Sl. No. :

CECHE/18

Register Number

2018

CHEMICAL ENGINEERING
(Degree Standard)

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 Number with Blue or Black ink Ball point pen in the space provided on the side 2 of the Answer Sheet. If you do not encode properly or fail to encode the above information, action will be taken as per commission's notification.
7. Each question comprises *four* responses (A), (B), (C) and (D). You are to select ONLY ONE correct response and mark in your Answer Sheet. In case you feel that there are more than one correct response, mark the response which you consider the best. In any case, choose ONLY ONE response for each question. Your total marks will depend on the number of correct responses marked by you in the Answer Sheet.
8. In the Answer Sheet there are **four** circles Ⓐ, Ⓑ, Ⓒ and Ⓓ against each question. To answer the questions you are to mark with Blue or Black ink Ball point pen ONLY ONE circle of your choice for each question. Select one response for each question in the Question Booklet and mark in the Answer Sheet. If you mark more than one answer for one question, the answer will be treated as wrong. *e.g.* If for any item, Ⓑ is the correct answer, you have to mark as follows :

   Ⓐ ● Ⓒ Ⓓ

9. You should not remove or tear off any sheet from this Question Booklet. You are not allowed to take this Question Booklet and the Answer Sheet out of the Examination Hall during the time of examination. After the examination is concluded, you must hand over your Answer Sheet to the Invigilator. You are allowed to take the Question Booklet with you only after the Examination is over.
10. The sheet before the last page of the Question Booklet can be used for Rough Work.
11. Do not tick-mark or mark the answers in the Question Booklet.
12. 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.
13. 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.

SEAL

SPACE FOR ROUGH WORK

1. The wash liquor from a paper mill contains 2% (by weight) of solids is concentrated in an evaporator to yield a product with 20% (by weight) of solids. The quantity of water evaporated per 100 kg of feed is

(A) 20 kg (B) 80 kg

(C) 40 kg (D) 90 kg

2. Fresh feed of 100 mol/hr is passed into a reactor followed by a separator. The product is removed from the separator and unreacted feed is recycled. If single pass conversion of $A \rightarrow B$ is 20%, assuming A and B both pure, the rate of recycle (in mol/hr) is

(A) 300 (B) 400

(C) 500 (D) 600

3. It is required to make 100 kg of a solution containing 40% salt by mixing solution A containing 25% salt and solution B containing 50% salt. The mass in kilograms of solution A required is

(A) 40 (B) 60

(C) 75 (D) 25

4. At this point, all three phases (solid, liquid and gas) coexist

(A) Eutectic (B) Triple

(C) Plait (D) Critical

5. Which of the following is unity for an ideal liquid solution?

(A) Fugacity (B) Fugacity coefficient

(C) Activity (D) Activity coefficient

6. All spontaneous process are

(A) Reversible (B) Irreversible

(C) Reversible adiabatic (D) Adiabatic

7. For ideal gases the fugacity is directly proportional to

(A) Pressure (B) Temperature

(C) Entropy (D) Enthalpy

8. A Carnot cycle consists of the following steps

(A) Two isothermal and Two isentropics (B) Two isobarics and Two isothermals

(C) Two isochorics and Two isobarics (D) Two isothermals and Two isochorics

9. For a spontaneous process, the total entropy of a system and its surroundings always

(A) increases (B) decreases

(C) does not change (D) cannot specify as increase or decrease

10. A binary mixture $A-B$ forms an azeotrope with a boiling point of 71.8°C at 1 bar pressure, the azeotropic composition being 55 mole percent 'A'. The pure component vapor pressures at 71.8°C are $A = 0.50$ bar; $B = 0.70$ bar. What is the activity coefficient of 'A' in the liquid, assuming the vapor to be an ideal

(A) 1 (B) 1.5

(C) 2 (D) 2.5

11. Which of the following is an ore of Copper?

(A) Galena (B) Hematite

(C) Bauxite (D) Chalcopyrite

12. Epoxy resins come under the category of

(A) Thermoplastic (B) Thermosetting

(C) Polychloroprene (D) Elastomer

13. The percentage of carbon is the least in

(A) White cast iron (B) Grey cast iron

(C) Wrought iron (D) Stainless steel

14. Teflon is polymer product of

(A) C_2F_4 (B) CF_4

(C) C_2F_2 (D) $CH_2 = CHF$

15. For size reduction of a large plastic sheet into small units of fixed dimensions, which equipment is the most useful?

(A) Jaw crusher
(B) Roll crusher
(C) Rod mill
(D) Rotary knife cutter

16. Fluid Energy Mill is an example of

(A) Crusher
(B) Grinder
(C) Ultra fine grinder
(D) Cutting machine

17. The power number, N_P is defined by

(A) $n^3 Da^5 \rho / Pg_c$
(B) $q/n\,Da^3$
(C) $Pg_c/n^3\,Da^5\,\rho$
(D) nDa^3/q

18. The screen effectiveness

(A) remains unaffected with change in the capacity of the screen
(B) decreases with increase in the capacity of the screen
(C) increases with increase in the capacity of the screen
(D) increases linearly with increase in the capacity of the screen

19. For pseudoplastic liquids with intermediate range (between 10 to 100), the power consumed by six blade turbine compared to newtonium fluid will be

(A) less
(B) more
(C) equal
(D) not predicted

20. The constants K_R, K_B and K_K in the laws of crushing depends on

(A) feed material
(B) compression
(C) finer products
(D) capacity of machine

21. For a constant pressure filtration, neglecting the filter cloth resistance, the filtration equation is

(A) $dt/dV = K_c V$
(B) $dV/dt = K_c V$
(C) $dV/t = K_c V$
(D) $dt/V = K_c V$

22. Solar photovoltaic energy sources produce

(A) AC electricity
(B) DC electricity
(C) Voltage
(D) Power

23. A perfect black body

(A) is black in colour
(B) reflects all incident radiation
(C) absorbs all incident radiation
(D) transmit all incident radiation

24. Boiling water reactor and pressurised water reactor are

(A) Nuclear reactor
(B) Solar reactor
(C) Ocean thermal electric conversion
(D) Biogas reactor

25. Tidal energy utilises

(A) potential energy
(B) chemical energy
(C) electrical energy
(D) bio energy

26. Which one of the following is the second most abundant series in most crudes?

(A) Cycloalkanes
(B) Olefin
(C) Iso-alkanes
(D) Alkanes

27. Fourdrinier machine is used in the manufacture of

(A) soap
(B) detergent
(C) paper
(D) leather

28. The first step in refining of cane-sugar is

(A) evaporation
(B) affination
(C) clarification
(D) bleaching

29. Compressible flow at ordinary densities and high velocities, the more basic parameter required is

(A) Reynolds number
(B) Mach number
(C) Froude number
(D) Pressure co-efficient

30. Navier-Stokes equation is of the form

(A) $\rho\frac{DV}{Dt} = -\nabla_P + \rho g$
(B) $\rho\frac{DV}{Dt} = -\nabla_P + \mu\nabla^2 V + \rho g$
(C) $\frac{D\rho}{Dt} = -\rho(\nabla.V)$
(D) $\rho\frac{\partial V}{\partial t} = -(\nabla.\rho \vee V) - \nabla_P - \nabla.\tau + \rho g$

31. Laminar part of Ergun equation is called as

(A) Hagen-Poiseuille equation
(B) Stoke's equation
(C) Kozeny-Cosman equation
(D) Burke-Plummer equation

32. Which of the following is used for low range pressure measurement?

(A) Venturimeter
(B) Orifice meter
(C) U-tube manometer
(D) Pitot tube

33. With same logarithmic mean temperature difference, the heat transfer area requirement will be minimum for

(A) Parallel flow
(B) Co-current flow
(C) Cross flow
(D) Counter-current flow

34. Vena contracta is defined as the cross section of minimum area, at which the streamlines of fluid changes from

(A) an expansion to a contraction
(B) entrance to exit of pipe
(C) a contraction to an expansion
(D) laminar region to turbulent region

35. The relation between the gas, liquid contactor terminologies NTU, HTU, HETP and number of stages (N) is

(A) $HETP = NTU \times HTU \times N$

(B) $HETP = \frac{NTU \times HTU}{N}$

(C) $HETP = \frac{NTU \times N}{HTU}$

(D) $HETP = \frac{HTU \times N}{NTU}$

36. Operating velocity of gas in a packed column absorber is

(A) 40 – 50% of flooding velocity

(B) 65 – 90% of flooding velocity

(C) 100% of flooding velocity

(D) 120 – 150% of flooding velocity

37. A glass window is 5 mm thick and the thermal conductivity of glass is 1.5 W/mK. The inner surface of the window is at 20°C and the outer surface is at 10°C. The dimension of the window is 1 m × 2 m. Calculate the rate of heat loss through the window

(A) 60 KW

(B) 600 W

(C) 60 W

(D) 6000 W

38. The type of evaporator used for concentrating of highly heat–sensitive materials is

(A) Climbing film evaporators

(B) Falling film evaporators

(C) Forced circulation evaporators

(D) Agitated film evaporators

39. What will be the cause for temperature drop at the composite wall interface?

(A) Temperature difference

(B) Temperature gradient

(C) Thickness

(D) Voids

40. Capacity of an evaporator is defined as

(A) No. of kilograms water vaporized per kilograms of steam fed

(B) No. of kilograms of water vaporized per hour

(C) No. of kilograms of steam consumed per kilogram of water vaporized

(D) No. of kilograms of steam consumed per hour

41. There is no correspondence between stoichiometry and the rate equation in case of ———— reaction.

(A) Elementary
(B) Multiple
(C) Autocatalytic
(D) Non-Elementary

42. A unimolecular type first order reaction in series $A \xrightarrow{K_1} R \xrightarrow{K_2} S$ is treated in CSTR. The optimum residence time $\tau_{m,\,opt}$ for the reactor is

(A) $K_1 K_2$
(B) $K_1 + K_2$
(C) $\frac{1}{\sqrt{K_1 K_2}}$
(D) K_1/K_2

43. Trickle bed reactor is an example for

(A) single phase reactor
(B) two phase reactor
(C) three phase reactor
(D) homogeneous reactor

44. Helium-Mercury method is used to determine

(A) surface area of the catalyst
(B) density of the catalyst
(C) pure volume of the catalyst
(D) weight of the catalyst

45. Fluid flow in a real packed bed can be approximated as ———— model.

(A) Plug flow
(B) Dispersion
(C) Mixed flow
(D) Tanks in series

46. A liquid decomposes by irreversible first order kinetics and the half life period of this reaction is 8 minutes. The time required for 75% conversion of the liquid will be ———— minutes.

(A) 4
(B) 8
(C) 12
(D) 16

47. The common industrial method of measuring pH is by glass cell and calomel electrodes used with a

(A) Spectrophotometer

(B) Potentiometer

(C) Turbidity meter

(D) Refractometer

48. For a first-order isothermal chemical reaction in a porous catalyst, the effectiveness factor is 0.3. The effectiveness factor will increase if the

(A) catalyst size is reduced or the catalyst diffusivity reduced

(B) catalyst size is reduced or the catalyst diffusivity is increased

(C) catalyst size is increased or the catalyst diffusivity is reduced

(D) catalyst size is increased or the catalyst diffusivity is increased

49. For the 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

50. The unit of frequency factor in Arrhenis equation

(A) is same as those of the rate constant

(B) depend on the order of reaction

(C) depend on temperature of the reaction

(D) depend on pressure of the reaction

51. The transfer function of the system $\frac{Y}{X} = \frac{1}{S^2 + 5S + 6}$ the roots of the characteristics equation are located,

(A) to the left of imaginary axis and on real axis

(B) on the imaginary axis

(C) right of imaginary axis

(D) at the origin

52. The transfer function for second order system is

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

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

(C) $\frac{1}{TS^2 + 2\varepsilon T + 1}$

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

53. For two non-interacting first order systems in series the overall transfer function is ————————of the individual transfer functions.

(A) Ratio

(B) Product

(C) Sum

(D) Difference

54. The laplace transform of cost is

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

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

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

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

55. Mercury in glass thermometer in oil wall is

(A) First – order system

(B) Second – order system

(C) Zero order system

(D) First – order system with time log

56. The system is stable. Using the theorems of the Routh test choose the wrong answer

(A) No change is sign in the first column

(B) No – roots having positive real parts

(C) All the coefficients are positive

(D) Roots having positive real parts

57. Flat glass gauges are suitable for clean liquids upto pressure of

(A) 260 kg/cm^2 (B) 260 N/m^2

(C) 260 kPa (D) 260 mmHg

58. Diaphragm box method is best suitable for measuring liquid levels in the range

(A) 20' to 250' (B) 20' to 250"

(C) 20" to 250' (D) 20" to 250"

59. Processes that contain a large transport lag can be controlled using

(A) Cascade control system (B) Feed forward control system

(C) Ratio control system (D) Smith predictor controller system

60. Which one of the following is not a basic functional element of a measuring element?

(A) Transducers (B) Signal conditioners

(C) Data presentation elements (D) Calibration element

61. If particular load disturbance occurs frequently in a control process, the quality of control can often be improved by the addition of

(A) Feed backward control (B) Feed forward control

(C) Cascade control (D) Ratio control

62. Master controller in a cascade control system refers to

(A) Secondary controller (B) Slave controller

(C) Cascade controller (D) Primary controller

63. The design value of the gain margin should be

(A) greater than 1.7 (B) less than 1.7

(C) equal to 1.7 (D) equal to 0.59

64. The process of using a ion-selective membrane and a potential gradient to speed migration of ions through membranes is

(A) Reverse Osmosis
(B) Ultra Filtration
(C) Dialysis
(D) Electro dialysis

65. The flux through a dense polymer film is inversely proportional to its

(A) Thickness
(B) Temperature
(C) Pressure
(D) Concentration gradient

66. The separation of Uranium isotopes using hexa fluorides can be done by

(A) Adsorption
(B) Leaching
(C) Separation
(D) Extraction

67. The technique used in separation of products from bioreactors is

(A) Super critical fluid extraction
(B) Ion exchange
(C) Permeation
(D) Osmosis

68. Separation processes that work by virtue of difference in time of movement through some medium under the impetus of any driving force are collectively called as

(A) Pressure governed processes
(B) Temperature governed processes
(C) Rate governed processes
(D) Composition governed processes

69. The action which transforms a mixture of substance into 2 or more products which differ from each other in composition is

(A) Reaction
(B) Separation
(C) Mixing
(D) Sublimation

70. The normal boiling points of water and toluene are 100°C and 111°C respectively. Toluene and water are completely immiscible in each other. The normal boiling point of equimolar mixture of toluene and water is

(A) less than 100°C
(B) 100°C
(C) between 100 and 111°C
(D) 111°C

71. The ———— process is based on the difference in rates of diffusional transport through membranes

(A) Thermal diffusion
(B) Permeation
(C) Dialysis
(D) Osmosis

72. Reactivation of carbon involves

(A) The carbon is heated to drive off the adsorbed organic material
(B) The carbon is heated to recover the adsorbed capacity
(C) The carbon is heated to increase its porosity
(D) The carbon is heated to increase the surface active area

73. A non-corrosive substance which can cause skin or long inflammation after repeated contact is a

(A) Harmful substance
(B) Irritant substance
(C) Mutagenic substance
(D) Toxic substance

74. The presence of multivalent cations, notably Ca and Mg ions in water causes

(A) Total solids
(B) Hardness
(C) Softness
(D) Turbidity

75. The theoretical time taken by a particle to pass between entry and exit of a sedimentation basin is called

(A) Settling period
(B) Screening period
(C) Detention period
(D) Cleaning period

76. Run off coefficient is the

(A) ratio of surface run off to the total rain fall on the area in the fixed interval of time
(B) ratio of surface run off to the area of catchment in the fixed interval of time
(C) ratio of intensity of rain fall to the total rain fall in the fixed interval of time
(D) ratio of duration of rain fall to average rain fall

77. Trickling filter with rock or plastic packing for waste water treatment process is

(A) Non submerged fixed film biological reactor

(B) Suspended growth processes with fixed film packing

(C) Submerged attached growth aerobic processes

(D) Activated sludge processes with fixed film packing

78. The unit of Freundlich capacity factor in the Freundlich adsorption isotherm equation is

(A) $(mg/g)\left(\frac{L}{mg}\right)^{1/n}$

(B) $(mg/g)^{\frac{1}{n}}\left(\frac{L}{mg}\right)$

(C) $(mg/g)^{\frac{1}{n}}\left(\frac{L}{mg}\right)^{1/n}$

(D) $(mg/g)\left(\frac{L}{mg}\right)^{n}$

79. The fine dust that is much more hazardous penetrating deep into the lungs and remains there is known as

(A) Inhalable dust

(B) Respirable dust

(C) Particulate dust

(D) Pulverizing dust

80. A jet plane during its take off produces ———— sound.

(A) 70 decibel

(B) 200 decibel

(C) 150 decibel

(D) 100 decibel

81. The operation of cyclone separator relies on

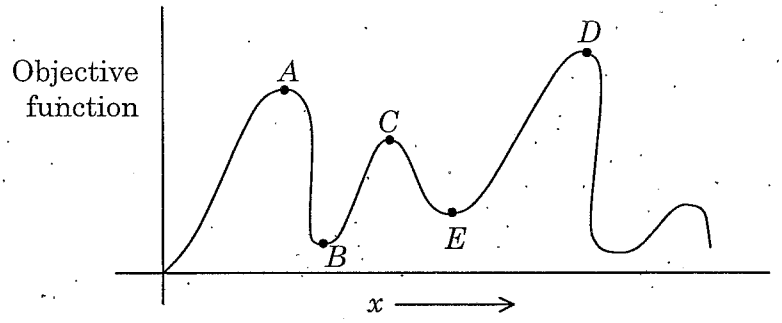
(A) Centrifugal force acting on the particle

(B) Diffusion of dust particle

(C) The creation of intimate contact between a stream of gas and a flow of scrubbing liquor

(D) Producing an electric charge on the particle to be collected and then directing it, by electrostatic forces, to the collecting electrodes

82.



The point 'D' in the above figure is

(A) Local maximum

(B) Global maximum

(C) Local minimum

(D) Global minimum

83. The function $f(x) = \ln x$ is

(A) Error function

(B) Laplace function

(C) Continuous function for $x > 0$

(D) Discontinuous function

84. Major components of economic objective function are

(A) inventory costs and capital costs

(B) capital costs and operating costs

(C) operating cost and transportation costs

(D) inventory cost and transportation costs

85. Black box model is known as

(A) Theoretical model

(B) Empirical model

(C) Hybrid model

(D) Universal model

86. When a unique solution exists then

(A) Optimization is needed to obtain a solution

(B) No Optimization is needed to obtain a solution

(C) Equality constraints will beams as inequality constraints

(D) Constraints form a optimal solution

87. ———— generates a sequence of points that may not satisfy all the constraints till the method converges and none of the points are extreme point.

(A) Quadratic programming

(B) Linear programming

(C) Simplex algorithm

(D) Barrier methods

88. For the condition $X^p \to X^q$ and the slope of the line connecting X^p and X^q approaching the second derivative of $f(x)$ quasi – Newton method approximates $f'(x)$ as a

(A) Parabola

(B) Straight line

(C) Hyperbola

(D) Ellipse

89. If $f(X^*) \leq f(X)$ for all X in the feasible region F, where X^* is a point (vector), ———— occurs.

(A) Global minimum

(B) Global maximum

(C) Local minimum

(D) Local maximum

90. The value of $(1+i)^{16}$ when $i = \sqrt{-1}$ is

(A) $8 + 4i$ (B) $6 - 2i$

(C) 16 (D) 256

91. $\lim_{x \to 0} \frac{x - \sin 2x}{x + \sin 3x}$ has the value

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

(C) 0 (D) ∞

92. The Laplace transform of the function e^{at} has the form

(A) $\frac{1}{s-a}$ (B) $\frac{1}{s+1}$

(C) $\frac{1}{s(s+a)}$ (D) a/s

93. The harmonic series $\sum_{n=1}^{\infty} \frac{1}{n^p}$

(A) converges for $p > 1$ (B) diverges for $p > 1$

(C) converges for $p < 1$ (D) diverges for $p < 1$

94. $\lim_{x \to 0} \frac{x - \sin 3x}{x + \sin 2x}$ has the value

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

(C) 1 (D) 0

95. Given $f(x, y) = x^2 + y^2$; $\nabla^2 f$ is

(A) 2 (B) 4

(C) 0 (D) $4(x^2 + y^2)$

96. The cubic equation $x^3 - x + 10 = 0$ has a root in the interval

(A) $(-1, 0)$ (B) $(0, 1)$

(C) $(-3, -1)$ (D) $(3, 4)$

97. The integral $\frac{dx}{x^p}$ is convergent for

(A) no value of p (B) $p > 1$

(C) $p < 1$ (D) $p = 0$

98. The value of compressibility factor 'Z' of an ideal gas is

(A) 0 (B) 1

(C) <1 (D) >1

99. The sound pressure level, expressed in decibels (dB) where P_1 is the pressure amplitude of sound and p_0 is the reference pressure, is defined as

(A) $L_p = 10 \log_{10}\left(\frac{p_1}{p_0}\right)^2$ (B) $L_p = \left(\frac{p_1}{p_0}\right)^2$

(C) $L_p = e^{\left(\frac{p_0}{p_1}\right)^2}$ (D) $L_p = 10 \log_{10}\left(\frac{p_0}{p_1}\right)^2$

100. Mass transfer coefficient 'k' is related with molecular diffusivity D_{AB} as $K \alpha D_{AB}^n$ what is the value of 'n'?

(A) –1 (B) 0

(C) 0.5 (D) 1

101. The stream that skips one or more stages of the process and goes directly to another downstream stage is called as

(A) Recycle stream
(B) Bypass stream
(C) Purge stream
(D) Secondary stream

102. Kopp's rule is useful for the determination of

(A) molar heat capacities of gases
(B) heat capacities of solids
(C) activation energy
(D) heat capacities of gases

103. PURGE STREAM is a stream

(A) that is recycled to improve conversion
(B) bled off to remove accumulation of inerts in recycle stream
(C) that skips one or two stages
(D) that changes the equilibrium of the reaction

104. 1000 kg of wet solids are dried from 60% to 20% moisture (by weight). The mass of moisture removed in kg is

(A) 520
(B) 200
(C) 400
(D) 500

105. How many moles are there in 256 g of oxygen?

(A) 2
(B) 16
(C) 9.4×10^{24}
(D) 22×10^{3}

106. Ammonia is catalytically oxidised by oxygen to give nitric acid and water. How much ammonia and oxygen by volume are required to manufacture 63 g of nitric acid at STP?

(A) 1 l of NH_3 and 2 l of O_2
(B) 17 l of NH_3 and 32 l of O_2
(C) 22.4 l of NH_3 and 44.8 l of O_2
(D) 22414 l of NH_3 and 44828 l of O_2

107. The thermal efficiency of a heat engine is defined as

(A) the ratio of the heat source to heat sink

(B) the ratio of the work output to the heat input

(C) the ratio of the energy output to the work input

(D) the ratio of heat output to the work input

108. To test the thermodynamic consistency of data by Redlich-Kister method, the area $\int_0^1 \ln\frac{r_1}{r_2}\,dx_1$ must be equal to?

[where r_1 and r_2 are activity coefficient of component 1 and 2 and x_1 is the mole fraction of component 1]

(A) zero

(B) one

(C) two

(D) infinity

109. Match the following and select correct answer from the codes given below the lists :

	List I		List II
(a)	$y_iP = x_iP_i^{sat}$	1.	Gibbs-Duhem equation
(b)	$\ln P^{sat} = A - \frac{B}{T+C}$	2.	Raoults law
(c)	$\hat{f}_i^{id} = f_ix_i$	3.	Antoine equation
(d)	$\sum_{i=1}^{2} x_i\left[\frac{d\ln r_i}{dx_i}\right]_{T,P} = 0$	4.	Lewis-Randall rule

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

110. The molar excess free energy, G^E for a binary liquid mixture at T and P is given by $\frac{G^E}{RT} = AX_1X_2$ where A is constant. The corresponding equation for $\ln r_1$, where r_1 is the activity coefficient of component 1, is

(A) Ax_1

(B) Ax_2

(C) Ax_1^2

(D) Ax_2^2

111. Pilling-Bedworth ratio is the ratio of

(A) the volume of the metal consumed to the volume of the oxide formed

(B) the mass of the metal consumed to the mass of the oxide formed

(C) the volume of the oxide formed to the volume of the metal consumed

(D) the mass of the oxide formed to the mass of the metal consumed

112. The compressibility coefficient of incompressible cake is

(A) 1 (B) 0

(C) –1 (D) ∞

113. If the radii of the ball mill and the ball are R and r, respectively, the critical speed (n_c) of the mill is given by

(A) $n_c = \frac{1}{2}\sqrt{\frac{g}{R-r}}$ (B) $n_c = \frac{1}{2\pi}\sqrt{\frac{g}{R-r}}$

(C) $n_c = \frac{1}{\pi}\sqrt{\frac{g}{R-r}}$ (D) $n_c = \frac{1}{2\pi}\sqrt{\frac{R-r}{g}}$

114. Match the size reduction equipments with the principles :

(a)	Ball mill	1.	compression
(b)	Jaw crushers	2.	attrition
(c)	Ultra fine grinders	3.	cutting
(d)	Knife cutter	4.	impact

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

115. Sphericity for a non-spherical particle is given by _____. Where D_P – Equivalent diameter of particle, S_P – Surface area of one particle, V_P – Volume of one particle

(A) $\frac{6V_P}{D_P S_P}$ (B) $\frac{V}{6 D_P S_P}$

(C) $\frac{D_P S_P}{V_P}$ (D) $\frac{V_P}{D_P S_P}$

116. The masticators that disintegrate scrap rubbers are called as

(A) Intensive mixers
(B) Extensive mixers
(C) Agitator
(D) Kneader

117. A filter acid is added to the slurry before filtration to

(A) decrease the porosity of the cake
(B) increase the porosity of the cake
(C) increase the compressibility coefficient of the cake
(D) decrease the compressibility coefficient of the cake

118. Horizontal axis and vertical axis rotor are types of

(A) nuclear reactor
(B) wind mill
(C) biogas reactor
(D) solar cell

119. Yeast is used in the manufacture of

(A) Penicillin
(B) Streptomycin
(C) Wine
(D) Lactose

120. Kinetic energy of the wind flowing across a wind turbine is used to derive

(A) electrical energy from wind
(B) thermal energy from wind
(C) bio energy from wind
(D) both (B) and (C)

121. Sulphuric acid containing 93.19% H_2SO_4 is transported in tanks made of

(A) Steel
(B) Iron
(C) Copper
(D) Zinc

122. Glass is

(A) a crystalline solid
(B) a undercooled liquid
(C) a solid having a definite melting point
(D) a solid of volatile oxides

123. A rubber that is extremely resistant to heat, weathering and ozone attack

(A) Urethane rubber
(B) Hypalon
(C) Natural rubber.
(D) Chloroprene

124. The maximum percentage content of N_2 in Urea is

(A) 16%
(B) 26%
(C) 46%
(D) 66%

125. Cigarette smoking constitute a major source of ———— in humans.

(A) Cadmium
(B) Cobalt
(C) Magnesium
(D) Potassium

126. Ratio of emissive power of a body to the emissive power of a perfectly black body is called

(A) emissivity
(B) absorptivity
(C) transmissivity
(D) reflectivity

127. In cassava starch, the average starch content varies from

(A) 20 – 30%
(B) 10 – 15%
(C) 35 – 45%
(D) 50 – 60%

128. The available P_2O_5 is Triple super phosphate is

(A) 1 to 11%
(B) 12 to 33%
(C) 34 to 43%
(D) 44 to 51%

129. Unit of molecular diffusivity 'D_{AB}' is

(A) m/s
(B) m^2/s
(C) m/s^2
(D) $\frac{mol}{m^2.s}$

130. Dilatant and Pseudoplastic fluids follow a power law

$$\tau_v g_c = K'\left(\frac{du}{dy}\right)^{n'}$$

where constant K' is

(A) flow consistency index

(B) non newtonium flow correction factor

(C) flow behaviour index

(D) shear stress correction factor

131. The unit of packing factor is

(A) m^{-1} (B) m^2/m^3

(C) m (D) dimension less

132. At a given equilibrium pressure, the concentration of adsorbed gas on adsorbent solid

(A) remains constant with change in temperature

(B) increases with increased temperature

(C) decreases with increased temperature

(D) decreases with decreasing temperature

133. The moisture contained by a substance which exerts an equilibrium vapor pressure equal to that of pure liquid at the same temperature is known as

(A) Equilibrium moisture (B) Bound moisture

(C) Unbound moisture (D) Free moisture

134. Chilton-Colburn analogy of momentum, heat and mass transfer is applicable

(A) When there is only skin friction

(B) When there are both skin friction and form drag

(C) When there is only form drag

(D) When heat transfer happens by radiation

135. In conduction heat transfer, the rate of heat transfer is given by $Q = K.A\frac{(T_1 - T_2)}{x}$, in which the ratio x/K is called as

(A) Thermal conductivity
(B) Thermal diffusivity
(C) Thermal resistance
(D) Thermal gradient

136. Wilson plot is used to determine

(A) film heat transfer coefficients
(B) overall heat transfer coefficients
(C) rate of heat flow
(D) thermal diffusivity

137. The LMTD correction factor for multipass exchangers is always

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

138. Molecularity of an elementary reaction $P + Q \rightarrow R + S$ is

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

139. In a steady state, CSTR the composition of the end stream

(A) is same as that in reactor
(B) is different as that in reactor
(C) depends on flow rate
(D) insufficient information

140. Reactions with very high activation energy are

(A) very sensitive to temperature
(B) temp insensitive
(C) always irreversiable
(D) always reversiable

141. From the Brunauer-Emmett-Teller plot, the intercept and slope are estimated as $2\times10^{-3}cm^{-3}$, $8\times10^{-3}cm^{-3}$ respectively. The monomolecular volume of the catalyst is

(A) $10\ cm^3$ (B) $1\ cm^3$

(C) $100\ cm^3$ (D) $7\ cm^3$

142. The half life period $(t_{1/2})$ of a zero order reaction $A \xrightarrow{K}$ products is equal to

(A) $\frac{C_{AO}}{2K}$ (B) $\frac{C_{AO}}{K}$

(C) $\frac{0.693}{K}$ (D) $1/K$

143. The reaction rate constants at two different temperatures T_1 and T_2 are related by

(A) $\ln\frac{K_2}{K_1} = E/R\left(1/T_2 - 1/T_1\right)$

(B) $\ln\frac{K_2}{K_1} = \frac{E}{R}\left(1/T_1 - 1/T_2\right)$

(C) $\exp\left(\frac{K_2}{K_1}\right) = E/R\left(1/T_1 - 1/T_2\right)$

(D) $\exp\left(\frac{K_2}{K_1}\right) = E/R\left(1/T_2 - 1/T_1\right)$

144. The conversion X_A and residence time τ data are collected for zero order liquid phase reaction in a stirred tank reactor. Which of the following will be a straight line?

(A) X_A vs τ (B) X_A vs. $\ln\tau$

(C) $\frac{X_A}{1-X_A}$ vs τ (D) $X_A(1-X_A)$ vs. τ

145. The conversion of a reactant, undergoing a first order reaction, at a time equal to three times the half life of the reaction is

(A) 0.875 (B) 0.5

(C) 0.425 (D) 0.3

146. The sequence in which three CSTR's of volume 5, 10 and 15 lt. will be connected in series to obtain the maximum production in a second order irreversiable reaction is

(A) 15, 10, 5 (B) 5, 10, 15

(C) 10, 5, 15 (D) 10, 15, 5

147. For a tubular reactor with space time 'τ' and residence time 'θ', the following statement holds

(A) τ and θ are always equal

(B) $\tau = \theta$ when fluid density changes in the reactor

(C) $\tau = \theta$ when fluid density remains constant

(D) $\tau = \theta$ for a non-isothermal reactor

148. Response of a linear control system for a change in load variable is called

(A) Frequency response (B) Transient response

(C) Serro problem (D) Regulator problem

149. The frequency at which maximum amplitude ratios attained is called _____ frequency.

(A) Cornor (B) Resonant

(C) Cross-over (D) Natural

150. Number of poles in a system with transfer function $\frac{2S+1}{S^2+3S+1}$

(A) 0 (B) 1

(C) 2 (D) 3

151. Choose the correct one from the following components and the respective conversions

(A) Converter (pressure to flow rate)

(B) Control valve (current to pressure)

(C) Controller – recorder (current to temperature)

(D) Transducer (temperature to current)

152. The accuracy of rotameter ranges from

(A) $\pm 0.25\%$ to $\pm 2\%$ (B) $\pm 0.5\%$ to $\pm 1.5\%$

(C) $\pm 1\%$ to $\pm 3\%$ (D) $\pm 1.5\%$ to $\pm 3\%$

153. One inch of water is equal to

(A) 6.9 kPa (B) 14.7 Psi

(C) 133 Pa (D) 24 Pa

154. Offset can be completely eliminated by the use of

(A) Proportional controller

(B) Proportional derivative controller

(C) Proportional integral controller

(D) Proportional integral derivative controller

155. A stable system is one that produces

(A) a bounded output for unbounded input

(B) a unbounded output for a bounded input

(C) a bounded output for bounded input

(D) a unbounded output for any type of input

156. For a tank temperature control system, use of proportional derivative controller would result in the

(A) decrease of the phase lag for increasing frequencies

(B) increase of the phase lag for increasing frequencies

(C) decrease of the phase lag at all frequencies

(D) increase of the phase lag at all frequencies

157. The number of crystal forms based on the angles of the individual faces are

(A) 3
(B) 4
(C) 7
(D) 9

158. The technique used to obtain pure water from dilute aqueous solutions is

(A) Osmosis
(B) Reverse osmosis
(C) Dialysis
(D) Filtration

159. The separation accomplished mainly by including large molecules or collodial partial from pores of membrane is

(A) Reverse osmosis
(B) Ultra filtration
(C) Micro filtration
(D) Dialysis

160. The term used for separations carried out at high pressure with very fine particles and high flow rates is

(A) GC
(B) GPC
(C) LC
(D) HPLC

161. The advantages of reverse osmosis is

(A) Separation takes places at room temperature
(B) Separation takes place at elevated pressures
(C) Phase change is involved
(D) None of these

162. The separation process in which one or more components of a liquid mixture diffuse through a selective membrane evaporate under low pressure on the downstream side is known as

(A) Pervaporation
(B) Permeation
(C) Crystallization
(D) Dialysis

163. Polyethylene is a polymer obtained by the polymerization of

(A) ethane (B) ethylene

(C) isoprene (D) butadiene

164. Solubility in a super critical fluid are strong functions of

(A) Compositions (B) Mobility of ions

(C) Temperature (D) Osmosis

165. In decaffeination of coffee, the caffeine is separated from CO_2 by adsorption on

(A) Silica gel (B) Activated carbon

(C) Alumina (D) Zeolite

166. Flat sheet membranes for reverse osmosis are usually used in

(A) Spiral – wand modulus (B) Frame modulus

(C) Tubular modulus (D) Hollow modulus

167. The separation technique used for separation of multi component mixtures of gas or liquids is

(A) Ion exchange (B) Absorption

(C) Chromatography (D) Adsorption

168. The capacity of anion resins is expressal as

(A) Milli equivalents per gram of dry hydrogen – form resins

(B) Gram of dry chlorine – form resins

(C) Milli equivalents per gram of dry sodium form resins

(D) Gram of dry nitrogen – form resins

169. ICRP stands for

(A) Indian Commission for Radiological Protection

(B) International Commission for Radiological Protection

(C) Indian Commission for Radiological Prevention

(D) International Commission for Radiological Prevention

170. The concentration to which workers can be exposed to eight hours per day without any adverse effect is given by

(A) LD_{40} – TLV

(B) TLV – TWA

(C) TLV – STEL

(D) C – TLV

171. Chlorination is done for the removal of

(A) Sediments

(B) Hardness

(C) Bacteria

(D) Suspended solids

172. An example for Class II flammable liquid is

(A) n – pentane

(B) kerosene

(C) benzene

(D) phenol

173. The situation that, in particular circumstances could lead to the loss to a human being and the loss of an inherent quality suffered by an entity is termed as

(A) RISK

(B) HAZARD

(C) HARM

(D) DAMAGE

174. The principal by product from the anaerobic decomposition of the organic matter in waste water is

(A) Hydrogen sulfide gas

(B) Carbon dioxide gas

(C) Ammonia gas

(D) Methane gas

175. Inhalation of ———— particles cause asbestosis.

(A) asbestos
(B) chromium
(C) cadmium
(D) smog

176. Smelters are the main source of ————, a toxic metal emitted into the atmosphere as particulate matter.

(A) Cadmium
(B) Chromium
(C) Magnesium
(D) Potassium

177. The O_2 starvation characteristic of haemoglobin in blood stream is called as

(A) Angel man's syndrome
(B) Barth syndrome
(C) Blue baby syndrome
(D) Down's syndrome

178. ———— is a chemical decomposition of waste brought about by heating the waste in absence of oxygen.

(A) Pyrolysis
(B) Incineration
(C) Recovery
(D) Biological reprocessing

179. e-waste is

(A) Waste from nuclear power generation
(B) Eco friendly waste
(C) Hazardous chemical waste
(D) Obsolete electronic waste

180. The equation $x = \alpha x_1 + (1 - \alpha) x_2$, when $0 \leq \alpha \leq 1$, represents

(A) Elliptical set
(B) Hyperbolic set
(C) Concave set
(D) Convex set

181. Which of the following is not a vulcanising agent

(A) Sulphur
(B) Selenium
(C) Tellurium
(D) Salicylic acid

182. When the model is linear in coefficients, they can be estimated by

(A) Non linear regression
(B) Linear regression
(C) Least squares
(D) Taylor approximation

183. The equation $Y = a_0 + a_{11}\, x_1^2 + a_{12} x_1 x_2 + \ldots$ is

(A) linear in variables and coefficients
(B) non linear in coefficients and linear in variables
(C) linear in coefficients and non linear in variables
(D) non linear in variables and coefficients

184. Tubular reactor with axial flow falls into which category of model?

(A) Steady state
(B) Unsteady state
(C) Lumped parameter
(D) Distributed parameter

185. Unsteady state model is called

(A) Stationary model
(B) Transient model
(C) Distributed parameter model
(D) Lumped parameter model

186. When the dependent variable or their derivations appear only to the first power, then the model is said to be

(A) Lumped Parameter
(B) Distributed Parameter
(C) Non Linear
(D) Linear model

187. The objective function of capital costs for a cylindrical pressure vessel is given by

(A) $\left(\frac{\pi D^2}{2}\right)+\left(\frac{4V}{D}\right)$ (B) $(\pi D^2)+(4V/D)$

(C) $(\pi D^2)+(4V)$ (D) $4V/D$

188. If the degrees of freedom is less than zero, then the problem is

(A) Exactly determined (B) Under determined

(C) Over determined (D) Not determined

189. $\lim_{n\to\infty}\frac{x^4+1}{3x^3+80x+1}$ is

(A) 0 (B) 1/2

(C) infinite (D) 1

190. The system of equations $3x + 9y = 15$, $7x + 21y = 35$

(A) has infinite solution (B) has no unique solution

(C) has only one solution (D) has only two solutions

191. The inverse of matrix $\begin{bmatrix}2 & 0\\ 0 & 3\end{bmatrix}$ is

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

(C) $\frac{1}{6}\begin{bmatrix}3 & 0\\ 0 & 2\end{bmatrix}$ (D) $\frac{1}{6}\begin{bmatrix}2 & 0\\ 0 & 3\end{bmatrix}$

192. Lyophilization is a process of drying

(A) of heat sensitive products
(B) of suspended particles
(C) of non-porous solids
(D) of solids and pastes

193. Match the substances with their thermal conductivity

	Substance		Thermal conductivity, W/m°C
(a)	Air	1.	17
(b)	Water	2.	415
(c)	Stainless steel	3.	0.5
(d)	Silver	4.	0.014

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

194. A centrifugal pump with air in its casing is air bound and displacing this air by drawing liquid into the suction line by an independent source to operate the pump is called as

(A) Pump hammering
(B) Pump priming
(C) NPSH of pump
(D) Pump cavitation

195. Flexible foam for mattresses is usually made of

(A) Polymethane
(B) Poly propylene
(C) Polyvinyl chloride
(D) Butyl rubber

196. The inverse of the matrix $\begin{pmatrix} 1 & -1 \\ -1 & -1 \end{pmatrix}$

(A) does not exist

(B) $\begin{pmatrix} 1 & 1 \\ 1 & -1 \end{pmatrix}$

(C) $\begin{pmatrix} 0.5 & -0.5 \\ -0.5 & -0.5 \end{pmatrix}$

(D) $\begin{pmatrix} 1 & -1 \\ 1 & -1 \end{pmatrix}$

197. The differential equation $\frac{d^2x}{dt^2} + 3\frac{dx}{dt} + 2x = 0$ will have a solution of the form

(A) $c_1 e^{3t} + c_2 e^{2t}$

(B) $c_1 e^{-2t} + c_2 e^{-t}$

(C) $c_1 e^{-3t} + c_2 e^{-2t}$

(D) $c_1 \cdot e^{-5t}$

198. The complex conjugate of $\frac{1}{1+i}$ is

(A) $\frac{1}{1-i}$

(B) $1-i$

(C) $0.5\,(1-i)$

(D) $2\,(1-i)$

199. Laplace transfer of unit impulse function is

(A) 0

(B) 1

(C) 1/s

(D) $1/s^2$

200. The differential equation $\frac{d^2x}{dt^2} + 9\frac{dx}{dt} + 20x = 0$ will have a solution of the form

(A) $c_1 e^{-5t} + c_2 e^{-4t}$

(B) $c_1 e^{5t} + c_2 e^{4t}$

(C) $c_1 e^{-5t} + c_2 e^{4t}$

(D) $c_1 e^{5t} + c_2^{-4t}$

SPACE FOR ROUGH WORK

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