2019
CHEMICAL ENGINEERING
(DEGREE Std.)

Time Allowed : 3 Hours]   [Maximum Marks : 300

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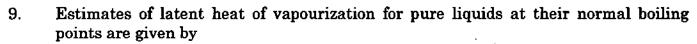
IMPORTANT INSTRUCTIONS

1. The applicant will be supplied with Question Booklet 15 minutes before commencement of the examination.

2. This Question Booklet contains **200** questions. Prior to attempting to answer, the candidates are requested to check whether all the questions are there in series and ensure there are no blank pages in the question booklet. **In case any defect in the Question Paper is noticed, it shall be reported to the Invigilator within first 10 minutes and get it replaced with a complete Question Booklet. If any defect is noticed in the Question Booklet after the commencement of examination, it will not be replaced.**

3. Answer **all** questions. **All** questions carry equal marks.

4. You must write your Register Number in the space provided on the top right side of this page. Do not write anything else on the Question Booklet.

5. An answer sheet will be supplied to you, separately by the Room Invigilator to mark the answers.

6. You will also encode your Question Booklet Code <u>with Blue or Black ink Ball point pen</u> in the space provided on the side 2 of the Answer Sheet. If you do not encode properly or fail to encode the above information, action will be taken as per Commission's notification.

7. Each question comprises *four* responses (A), (B), (C) and (D). You are to select ONLY ONE correct response and mark in your Answer Sheet. In case you feel that there are more than one correct response, mark the response which you consider the best. In any case, choose ONLY ONE response for each question. Your total marks will depend on the number of correct responses marked by you in the Answer Sheet.

8. In the Answer Sheet there are **four** circles Ⓐ, Ⓑ, Ⓒ and Ⓓ against each question. To answer the questions you are to mark with Blue or Black ink Ball point pen ONLY ONE circle of your choice for each question. Select one response for each question in the Question Booklet and mark in the Answer Sheet. If you mark more than one answer for one question, the answer will be treated as wrong. *e.g.* If for any item, Ⓑ is the correct answer, you have to mark as follows :

    Ⓐ ● Ⓒ Ⓓ

9. You should not remove or tear off any sheet from this Question Booklet. You are not allowed to take this Question Booklet and the Answer Sheet out of the Examination Hall during the time of examination. <u>After the examination is concluded, you must hand over your Answer Sheet to the Invigilator. You are allowed to take the Question Booklet with you only after the Examination is over.</u>

10. **Do not make any marking in the question booklet except in the sheet before the last page of the question booklet, which can be used for rough work. This should be strictly adhered.**

11. Applicants have to write and shade the total number of answer fields left blank on the boxes provided at side 2 of OMR Answer Sheet. An extra time of 5 minutes will be given to specify the number of answer fields left blank.

12. Failure to comply with any of the above instructions will render you liable to such action or penalty as the Commission may decide at their discretion.

SPACE FOR ROUGH WORK

1. When a gas is expanded from high pressure region to low pressure region, temperature change occurs, this phenomena is related with

   (A) Gibbs-Duhem equation
   (B) Gibbs-Helmholtz equation
   (C) Third law of thermodynamics
   (D) Joule-Thompson effect ✓

2. Mollier chart is a

   (A) Pressure Vs Enthalpy plot
   (B) Pressure Vs Volume plot
   (C) Enthalpy Vs Entropy chart ✓
   (D) Temperature Vs Entropy chart

3. In a polytropic process (pV^δ = constant), $\delta = 0$; it means

   (A) an adiabatic process
   (B) an isothermal process
   (C) a reversible process
   (D) an isobaric process ✓

4. All excess properties becomes ————— as their species approached to pure state.

   (A) super critical
   (B) sub critical
   (C) zero ✓
   (D) unequal

5. Water flows over a waterfall 100 meters in height. Take 1 kilogram of water as the system and assume it does not exchange energy with its surroundings. What is the potential energy of water at the top of the falls with respect to base of the falls?

   (A) 1980.66 Kg m²/s²
   (B) 980.66 Kg m²/s² ✓
   (C) 2980.66 Kg m²/s²
   (D) 3980.66 Kg m²/s²

6. The kilogram (kg) is the mass of a ————— cylinder kept at the International Bureau of weights and measures.

   (A) Platinum/iridium ✓
   (B) Plutonium/iridium
   (C) Neobium/iridium
   (D) Cadmium/iridium

7. The unit of temperature in Kelvin (K) equal to 1/273.16 of the thermodynamic temperature of

    (A) Triple point of mercury

    (B) Dual point of water

    ✓(C) Triple point of water

    (D) Freezing point of mercury

8. No heat transfer between the system and its surroundings is called ——————— process.

    (A) Isothermal process

    ✓(B) Adiabatic process

    (C) Isobaric process

    (D) Isochoric process

9. Estimates of latent heat of vapourization for pure liquids at their normal boiling points are given by

    (A) Hess's law

    (B) Kirchoff's law

    ✓(C) Trouton's rule

    (D) Laplace law

10. The overall flow pattern in an agitated vessel is not depend on ——————— velocity component.

    (A) radial

    ✓(B) centrifugal

    (C) longitudinal

    (D) tangential

11. Choose the correct relationship from the following power equation used in power calculation in agitated vessels.

    (A) $N_p = \psi(R_e, F_o)$ ✓(B) $N_p = \psi(R_e, F_r)$

    (C) $N_p = \psi(R_e, S_c)$ (D) $N_p = \psi(R_e, S_h)$

12. Cutting size reduction equipment gives

    (A)   coarse reduction and hard solids

    (B)   coarse, medium or fine products

    (C)   fine products

    ✓(D)   definite size

13. Value of ϕ_s for a spherical particle is

    (A)   0

    (B)   < 1

    (C)   > 1

    ✓(D)   1

14. Generally, particle size are expressed in different units, choose the correct one.

    (A)   Ultra fine particles in nanometers

    (B)   Very fine particles in square meters per gram

    (C)   Fine particles in millimeters

    ✓(D)   Coarse particles in inches or millimeters

15. The specific surface of particles means

    (A)   total surface area of a unit size of particles

    (B)   total surface area of a unit volume of particles

    ✓(C)   total surface area of a unit mass of particles

    (D)   total surface area of a unit density of particles

16. In a equation $v_p = aD_p^3$ where a is the volume shape factor, for a cube, the value of a is

    (A)   0.5

    ✓(B)   1.0

    (C)   1.5

    (D)   2.0

17. The purpose of adding filter aid in feed slurry is

   (A) to increase the porosity of cake

   (B) to decrease the porosity of cake

   (C) to increase the density of cake

   (D) to decrease the density of cake

18. Carbon black is added to the natural rubber as a

   (A) filler

   (B) antioxidant

   (C) vulcanizing accelerator

   (D) preservative

19. Solvay process refers to manufacture of

   (A) Sodium Hydroxide

   (B) Sulphuric acid

   (C) Nitric acid

   (D) Sodium carbonate

20. In pulp bleaching process which chemical is used as oxidative bleacher.

   (A) Sodium borohydride

   (B) Sodium bisulfite

   (C) Sodium dithionate

   (D) Hydrogen peroxide

21. The catalyst normally used for hydrogenation of vegetable oil is

   (A) Nickel compound ✓

   (B) Iron compound

   (C) Aluminium compound

   (D) Copper compound

22. Kraft process can also be known as

   (A) Ammonia process

   (B) Bisulphite process

   (C) Sulphite process

   (D) Sulphate process ✓

23. The chemical formula for caustic soda is

   (A) Na_2CO_3

   (B) NaOH ✓

   (C) $NaHCO_3$

   (D) NaOCl

24. The detonating properties of petrol are described by its

   (A) Cetane number

   (B) Cloud point

   (C) Octane number ✓

   (D) Smoke point

25. In crude petroleum distillation a dark coloured thick liquid comes out through the bottom of the distillation still is known as

   (A) Diesel

   (B) Tar ✓

   (C) Kerosene

   (D) Lubricating oil

26. Chromogen is an aromatic body containing a colour giving group commonly called as

   (A) Chromotid

   (B) Chromophore ✓

   (C) Chromosome

   (D) Auxo chrome

27. Soaps form insoluble compounds with the calcium and magnesium ions present in

   (A) Soft water

   (B) Heavy water

   (C) Hard water ✓

   (D) Double distilled water

28. Perfect number is the product of ——————— number and ——————— number.

 (A) Reynolds, Schmidt

 (B) Prandtl, Weber

 (C) Prandtl, Schmidt

 (D) Reynolds, Prandtl ✓

29. ——————— number can be used for convective heat transfer.

 (A) Mach

 (B) Froude

 (C) Nusselt ✓

 (D) Power

30. Thermal conductivity of gases ——————— with increasing temperatures and for liquids ——————— with increasing temperature.

 (A) increase, increase

 (B) increase, decrease ✓

 (C) decrease, increase

 (D) decrease, decrease

31. A black body has the ——————— attainable emissive power at any given temperature.

 (A) minimum

 (B) maximum ✓

 (C) average

 (D) total

32. The velocity distribution with respect to radius is ————— with the open at the centerline of pipe for the flow of Newtonian fluid under laminar condition.

   (A) Log   (B) Parabola ✓

   (C) Linear   (D) Hyperbola

33. For laminar flow of a shear–thinning fluid in a pipe if the volumetric flow rate is doubled, the pressure gradient will increase by a factor of

   (A) $\frac{1}{2}$ (B) <2 ✓

   (C) >2   (D) 2

34. Dilatant fluids are said to be shear rate

   (A) thinning   (B) thickening ✓

   (C) both (A) and (B)   (D) independent

35. Extraction of coffee from its seed is done by

   (A) Leaching ✓   (B) Absorption

   (C) Extractive distillation (D) Steam Distillation

36. Chemisorption is

   (A) A reversible phenomenon

   (B) An irreversible phenomenon ✓

   (C) Same as 'Van Der Waals' Phenomenon

   (D) Characterised by adsorption of heat

37. Humidification involves mass transfer between a pure liquid phase and a fixed gas, which is

   (A) Soluble in the liquid   (B) Insoluble in the liquid ✓

   (C) At a fixed temperature   (D) Non–ideal in nature

38. Why are floating heads provided in heat exchangers?

   (A) To regulate the flow

   (B) To increase the pressure drop

   (C) To decrease the pressure drop

   (D) ✓ To avoid deformation of tuber due to thermal expansion.

39. Planck's law holds good for bodies

   (A) Polished   (B) ✓ black

   (C) all coloured   (D) white

40. ——————— is the ratio of the energy absorbed by the body to total energy falling on it.

   (A) Emissivity   (B) Emissive power

   (C) Absorptive power   (D) ✓ Absorptivity

41. The overall coefficient of heat transfer is used in the problem of

   (A) Radiation   (B) Diffusivity

   (C) Viscosity   (D) ✓ Conduction and conversion

42. Due to which of the following reasons most metals are good conduction of heat?

   (A) Capacity to absorb free energy of electrons

   (B) Energy transport due to molecular vibration

   (C) Lattice defect

   (D) ✓ Lattice vibration and transfer by free electrons.

43. Which of the following equation refers Graetz number?

   (A) ✓ $\dfrac{mCp}{KL}$ (B) $\dfrac{KL}{mCp}$

   (C) $\dfrac{mCp}{K\mu}$ (D) $\dfrac{KL}{mCp\Delta T}$

   Where m is mass flow rate : Cp is heat capacity : K is thermal conductivity and L is length

44. For a first order reaction the plot of $\ln\left(\dfrac{CA_0}{CA}\right)$ Vs time

    (A) is linear and passes through origin

    (B) is exponential and passes through origin

    (C) is linear but not pass through the origin

    (D) is exponential but does no pass through the origin

45. The reaction $A \rightarrow B$, $r = KC_A^2$, occurs in CSTR with 90% conversion. If $K = 0.5$ litre mole^{-1},min^{-1} and $CA_0 = 2$ moles/litre. Estimate the residence time required?

    (A) 30 minutes   (B) 60 minutes

    (C) 90 minutes   (D) 120 minutes

46. The number of moles of an excess reactant per mole of the limiting reactant into the reactor feed is called ——————

    (A) Recycle Ratio   (B) Decay Ratio

    (C) Reactant Ratio   (D) Yield Ratio

47. What is the unit of Liquid hourly space velocity?

    (A) hours   (B) (hour)$^{-1}$

    (C) (hours)^2 (D) (hours)$^{-2}$

48. Space time is equal to residence time in a —————— reactor.

    (A) Constant - volume   (B) Constant - density

    (C) Constant - pressure   (D) Constant - temperature

49. When the vessel dispersion number $\left(\dfrac{D}{uL}\right)$ is approximately zero, then the flow is called ————

    (A) Mixed flow   (B) Plug flow

    (C) Laminar flow   (D) Transition flow

50. Which among the following particle has no influence on the rate of reaction when surface reaction prevails?

    (A) Porous catalyst particle   (B) Catalyst coated surface

    (C) ✓ Burning of Droplet of a fuel   (D) Cells and simple living creatures

51. Name the catalyst that is used in steam reforming process

    (A) ✓ Nickel   (B) Cobalt

    (C) Iron   (D) Molybdenum

52. A mixture of H_2 and Co (Hydrogen and Carbon monoxide) is called ———— gas.

    (A) biogas   (B) ✓ synthesis gas

    (C) water gas   (D) natural gas

53. In distillation column, the top product quality is maintained by manipulating.

    (A) flow rate of feed   (B) ✓ flow rate of reflex stream

    (C) column pressure   (D) liquid holdup

54. Humidity of gases can be measured by

    (A) Pitot tube   (B) Orificemeter

    (C) ✓ Hygrometer   (D) Barometer

55. Laser Anemometer works on the principle of ————

    (A) ✓ Doppler phenomena   (B) Seeback Effect

    (C) Raman's Effect   (D) Radiation Effect

56. Which one of the following is suitable for meaning the temperature of red hot moving object (eg. steel ingots on roller table)

    (A) Manometer   (B) ✓ Radiation pyrometer

    (C) Thermister   (D) Thermometers

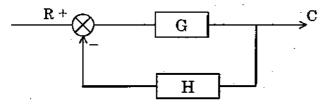57. Routh stability method uses for ——————— loop transfer function.
   (A) Open
   (B) Closed ✓
   (C) Open and Closed
   (D) neither Open nor Closed

58.

The transfer function $\frac{C}{R}$ is

   (A) $\dfrac{1}{1+GH}$

   (B) $\dfrac{G}{1+GH}$ ✓

   (C) $\dfrac{H}{1+GH}$

   (D) $\dfrac{G}{1-GH}$

59. It excessive oscillations had to be eliminated, ——————— action will be added.
   (A) Proportional
   (B) Integral
   (C) Derivative ✓
   (D) Proportional Integral

60. Reset rate is defined as
   (A) $\dfrac{1}{T_I}$ ✓

   (B) T_I

   (C) $\dfrac{1}{T_D}$

   (D) T_D

   where T_I = Integral time, T_D = Derivative time.

61. The output range of transducer is
   (A) 0-3 ma
   (B) 7-50 ma
   (C) 30-40 ma
   (D) 4-20 ma ✓

62. The error is expressed as
   (A) T_R / T_M
   (B) $T_R + T_M$
   (C) $T_R - T_M$ ✓
   (D) $T_R \times T_M$

   where T_R = desired temperature T_M = measured temperature

63. Regular problem means that
   (A) Set point is constant ✓
   (B) Load is constant
   (C) both Set point and load are constant
   (D) Set point and load are variable.

64. Laplace transform of unit impulse input is

(A) 0

(B) $\frac{1}{2}$

(C) 1 ✓

(D) 2

65. For a feedback control system to be stable, the

(A) Roots of the characteristic equation should be real

(B) ✓ Poles of the closed loop transfer function should lie in the left half of the complex plane.

(C) Bode plots of the corresponding open loop transfer function should decrease.

(D) Poles of the closed loop transfer function should lie in the right half of the complex plane.

66. In a control system configuration involves more than one measurement and one manipulation then the system is

(A) ✓ Multiple loop system

(B) Single loop system

(C) Distributed system

(D) Simple system

67. The control action is removed from the controller by placing it in manual mode and an open-loop transient is induced by a step change in the signal to the valve and this method of tuning is called as

(A) Zigler – Nichols Tuning

(B) ✓ Cohen and Coon Tuning

(C) Closed – loop Tuning

(D) ITAE Tuning

68. According to Bode stability criterion a system is unstable if the open loop frequency response exhibits an amplitude ratio exceeding unity at frequency for which phase lag

(A) 0°

(B) 45°

(C) 90°

(D) ✓ 180°

69. The order of differential equation $3\frac{d^2y}{dt^2} + 4\left(\frac{dy}{dt}\right)^3 + y^2 + 2 = x$ is

(A) 1

(B) ✓ 2

(C) 3

(D) 4

70. The three characteristic roots of the following matrix A $A = \begin{vmatrix} 1 & 2 & 3 \\ 0 & 2 & 3 \\ 0 & 0 & 2 \end{vmatrix}$ are

(A) 2, 3   (B) ✓ 1, 2, 2

(C) 1, 0, 0   (D) 0, 2, 3

71. If $A^{-1} = A^T$ for a real matrix 'A' then matrix 'A' is

(A) ✓ orthogonal   (B) symmetric

(C) hermitian   (D) positive definite

72. If the rows and columns of a matrix are interchanged, then the valve of its determinants is

(A) 0   (B) 1

(C) –1   (D) ✓ unchanged

73. If any two rows (or columns) are interchanged, then the value of determinant is multiplied by

(A) 2   (B) 1

(C) ✓ –1   (D) –2

74. If all the elements of a diagonal matrix of order 'n' are 1, then the matrix is

(A) transpose matrix   (B) ✓ identity matrix

(C) sub matrix   (D) null matrix

75. The order of largest non-zero minor of $|A|$, is called ——————— where A = matrix.

(A) transpose of matrix   (B) ✓ rank of matrix

(C) trace of matrix   (D) diagonal matrix

76. The trace and determinant of 2×2 matrix are known to be –2 and –35 respectively. Its eigen values are

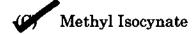(A) – 30 and – 5   (B) – 35 and – 1

(C) ✓ – 7 and 5   (D) 17.5 and – 2
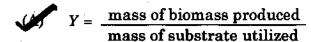
77. Which design of membrane module have poor resistance to mechanical damage?

    (A) Plate and frame   (B) Spiral wound

    (C) Tabular   (D) Hollow fibre

78. Metal membranes are stable at a temperature range of ——————°C.

    (A) 500 – 800°C   (B) 1000 – 1500°C

    (C) 2000 – 2500°C   (D) <500°C

79. In a biopharmaceutical industry, chromatography is a technology used in —————————— processing.

    (A) inoculum   (B) downstream

    (C) pretreatment   (D) fermentation

80. An ideal dialyser has a clearance of ————————— ml/min for a low molecular weight solute like urea.

    (A) 50 – 100 ml/min   (B) 100 – 200 ml/min

    (C) 200 – 300 ml/min   (D) 400 – 500 ml/min

81. ————————— pressure is the principal during force responsible for the transport of materials in nano filtration process.

    (A) osmotic   (B) hydraulic

    (C) transmembrane   (D) pneumatic

82. ————————— theory describes the membrane as a porous film into which both water and solute (ion) dissolve.

    (A) Solution – diffusion

    (B) Surface – capillary

    (C) Polarization

    (D) Donnan exclusion

83. Choose the correct sequence of stages in the evolution of a crystal.

    (A)   nucleus → embryo → cluster → crystal

    (B)   embryo → nucleus → cluster → crystal

    (C)   nucleus → cluster → embryo → crystal

    (D)   cluster → embryo → nucleus → crystal ✓

84. Which one of the following is called salting?

    (A)   Increasing the solubility of solute by increasing temperature

    (B)   Cooling/temperature reduction of saturated solution

    (C)   Evaporating portion of a solvent

    (D)   Adding a third component to generate supersaturation ✓

85. Driving force across a membrane in Dialysis is

    (A)   pressure difference

    (B)   size difference

    (C)   concentration difference ✓

    (D)   activity difference

86. Pervaporation, a separation process which is used to separate

    (A)   one or more components of a gas mixture

    (B)   one or more components of a liquid mixture ✓

    (C)   a mixture of gas and liquid

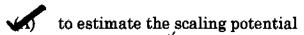   (D)   one or more components of a liquid solution

87. Which chemical released in Bhopal accident in 1984.

   (A) Benzene

   (B) Caprolactam

   (C) ✓ Methyl Isocynate

   (D) Polyethylene

88. The Biomass yield is defined as

   (A) ✓ $Y = \dfrac{\text{mass of biomass produced}}{\text{mass of substrate utilized}}$

   (B) Y = mass of biomass produced × mass of substrate utilized

   (C) $Y = \dfrac{COD}{BOD}$

   (D) Y = mass of biomass produced + mass of substrate utilized

89. What is the application of "Ryznar Index"?

   (A) ✓ to estimate the scaling potential

   (B) to determine sludge volume

   (C) to estimate corrosion rate

   (D) to estimate COD

90. What type of reactor used in Aerated Lagoons?

   (A) ✓ Complete Mix reactor

   (B) Plug flow reactor

   (C) Fluidized leed reactor

   (D) Bubble columns

91. Name the equation to estimate visibility

    (A)   Ergun Equation

    (B)   Keschmeider Equation ✓

    (C)   Holland Equation

    (D)   Antoine Equation

92. Submergence and Emergence is the best example for

    (A)   Atmospheric Natural hazards

    (B)   Cumulative Atmospheric Hazards

    (C)   Terrestrial Natural Hazards ✓

    (D)   Man Induced Hazards

93. The Longitudinal stress σ_l and the circumferential stress σ_h, in a cylindrical vessel are related by

    (A)   No relation exists

    (B) $\sigma_h = \frac{\sigma_l}{2}$

    (C) $\sigma_h = \sigma_l$

    (D) $\sigma_h = 2\sigma_l$ ✓

94. As per Noise pollution control laws, the ambient noise level in the Industrial Zone during night time is

    (A)   40 dB

    (B)   45 dB

    (C)   55 dB

    (D)   70 dB ✓

95. Randomness of a system is a measure of

   (A) specific volume   (B) internal energy

   (C) entropy ✓   (D) enthalpy

96. Second law of thermodynamics deals with

   (A) reversible process only   (B) irreversible process only

   (C) direction of energy transfer ✓   (D) entropy

97. Which one is not a variable of phase-rule?

   (A) temperature   (B) pressure

   (C) phase composition   (D) molecular structure ✓

98. Fugacity coefficient of a substance is the ratio of its fugacity to

   (A) mole fraction   (B) activity

   (C) pressure ✓   (D) activity coefficient

99. How many degrees of freedom does the following system posses?

   "Liquid water in equilibrium with its vapour"

   (A) one ✓   (B) two

   (C) three   (D) four

100. Ist Law of thermodynamics is nothing but the Law of conservation of

   (A) momentum   (B) energy ✓

   (C) mass   (D) force

101. The fugacity of species 'i' in an ideal gas mixture is equal to its

    (A) atmospheric pressure   (B) partial pressure

    (C) latent pressure   (D) liquid pressure

102. Gibb's free Energy (G) is given by

    (A) $G = U - TS$ (B) $G = U + TS$

    (C) $G = H - TS$ (D) $G = H + TS$

    When U – internal energy H – enthalpy S – entropy T – temperature

103. $\dfrac{d(enk)}{dt} = \dfrac{DH^{\circ}}{RT^{2}}$ gives

    (A) the effect of DH on pressure

    (B) the effect of temperatures on equilibrium constant

    (C) the effect of pressure on temperature

    (D) the effect of pressure on equilibrium constant

104. Glass with highest softening point is

    (A) Pyrex Borosilicate   (B) Fused silica

    (C) Pyrocerum   (D) Vycor 96% silica

105. For one mole of a homogenous fluid of constant composition Tds – Pdv is

    (A) dH   (B) dG

    (C) dU   (D) dA

106. In a pressure (P) – Temperature (T) diagram for a pure substance, —————— separates the solid and liquid region.

    (A) sublimation curve   (B) fusion curve

    (C) vapourization curve   (D) triple point

107. Choose a correct proportion followed in the design of agitated vessel
D_a - Diameter of agitator, D_t = diameter of tank

(A) $\dfrac{D_a}{D_t} = \dfrac{1}{2}$

(B) $\dfrac{D_a}{D_t} = \dfrac{1}{3}$ ✓

(C) $\dfrac{D_a}{D_t} = \dfrac{1}{4}$

(D) $\dfrac{D_a}{D_t} = \dfrac{1}{5}$

108. In which of the following condition, the circulatory flow and swirling is larger in agitated vessels.

(A) impeller can be mounted off center

(B) shaft is moved away from the centerline of the tank

(C) impeller and shaft on the centerline of the tank ✓

(D) agitator mounted in the side of the tank

109. Choose the correct relationship used in work index. If D_p is in mm, P in kW, and $\dot{m}$ in tons per hour.

(A) $K_b = 0.2162\, W_i$

(B) $K_b = 0.3162\, W_i$ ✓

(C) $K_b = 0.4162\, W_i$

(D) $W_b = 0.5162\, W_i$

110. According to bond law, which of the following is correct?

(A) $\dfrac{P}{\dot{m}} \propto D_p$

(B) $\dfrac{P}{\dot{m}} \propto \dfrac{1}{D_p}$

(C) $\dfrac{P}{\dot{m}} \propto \sqrt{D_p}$

(D) $\dfrac{P}{\dot{m}} \propto \dfrac{1}{\sqrt{D_p}}$ ✓

111. Choose the correct relationship

(A) $\dfrac{s_p}{v_p} = \dfrac{3}{\phi_s D_p}$

(B) $\dfrac{s_p}{v_p} = \dfrac{6}{\phi_s D_p}$ ✓

(C) $\dfrac{s_p}{v_p} = \dfrac{9}{\phi_s D_p}$

(D) $\dfrac{s_p}{v_p} = \dfrac{3}{\phi_s D_p^2}$

112. Generally, the food pulp is admitted in thickener is
    (A) at the top
    (B) slightly below the surface of the liquid ✓
    (C) at the middle
    (D) near the bottom

113. Area required for thickener can be minimized by
    (A) increasing the downward velocity ✓
    (B) decreasing the downward velocity
    (C) maintaining the downward velocity
    (D) decreasing the solid flux

114. Choose the correct relationship used in flow calculations in agitated vessels
    (A) $R_e = D_a^2 \rho / \mu$
    (B) $R_e = D_t^2 \rho / \mu$
    (C) $R_e = D_a V \dfrac{\rho}{\mu}$
    (D) $R_e = n D_a^2 \rho / \mu$ ✓

115. In settling in the stokes law range, the terminal velocity u_+ is proportional to
    (A) D_p
    (B) $D_p^{0.5}$
    (C) $D_p^{1.5}$
    (D) D_p^2 ✓

116. In general cake porosity near the filter medium is
    (A) Zero
    (B) Low ✓
    (C) High
    (D) Very high

117. Bag filters are used for
    (A) Liquid-Liquid separations
    (B) Gas-Liquid separations
    (C) Liquid-solid separations
    (D) Gas-solid separations ✓

118. Select a condition which prevails in cross of low filtration
    (A) Filter medium resistance increases
    (B) Filter cake resistance increases
    (C) No resistances ✓
    (D) Both resistances increase

119. Rock formed entirely of plagioclase feldspar is known as

    (A) Bauxite   (B) Magnatite

    ✓(C) Anorthosite   (D) Illite

120. The standard solvay process is used for the manufacture of

    (A) Caustic soda   ✓(B) Soda ash

    (C) Caustic potash   (D) Soda lime

121. In cement industry the diameter of the rotary kiln range from

    (A) 20 to 30 ft   (B) 16 to 22 ft

    (C) 15 to 20 ft   ✓(D) 6 to 12 ft

122. Vulcanization make the rubber

    (A) Solube in water   (B) Less elastic

    ✓(C) Hard and more stiff (D) Soft

123. Platinum – 10% Rhodium gauze catalyst is used in the manufacture of

    (A) Hydrochloric acid   (B) Phosphoric acid

    ✓(C) Nitric acid   (D) Sulphuric acid

124. Major constituent of Biogas is

    ✓(A) Methane   (B) Ethane

    (C) Propane   (D) Butane

125. The structural formula of Acetic acid is represented by

    ✓(A) CH_3COOH (B) CH_2COOH

    (C) $C_3H_6O_3$ (D) C_2H_5OH

126. Sugar cane contains ————————— sucrose by weight

    (A)   6 to 8%   (B)   11 to 15%

    (C)   20 to 25%   (D)   2 to 5%

127. The Hargreaves method is for the manufacture of

    (A)   Sodium carbonate

    (B)   Potassium sulphate ✓

    (C)   Calcium sulphate

    (D)   Ammonium sulphate

128. Bismarck brown is mainly used for dyeing

    (A)   Wool   (B)   Cotton

    (C)   Leather ✓   (D)   Silk

129. Flash distillation is not effective in separating components of comparable

    (A)   Purity

    (B)   Density

    (C)   Volatility ✓

    (D)   Viscosity

130. In gas absorption, the point at which the liquid hold up starts to increase as judged by a charge in the slope of the pressure drop line is called

    (A)   Loading point ✓

    (B)   Flooding point

    (C)   Wetting point

    (D)   Hold up point

131. A chief disadvantage of supercritical fluid extraction is because of it requires

    (A)   a high density

    (B)   a high viscosity

    (C)   a high temperature

    (D)   a high pressure ✓

132. Cavitation can be prevented by

    (A) Maintain the discharge head greater than the vapour pressure

    ✓(B) Maintaining the suction head sufficiently greater than the vapour pressure

    (C) Maintaining suction head = developed head

    (D) Maintaining suction head lower than the vapour pressure

133. —————— fluids break down under continued shear and on mixing give lower shear stress for a given shear rate.

    (A) Pseudoplastic

    (B) Rheopectic

    ✓(C) Thixotropic

    (D) Newtonian

134. For a Newtonian fluid flowing in a circular pipe under steady state conditions in fully developed laminar flow, the fanning friction factor is

    (A) $0.046\ Re^{-0.2}$ (B) $0.0014 + \dfrac{0.125}{Re^{0.32}}$

    ✓(C) $\dfrac{16}{Re}$ (D) $\dfrac{24}{Re}$

135. The discharge line of a —————— pump can be completely closed without damage.

    (A) Reciprocating pump

    ✓(B) Centrifugal pump

    (C) Screw pump

    (D) Piston pump

136. The local velocity of a fluid along a streamline flow can be measured using

    ✓(A) Pitot tube   (B) Venturimeter

    (C) Rotameter   (D) Orificemeter

137. Humid volume V_H is the total volume of a unit mass of

   (A)   Vapour laden gas at 1 atm and gas temperature

   (B)   Vapour laden gas at 1 atm and room temperature

   (C)   Gas plus its accompanying vapour at 1 atm and room temperature

   (D) ✓ Vapour free gas plus what ever vapour it may contain at 1 atm and the gas temperature.

138. Raoult's law is a good approximation for mixtures of

   (A)   Solids   (B) ✓ Similar compounds

   (C)   Water and alochol   (D)   Non - ideal gases

139. Entrainer used in azeotropic distillation to

   (A)   Form a new azeotrope of low relative volatility with one of the constitutes of the mixture

   (B) ✓ Form a low boiling azeotrope with one of the constituents of the mixture

   (C)   Have high latent heat of vaporization

   (D)   Have high viscosity to provide high tray efficiency

140. If mass diffusivity in a mixture is equal to the thermal diffusivity, then the Lewis number is

   (A) ✓ 1   (B)   0

   (C)   > 1   (D)   < 1

141. The typical design objectives of optimization techniques are

   (A) ✓ Minimize cost of production and maximize Return on Investment

   (B)   Maximize cost of production and minimize Return on Investment

   (C)   Minimize project net present value and maximize project expense

   (D)   Maximize total annualized cost and Minimize process yield of mass product

142. The total Capital Investment for a chemical plant is Rs.1,00,00,000 and the working capital is Rs. 10,00,000. If a turn over ratio is 1, the gross annual sales will be

   (A) ✓ Rs. 90,00,000   (B)   Rs. 80,00,000

   (C)   Rs. 10,00,000   (D)   Rs. 11,00,000

143. When the hydrodynamic and thermal boundary layers of a fluid flowing over a heated plate is identical, then the value of prandtl number of a gas is

(A) <1   (B) ✓ 1.0

(C) >1   (D) 0.9

144. ——————— is the best example of a reactor with mixed flow of solids

(A) PFR   (B) CSTR

(C) Semi–Batch Reactor   (D) ✓ Fluidized Bed

145. Activation energy of a chemical reaction can be determined by

(A) Changing concentration of reactants

(B) Evaluating rate constant at standard temperature

(C) ✓ Evaluating rate constant at two different temperature

(D) Evaluating concentration of catalyst

146. For irreversible unimolecular type first order reactions A $\xrightarrow{k}$ product a plot of $-\ln(1 - \lambda A)$ versus time gives a straight line passing through the origin whose slope is ——————— where λA is fractional conversion of component 'A' at time 't'.

(A) ✓ k (B) $-k$

(C) $1/k$ (D) $-1/k$

147. A ideal plug flow is characterized by

(A) high capacity

(B) presence of axial mixing

(C) ✓ presence of lateral mixing

(D) no mixing in axial and lateral

148. The temperature dependency of the reaction rate constant (k) by the transition state theory is given by

(A) $k \alpha e^{\frac{-E}{RT}}$ (B) $k \alpha T^{\frac{1}{2}} e^{\frac{-E}{RT}}$

(C) $k \alpha T^{2} e^{\frac{-E}{RT}}$ (D) ✓ $k \alpha T e^{\frac{-E}{RT}}$

149. The activity of the catalyst lost due to the deposition of carbonaceous material on the surface of catalyst is called ———————

(A) Fouling ✓   (B) Poisoning

(C) Sinking   (D) Carrier

150. ——————— occurs when the mean free path of the molecule is greater than the diameter of the catalyst pore

(A) Molecular Diffusion   (B) Surface Tension

(C) Knudsen diffusion ✓   (D) Reaction

151. The exit age distribution of fluid leaving a vessel is used to

(A) study the reaction kinetics

(B) study the extent of non-ideal flow in the venus ✓

(C) study the reaction mechanism

(D) know activation energy of a reaction

152. The vessel dispersion number for plug flow reactor is equal to

(A) 0 ✓   (B) between 2100-4000

(C) between 4000 - 10,000   (D) ∞

153. In which of the following reaction does have the solid change in size is appreciably?

(A) $2ZnS(s) + 3O_2(g) \rightarrow 2ZnO(S) + 2SO_2(g)$

(B) $Fe_3O_4(s) + 4H_2(g) \rightarrow 3Fe(s) + 4H_2O(g)$

(C) $CaC_2(s) + N_2(g) \rightarrow CaCH_2(s) + C(s)$

(D) $NaNH_2(l) + C(s) \rightarrow NaCN(l) + H_2(g)$ ✓

154. The ratio of maximum possible conversion in the film to that of maximum diffusional transport through the film is called ———————

(A) Yield coefficient   (B) Hatta number ✓

(C) Biot number   (D) Thiele modulus

155. Orifice meter is used for measurement of

(A) temperature   (B) pressure

(C) ✓ rate of flow   (D) level

156. Which one of the temperature measuring device can be used in Corrosive Environment, where other sensors cannot be used

(A) Bimetallic thermometer

(B) Mercury filled thermometer

(C) Resistance temperature detector

(D) ✓ Radiation pyrometer

157. ———— Represents the degree of closeness of the measured value to the true value.

(A) Precision   (B) ✓ Accuracy

(C) Repeatability   (D) Linearity

158. Ability to withstand over loads and operating condition is called as

(A) Reproducibility   (B) Linearity

(C) Accuracy   (D) ✓ Ruggedness

159. A rectangular tank is filled with a valve at the bottom and is used for storing a liquid. The area of cross-section of the tank is $10m^2$ and the flow resistance of the valve (assumed constant) is $0.1 \ s/m^2$. The time constant of the tank will be :

(A) 100   (B) 10.1

(C) ✓ 1   (D) 0.1

160. The optical pyrometer is usable in temperature range of ————.

(A) 100° C and 400° C.

(B) 4000° C and 5000° C

(C) ✓ 700° C and 3000° C

(D) −700° C and −3000° C.

161. The amplitude ratio of transportation lag is

(A) ✓ 1   (B) 10

(C) 100   (D) 0.1

162. The time required for the response to first reach its ultimate value is

   (A) Time constant   (B) Response time

   (C) ✓ Rise time   (D) Period of oscillation

163. Characterization of a dynamic system by a transfer function can be done only for ————— system.

   (A) quadratic   (B) cubic

   (C) polynomial   (D) ✓ linear

164. The nature of roots of critically damped system is

   (A) Complex   (B) Real and unequal

   (C) Cannot be defined   (D) ✓ Real and equal

165. If L(Y) = laplace transform of output variable L(X) = laplace transform of input variable, then transfer function is defined as

   (A) L(X).L(Y)   (B) L(X)–L(Y)

   (C) ✓ L(Y)/L(X)   (D) L(X)/L(Y).

166. Phase lag of first order system is

   (A) $\text{Tan}^{-1}(wT)$ (B) ✓ $-\text{Tan}^{-1}(wT)$

   (C) $\pi/2$ (D) 0

167. For two non interaction first order systems connected Si series, the overall transfer function is the ————— of individual transfer functions

   (A) ✓ product   (B) ratio

   (C) sum   (D) difference

168. Laplace transform of sinh $k(t)$ is

   (A) $\dfrac{1}{s^2 - k^2}$ (B) $\dfrac{1}{s^2 + k^2}$

   (C) $\dfrac{k}{s^2 + k^2}$ (D) ✓ $\dfrac{k}{s^2 - k^2}$

169. The integrating factor for $\dfrac{dy}{dx} - \dfrac{2}{x}y = x^3 + 6x + 2$ is

    (A) $\dfrac{1}{x}$ (B) ✓ $\dfrac{1}{x^2}$

    (C) x (D) x^2

170. When the dependent variable and its derivatives occurs only in the first degree and no products of the dependent variables and its derivatives or of various order derivatives occurs, then the differential equations is called as

    (A) Dependent   (B) Independent

    (C) ✓ Linear   (D) Non-Linear

171. $U_{xx} + U_{yy} = 0$ represents

    (A) Poisson equation   (B) Wave equation

    (C) ✓ Laplace equation   (D) Lagrange's equation

172. $\lim\limits_{x \to \infty} x \cdot \tan\left(\dfrac{1}{x}\right)$ is

    (A) 0   (B) ✓ 1

    (C) 2   (D) ∞

173. $\int\limits_{1}^{\infty} \dfrac{dx}{x^p}$ converges when

    (A) ✓ $p > 1$ (B) $p < 1$

    (C) $p = 1$ (D) not defined

174. $\lim\limits_{x \to 0} \dfrac{x - \sin 2x}{x + \sin 3x}$ has the value

    (A) 0   (B) ½

    (C) ✓ $-¼$ (D) ∞

175. The inverse of the matrix A, denoted by A^{-1}, is defined by,

    (A) $adj\,(A)$ (B) $|A|\,adj\,(A)$

    (C) $\dfrac{|A|}{adj(A)}$ (D) ✓ $\dfrac{1}{|A|} \cdot adj\,(A)$

    where $adj(A)$ = adjoint matrix of 'A'

176. The inverse of a matrix $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ is

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

    (C) $\begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}$ (D) ✓ $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

177. For which value of n, in the matrix A given below becomes singular?

where $A = \begin{bmatrix} 8 & x & 0 \\ 4 & 0 & 2 \\ 12 & 6 & 0 \end{bmatrix}$

(A) 4   (B) 6
(C) 8   (D) 12

178. Match the items in Column I & Column II

	Column I		Column II
(a)	Gauss-Seidal method	1.	Interpolation
(b)	Forward Newton – Gauss method	2.	Non-Linear differential equation
(c)	Runge – Kutta method	3.	Numerical Integration
(d)	Trapezoidal rule	4.	Linear algebraic equations

	(a)	(b)	(c)	(d)
(A)	1	4	3	2
(B)	4	1	2	3
(C)	1	4	2	3
(D)	1	3	2	4

179. With 1 unit change in b, what is the change in 'x' in the solution of systems of equations

$x + y = 2$; $1.01x + 0.99y = b$?

(A) 0 units   (B) 2 units
(C) 50 units   (D) 100 units

180. The number $\pi = 3.14159265\ldots$ is approximated by $\dfrac{22}{7} = 3.14285714$ the relative error is

(A) 0.02   (B) 0.01
(C) 0.00126   (D) 0.0004

181. Which one of the following method is called as tangent method?

(A) Netwon-Raphson method   (B) Regula-Falsi method
(C) Secant method   (D) Bisection method

182. The chord method is

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

183. The Taylor's polynomial approximation of $f(x) = e^x$ at $x = 0$ is

(A) $1 + x + \dfrac{x^2}{2!} + \cdots + \dfrac{x^n}{n!}$ (B) $1 - x + \dfrac{x^2}{2!} - \dfrac{x^3}{3!} + \cdots + \dfrac{x^n}{n!}$

(C) $1 + x + x^2 + x^3 + \ldots + x^n$ (D) $1 - x + x^2 - x^3 + \ldots + x^n$

184. Reverse osmosis system in house hold appliances usually operates in the range.

(A) 10 to 20 psi   (B) 20 to 30 psi

(C) 50 to 70 psi ✓   (D) 80 to 100 psi

185. Solutions having the same osmotic pressure are known as ———————— solutions.

(A) isobaric

(B) isotonic ✓

(C) isometric

(D) isosonic

186. The packing density of a hollow fibre membrane is in the range of ——————.

(A) 50 to 100 m^2/m^3

(B) 100 to 300 m^2/m^3

(C) 300 to 500 m^2/m^3

(D) 500 to 9000 m^2/m^3 ✓

187. Microfiltration process is carried out with the help of membranes having pore size range of ————

(A) 0.1 to 10 microns ✓

(B) 10 to 100 microns

(C) 0.001 to 0.01 microns

(D) 0.01 to 0.1 microns

188. Reverse osmosis is used as an alternate to

(A) Leaching

(B) Crystallization

(C) Evaporation ✓

(D) Adsorption

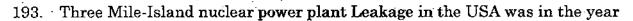189. The retained mother liquor is separated from the crystals by

 (A) Evaporation

 (B) Drying

 (C) Adsorption

 (D) Centrifuging ✓

190. What is FMECA stands for

 (A) Failure Mode Effects and Criticality Analysis ✓

 (B) Failure Mode Events and Critical Assessment

 (C) Failure Method of Event and Critical Assessment

 (D) Fractional Mode Events and Critical Analysis

191. Which Hazard identification techniques uses "Guide words" for Hazard assessment.

 (A) FTA – Fault Tree Analysis

 (B) ETA – Event Tree Analysis

 (C) HAZOP – Hazards and Operability Studies ✓

 (D) PHA – Primary Hazard Analysis

192. The lowest temperature at which a liquid gives enough vapour to form a ignitable mixture with air is called.

 (A) Flash point ✓

 (B) Fire point

 (C) Ignition temp

 (D) Combustion

193. Three Mile-Island nuclear power plant Leakage in the USA was in the year

(A) 1977

(B) 1980

(C) 1978

(D) 1979 ✓

194. 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 the mth year by the sum-of-years – Digits method will be

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

(B) $\dfrac{m}{n}(P-S)$

(C) ✓ $\dfrac{2(n-m+1)}{n(n+1)}(P-S)$

(D) $1-\left(\dfrac{P}{S}\right)^{1/m}$

195. The Redlich-Kwong Equation of state is

(A) ✓ $P=\dfrac{PT}{V-b}\times\dfrac{a}{T^{1/2}V(V+b)}$

(B) $P=\dfrac{PT}{V+b}\times\dfrac{a}{T^{1/2}V(V+b)}$

(C) $P=\dfrac{PT}{V-b}\times\dfrac{a}{T^{1/2}V(V-b)}$

(D) $P=\dfrac{PT}{(V+b)}\times\dfrac{a}{T^{1/2}V(V+b)^{1/2}}$
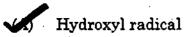
196. Return On Equity (ROE) is defined as

(A) $ROE=\dfrac{Stockholders\ equity}{net\ annual\ profit}\times100$

(B) ✓ $ROE=\dfrac{Net\ annual\ profit}{Stockholders\ equity}\times100$

(C) $ROE=$ net annual profit – stockholder's equity

(D) $ROE=$ Stockholder's equity – net annual profit

197. The main pollution sources for Acid Rain are

    (A) ✓ Sulphur dioxide (SO_2) and Nitrogen oxide (NO_x)

    (B) Maleic acid and Tartaric Acid

    (C) Particulate matter and heavy metal

    (D) Carbon monoxide and Ozone

198. The Chernobyl nuclear disaster occured in the year.

    (A) 1927

    (B) 1966

    (C) ✓ 1986

    (D) 1991

199. What are the pollutants released while using Air fresheners?

    (A) Toluamide, lanolin

    (B) Turpentine, wax

    (C) ✓ Propylene glycol, morpholine

    (D) Cyclopropane, Toluamide

200. Which is the most important reactive intermediate species formed during photochemical process

    (A) ✓ Hydroxyl radical

    (B) Hypochloride

    (C) Carbon monoxide

    (D) Hydroperoxyl radical

SPACE FOR ROUGH WORK

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