

## INSPECTOR OF FACTORIES IN A.P FACTORIES SERVICE

## GENERAL RECRUITMENT - 2012

Held on 19-08-2012

## CHEMICAL ENGINEERING

**D**

## Paper II

Time : 150 Minutes

## INSTRUCTIONS

1. Please check the Test Booklet and ensure that it contains all the questions. If you find any defect in the Test Booklet or Answer Sheet, please get it replaced immediately.
2. The Test Booklet contains 150 questions. Each question carries two marks.
3. The Test Booklet is printed in four (4) Series, viz. **A** **B** **C** **D**. The Series, **A** or **B** or **C** or **D** is printed on the right-hand corner of the cover page of the Test Booklet. Mark your Test Booklet Series **A** or **B** or **C** or **D** in Part C on side 1 of the Answer Sheet by darkening the appropriate circle with Blue/Black Ball point pen.

Example to fill up the Booklet Series

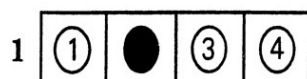
If your Test Booklet Series is A, please fill as shown below :



*If you have not marked the Test Booklet Series at Part C of side 1 of the Answer Sheet or marked in a way that it leads to discrepancy in determining the exact Test Booklet Series, then, in all such cases, your Answer Sheet will be invalidated without any further notice. No correspondence will be entertained in the matter.*

4. Each question is followed by 4 answer choices. Of these, you have to select one correct answer and mark it on the Answer Sheet by darkening the appropriate circle for the question. If more than one circle is darkened, the answer will not be valued at all. Use Blue/Black Ball point pen to make heavy black marks to fill the circle completely. Make no other stray marks.

e.g. : If the answer for Question No. 1 is Answer choice (2), it should be marked as follows :



(2)

5. Mark Paper Code and Roll No. as given in the Hall Ticket with Blue/Black Ball point pen by darkening appropriate circles in Part A of side 1 of the Answer Sheet. Incorrect/not encoding will lead to **invalidation** of your Answer Sheet.

**Example :** If the Paper Code is **027**, and Roll No. is **95640376** fill as shown below :

**Paper Code**

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**Roll No.**

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6. Please get the signature of the Invigilator affixed in the space provided in the Answer Sheet. An Answer Sheet without the signature of the Invigilator is liable for **invalidation**.
7. The candidate should **not** do rough work or write any irrelevant matter in the Answer Sheet. Doing so will lead to **invalidation**.
8. Do **not** mark answer choices on the Test Booklet. Violation of this will be viewed seriously.
9. Before leaving the examination hall, the candidate should hand over the original OMR Answer Sheet (top sheet) to the Invigilator and carry the bottom sheet (duplicate) for his/her record, failing which disciplinary action will be taken.
10. Use of whitener is prohibited. If used, the answer sheet is liable for invalidation.

1. Which one of the following is most severe air pollutant ?
  - (1)  $\text{SO}_2$
  - (2)  $\text{NO}_x$
  - (3) CO
  - (4)  $\text{CH}_4$
2. Thermal power plants are the major source of
  - (1)  $\text{SO}_2$  pollutants
  - (2) Ammonia pollutants
  - (3)  $\text{NO}_x$  pollutants
  - (4) Phosgene pollutants
3. The main cause of ozone depletion is
  - (1) Chlorofluorocarbons
  - (2)  $\text{CO}_2$
  - (3) Hydrocarbons
  - (4) CO
4. The source of Hg trace element in environment is
  - (1) paint industry
  - (2) electrochemical industry
  - (3) coal burning
  - (4) nuclear fuel processing
5. A fire cannot be extinguished by
  - (1) cooling the burning material below its ignition temperature
  - (2) accelerating the combustion chain reaction
  - (3) reducing the quality of available oxygen
  - (4) removal or separation of fuel
6. For flow of an ideal fluid, the Reynolds number is
  - (1) infinity
  - (2) zero
  - (3) one
  - (4) 2100
7. For a dilatant fluid, the magnitude of the slope of the shear stress versus the velocity gradient curve \_\_\_\_\_ with increasing velocity gradient.
  - (1) increases
  - (2) decreases
  - (3) remains unchanged
  - (4) may increase or decrease
8. For flow through a horizontal system, the ratio of exit pressure to inlet pressure is found to be greater than one. The system is a
  - (1) converging pipeline
  - (2) diverging pipeline
  - (3) pipeline of uniform diameter
  - (4) None of the above
9. A Newtonian fluid ( $\rho$  = density,  $\mu$  = viscosity) is flowing with a velocity  $v$  in a tube of diameter  $D$ . Let  $\Delta P$  be the pressure drop across the length  $L$ . For laminar flow,  $\Delta P$  is proportional to
  - (1)  $L\rho v^2/D$
  - (2)  $D\rho v^2/L$
  - (3)  $Lv\mu/D^2$
  - (4)  $\mu v/L$



(4)

10. Consider a duct of square cross-section of side 'b'. The hydraulic radius is given by
- (1)  $b/8$
  - (2)  $b/4$
  - (3)  $b/2$
  - (4)  $b$
11. In a gyratory crusher, the size reduction is effected primarily by
- (1) compression
  - (2) impact
  - (3) attrition
  - (4) cutting action
12. A fluid energy mill is used for
- (1) cutting
  - (2) grinding
  - (3) ultra grinding
  - (4) crushing
13. A particle A of diameter 10 microns settles in an oil of specific gravity 0.9 and viscosity 10 poise under Stokes law. A particle B with diameter 20 microns settling in same oil will have a settling velocity
- (1) same as that of A
  - (2) one-fourth of that of A
  - (3) twice as that of A
  - (4) four times as that of A
14. For a turbine agitated and baffled tank, operating at low Reynolds number (based on impeller diameter), the power number  $P$  varies with  $Re$  as
- (1)  $P \propto Re$
  - (2)  $P \propto Re^{0.5}$
  - (3)  $P = Re^2$
  - (4)  $P \propto 1/Re$
15. The power number for a stirred tank becomes constant at high Reynolds number. In this limit, the variation of power input with impeller rotational speed  $N$  is proportional to
- (1)  $N^0$
  - (2)  $N^1$
  - (3)  $N^2$
  - (4)  $N^3$
16. The variation of thermal conductivity of a metal with temperature is often correlated using an expression of the form  $k = k_0 + aT$ , where  $k$  is the thermal conductivity and  $T$  is the temperature in Kelvin. The units of 'a' in SI system will be
- (1)  $W/m K$
  - (2)  $W/m$
  - (3)  $W/m K^2$
  - (4) None of the above
17. The hydrodynamic and thermal boundary layers will merge when
- (1) Prandtl number is equal to 1
  - (2) Schmidt number tends to infinity
  - (3) Nusselt number tends to infinity
  - (4) Archimedes number is greater than 10,000



18. Prandtl number is the ratio of
- (1) mass diffusivity to thermal diffusivity
  - (2) momentum diffusivity to thermal diffusivity
  - (3) thermal diffusivity to mass diffusivity
  - (4) thermal diffusivity to momentum diffusivity
19. Heat transfer by natural convection is enhanced in systems with
- (1) high viscosity
  - (2) high coefficient of thermal expansion
  - (3) low temperature gradients
  - (4) low density change with temperature
20. In a heat exchanger, floating head is provided to
- (1) facilitate cleaning of exchanger
  - (2) increase the heat transfer area
  - (3) relieve stresses caused by thermal expansion
  - (4) increase the log mean temperature gradient
21. The advantage of backward feed multiple effect evaporators over forward feed units is that
- (1) heat sensitive materials can be handled
  - (2) there is no additional cost of pumping
  - (3) most concentrated liquor is at its highest temperature
  - (4) equal heat transfer coefficients exist in various effects
22. Solvent used in extractive distillation
- (1) is of low volatility
  - (2) forms a low boiling azeotrope
  - (3) forms a high boiling azeotrope
  - (4) does not alter the relative volatility of the original components
23. For a fixed number of ideal stages in a distillation column, as the reflux ratio is increased, the difference in composition between the product streams (distillate and residue)
- (1) increases
  - (2) decreases
  - (3) remains unchanged
  - (4) passes through a maximum
24. In distillation columns, the number of bubble caps per tray primarily depends on the
- (1) allowable liquid velocity
  - (2) allowable gas velocity
  - (3) allowable gas and liquid velocities
  - (4) feed composition
25. By increasing the feed rate to a fractionating column, for separating a binary mixture at a fixed ratio and separation, the required number of ideal stages
- (1) remains unaltered
  - (2) decreases
  - (3) increases
  - (4) will increase or decrease

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26. The fires of flammable liquids can be put in the category of
- (1) class A fires
  - (2) class B fires
  - (3) class C fires
  - (4) class D fires
27. Which one of the following is **not** an active fire fighting system ?
- (1) Water spray
  - (2) Foam
  - (3) Dry chemicals
  - (4) Fire-proofing
28. The biochemical treatment of sewage effluents is essentially a process of
- (1) reduction
  - (2) oxidation
  - (3) dehydration
  - (4) alkalization
29. Ecological system or ecosystem refers to
- (1) a group of individuals of any one kind of organism
  - (2) all of the population occupying a given area
  - (3) the community and non-living environment working together
  - (4) a portion of the Earth where living objects can be found
30. The term ultrafiltration is used to separate particles in the size range
- (1)  $0.1 \mu\text{m}$  to  $5 \mu\text{m}$
  - (2)  $1 \mu\text{m}$  to  $10^{-8} \mu\text{m}$
  - (3)  $5 \mu\text{m}$  to  $10 \mu\text{m}$
  - (4)  $10 \mu\text{m}$  to  $100 \mu\text{m}$
31. Oscillations of a system may be reduced by one of the following controllers :
- (1) P controller
  - (2) PI controller
  - (3) PD controller
  - (4) No controller can reduce
32. The response of a first order system with a proportional controller  $K_c$  has an offset to a step input. The offset can be eliminated by which one of the following actions ?
- (1) Decreasing  $K_c$
  - (2) Adding an integral mode
  - (3) Adding a derivative mode
  - (4) No change needs to be done because offset cannot be eliminated
33. For microprocessor based automatic process control, name the most suitable instrument for temperature measurement.
- (1) Gas thermometer
  - (2) Mercury filled thermometer
  - (3) Resistance thermometer
  - (4) Thermocouple
34. Gas chromatography is used for measurement of
- (1) temperature
  - (2) pressure
  - (3) concentration
  - (4) flow rate

(7)

35. A first order system with a time constant of 1 min is subjected to frequency response analysis. At an input frequency of 1 rad/min, the phase shift is
- (1)  $45^\circ$
  - (2)  $-90^\circ$
  - (3)  $-180^\circ$
  - (4)  $-45^\circ$
36. 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 is
- (1)  $0^\circ$
  - (2)  $45^\circ$
  - (3)  $90^\circ$
  - (4)  $180^\circ$
37. In a manufacturing industry, break even point occurs when
- (1) the annual rate of production equals the assigned value
  - (2) the total annual product cost equals the total annual sales
  - (3) the annual profit equals the expected value
  - (4) The annual sales equals the fixed cost
38. The total capital investment for a chemical plant is ₹ 1,000,000 and the working capital is ₹ 100,000. If turnover ratio is 1, the gross annual sales will be
- (1) ₹ 800,000
  - (2) ₹ 900,000
  - (3) ₹ 1,000,000
  - (4) ₹ 1,100,000
39. An investment of ₹ 1,000 is carrying an interest of 10% compounded quarterly. The value of the investment at the end of five years will be
- (1)  $1000(1 + 0.1/4)^{20}$
  - (2)  $1000(1 + 0.1)^{20}$
  - (3)  $1000(1 + 0.1/4)^5$
  - (4)  $1000(1 + 0.1/2)^5$
40. An investment of ₹ 100 lakhs is to be made for construction of a plant which will take 2 years to start production. The annual profit from operation of the plant is ₹ 20 lakhs. What will be the payback time ?
- (1) 5 years
  - (2) 7 years
  - (3) 12 years
  - (4) 10 years
41. The plant of a chemical company has an initial worth of ₹ 50 lakhs, and estimated salvage value of ₹ 2 lakhs in a service life of 8 years. The book value at the end of 4 years by straight line method of depreciation is
- (1) ₹ 6 lakhs
  - (2) ₹ 24 lakhs
  - (3) ₹ 26 lakhs
  - (4) ₹ 48 lakhs



42. The ends of a cylindrical vessel can be closed by a head, which can be one of the four shapes. For the same thickness, choose the one which can withstand the highest pressure
- (1) Flat plate
  - (2) Hemispherical
  - (3) Torispherical
  - (4) Elliptical
43. In a cylindrical vessel subjected to internal pressure, the longitudinal stress  $\sigma_l$  and the circumferential stress  $\sigma_h$  are related by
- (1)  $\sigma_h = 2\sigma_l$
  - (2)  $\sigma_h = \sigma_l$
  - (3)  $\sigma_h = \sigma_l/2$
  - (4) no relation exists
44. Design temperature for unheated vessel must be \_\_\_\_\_ the highest temperature of stored material.
- (1) equal to
  - (2) 5°C higher than
  - (3) 7°C higher than
  - (4) 10°C higher than
45. The factor of safety on design stress factor indicates the margin between
- (1) design stress and damaging stress
  - (2) design stress and working stress
  - (3) design stress and allowable stress
  - (4) any one of the above
46. Thickness calculated from the stress consideration alone gives the
- (1) minimum wall thickness
  - (2) maximum wall thickness
  - (3) design wall thickness
  - (4) any of the above
47. No corrosion allowance is required in wall thickness of a part if its thickness is more than \_\_\_\_\_
- (1) 5 mm
  - (2) 30 mm
  - (3) 10 mm
  - (4) 15 mm
48. In the design of chemical process equipment, usually welded joint efficiency factor is
- (1) 0.2
  - (2) 0.4
  - (3) 0.85
  - (4) 0.5
49. Dilute sulphuric acid is handled in vessels made of
- (1) stainless steel
  - (2) brass
  - (3) lead
  - (4) cast iron
50. Nichrome, a steel alloyed with 10% nickel and 20% chromium, can be used upto
- (1) 600°C
  - (2) 1100°C
  - (3) 900°C
  - (4) 2700°C

51. A cylindrical storage tank can have a self supported conical roof
- (1) if its diameter is less than 15 – 20 m
  - (2) if its diameter is more than 50 m
  - (3) if the thickness of the roof is more than that of the cylindrical shell
  - (4) irrespective of its diameter
52. Skirt support is most suitable for
- (1) small horizontal vessels
  - (2) large horizontal vessels
  - (3) tall vertical vessels
  - (4) thick walled small vertical vessels
53. Liquid ammonia is shipped in
- (1) steel containers
  - (2) aluminium containers
  - (3) glass containers
  - (4) lead lined vessels
54. The ammonia synthesis catalyst is
- (1) alumina
  - (2) vanadium pentoxide
  - (3) iron oxide
  - (4) kieselguhr
55. Which of the following gaseous fuels is likely to have the highest gross calorific value ?
- (1) Sewage gas
  - (2) LPG
  - (3) Producer gas
  - (4) Natural gas
56. The gas which contributes the maximum to the heating value of natural gas is
- (1) CO
  - (2) CO<sub>2</sub>
  - (3) H<sub>2</sub>
  - (4) CH<sub>4</sub>
57. The ethyl alcohol content in the fermented liquor from molasses is
- (1) 50 – 55%
  - (2) 20 – 22%
  - (3) 8 – 10%
  - (4) 3 – 5%
58. Which one of the following is *not* likely to be a constituent of vegetable oils ?
- (1) Citric acid
  - (2) Oleic acid
  - (3) Stearic acid
  - (4) Glycerol
59. A biodegradable detergent is one which
- (1) is manufactured using biotechnology
  - (2) contains straight chain alkyl benzenes
  - (3) contains branch chain alkyl benzenes
  - (4) is easily decomposed by micro-organisms
60. Hydrogenation of edible oils is done to
- (1) decrease the number of unsaturated bonds
  - (2) lower the melting point of oil
  - (3) increase the thermal conductivity of oil
  - (4) enable the oil to be packed

61. Kremser-Brown-Souders equation is used to calculate
- (1) HTU
  - (2) NTU
  - (3) plate spacing in plate column
  - (4) the number of ideal plates in the plate column
62. NTU can be considered as a
- (1) performance concept of the equipment
  - (2) measure of approach to ideality
  - (3) measure of difficulty of separation
  - (4) measure of departure from ideality
63. In binary distillation, the separation of the components is easier if the relative volatility ( $\alpha$ )
- (1)  $\alpha \gg 1$
  - (2)  $\alpha \ll 1$
  - (3)  $\alpha = 1$
  - (4) None of the above
64. Assume that benzene is insoluble in water. The normal boiling points of benzene and water are  $80.1^\circ\text{C}$  and  $100^\circ\text{C}$  respectively. At a pressure of 1 atm, the boiling point of a mixture of benzene and water is
- (1)  $80.1^\circ\text{C}$
  - (2) less than  $80.1^\circ\text{C}$
  - (3)  $100^\circ\text{C}$
  - (4) greater than  $80.1^\circ\text{C}$  but less than  $100^\circ\text{C}$
65. In steam distillation of nitrobenzene (boiling point  $210.6^\circ\text{C}$ ) at a total pressure of one atmosphere, the boiling point of the mixture is
- (1) less than  $100^\circ\text{C}$
  - (2)  $100^\circ\text{C}$
  - (3) between  $100^\circ\text{C}$  and  $210^\circ\text{C}$
  - (4)  $210^\circ\text{C}$
66. In distillation under minimum reflux conditions, number of theoretical stages would be
- (1) one
  - (2) minimum
  - (3) infinite
  - (4) None of the above
67. The type of tray which gives greatest flexibility in distillation columns is
- (1) sieve tray
  - (2) bubble cap tray
  - (3) valve tray
  - (4) None of the above
68. Air, initially at 101.3 kPa and  $40^\circ\text{C}$ , with a relative humidity at 50%, is cooled at constant pressure to  $30^\circ\text{C}$ . The cooled air has
- (1) a higher dew point
  - (2) a higher absolute (specific) humidity
  - (3) a higher relative humidity
  - (4) a higher wet bulb temperature



(11)

69. If the temperature of atmosphere increases at constant absolute humidity, the percentage saturation would
- (1) decrease
  - (2) remain constant
  - (3) increase
  - (4) None of the above
70. A batch of material is dried under constant drying conditions. When drying is taking place from all the surfaces, the rate of drying during the constant rate period is
- (1) directly proportional to the solid thickness
  - (2) independent of the solid thickness
  - (3) inversely proportional to the solid thickness
  - (4) directly proportional to the square of solid thickness
71. The reaction  $A \rightarrow B$  is conducted in an isothermal batch reactor. If the conversion of A increases linearly with holding time, then the order of reactor is
- (1) 0
  - (2) 1
  - (3) 1.5
  - (4) 2
72. Overall order of reaction for which the rate constant has units of  $(\text{mol/liter})^{-3/2} (\text{sec})^{-1}$  is
- (1)  $-\frac{3}{2}$
  - (2)  $\frac{1}{2}$
  - (3)  $\frac{3}{2}$
  - (4)  $\frac{5}{2}$
73. For the gaseous reaction  $2A \rightarrow B$  where the feed consists of 50 mol% A and 50 mol% inerts, the expansion factor is
- (1) 1
  - (2) -0.5
  - (3) -0.25
  - (4) 0
74. For a given duty and for all positive reaction orders, the size of a mixed reactor is
- (1) smaller than that of a plug flow reactor
  - (2) larger than that of a plug flow reactor
  - (3) same as that of a plug flow reactor
  - (4) None of the above
75. For a first order reaction in a porous catalyst, the Thiele modulus is 10. The effectiveness factor is approximately equal to
- (1) 1
  - (2) 0.5
  - (3) 0.1
  - (4) 0
76. When an exothermic reversible reaction is conducted adiabatically the rate of reaction
- (1) continuously increases
  - (2) continuously decreases
  - (3) passes through a maximum
  - (4) passes through a minimum

77. A reversible liquid phase endothermic reaction is to be carried out in a plug flow reactor. For minimum reactor volume, it should be operated such that the temperature along the length
- (1) decreases
  - (2) increases
  - (3) is at the highest allowable temperature throughout
  - (4) first increases and then decreases
78. When the density of the reaction mixture is constant in a chemical reaction, the ratio of space time to the mean residence time is
- (1) 0
  - (2) 1
  - (3)  $> 1$
  - (4)  $< 1$
79. Name the method for analyzing kinetic data for the testing of complicated mechanisms.
- (1) Differential method
  - (2) Integral method
  - (3) Half-life method
  - (4) None of the above
80. A first order reaction is 50% complete in 30 min. Calculate the time taken for 75% completion of reaction.
- (1) 45 min
  - (2) 60 min
  - (3) 90 min
  - (4) 120 min
81. The knowledge of initial concentration and rate constant is necessary to determine the half-life time of a reaction of
- (1) zero order
  - (2) first order
  - (3) second order
  - (4) None of the above
82. A gaseous reaction  $A \rightarrow 2B + C$  takes place isothermally in a constant pressure reactor starting with a gaseous mixture containing 50% of A (rest inerts). The ratio of final to initial volume is found to be 1.6. The percentage conversion of A is
- (1) 30
  - (2) 50
  - (3) 60
  - (4) 74
83. The conversion for a first order liquid phase reaction  $A \rightarrow B$  in a CSTR is 50%. If another CSTR of the same volume is connected in series, then the % conversion at the exit of the second reactor will be
- (1) 60
  - (2) 75
  - (3) 90
  - (4) 100

84. For an input forcing function,  $X(t) = 2t^2$ , the Laplace transform of this function is
- (1)  $2/s^2$
  - (2)  $4/s^2$
  - (3)  $2/s^3$
  - (4)  $4/s^3$
85. A process is initially at steady state with its output  $y = 1$  for an input  $u = 1$ . The input is suddenly changed to 2 at  $t = 0$ . The output response is  $y(t) = 1 + 2t$ . The transfer function of the process is
- (1)  $\frac{2}{s}$
  - (2)  $1 + \frac{2}{s^2}$
  - (3)  $1 + \frac{2}{s}$
  - (4)  $\left(\frac{1}{s}\right)\left(1 + \frac{2}{s}\right)$
86. A rectangular tank is fitted with a valve at the bottom and is used for storing a liquid. The area of cross section of the tank is  $10 \text{ m}^2$  and the flow resistance of the valve (assumed constant) is  $0.1 \text{ s/m}^2$ . The time constant of the tank will be
- (1) 1
  - (2) 100
  - (3) 10.1
  - (4) 9.9
87. The open loop transfer function of a control system is  $KR/(1 + \tau s)$ . This represents
- (1) a first order system
  - (2) dead time system
  - (3) a first order time lag
  - (4) a second order system
88. The second order system with a transfer function  $4/(s^2 + 2s + 4)$  has a damping ratio of
- (1) 2.0
  - (2) 0.5
  - (3) 1.0
  - (4) 4.0
89. When a bare thermocouple is covered by a protective sheath, the response becomes
- (1) faster and oscillatory
  - (2) faster and non-oscillatory
  - (3) slower and oscillatory
  - (4) slower and non-oscillatory
90. A second order system can be obtained by connecting two first order systems  $1/(\tau_1 s + 1)$  and  $1/(\tau_2 s + 1)$  in series. The damping ratio of the resultant second order system for the case  $\tau_1 \neq \tau_2$  will be
- (1)  $> 1$
  - (2)  $= 1$
  - (3)  $< 1$
  - (4) equal to  $\tau_2/\tau_1$



91. The condition that is not necessary for the applicability of Bernoulli equation is
- (1) steady state
  - (2) incompressible
  - (3) inviscid
  - (4) irrotational
92. A pipe of internal diameter 4 m is bifurcated into two pipes of internal diameter 2 m each. If the average velocity of water flowing through the main pipe is 5 m/s, the average velocity through the bifurcated pipe is
- (1) 20 m/s
  - (2) 10 m/s
  - (3) 7.07 m/s
  - (4) 5 m/s
93. Toothpaste is
- (1) Bingham plastic
  - (2) Pseudo plastic
  - (3) Newtonian fluid
  - (4) Dilatant
94. For pseudo plastic fluid, increase in shear rate
- (1) increases the apparent viscosity
  - (2) decreases the apparent viscosity
  - (3) has no effect on apparent viscosity
  - (4) has unspecified effect
95. For laminar flow of a fluid in a circular pipe of radius R, the Hagen - Poiseuille equation predicts that volumetric flow rate is proportional to
- (1) R
  - (2)  $R^2$
  - (3)  $R^4$
  - (4)  $R^{0.5}$
96. A particle attains its terminal settling velocity when
- (1) gravity force + drag force = buoyancy force
  - (2) gravity force - drag force = buoyancy force
  - (3) buoyancy force + drag force = gravity force
  - (4) drag force = buoyancy force
97. For a fluidized bed with the increase in expansion of bed, upto solids carry over from the bed, the pressure drop across the bed
- (1) increase rapidly
  - (2) decreases rapidly
  - (3) first increases and then decreases
  - (4) remains essentially constant
98. For crushing of solids, the Rittinger's law states that the work required for crushing is proportional to
- (1) the new surface created
  - (2) the size reduction ratio
  - (3) the change in volume due to crushing
  - (4) None of the above
99. Energy requirement (per unit mass of material crushed/ground) is highest for
- (1) Jaw crusher
  - (2) Rod mill
  - (3) Ball mill
  - (4) Fluid energy mill
100. For separating particles of different densities, the differential settling method uses a liquid sorting medium of density
- (1) intermediate between those of the light and heavy ones
  - (2) less than that of either one
  - (3) greater than that of either one
  - (4) of any arbitrary value

101. Stokes equation is valid in the Reynolds number range
- (1) 0.01 to 0.1
  - (2) 0.1 to 2
  - (3) 2 to 10
  - (4) 10 to 100
102. During washing of filter at the end of constant pressure filtration, the rate of washing equals the rate of filtration
- (1) at time zero
  - (2) at the end of filtration
  - (3) when half the filtrate has been obtained
  - (4) at the end of filtration, but decreases with time subsequently
103. At very low rpm (Re less than 5), the power required for agitation is proportional to
- (1)  $D$
  - (2)  $D^2$
  - (3)  $D^3$
  - (4)  $D^5$
104. Thermal conductivity is minimum for
- (1) silver
  - (2) chrome-nickel steel
  - (3) aluminium
  - (4) carbon steel
105. In pipe flow, heat is transferred from the hot wall to the liquid by
- (1) conduction only
  - (2) forced convection only
  - (3) forced convection and conduction
  - (4) free and forced convection
106. The heat flux (from outside to inside) across an insulating wall with thermal conductivity  $k = 0.04 \text{ W/mK}$  and thickness  $0.16 \text{ m}$  is  $10 \text{ W/m}^2$ . The inside temperature of the wall is  $-5^\circ\text{C}$ . The outside temperature of the wall is
- (1)  $25^\circ\text{C}$
  - (2)  $30^\circ\text{C}$
  - (3)  $35^\circ\text{C}$
  - (4)  $40^\circ\text{C}$
107. The Grashof number is defined as the ratio of
- (1) buoyancy to inertial forces
  - (2) buoyancy to viscous forces
  - (3) inertial to viscous forces
  - (4) buoyancy to surface tension forces
108. To determine the heat transfer coefficient, Dittus - Boelter equation is valid for
- (1) laminar flow
  - (2) liquid metals
  - (3) turbulent flow
  - (4) natural convection
109. As the difference between the wall temperature and bulk temperature increases, the boiling heat transfer coefficient
- (1) continues to increase
  - (2) continues to decrease
  - (3) goes through a minimum
  - (4) goes through a maximum
110. For condensation of pure vapours, the heat transfer coefficient in filmwise condensation \_\_\_\_\_ the heat transfer coefficient in dropwise condensation.
- (1) is equal to
  - (2) is greater than
  - (3) is less than
  - (4) could be greater or lesser than

111. The advantage of using a 1 – 2 shell and tube heat exchanger over a 1 – 1 shell and tube heat exchanger is
- (1) lower tube side pressure drop
  - (2) lower shell side pressure drop
  - (3) higher tube side heat transfer coefficient
  - (4) higher shell side heat transfer coefficient
112. A multiple effect evaporator as compared to a single effect evaporator of the same capacity has
- (1) lower heat transfer area
  - (2) lower steam economy
  - (3) higher steam economy
  - (4) higher solute concentration in the product
113. Molecular diffusivity of a liquid
- (1) increases with temperature
  - (2) decreases with temperature
  - (3) may increase or decrease with temperature
  - (4) is independent of temperature
114. In an interphase mass transfer process, the lesser the solubility of a given solute in a liquid, the higher are the chances that the transfer process will be
- (1) liquid phase resistance controlled
  - (2) gas phase resistance controlled
  - (3) impossible
  - (4) driven by a non-linear driving force
115. The condition for equilibrium in an interphase mass transfer process is equality of
- (1) concentrations
  - (2) chemical potentials
  - (3) activity coefficients
  - (4) mass transfer coefficients
116. Diffusion coefficient in a binary gas mixture at low pressures varies with pressure as
- (1)  $P$
  - (2)  $P^2$
  - (3)  $1/P$
  - (4)  $P^{3/2}$
117. Mass transfer coefficient,  $k$ , according to penetration theory, varies with mass diffusivity as
- (1)  $D^{0.5}$
  - (2)  $D$
  - (3)  $1/D$
  - (4)  $D^{1.2}$
118. Sherwood number in mass transfer is analogous to \_\_\_\_\_ in heat transfer.
- (1) Graetz number
  - (2) Grashof number
  - (3) Nusselt number
  - (4) Prandtl number
119. Lewis number = 1 signifies that
- (1)  $Pr = Sc$
  - (2)  $Pr = Re$
  - (3)  $Sc = Re$
  - (4)  $Nu = Sh$
120. Absorption towers are operated under conditions of
- (1) low pressure, high temperature
  - (2) high pressure, high temperature
  - (3) high pressure, low temperature
  - (4) low pressure, low temperature



121. In petroleum refining, the process used for conversion of hydrocarbons to aromatics is
- (1) catalytic cracking
  - (2) catalytic reforming
  - (3) hydrotreating
  - (4) alkylation
122. Commercially, ethylene is produced from naphtha by
- (1) catalytic cracking
  - (2) catalytic dehydrogenation
  - (3) pyrolysis
  - (4) hydrocracking
123. The organic monomer in Nylon 66 is
- (1) sebacic acid
  - (2) terephthallic acid
  - (3) adipic acid
  - (4) benzoic acid
124. Phthalic anhydride is produced by the oxidation of
- (1) naphthalene
  - (2) benzene
  - (3) toluene
  - (4) aniline
125. Styrene - Butadiene rubber is commercially manufactured by
- (1) bulk polymerization
  - (2) suspension polymerization
  - (3) solution polymerization
  - (4) emulsion polymerization
126. The kinetic energy of gas molecules is zero at
- (1)  $0^{\circ}\text{C}$
  - (2)  $273^{\circ}\text{C}$
  - (3)  $100^{\circ}\text{C}$
  - (4)  $-273^{\circ}\text{C}$
127. A Carnot cycle consists of following steps :
- (1) two isothermals and two isentropics
  - (2) two isothermals and two isobarics
  - (3) two isochorics and two isobarics
  - (4) two isothermals and two isochorics
128. It is desired to bring about a certain change in the state of a system by performing work on the system under adiabatic conditions.
- (1) The amount of work needed is path dependent
  - (2) Work alone cannot bring about such a change of state
  - (3) The amount of work needed is independent of path
  - (4) More information is needed to conclude anything about the path of dependence
129. The shape of T - S diagram for Carnot cycle is a
- (1) rectangle
  - (2) rhombus
  - (3) trapezoid
  - (4) circle
130. Mixing of two fluids is a.....
- (1) reversible process
  - (2) irreversible process
  - (3) isothermal process
  - (4) None of the above
131. Entropy is
- (1) intensive property
  - (2) derived property
  - (3) extensive property
  - (4) None of the above

132. Which among the following relations is valid only for reversible process undergone by a pure substance ?
- (1)  $\delta Q = dU + \delta W$
  - (2)  $TdS = dU + \delta W$
  - (3)  $TdS = dU + pdV$
  - (4)  $\delta Q = pdV + dU$
133. A solid is transformed into its vapour state without passing through the liquid state
- (1) at triple point
  - (2) at boiling point
  - (3) always
  - (4) below triple point
134. For a system in equilibrium, at a given temperature and pressure
- (1) the entropy must be a minimum
  - (2) the enthalpy must be a minimum
  - (3) the internal energy must be a minimum
  - (4) the Gibbs free energy must be a minimum
135. A change in state involving a decrease in entropy can be spontaneous only if
- (1) it is exothermic
  - (2) it is isenthalpic
  - (3) it takes place isothermally
  - (4) it takes place at constant volume
136. During Joule - Thomson expansion of gases
- (1) enthalpy remains constant
  - (2) entropy remains constant
  - (3) temperature remains constant
  - (4) None of the above
137. The change in Gibbs free energy for vaporization of a pure substance is
- (1) positive
  - (2) negative
  - (3) zero
  - (4) may be positive or negative
138. The number of degrees of freedom for a mixture of ice and water (liquid) are
- (1) 2
  - (2) 3
  - (3) 1
  - (4) 0
139. The equilibrium constant K for a chemical reaction depends on
- (1) temperature only
  - (2) pressure only
  - (3) temperature and pressure
  - (4) ratio of reactants
140. The decomposition of A into B is represented by the exothermic reaction  $A \rightleftharpoons B$ . To achieve maximum decomposition, it is desirable to carry out the reaction at
- (1) high pressure and high temperature
  - (2) low pressure and high temperature
  - (3) low pressure and low temperature
  - (4) high pressure and low temperature
141. Fugacity coefficient of a substance is the ratio of its fugacity to
- (1) mole fraction
  - (2) activity
  - (3) pressure
  - (4) activity coefficient
142. Van Laar equation deals with activity coefficients in
- (1) binary solutions
  - (2) ternary solutions
  - (3) azeotropic mixture only
  - (4) None of the above

143. In a working refrigerator, value of COP is always
- (1) 0
  - (2)  $< 0$
  - (3)  $< 1$
  - (4)  $> 1$
144. The molar composition of a gas is 10%  $H_2$ , 10%  $O_2$ , 30%  $CO_2$  and balance  $H_2O$ . If 50%  $H_2O$  condenses, the final mole percent of  $H_2$  in the dry gas will be
- (1) 10%
  - (2) 5%
  - (3) 18.18%
  - (4) 20%
145. A solution of specific gravity 1.0 consists of 35% A by weight and the remaining B. If the specific gravity of A is 0.7, the specific gravity of B is
- (1) 1.25
  - (2) 1.3
  - (3) 1.35
  - (4) 1.2
146. In a paper mill, a wash liquor containing 3% (by wt) solids is concentrated in an evaporator to yield a lye containing 30% by weight solids. The quantity of water evaporated per 100 kg of feed is
- (1) 30 kg
  - (2) 70 kg
  - (3) 60 kg
  - (4) 90 kg
147. Pure A in gas phase enters a reactor. 50% of this A is converted to B through the reaction  $A \rightarrow 3B$ . Mole fraction of A in the exit stream is
- (1)  $1/2$
  - (2)  $1/3$
  - (3)  $1/4$
  - (4)  $1/5$
148. A liquid mixture contains 30% o-xylene, 60% p-xylene and 10% m-xylene (all percentages in w/w). Which of the following statements would be true in respect of the mixture?
- (1) The mixture exhibits an azeotrope at 101.3 kPa
  - (2) The composition of the mixture in percent by volume is o-xylene 30%, p-xylene 60%, m-xylene 10%
  - (3) The composition of the mixture in mol% is o-xylene 30%, p-xylene 60%, m-xylene 10%
  - (4) The mixture contains optical isomers
149. Methane is completely burned with air. The maximum possible volume percent of carbon dioxide (on dry basis) in the flue gas is
- (1) 11.7
  - (2) 21
  - (3) 44
  - (4) 28
150. For the case of fuel gas undergoing combustion with air, if the air/fuel ratio is increased, the adiabatic flame temperature will
- (1) increase
  - (2) decrease
  - (3) increase or decrease depending on the fuel type
  - (4) not change