

प्रश्न पुस्तिका / QUESTION BOOKLET

विषय / Subject :

Chemical Engineering

ACF

कोड / Code : OP99

पुस्तिका में पृष्ठों की संख्या /

Number of Pages in Booklet : 32

पुस्तिका में प्रश्नों की संख्या /

Number of Questions in Booklet : 200

Chemical Engineering

OP
99

विषय कोड

A

बुकलेट
सीरीज

समय / Time : 3 घंटे / Hours

पूर्णांक / Maximum Marks : 100

INSTRUCTIONS

1. Answer all questions.
2. All questions carry equal marks.
3. Only one answer is to be given for each question.
4. If more than one answers are marked, it would be treated as wrong answer.
5. Each question has four alternative responses marked serially as 1, 2, 3, 4. You have to darken only one circle or bubble indicating the correct answer on the Answer Sheet using BLUE BALL POINT PEN.
6. 1/3 part of the mark(s) of each question will be deducted for each wrong answer. (A wrong answer means an incorrect answer or more than one answers for any question. Leaving all the relevant circles or bubbles of any question blank will not be considered as wrong answer.)
7. The candidate should ensure that Series Code of the Question Paper Booklet and Answer Sheet must be same after opening the envelopes. In case they are different, a candidate must obtain another Question Paper of the same series. Candidate himself shall be responsible for ensuring this.
8. Mobile Phone or any other electronic gadget in the examination hall is strictly prohibited. A candidate found with any of such objectionable material with him/her will be strictly dealt as per rules.
9. Please correctly fill your Roll Number in O.M.R. Sheet. 5 marks will be deducted for filling wrong or incomplete Roll Number.

Warning : If a candidate is found copying or if any unauthorised material is found in his/her possession, F.I.R. would be lodged against him/her in the Police Station and he/she would liable to be prosecuted under Section 3 of the R.P.E. (Prevention of Unfairmeans) Act, 1992. Commission may also debar him/her permanently from all future examinations of the Commission.

निर्देश

1. सभी प्रश्नों के उत्तर दीजिए ।
2. सभी प्रश्नों के अंक समान हैं ।
3. प्रत्येक प्रश्न का केवल एक ही उत्तर दीजिए।
4. एक से अधिक उत्तर देने की दशा में प्रश्न के उत्तर को गलत माना जाएगा ।
5. प्रत्येक प्रश्न के चार वैकल्पिक उत्तर दिये गये हैं, जिन्हें क्रमशः 1, 2, 3, 4 अंकित किया गया है। अभ्यर्थी को सही उत्तर निर्दिष्ट करते हुए उनमें से केवल एक गोले अथवा बबल को उत्तर-पत्रक पर नीले बॉल प्वाइंट पेन से गहरा करना है ।
6. प्रत्येक गलत उत्तर के लिए प्रश्न अंक का 1/3 भाग काटा जायेगा। गलत उत्तर से तात्पर्य अशुद्ध उत्तर अथवा किसी भी प्रश्न के एक से अधिक उत्तर से है । किसी भी प्रश्न से संबंधित गोले या बबल को खाली छोड़ना गलत उत्तर नहीं माना जायेगा।
7. प्रश्न-पत्र पुस्तिका एवं उत्तर पत्रक के लिफाफे की सील खोलने पर परीक्षार्थी यह सुनिश्चित कर लें कि उसके प्रश्न-पत्र पुस्तिका पर वही सीरीज अंकित है जो उत्तर पत्रक पर अंकित है। इसमें कोई भिन्नता हो तो वीक्षक से प्रश्न-पत्र की ही सीरीज वाला दूसरा प्रश्न-पत्र का लिफाफा प्राप्त कर लें। ऐसा न करने पर जिम्मेदारी अभ्यर्थी की होगी।
8. मोबाइल फोन अथवा इलेक्ट्रॉनिक यंत्र का परीक्षा हॉल में प्रयोग पूर्णतया वर्जित है। यदि किसी अभ्यर्थी के पास ऐसी कोई वर्जित सामग्री मिलती है तो उसके विरुद्ध आयोग द्वारा नियमानुसार कार्यवाही की जायेगी।
9. कृपया अपना रोल नम्बर ओ.एम.आर. पत्रक पर सावधानी पूर्वक सही भरें। गलत अथवा अपूर्ण रोल नम्बर भरने पर 5 अंक कुल प्राप्तांकों में से अनिवार्य रूप से काटे जाएंगे।

चेतावनी : अगर कोई अभ्यर्थी नकल करते-पकड़ा जाता है या उसके पास से कोई अनधिकृत सामग्री पाई जाती है, तो उस अभ्यर्थी के विरुद्ध पुलिस में प्राथमिकी दर्ज कराई जायेगी और आर. पी. ई. (अनुचित साधनों की रोकथाम) अधिनियम, 1992 के नियम 3 के तहत कार्यवाही की जायेगी। साथ ही आयोग ऐसे अभ्यर्थी को भविष्य में होने वाली आयोग की समस्त परीक्षाओं से विवर्जित कर सकता है।

OP99_A]

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[Contd...

- 1 The unit of viscosity in CGS system is commonly known as Poise. The dimension of Poise is
- (1) g/cm.s^2 (2) g.cm/s
 (3) $\text{g.cm}^2/\text{s}$ (4) g/cm.s
- 2 The equation of continuity applies to
- (1) incompressible fluids
 (2) compressible fluids
 (3) highly viscous fluids
 (4) both incompressible and compressible fluids
- 3 Stokes' law is valid (strictly theoretically) when particle Reynolds number is $N_{Re,p}$ is
- (1) much less than one (2) equal to one
 (3) much greater than one (4) none of the foregoing
- 4 Two spherical particles, one of dia d_1 and the other of dia d_2 , settle freely through a pool of liquid and the settling is in accordance with Stoke's law. $d_1:d_2 = 1 : 2$. Therefore, $u_1 : u_2$ is equal to
- (1) 1 : 2 (2) 2 : 1
 (3) 4 : 1 (4) 1 : 4
- 5 Cavitation will not occur if the sum of the velocity and pressure heads at the suction is
- (1) zero
 (2) much larger than the vapour pressure of the liquid
 (3) much smaller than the vapour pressure of the liquid
 (4) equal to the vapour pressure of the liquid.
- 6 In constant – pressure filtration,
- (1) the filtrate flow rate is maximum at the start and decreases continuously to the end
 (2) the filtrate flow rate is minimum at the start and increases continuously to the end
 (3) the filtrate flow rate is constant throughout,
 (4) increases slowly to a constant value



- 7 Monel is an alloy of
 (1) iron and silicon (2) copper and chromium
 (3) nickel and molybdenum (4) copper and nickel
- 8 Which of the following metals is called metallic glass?
 (1) lead (2) molybdenum
 (3) tantalum (4) titanium
- 9 A rotary drum filter is –
 (1) a continuous vacuum filter
 (2) a discontinuous pressure filter
 (3) a continuous pressure filter
 (4) none of the above
- 10 The major material of construction in a soda ash plant is
 (1) Cast iron (2) PVC
 (3) Graphite (4) Stainless steel
- 11 The corrosion resistance of stainless steel is due to the
 (1) formation of a thin oxide film on the surface
 (2) formation of graphitic carbon on the surface
 (3) formation of an inert Fe - C - Fe type complex chain
 (4) none of the foregoing
- 12 The dimension of the rate constant k for an n-th order reaction is
 (1) (time)⁻¹ (concentration)⁻¹ (2) (time)¹⁻ⁿ (concentration)⁻¹
 (3) (time)⁻¹ (concentration)¹⁻ⁿ (4) (time)⁻¹ (concentration)ⁿ
- 13 For an autocatalytic reaction $A + R \rightarrow R + R$, the rate vs. concentration of A profile is
 (1) linear (2) exponential
 (3) parabolic (4) none of these
- 14 The dimension of “space velocity” is
 (1) [length] [time⁻¹]
 (2) [time⁻¹]
 (3) [length] [time]
 (4) none of these; it is dimensionless

- 15 Consider a homogeneous reaction of the type $A \xrightarrow{k_1 \text{ (1st order)}} R$ and also $A \xrightarrow{k_2 \text{ (2nd order)}} S$. R is the desired product and its concentration is to be maximized by selection of a proper reactor. Which reactor system will you choose in order to get the highest R – concentration (under otherwise uniform conditions)?
- (1) Batch reactor (2) PFR
 (3) single CSTR (4) Five CSTRs in series
- 16 The values of C_p and C_v for a monatomic gas are
- (1) 5 and 3 (2) 3.987 and 1.987
 (3) 0.66 and 1.987 (4) None of the above.
- 17 The triple point of most fluids is close to
- (1) Boiling point (2) Melting point
 (3) Critical point (4) none of these
- 18 The chemical potential of a species in an ideal solution depends on
- (1) Temperature (2) Pressure
 (3) Composition of solution (4) All of these.
- 19 A mixture of ideal gases is an ideal solution
- (1) Never.
 (2) Only at low pressure.
 (3) Only at low pressure and temperature well above critical point.
 (4) Always.
- 20 In flash vaporization, the product vapour
- (1) is always in equilibrium with the liquid leaving the flash chamber
 (2) is never in equilibrium with the liquid leaving the flash chamber
 (3) may be in equilibrium with the liquid leaving the flash chamber and the extent of equilibration depends on the vapor – liquid contact time in the chamber
 (4) is 100% pure.



- 21 Mercaptans present in light distillates are removed by extraction with
- (1) concentrated sulfuric acid solution
 - (2) concentrated phosphoric acid solution
 - (3) aqueous caustic soda solution
 - (4) none of these
- 22 The operation which is employed for the removal of caffeine from coffee is
- (1) adsorption
 - (2) crystallization
 - (3) solvent extraction
 - (4) fractional distillation
- 23 Adsorption of a gas onto a solid
- (1) is an exothermic process
 - (2) is an endothermic process
 - (3) does not product any heat effect
 - (4) may be exothermic or endothermic, depending on the system
- 24 Absorptivity for a blackbody is
- (1) zero
 - (2) 0.5
 - (3) 1.0
 - (4) none of the above
- 25 Heat transfer coefficients for fluids flowing through pipes in laminar region are calculated by using the correlation of Sieder and Tate. Which one of the following is the correlation proposed by Sieder and Tate ?
- (1) $Nu = 0.023 (Re)^{0.8} (Pr)^{0.33} (\mu / \mu_w)^{0.14}$
 - (2) $Nu = 1.86 [(Re) (Pr) (D/L)]^{1/3} (\mu / \mu_w)^{0.14}$
 - (3) $Nu = 2.0 + 0.60 (Re)^{0.50} (Pr)^{1/3}$
 - (4) None of the above
- 26 In a fin tube heat exchanger,
- (1) only heat transfer area is augmented
 - (2) only heat transfer coefficient is augmented
 - (3) both heat transfer area and heat transfer coefficient are augmented
 - (4) none of the above
- 27 For laminar flow of Newtonian fluids in pipes, the ratio of average velocity to maximum velocity is equal to
- (1) 0.5
 - (2) 1.0
 - (3) 1.5
 - (4) 2.0

- 28 Forces acting on a particle settling in fluid are
- (1) gravitational and buoyant forces
 - (2) centrifugal and drag forces
 - (3) gravitational or centrifugal, buoyant and drag forces
 - (4) external, drag and viscous forces
- 29 Sedimentation on commercial scale occurs in
- (1) classifiers
 - (2) rotary drum filters
 - (3) Thickeners
 - (4) cyclones
- 30 Material of construction for heat exchanger tubes handling sea water is
- (1) mild steel
 - (2) stainless steel
 - (3) cupro - nickel alloys (70 % Cu, 30 % Ni)
 - (4) aluminium

- 31 The rate expression for the reaction between H_2 and Br_2 to produce

$$HBR (H_2 + Br_2 \rightarrow HBR) \text{ is given by rate} = \frac{k_1 [H_2] [Br_2]^{1/2}}{k_2 + \frac{[HBr]}{[Br_2]}}$$

The reaction is

- (1) stoichiometric
 - (2) fundamental
 - (3) elementary
 - (4) non-elementary
- 32 Which of the following plots is called Mollier diagram?
- (1) h-s
 - (2) h- P
 - (3) T-s
 - (4) None of these
- 33 Van-der Waal's equation of state improved over the ideal gas equation of state with the following assumptions
- (1) infinitesimal molecular volume
 - (2) no inter molecular force
 - (3) both (1) and (2)
 - (4) none of the above.



- 34 In which type of impeller used in liquid agitation, flow is coaxial?
- (1) Turbine (2) Propeller
(3) Paddle (4) none of these
- 35 Final control element is a
- (1) Valve (2) Switch
(3) Signal (4) none of these
- 36 In petroleum industry, which of the flow meters is normally used for heavy liquids characterised by high viscosity ?
- (1) nutating disc meter (2) orifice meter
(3) nozzle (4) rotating vane/lobe meter
- 37 Schmidt number is a ratio of
- (1) momentum diffusivity to mass diffusivity
(2) thermal diffusivity to mass diffusivity
(3) thermal diffusivity to momentum diffusivity
(4) None of these.
- 38 Absorption factor is defined as
- (1) mGL (2) mG/L
(3) G/mL (4) L/mG
- 39 During evaporative cooling process with recirculated water, which one of the following will remain constant?
- (1) partial pressure of vapor (2) relative humidity
(3) dry bulb temperature (4) wet bulb temperature
- 40 The driving force for separation by distillation is the highest
- (1) at total reflux
(2) at minimum reflux
(3) at an intermediate reflux between the total and the minimum
(4) at the point of intersection of the enriching section operating line with the equilibrium curve

- 41 Ponchon-Savarit method of calculation of number of theoretical plates of a distillation column is based on
- (1) material balance only
 - (2) enthalpy balance only
 - (3) both material and enthalpy balances
 - (4) assumption of constant molal overflow
- 42 For laminar flow in a pipe, the Fanning friction factor depends on Reynolds number according to the relation
- (1) $f = 24/Re$
 - (2) $f = 18.5/Re$
 - (3) $f = 16/Re$
 - (4) none of the above
- 43 In a certain process, one needs fluid flow in a given direction and the valve is to open or close by the fluid pressure. Which of the following valves permits fluid flow in one direction only ?
- (1) gate valve
 - (2) globe valve
 - (3) check valve
 - (4) any of the above
- 44 Filter aids are added to the slurry prior to filtration in order to form
- (1) compact cakes of low porosity
 - (2) cakes of increased porosity
 - (3) crystalline cakes
 - (4) none of the above
- 45 Impellers of 98% sulfuric acid pump are made of
- (1) mild steel
 - (2) cast iron
 - (3) lead
 - (4) Inconel (a nickel - chrome alloy)
- 46 An isothermal gas phase reaction, $A \rightarrow 5B$ is being conducted initially with pure A. The expansion factor for this reaction, $\epsilon_A = \rightarrow$
- (1) 1
 - (2) 2
 - (3) 3
 - (4) 4



- 47 An irreversible first order reaction occurs in presence of a spherical porous catalyst particle. The expression for effectiveness factor for a spherical catalyst particle is given by

$$(1) \quad \eta = \frac{3}{\phi} \left(\frac{1}{\tanh \phi} - \frac{1}{\phi} \right) \qquad (2) \quad \eta = \frac{1}{\phi} \left(\frac{1}{\coth \phi} - \frac{1}{\phi^2} \right)$$

$$(3) \quad \eta = \frac{3\phi}{\tanh \phi} \qquad (4) \quad \eta = 3 \tanh \phi - \frac{\coth \phi}{\phi}$$

Note : $\phi = R \sqrt{\frac{k}{D_c}}$ R is the radius of the catalyst particle

- 48 For an ideal gas enthalpy

- (1) Increases with pressure
- (2) Decreases with pressure.
- (3) Independent of changes in pressure
- (4) None of these

- 49 The constant pressure heat capacity is defined as

$$(1) \quad C_P = \left(\frac{\partial h}{\partial T} \right)_V \qquad (2) \quad C_P = \left(\frac{\partial h}{\partial T} \right)_P$$

$$(3) \quad C_P = \left(\frac{\partial h}{\partial P} \right)_T \qquad (4) \quad \text{None of these}$$

- 50 A paper reports VLE data for a binary hydrocarbon mixture. Experimental data shows formation of an azeotrope and the author claims that the liquid behavior can be fitted well by a Regular solution model. Which of the following conclusions may be made about the azeotrope?

- (1) It must be maximum boiling azeotrope
- (2) It must be a minimum boiling azeotrope
- (3) There is no way to tell from the above statement whether it will be a maximum boiling or minimum boiling azeotrope
- (4) The author's claim about the Regular solution model is wrong as Regular solution model forbids formation of any azeotrope

- 51 For bulk separations adsorption becomes competitive with distillation when the relative volatility is
- (1) less than about 1.25 (2) between 1.5 and 2.0
 (3) more than 2.0 (4) between 2 and 2.5
- 52 In equilateral triangular coordinate a point on any side of the triangle represents
- (1) a pure component (2) a binary mixture
 (3) a ternary mixture (4) none of the above
- 53 Corresponding to Prandtl number in heat transfer, the dimensionless group in mass transfer is
- (1) Reynolds number (2) Sherwood number
 (3) Peclet number (4) Schmidt number.
- 54 Measurement of pressure in ammonia reactor is done by
- (1) Bourdon gauge (2) U-tube manometer
 (3) Pirani gauge (4) Inclined tube manometer
- 55 A P & I controller with an error of 9%, a gain of 2.3 and a reset of 0.94 min/repeat in open loop would produce an output signal that would ramp at the rate of :
- (1) 42.7%/min (2) 19.5%/min
 (3) 20.7%/min (4) 22.0%/min
- 56 The total vapor pressure of two immiscible liquids is equal to
- (1) $P = x_1 \gamma_1 P_1^{\text{vap}} + x_2 \gamma_2 P_2^{\text{vap}}$
 (2) Same as (1) but $\gamma_1 = 1 = \gamma_2$
 (3) Same as (2) but $x_1 = 1 = x_2$
 (4) None of the above.
- 57 In on-off control, the value of the controller output depends only upon:
- (1) the amount of offset in the system
 (2) the sign of the error
 (3) the rate at which the error has occurred
 (4) how long the error has existed



- 58 Consider the reaction $N_2 + 3 H_2 \xrightleftharpoons{K} 2NH_3$. The same reaction can also be written as $\frac{1}{2}N_2 + \frac{3}{2}H_2 \xrightleftharpoons{K^*} NH_3$. Where K and K* are the respective equilibrium constants. Then
- (1) $K = 0.5 K^*$ (2) $K = K^*$
 (3) $K = 2 K^*$ (4) $K = K^{*2}$
- 59 Enthalpy for the reaction $C + O_2 \rightarrow CO_2$ is
- (1) Positive (2) Negative
 (3) Zero (4) None of these
- 60 The compressibility factor (Z) of an ideal gas is always
- (1) 0 (2) 1
 (3) > 1 (4) < 1
- 61 The degree of freedom (F) of non-reacting system is equal to
- (1) $2-n+N$ (2) $2+n+N$
 (3) $2-N-n$ (4) $n+N-2$
- Where n = number of phases
 N = number of chemical species
- 62 The triple point of water occurs at 0.00602 atm &
- (1) 0.01 °C (2) 444.6 °C
 (3) 100 °C (4) None of these
- 63 Value of heat of formation which indicates that products is least stable, is
- (1) -64.8 Kcal (2) -94 Kcal
 (3) 64.8 Kcal (4) 94 Kcal
- 64 At absolute zero temperature, all substances have same
- (1) Heat capacity (2) Crystalline structure
 (3) Entropy (4) None of these

- 65 Temperature affect
- (1) Fugacity (2) Activity co-efficient
(3) Free energy (4) All of these
- 66 A piece of metal of specific gravity 7 floats in mercury of specific gravity 13.6. what fraction of its volume is under mercury ?
- (1) 0.5 (2) 0.4
(3) 0.515 (4) None of these
- 67 If the pressure at the inlet of a pipe is 90 Kg/cm² & pressure drop over the pipe line is 10 Kg/cm², then efficiency of transmission is
- (1) 66.6% (2) 77.7%
(3) 55.5% (4) 88.8%
- 68 Pressure at an elevation of 2000 m in an isothermal atmosphere assuming T = 20 °C & P_{atm} = 100 kPa is
- (1) 87 kPa (2) 82 kPa
(3) 79 kPa (4) 21 kPa
- 69 The shear stress at a point in a glycerine mass in motion if velocity gradient is 0.25 m/s/m, will be
- (1) 0.0236 kg/m² (2) 0.02036 kg/m²
(3) 0.0024 kg/m² (4) None of these
- 70 For laminar flow in a pipe, V is equal to
- (1) U_{max} (2) 0.5 U_{max}
(3) 0.25 U_{max} (4) 2 U_{max}
- 71 Transfer of heat by molecular collision is called
- (1) Conduction (2) Convection
(3) Radiation (4) All of these
- 72 Depth of oil having specific gravity 0.6 to produce a pressure of 3.6 kg/cm² will be
- (1) 40 cm (2) 36 cm
(3) 50 cm (4) 60 cm



- 73 Prandtl number for air is
- (1) 0.65 (2) 0.75
(3) 6.5 (4) 65
- 74 A furnace wall of thickness 1 m and of surface area 2m^2 , is made of a material whose thermal conductivity is $1\text{ KJ/hr m }^\circ\text{C}$. The temperature of inner surface wall is 1000°C and of outer surface is 200°C . heat flow through the wall in KJ/hr will be
- (1) 2000 (2) 1600
(3) 1200 (4) 800
- 75 Ratio of the thermal conductivity of water to that of ice is approximately
- (1) 0.25 (2) 0.5
(3) 1.0 (4) 2.0
- 76 The Knudsen diffusivity is proportional to
- (1) $T^{-1/2}$ (2) $T^{1/2}$
(3) T (4) $1/T$
- 77 Bernoulli's equation cannot be applied when the flow is
- (1) Rotational (2) Turbulent
(3) Unsteady (4) All of the above
- 78 Generally tower packing are made of
- (1) Quartz (2) Coke
(3) Clay (4) Stone ware
- 79 The specific heat of concentrated orange juice is $3.8\text{ kilo-joules per kg }^\circ\text{C}$. How much heat must be removed to cool 3.0 kg of juice from 30°C to 0°C ?
- (1) 24 KJ (2) 38 KJ
(3) 340 KJ (4) 600 KJ
- 80 Flooding results in
- (1) Low efficiency (2) High efficiency
(3) High gas velocity (4) None of these



- 81 Highest value of emissivity is of
- (1) Ice (2) Carbon
(3) Rubber (4) Paper
- 82 The rate of reaction between a and b increases by a factor of 50, when the concentration of a is increased 10 folds, the order of reaction with respect to a is:
- (1) 5 (2) 0
(3) 1 (4) 15
- 83 Space time in flow reactor is
- (1) Usually equal to residence time
(2) The reciprocal of the space velocity
(3) Both (1) and (2)
(4) None of these.
- 84 For isothermal gas phase reaction $A \rightarrow B$ the fractional change in volume of the system between no conversion and complete conversion is
- (1) 1 (2) 3
(3) 2 (4) $2/3$
- 85 The gas absorption from dilute solution under isothermal conditions give:
- (1) Straight equilibrium line.
(2) Straight operating line
(3) Straight equilibrium and operating line both.
(4) None of these.
- 86 For identical feed composition, flow rate, conversion and for zero order reaction, the ratio of value of mixed reactor to the volume of plug reactor is
- (1) 0 (2) 1
(3) <1 (4) >1
- 87 The dispersion number of perfect mixed flow is:
- (1) 0 (2) >500
(3) Infinity (4) <2100



- 88 The eddy diffusivity for a liquid in a plug flow must be
(1) 1 (2) 0
(3) infinity (4) Between 0 to 1
- 89 If time required to change the concentration of reactant to half its original value is independent of the initial concentration, the order of reaction is
(1) 0 (2) 1
(3) 2 (4) 3
- 90 For many coatings, denaturation begin to occur at
(1) 25°C (2) 35°C
(3) 45°C (4) 60°C
- 91 Pneumatic controllers are used to control upto a distance of about
(1) 350 m (2) 500 m
(3) 1000 m (4) 5000 m
- 92 The rate of forward reaction, at chemical equilibrium is compared to the rate of backward reaction is
(1) More (2) Less
(3) Equal (4) Equal or less
- 93 Most expensive controller is
(1) P-controller (2) PI-controller
(3) PID-controller (4) PD-controller
- 94 First empirical temperature scale is
(1) Fahrenheit scale (2) Reaumer scale
(3) Celsius scale (4) Thermodynamic celsius scale
- 95 Platinum resistance thermometer can be used upto
(1) 419.58°C (2) 630.74°C
(3) 961.93°C (4) 1064.43°C



- 96 The flow meter which can be used to measure the flow rate of hostile acids or alkalis is
- (1) Rotameter (2) Magnetic flow meter
 (3) Orifice meter (4) Venturi meter
- 97 Bimetallic thermometers are used to measure the temperature in the range of
- (1) -20 to 1600°C (2) 300 to 1100°C
 (3) 800 to 2000°C (4) -20 to 300°C
- 98 Which of the following controller has the maximum offset?
- (1) P -controller (2) PI-controller
 (3) PD-controller (4) PID-controller
- 99 A pressure guage 0-100 Pa has a guaranteed accuracy of 1% of full scale deflection. The limiting error while reading 25 Pa will be
- (1) 1% (2) 2%
 (3) 2.4% (4) 4%
- 100 Active transducer is
- (1) Photo-emissive cell (2) Photo-voltaic cell
 (3) Selsyn (4) All of these
- 101 The resistance of thermistor at 300 K is 5000 Ω . Its resistance temperature coefficient is 0.04/°C. a measurement with a lead resistance of 10 Ω will cause an error of
- (1) 0.025°C (2) 0.05°C
 (3) 0.075°C (4) 0.10°C
- 102 Voltmeter is a galvanometer with.
- (1) High resistance (2) Low resistance
 (3) Both (1) and (2) (4) Uncertain.



- 103 Viscosity of a fluid with specific gravity 1.3 is measured to be 0.0034 Ns/m^2 . Its kinematic viscosity, in m^2/s is
- (1) 2.6×10^{-6} (2) 4.4×10^{-6}
(3) 5.8×10^{-6} (4) 7.2×10^{-6}
- 104 For turbulent fluid flow through pipes, the kinetic energy and momentum correction factors are practically equal to
- (1) 0.5 (2) 1
(3) 2 (4) 4
- 105 In hindered settling, particles are
- (1) placed farther from the wall
(2) near each other
(3) not affected by other particles and the wall
(4) none of these
- 106 For spheres and cubes, sphericity is equal to one. For a cylinder whose length is equal to diameter, sphericity is equal to –
- (1) 0.28 (2) 0.65
(3) 0.73 (4) 1.0
- 107 The thickness of cakes formed on industrial rotary vacuum filters is usually between
- (1) 0.5 and 2 mm (2) 3.2 and 38 mm
(3) 80 and 100 mm (4) 200 and 400 mm
- 108 Which one of the following materials contains copper?
- (1) SS 321 (2) Inconel 0.05%
(3) Monel (4) Karbate

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

(1) $-r_A = -\frac{1}{3}r_B = \frac{1}{5}r_C = \frac{1}{7}r_D$

(2) $-r_A = -3r_B = 5r_C = 7r_D$

(3) $-r_A = -\frac{1}{3}r_B = -5r_C = -7r_D$

(4) $-r_A = \frac{1}{3}r_B = -\frac{1}{5}r_C = -\frac{1}{7}r_D$

110 An isothermal gas phase reaction, $A \rightarrow 3B$, is being conducted by starting with pure A in a variable volume batch reactor. Initially, the reactor volume is 1 L. When 50% conversion of A has been achieved, reactor volume is

(1) 1 L

(2) 1.5 L

(3) 2L

(4) 3 L

111 The Thiele modulus for a gas-phase first-order isothermal reaction for a spherical catalyst particle is found to be 2. The catalyst effectiveness factor is

(1) 0.33

(2) 0.49

(3) 0.80

(4) 0.91

112 Natural gas containing CH_4 (77%), CO_2 (4%), C_2H_6 (5%) and rest N_2 is compressed to a pressure of 2 atm. What is the partial pressure (atm) of CH_4 ?

(1) 1.54

(2) 0.46

(3) 2.39

(4) 1.0

113 When water is vaporized to steam, the total amount of heat added is equal to ...

(1) $u_{\text{steam}} - u_{\text{water}}$

(2) $h_{\text{steam}} - h_{\text{water}}$

(3) $s_{\text{steam}} - s_{\text{water}}$

(4) h_{steam}



114 For a multi component system, chemical potential is equivalent to

- (1) Molal concentration difference.
- (2) Molar free energy of the pure compounds.
- (3) Partial molar free energy.
- (4) Change in molar free energy due to phase change.

115 The Joule – Thompson expansion coefficient (μ) is defined as...

$$(1) \quad \mu = \left(\frac{\partial T}{\partial P} \right)_h \qquad (2) \quad \mu = \left(\frac{\partial T}{\partial P} \right)_s$$

$$(3) \quad \mu = \left(\frac{\partial P}{\partial T} \right)_v \qquad (4) \quad \mu = \left(\frac{\partial h}{\partial s} \right)_T$$

116 During the start-up of the hypochlorate plant you have the opportunity to tune the three mode level controller installed on the inlet separator. Using the Ultimate Sensitivity Method you establish that the system oscillates with a period of 1.26 min. The proportional setting that creates the oscillations is 190 %. The optimum settings for good control (One quarter amplitude decay QAD) using the Ziegler and Nichols method will be :

- (1) Proportional band = 317, Reset = 0.630 min/repeat, and 0.157 Rate-min
- (2) Proportional band = 422, Reset = 0.504 min/repeat, and 0.180 Rate-min
- (3) Proportional band = 380, Reset = 1.59 min/repeat, and 0.210 Rate-min
- (4) Proportional band = 238, Reset = 0.840 min/repeat, and 0.140 Rate-min

117 A barometer measures

- (1) absolute pressure
- (2) gauge pressure
- (3) both absolute and gauge pressure
- (4) dynamic pressure

118 Which of the following analogies gives $St = f / 2?$

- (1) Reynolds analogy
- (2) Prandtl analogy
- (3) Chilton–Colburn analogy
- (4) none of these

- 119 Relative humidity is the ratio of
- (1) actual humidity to the saturation humidity at the gas temperature
 - (2) partial pressure of the vapor to the vapor pressure of the liquid at the gas temperature
 - (3) mass of vapor to the mass of vapor free gas
 - (4) none of these
- 120 Distillation is particularly important in
- (1) petroleum refining
 - (2) manufacture of sulfuric acid
 - (3) vegetable oil hydrogenation
 - (4) all (1), (2) and (3)
- 121 One of the examples of minimum boiling azeotropes is a mixture of
- (1) benzene and toluene
 - (2) hydrochloric acid and water
 - (3) ethanol and water
 - (4) none of these
- 122 Consider a composite wall consisting of three layers of insulation of length L_1 , L_2 and L_3 , and thermal conductivities k_1 , k_2 and k_3 respectively. The insulating layers are placed in sequence 1, 2 and 3 and a certain rate of heat transfer results. If the order is now reversed to 3, 2, 1, rate of heat transfer through the wall under otherwise uniform conditions.
- (1) will decrease
 - (2) will increase
 - (3) will remain unchanged
 - (4) cannot be predicted, more information required
- 123 If R_m is the minimum reflux ratio the optimum reflux ratio is
- (1) 1.25 to 1.5 R_m
 - (2) 2 R_m
 - (3) 2.5 to 3.5 R_m
 - (4) 5 R_m
- 124 In any process application feedback control requires ?
- (1) a remote loop
 - (2) an open loop
 - (3) a closed loop
 - (4) an internal loop
- 125 Instead of natural gas, air (also assume ideal) is stored at same pressure under identical conditions. What would be the molar density of air? Average mol wt of natural gas = 19.50 kg/kmol and that of air = 28.8 kg/kmol.
- (1) 30.46
 - (2) 1.523
 - (3) 44.9
 - (4) 20.6



126 For an elementary reaction $2A \xrightarrow{k_1} 2B$

(1) $-r_A = r_B = k_1 C_A^2$

(2) $-r_A = r_B = k_1 C_A$

(3) $-r_A = r_B = k_1$

(4) $-r_A = r_B = k_1 C_A^{1.5}$

127 Terminal velocity is

- (1) constant velocity with no acceleration
- (2) a fluctuating velocity
- (3) attained after moving one-half of total distance
- (4) none of these

128 In sulfuric acid manufacture, sulfur trioxide is absorbed in 98 - 99 % sulfuric acid in a packed absorber. The material of construction of the absorber is usually

- (1) copper and copper - base alloys
- (2) aluminium
- (3) brick - lined steel or cast iron
- (4) nickel and nickel - base alloys

129 Dry bulb temperature of a gas is

- (1) less than the wet bulb temperature
- (2) more than the wet bulb temperature
- (3) equal to the wet bulb temperature
- (4) none of the above

130 The distillate flow rate from a distillation column is 100 kmol / hr and the reflux ratio is 2. The flow rate of vapor from the top plate in kmol /h is

- | | |
|---------|---------|
| (1) 100 | (2) 200 |
| (3) 300 | (4) 50 |

131 A porous solid catalyst has the following characteristics : particle density = 0.98 g/cm³; particle diameter = 0.6 mm; total surface area = 50 m²/g. The external surface area of the catalyst is

- | | |
|-------------------------------|--|
| (1) 50 m ² /g | (2) 102.04 m ² /g |
| (3) 102.04 cm ² /g | (4) 102.04 x 10 ⁻⁴ cm ² /g |

132 Melting of ice result in an

- | | |
|--------------------------|---------------------------|
| (1) Increases in entropy | (2) Decreases in entropy. |
| (3) Isentropic process. | (4) None of these. |

- 133 Fenske's equation is used to calculate number of plates in a distillation column
- (1) at total reflux
 - (2) for system having constant relative volatility
 - (3) at minimum reflux
 - (4) for both (1) and (2)
- 134 By what factor will the rate constant be increased between 298K and 308 K if the activation energy is 35 000 cal/mol?
- (1) by a factor 1.35
 - (2) by a factor 1.92
 - (3) by a factor 2.79
 - (4) none of the above
- 135 Aluminium is suitable as a material of construction for vessels handling
- (1) 80% H_2SO_4
 - (2) 98% H_2SO_4
 - (3) HCl of all concentrations
 - (4) HNO_3 of concentration greater than 85%
- 136 A homogeneous liquid phase reaction $A \rightarrow B$ occurs in a batch reactor and a conversion of 50% is achieved in one hour. If the same reaction is conducted in a plug flow reactor the space time necessary for 50% conversion is
- (1) 1 s
 - (2) 1 min
 - (3) 1 hr
 - (4) between 1 min and 1 hr
- 137 As predicted by Stokes' law, the drag coefficient, C_D , is given by
- (1) $16/ N_{Re}^2 P$
 - (2) $8/ N_{Re}^2 P$
 - (3) $24/ N_{Re}^2 P$
 - (4) $32/ N_{Re}^2 P$
- 138 Half – life period for a first order reaction is
- (1) $t_{1/2} = 1/k$
 - (2) $t_{1/2} = 0.393/k$
 - (3) $t_{1/2} = 0.473/k$
 - (4) $t_{1/2} = 0.693/k$
- 139 Black liquor generated during paper manufacture is concentrated in a
- (1) single effect evaporator.
 - (2) single effect evaporator followed by a crystalliser.
 - (3) multiple effect evaporator.
 - (4) multiple effect evaporators followed by a crystalliser.



- 140 A rotameter, through which air at room temperature and atmospheric pressure is flowing, gives a certain reading for a flow rate of 100 cc/s. If helium (Molecular weight 4) is used and the rotameter shows the same reading, the flow rate is
- (1) 26 cc/s (2) 42 cc/s
(3) 269 cc/s (4) 325 cc/s
- 141 A suspension of uniform particles in water at a concentration of 500 kg of solids per cubic meter of slurry is settling in a tank. Density of the particles is 2500 kg/m³ and terminal velocity of a single particle is 20 cm/s. What will be the settling velocity of suspension? Richardson-Zaki index is 4.6
- (1) 20 cm/s (2) 14.3 cm/s
(3) 7.16 cm/s (4) 3.58 cm/s
- 142 Air enters an adiabatic compressor at 300 K. The exit temperature for a compression ratio of 3, assuming air to be an ideal gas (= CP /CV = 7/5) and the process to be reversible, is
- (1) $300(3^{2/7})$ (2) $300(3^{3/5})$
(3) $300(3^{3/7})$ (4) $300(3^{5/7})$
- 143 Pick out the wrong statement.
- (1) Orifice baffles are never used in a shell and tube heat exchanger.
(2) Pressure drop on the shell side of a heat exchanger depends upon tube pitch also.
(3) In a horizontal tube evaporator, surface blanketing by air is avoided.
(4) Split ring type and pull through type floating heads are two commonly used floating heads in heat exchangers.
- 144 Reactions in which the rate equation corresponds to a stoichiometric equation are called
- (1) elementary reactions (2) nonelementary reactions
(3) heterogeneous reactions (4) none of the above
- 145 Fill up the blanks
Arrhenius equation shows the variation of _____ with temperature
- (1) Reaction rate (2) Rate constant
(3) Energy of activation (4) Frequency factor

- 146 For maximum discharge through a chimney, its height should be
- (1) 200 meters
 - (2) infinitely long
 - (3) more than 105.7 meters
 - (4) equal to the height of the hot gas column producing draught.
- 147 which of the following accounts for maximum energy loss in a boiler
- (1) flue gases
 - (2) ash content in the fuel
 - (3) incomplete combustion
 - (4) unburnt carbon in flue gases
- 148 When steam is passed over coal resulting in the endothermic reaction
($C + H_2O \rightarrow CO + H_2$), it is called
- (1) carbonization of coal
 - (2) oxidation of coal
 - (3) coalification
 - (4) gasification of coal
- 149 A system consists of mixture of ice and water, amount of ice being 0.5 mol and water being 0.5 mol. What is the sp. heat of the mixture?
(sp heat of water is 18 cal/mol.K and that of ice is 9 cal/mol.K)
- (1) $C_{p,mixture} = 0$
 - (2) $C_{p,mixture} = 18$
 - (3) $C_{p,mixture} = 9$
 - (4) $C_{p,mixture} = \infty$
- 150 Turbine impeller
- (1) produces only radial current
 - (2) produces only tangential current
 - (3) is effective over wide range of viscosities
 - (4) does not produce tangential current
- 151 Path followed by water jet issuing from the bottom of a water tank will be a
- (1) parabola (vertex being at the opening)
 - (2) Hyperbolic
 - (3) Horizontal straight line
 - (4) zig-zag path (which is geometrically undefined)



- 152 The integral dial on a controller is calibrated in:
- (1) integral units
 - (2) gain units
 - (3) percentage
 - (4) minutes or repeats/min
- 153 Which of the following operations does not involve leaching?
- (1) dissolving gold from ores
 - (2) dissolving pharmaceutical products from bark or roots
 - (3) dissolving sugar from the cells of the best
 - (4) removing nicotine from its water solution by kerosene
- 154 Pine oil used in froth flotation technique acts as a
- (1) collector
 - (2) modifier
 - (3) frother
 - (4) activator
- 155 The solvent used in liquid extraction should not have high latent heat of vaporization because
- (1) the pressure drops and hence the pumping cost will be very high
 - (2) it cannot be recovered by distillation
 - (3) its recovery cost by distillation maybe prohibitively high
 - (4) it will decompose while recovering by distillation
- 156 Dry powdery solid material are transported by a
- (1) belt conveyor
 - (2) screw conveyor
 - (3) bucket elevator
 - (4) None of these
- 157 The ratio of the actual mesh dimension of Taylor series to that of the next smaller screen is
- (1) 2
 - (2) $\sqrt{2}$
 - (3) 1.5
 - (4) none of these
- 158 Which of the following controllers has maximum offset ?
- (1) P - controller
 - (2) P-D controller
 - (3) P-I controller
 - (4) PID controller



- 159 Which of the following is called 'domestic water meter' for measurement of flow ?
- (1) reciprocating piston type meter (2) dry gas meter
(3) rotating disc meter (4) sealed drum meter
- 160 Steam distillation is usually employed for
- (1) insoluble liquids
(2) a component which is heat sensitive
(3) miscible liquids
(4) both (1) and (2)
- 161 What is the degree of freedom of a system consisting of a gaseous mixture of carbon dioxide and nitrogen?
- (1) 0 (2) 1
(3) 2 (4) 3
- 162 The series in which the electrode potentials of metals are arranged in an order is known as:
- (1) electrical conductivity series
(2) electrode potential series
(3) electrochemical series
(4) chemical affinity series
- 163 Skirt support is most suitable for
- (1) small horizontal vessels (2) large horizontal vessels
(3) tall vertical vessels (4) thick walled small vertical
- 164 The reduction ratio for fine grinders is
- (1) 5 ± 10 (2) 20 ± 40
(3) 10 ± 20 (4) as high as 100
- 165 The main size reduction operation in ultra fine grinders is
- (1) cutting (3) compression
(2) attrition (4) impact



- 166 At low Reynolds number
- (1) viscous forces are unimportant
 - (2) viscous forces control
 - (3) viscous forces control and inertial forces are unimportant
 - (4) gravity forces control
- 167 With increase in the capacity of screens, the screen effectiveness
- (1) remains unchanged
 - (2) increases
 - (3) decreases
 - (4) decreases exponentially
- 168 Choose the best combination of properties for a good solvent for extraction out of the following : (i) high selectivity (ii) low selectivity (iii) high viscosity (iv) low viscosity (v) large distribution coefficient (vi) small distribution coefficient (vii) high interfacial tension (viii) low interfacial tension
- (1) (i), (iv), (v), (vii)
 - (2) (i), (iii), (v), (vi)
 - (3) (i), (iii), (v), (vii)
 - (4) (i), (ii), (iv), (vii)
- 169 Chemisorption (chemical adsorption) is
- (1) same as Van der Waals' adsorption
 - (2) characterized by adsorption of heat
 - (3) also called activated adsorption
 - (4) none of these
- 170 Diatomaceous earth is
- (1) explosive
 - (2) filter aid
 - (3) filter medium
 - (4) none of these
- 171 Flow of filtrate through cake in a plate and frame filter press is best described by
- (1) Kozeny-Carman equation
 - (2) Hagen-Poiseu equation
 - (3) Fanning's equation
 - (4) Kremser equation
- 172 Propellers are
- (1) axial flow mixers
 - (2) low speed impeller
 - (3) used for mixing liquids of high viscosity
 - (4) radial flow mixers



- 173 Boiler feed pump is usually a
- (1) reciprocating pump
 - (2) gear pump
 - (3) multi stage centrifugal pump
 - (4) diaphragm pump
- 174 With increase in pump speed, its NPSH requirement
- (1) decreases
 - (2) increases
 - (3) remains unaltered
 - (4) can either increase or decrease, depends on other factors
- 175 Consider two pipes of same length and diameter through which water is passed at the same velocity. The friction factor for rough pipe is f_1 and that for smooth pipe is f_2 . Pick out the correct statement.
- (1) $f_1 = f_2$
 - (2) $f_1 < f_2$
 - (3) $f_1 > f_2$
 - (4) data not sufficient to relate f_1 and f_2
- 176 Power loss in an orifice meter is
- (1) less than that in a venturi meter
 - (2) same as that in a venturi meter
 - (3) more than that in a venturi meter
 - (4) data insufficient, cannot be predicted
- 177 Mach. number is the ratio of the speed of the
- (1) fluid to that of the light
 - (2) light to that of the fluid
 - (3) fluid to that of the sound
 - (4) sound to that of the fluid
- 178 Shear stress in a fluid flowing in a round pipe
- (1) varies parabolically across the cross-section
 - (2) remains constant over the cross-section
 - (3) is zero at the center and varies linearly with the radius
 - (4) is zero at the wall and increase linearly to the center



- 179 Proximate analysis of determines
- (1) moisture, ash, sulfur, volatile matter
 - (2) moisture, volatile matter, ash, fixed carbon
 - (3) moisture, sulfur, nitrogen, fixed carbon
 - (4) none of these
- 180 Catalyst used in Fisher-Tropsch process is
- (1) Nickel
 - (2) Zinc oxide
 - (3) Alumina
 - (4) Thorium oxide
- 181 Ideal refrigeration cycle is
- (1) same as Carnot
 - (2) same as reverse Carnot cycle
 - (3) dependent on refrigerant properties
 - (4) the least efficient of all refrigeration processes
- 182 Van Laar equation deals with activity coefficients in
- (1) binary solution
 - (2) ternary solution
 - (3) azeotropic mixture only
 - (4) none of these
- 183 For nearly isothermal operation involving large reaction time in a liquid -phaseb. increases reaction, the most suitable reactor is
- (1) stirred tank reactor
 - (2) tubular flow reactor
 - (3) batch reactor
 - (4) fixed bed reactor
- 184 In a continuous distillation column as the reflux ratio is increased, the overhead product purity
- (1) increases
 - (2) decreases
 - (3) may increase or decrease, depending on the system
 - (4) remains constant
- 185 Forced convection is unimportant when
- (1) $(Re \cdot Pr)^{1/2} \gg 1$
 - (2) $(Re \cdot Pr)^{1/2} \ll 1$
 - (3) $(Re \cdot Pr)^{1/2} \rightarrow 1$
 - (4) none of the above



- 186 Which of the following instruments makes use of the standard electrode potentials and the variation of electrode potential with concentration?
- (1) Polarimeter (2) pH meter
(3) Electrophorous (4) Electrophotometer
- 187 What effect does an increase in temperature of 10 °C have on the rate of the reaction?
- (1) Halved (2) Multiplied by 1.5
(3) Doubled (4) Tripled
- 188 Distillation of a conjugate solution of two partially miscible liquids always results in
- (1) The lower boiling compound as the final distillate.
(2) The higher boiling compound as the final distillate.
(3) Depends on the relative proportions of the two existing phases.
(4) None of the above.
- 189 When the vapor pressure of a liquid equals atmospheric pressure, the temperature of the liquid equals:
- (1) 100 °C (2) boiling point
(3) the vaporization point (4) none of these
- 190 The property of liquid that measures its resistance to flow is called:
- (1) capillarity (2) polarizability
(3) Resistivity (4) viscosity
- 191 Of the following, _____ is a correct statement of Boyle's law.
- (1) $P V = \text{constant}$ (2) $P/V = \text{constant}$
(3) $V/P = \text{constant}$ (4) $n/P = \text{constant}$
- 192 A simple pitot tube measures
- (1) average velocity (2) maximum velocity
(3) point velocity (4) static pressure
- 193 The joint efficiency of seamless pipe is
- (1) 1 (2) 1.5
(3) 0.5 (4) none of these



- 194 Kick's law relates to
- (1) energy consumption
 - (2) final particle size
 - (3) feed size
 - (4) none of these
- 195 For non spherical particle, the sphericity
- (1) is defined as the ratio of surface area of a sphere having the same volume as the particle to the actual surface area of the particle
 - (2) has a dimension of length
 - (3) is always less than 1
 - (4) is the ratio of volume of a sphere having the same surface area as the particle to the actual volume of the particle
- 196 Heats sensitive materials with very high latent heat of vaporization may be economically separated using
- (1) liquid extraction
 - (2) distillation
 - (3) evaporation
 - (4) absorption
- 197 Ion exchange process is similar to
- (1) absorption
 - (2) extraction
 - (3) adsorption
 - (4) leaching
- 198 Freundlich equation applies to adsorption of solute from
- (1) concentrated solutions
 - (2) dilute solutions, over a small concentrated range
 - (3) gaseous solutions at high pressure
 - (4) none of these
- 199 The speed of a rotary drum vacuum filter (in rpm) may be
- (1) 1
 - (2) 50
 - (3) 100
 - (4) 500
- 200 For liquid flow through a packed bed, the superficial velocity as compared to average velocity through the channel in the bed is
- (1) more
 - (2) less
 - (3) equal
 - (4) independent of porosity



SPACE FOR ROUGH WORK

