm
- (D) 7 – 9 ppm
- (E) Answer not known

200. In the extended atmosphere, mesosphere is in the range of

- (A) upto 5 km
- (B) 5 to 45 km
- (C) 45 to 80 km
- (D) Above 80 km
- (E) Answer not known

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