

- (C) All multipass
 - (D) All (involving liquid/liquid heat transfer)
- Answer: Option C

04. The minimum baffle height should be

- (A) Equal to the impeller diameter
- (B) Twice the impeller diameter
- (C) Twice the tank diameter
- (D) 3/4 of the tank height

Answer: Option B

05. What is the value of 'q' for saturated vapor feed to a distillation column? (where q = fraction of the feed stream that is liquid.)

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

Answer: Option A

06. In actual operation of distillation column, the vapour is not distributed uniformly among the bubble caps, primarily because of the

- (A) Liquid gradient on the tray
- (B) Lower skirt clearance
- (C) Lower static submergence
- (D) Small downcomer liquid seal

Answer: Option A

07. Large process vessels operating under extreme temperature and pressure conditions are normally clad/ lined with materials like stainless steel, aluminium, nickel & its alloys, copper & its alloys and titanium. The cladding thickness is generally about _____ percent of the total thickness.

- (A) 1 to 5
- (B) 10 to 20
- (C) 30 to 40
- (D) 40 to 50

Answer: Option B

08. Pick out the wrong statement pertaining to shell and tube heat exchanger.

- (A) Clearance between shell & baffles and between tube & baffles should be minimum to avoid by-passing of the fluid, but it should be enough to permit the removal of tube bundle
- (B) Baffles are supported independently of the tubes by tie rods and positioned by spacers
- (C) Tie rods are fixed at one end in the tube sheet by making blind holes and the minimum number of tie rods is 4 with at least 10 mm diameter
- (D) Bracket supports are used for horizontal shell, while saddle support is used for vertical shell

Answer: Option D

09. Pick out the wrong statement pertaining to the design of a horizontal tube evaporator.

- (A) It is unsuitable for concentrating those liquids, which form a scale or deposit salt
- (B) It is suitable for process, in which the final product is a liquor instead of solid
- (C) Its usual dimensions are: tube dia = 2-3 cms; evaporator body dia = 1-4 metres and evaporator height = 2.5-4 metres
- (D) Liquor flows inside the tube, while the steam is outside submerging the tube

Answer: Option D

10. In case of plain carbon steel, butt welded joints are used for shell plate thickness \leq _____ cms.

- (A) 1.2
- (B) 0.5
- (C) 3.8
- (D) 6.8

Answer: Option C

11. Practical dividing line between a ductile and brittle materials is suggested, when the ultimate elongation is about 5%. Generally, larger the knuckle radius, stronger is the corner torus section of a head. The knuckle radius provided should be less than _____ of the head.

- (A) 6% of I.D.
 - (B) 3 times the thickness
 - (C) Either (A) or (B), whichever is larger
 - (D) Either (A) or (B), whichever is smaller
- Answer: Option C

12. In a distillation column, bubble caps are located on trays with a pitch of _____ times the outside diameter of the caps.

- (A) 1.3 to 2
- (B) 1.6 to 2
- (C) 2.5
- (D) 1.5 to 3

Answer: Option A

13. The $LMTD$ correction factor (F_T) is defined as the

- (A) Ratio of true temperature difference to the $LMTD$
- (B) Ratio of $LMTD$ to the true temperature difference
- (C) Differenced of true temperature difference and the $LMTD$
- (D) Geometric mean of the true temperature difference and the $LMTD$

Answer: Option A

14. _____ closure is the weakest enclosure for cylindrical vessels.

- (A) Hemispherical
- (B) Torispherical
- (C) Conical or flat plate
- (D) Elliptical

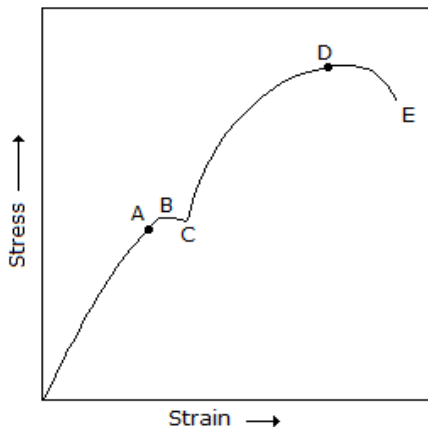
Answer: Option C

15. Which of the following is the best tube material from thermal conductivity point of view alone?

- (A) Aluminium
- (B) Stainless steel
- (C) Copper
- (D) Carbon steel

Answer: Option C

16. Stress-strain diagram for low carbon steel/mild steel is shown below in the Fig. The point 'A' on the Fig. represents the



Stress-strain diagram for mild steel.

- (A) Breaking stress
- (B) Ultimate stress
- (C) Elastic limit
- (D) Yield point

Answer: Option C

17. Power required for agitation depends upon the

- (A) Height & properties of the liquid
- (B) Agitator type & speed of agitation
- (C) Size of agitator & the tank
- (D) All (A), (B) and (C)

Answer: Option D

18. High pressure fluid in a shell and tube heat exchanger should preferably be routed through the

- (A) Tubes to avoid the expansion of high pressure shell construction
- (B) Shell side for smaller total pressure drop
- (C) Shell side, if the flow is counter-current and tube side if the flow is co-current
- (D) Shell side for large overall heat transfer co-efficient

Answer: Option A

19. Stage efficiency for packed tower varies with the

- (A) Type & size of packing
- (B) Fluid rates and fluid properties
- (C) Operating pressure and column diameter
- (D) All (A), (B) and (C)

Answer: Option D

20. What is the slope of the feed line, if the feed to a distillation column is a saturated liquid?

- (A) 0
- (B) ∞
- (C) > 1
- (D) < 1

Answer: Option B

21. Tube wall thickness depends on the corrosiveness of the fluids and their operating pressure & temperature and is specified by Birmingham wire gauge (B.W.G)-a number which varies from 8 to 18 with the numbers 14 and 16 being more commonly used. Outside diameter of tubes varies from about 15 to 50 mm; however a tube of less than _____ mm outside diameter is generally not recommended for fouling fluids.

- (A) 16
- (B) 19
- (C) 28
- (D) 38

Answer: Option B

22. _____ tower is the most suitable gas-liquid contacting device involving highly corrosive fluids.

- (A) Sieve plate
- (B) Packed
- (C) Bubble cap plate
- (D) None of these

Answer: Option B

23. In hydrostatic testing of welded pipe (for leakage, strength etc.) the ratio of minimum hydrostatic test pressure to internal design pressure is around

- (A) 0.5
- (B) 1.5
- (C) 2.5
- (D) 3.5

Answer: Option B

24. For a cylindrical shell, (subject to the thickness of uppermost course being more than the minimum for dia of the tank in question), the thickness of the courses of shell

- (A) Decreases upwards
- (B) Increases upwards
- (C) Remains same throughout
- (D) May decrease or increase upwards depending upon whether vacuum or positive pressure would be maintained inside the shell

Answer: Option A

25. In a shell and tube heat exchanger, the shortest centre to centre distance between the adjacent tubes is

- (A) Called tube pitch
- (B) Called tube clearance
- (C) Always less than the diameter of the tube
- (D) None of these

Answer: Option A

26. Pick out the wrong statement.

- (A) If sufficient residence time (around 8 seconds) is not provided to the downcoming liquid in the downcomer, it may entrain some vapour
- (B) The liquid head in the downcomer should not be greater than one half the plate spacing to avoid flooding
- (C) The discharge end of the downcomer must project far enough into the tray liquid so that no gas bubbles can enter the open end and by pass the bubble caps
- (D) None of these

Answer: Option D

27. If 'D' is the inside diameter of the shell of a shell and tube heat exchanger, then the baffle spacing is usually in the range of

- (A) $D/2$ or minimum 2" to $5D$
- (B) $D/5$ or minimum 2" to $5D$
- (C) $D/5$ or minimum 2" to D
- (D) None of these

Answer: Option B

28. For turbulent flow ($N_{Re} > 2100$) of low viscosity fluid ($\mu > 20cp$) in steel pipes, the optimum inside pipe diameter is given by (where, Q = fluid flow rate, ft^3/sec , ρ = fluid density, lb/ft^3 , μ = fluid viscosity, centipoise, D_i = optimum inside pipe diameter, inches)

- (A) $D_{i, opt} = 3.9 Q^{0.45} \rho^{0.13}$
- (B) $D_{i, opt} = 3.9 Q^{0.45} \mu^{0.95}$
- (C) $D_{i, opt} = 4.7 Q^{0.36} \mu^{3.2} \rho^{0.13}$
- (D) $D_{i, opt} = 3 Q^{0.36} \mu^{0.88}$

Answer: Option A

29. Scale up problem in design based on the similarity concept takes into account _____ similarity.

- (A) Geometrical
- (B) Kinematic
- (C) Dynamic
- (D) All (A), (B) and (C)

Answer: Option D

30. Weep holes provided in the plates of a distillation column

- (A) Facilitate draining out liquid from a tray when the unit is not in operation
- (B) Are normally located near the overflow weir so that any delivery of liquid during operation follows approximately the same path as the overflow fluid
- (C) Must be large enough (usually 1/4" to 5/8" dia) to prevent plugging but should not deliver excessive amount of fluid during operation
- (D) All (A), (B) and (C)

Answer: Option D

31. The longitudinal stress induced in a thin walled cylindrical vessel under internal pressure is

- (A) $pd/2t$
- (B) $pd/4t$
- (C) pd/t
- (D) $pd/8t$

Answer: Option B

32. Tube height in a calandria type evaporator is normally less than _____ metres.

- (A) 1
- (B) 2
- (C) 3.5
- (D) 5.5

Answer: Option B

33. 1.2 to 3.8 cms is the value of the

- (A) Downcomer liquid seal in case of a balanced tray design
- (B) Static submergence in case of a bubble cap tray for column operating under pressure (≥ 1 atm)
- (C) Skirt clearance for bubble caps
- (D) All (A), (B) and (C)

Answer: Option D

34. The ratio, (propeller agitator dia/tank dia) is normally taken as

- (A) 0.15-0.30
- (B) 0.5-0.65
- (C) 0.75-0.85
- (D) 0.60-0.90

Answer: Option A

35. In a pressure vessel containing multiple openings of various dimensions at different parts, stress concentration at the edges of the opening is maximum which becomes negligibly small beyond the area covered by _____ times the hole diameter.

- (A) Two
- (B) Five
- (C) Ten
- (D) Twenty

Answer: Option A

36. Normal screwed fittings are used for pipes upto a diameter of _____ inches.

- (A) 1.5
- (B) 3
- (C) 5
- (D) 9

Answer: Option B

37. Removable connection of tubes to tube sheet is called

- (A) Ferrule
- (B) Socket
- (C) Nipple
- (D) Saddle

Answer: Option A

38. The ratio of lateral strain to linear strain is termed as the

- (A) Poisson's ratio
- (B) Bulk modulus
- (C) Modulus of elasticity
- (D) Shear modulus

Answer: Option A

39. Bubble cap tray is the most commonly used tray in large distillation column, because

- (A) Of its flexibility and nearly constant efficiency under varying conditions of operation
- (B) It incurs less pressure drop as compared to any other tray designed for the same duty
- (C) It eliminates the foaming and entrainment tendency during operation
- (D) None of these

Answer: Option A

40. What is the slope of the operating line in the rectifying section of a distillation column?

- (A) 0
- (B) ∞
- (C) > 1
- (D) < 1

Answer: Option D

41. (L_e/D) for a Tee (used as elbow, entering run) would be around

- (A) 5
- (B) 60
- (C) 160
- (D) 200

Answer: Option B

42. Angled baffles are preferred in the agitation tank to control the swirling action; if the viscosity of the liquid to be mixed is about 200 poise. However, the baffle may be completely eliminated for mixing liquids having viscosity above _____ poise.

- (A) 300
- (B) 600
- (C) 1000

(D) 1500
Answer: Option B

43. At equal mass velocities, the values of film co-efficients for gases as compared to that for liquids are generally.

- (A) Higher
 - (B) Lower
 - (C) Same
 - (D) Unpredictable
- Answer: Option B

44. Which of the following efficiencies can be greater than 100%?

- (A) Overall plate efficiency
 - (B) Murphree plate efficiency
 - (C) Point efficiency
 - (D) None of these
- Answer: Option B

45. The design stress, which is more than the damaging stress, is the least unit stress that will render a member unfit for service before the end of its normal life. The design stress factor or factor of safety indicates the margin between design stress and the _____ stress.

- (A) Working
 - (B) Damaging
 - (C) Allowable
 - (D) None of these
- Answer: Option B

46. Minimum tube pitch recommended for shell and tube heat exchangers is about _____ times the outside diameter of the tube.

- (A) 1.25
- (B) 1.75
- (C) 2.5
- (D) 3.5

Answer: Option A

47. Pick out the wrong statement.

- (A) Lug supports are less expensive than other type of supports
- (B) A pipe is differentiated from a tube by the fact that a pipe has a greater wall thickness compared to the tube
- (C) A reducer is used to change the direction of a pipe in a straight run
- (D) The method of fixing tubes to a tube sheet by expanding is called 'tube rolling'

Answer: Option C

48. In a shell and tube heat exchanger, triangular pitch arrangement as compared to square pitch arrangement

- (A) Results in higher shell side pressure drop
- (B) Can accommodate less number of tubes for a given shell diameter
- (C) Facilitates easier shell side cleaning; hence is more suitable for handling high dirt factor shell side fluid
- (D) Creates relatively lower turbulence on the shell side resulting in lower shell side heat transfer co-efficient

Answer: Option A

49. Baffles are provided in a shell and tube heat exchanger to increase the turbulence and velocity of the shell side fluid. Which of the following shaped baffles does not fall in the category of transverse baffle?

- (A) Segmental baffle
- (B) Flat plate extending across the wall
- (C) Disk type baffle
- (D) Helical type baffle

Answer: Option B

50. _____ heat exchanger is also known as 'hair pin type' exchanger,

- (A) Double pipe
- (B) Finned

- (C) Plate type
 - (D) Regenerative
- Answer: Option A

51. Value of Peclet number = ∞ , is the representative of

- (A) Laminar flow
- (B) Complete back mixing
- (C) Plug flow
- (D) Eddy diffusivity = 0

Answer: Option C

52. The average velocity in the tubes of a 1-4 heat exchanger is _____ times that in 1-1 heat exchanger having the same size & number of tubes and operated at same liquid flow rate.

- (A) 2
- (B) 1/2
- (C) 4
- (D) 1/4

Answer: Option C

53. Steam economy is defined as the amount of evaporation per unit amount of steam used, while the capacity is the total evaporation obtained per hour. Use of multiple effects in evaporation

- (A) Increases capacity
- (B) Increases economy
- (C) Does not affect the capacity
- (D) Both 'b' & 'c'

Answer: Option D

54. Pick out the wrong statement about distillation operation

- (A) Distillation under vacuum is a substitute for steam distillation
- (B) In differential (simple) distillation, the vapour is removed as soon as it is formed without appreciable condensation
- (C) In flash (equilibrium) distillation, a definite fraction of liquid is vaporised in such a way that the evolved vapour & residual liquids are in equilibrium with each other
- (D) Flash distillation, differential distillation & steam distillation are all continuous distillation processes

Answer: Option D

55. Value of Peclet number = 0, is the representative of

- (A) Laminar flow
- (B) Complete back mixing
- (C) Plug flow
- (D) Eddy diffusivity = 0

Answer: Option B

56. A shell may be termed as thin if its thickness to diameter ratio is less than 0.1. The factor which can be neglected in the calculation of membrane stresses is

- (A) Bending
- (B) Deformation
- (C) Shear
- (D) Elongation

Answer: Option A

57. In case of a 'thin' pressure vessel, the ratio of its diameter to wall thickness is

- (A) < 10
- (B) > 10
- (C) > 20
- (D) 30

Answer: Option B

58. (L_e/D) for couplings and unions would be

- (A) 60
- (B) 200
- (C) 350
- (D) Negligible

Answer: Option D

59. For a 25 mm hole drilled in plates to be riveted, the shank diameter of the rivet should be _____ mm.

- (A) 25
- (B) 23
- (C) 26
- (D) 27

Answer: Option B

60. Ratio of tube length to shell diameter for a shell and tube heat exchanger is

- (A) 8 : 1 to 12 : 1 for both liquid-liquid and gas-gas heat exchangers
- (B) 4 : 1 to 8 : 1 for liquid-liquid exchanger
- (C) < 4 : 1 for gas-gas exchangers
- (D) Both (B) & (C)

Answer: Option D

61. The ratio of the largest load in a test to the original cross-sectional area of the test specimen is called the _____ stress.

- (A) Yield point
- (B) Breaking
- (C) Ultimate
- (D) None of these

Answer: Option C

62. Liquid gradient over a tray can be minimised by

- (A) Providing a higher skirt clearance or a higher weir
- (B) Decreasing the number of rows of caps through which the liquid flows or by decreasing the velocity of liquid flow past the caps or by reducing the distance along the tray through which the liquid must flow
- (C) Using split flow, radial flow or cascade flow for column diameter large than 4 ft
- (D) All (A), (B) and (C)

Answer: Option D

63. Factor of safety (i.e., overdesign factor) in heat transfer equipments is about _____ percent more than the actual/theoretical design factor.

- (A) 5-10
- (B) 15-20
- (C) 30-35
- (D) 35-40

Answer: Option B

64. Slope of counter-current flow rotary drier is in the range of _____ meter/metre.

- (A) 0 to 0.08
- (B) 0 to 0.8
- (C) 0 to 1.5
- (D) 0 to 2.2

Answer: Option A

65. Wind load consideration in the design of a support can be neglected, when the vessel is

- (A) Tall (say 30 metres), but is full of liquid
- (B) Tall but empty
- (C) Short (< 2 m) and housed indoor
- (D) None of these

Answer: Option C

66. In a multiple effect evaporator system having 'n' effects, the amount of water evaporated per unit surface area in approximately equal to _____ times that in a single effect.

- (A) n^{th}
- (B) $(1/n)^{\text{th}}$
- (C) $0.5 n^{\text{th}}$
- (D) $1.5 n^{\text{th}}$

Answer: Option B

67. Heat transfer co-efficient for a horizontal condenser as compared to a vertical condenser operating under similar conditions is

- (A) Same
- (B) Less
- (C) About 3 times
- (D) About 0.33 times

Answer: Option C

68. Tubes are fixed to the tube sheet (a thick circular metallic plate) by the method of tube rolling and brazing (non-removable) or ferrule connection (removable). Thickness of the tube, sheet is normally _____ the outside diameter of the tube but in no case it should be less than 22 mm (7/8").

- (A) Half
- (B) Three fourth
- (C) Equal to
- (D) 1.5 times

Answer: Option C

69. For identical operating conditions, the pressure drop over _____ tray is the highest out of the following.

- (A) Sieve
- (B) Valve
- (C) Counter flow
- (D) Bubble cap

Answer: Option D

70. Maximum plate efficiency is achieved in case of _____ flow.

- (A) Split
- (B) Cross
- (C) Cascade
- (D) Reverse

Answer: Option B

71. In a shell and tube heat exchanger having square pitch, the shell side equivalent diameter is given by (where, P = pitch, d = outside diameter of the tube)

- (A) $4(P^2 - \pi d^2/4)/\pi d$
- (B) $(P^2 - rd^2/4)/rd$
- (C) $4P^2/\pi d$
- (D) $\pi d/4P^2$

Answer: Option A

72. Diameter of the sieve tray column is determined by the

- (A) Lower limit of vapour velocity
- (B) Upper limit of the vapour velocity
- (C) Hole diameter of the sieve tray
- (D) Height of the plate spacing

Answer: Option B

73. In the allocated cap area, bubble caps are generally arranged on equilateral triangular pitch. Number of caps fixed on a plate is with a

- (A) Clearance of 25-75 mm
- (B) Cap pitch of 1.3-2 times the cap diameter
- (C) Either 'a' or 'b'
- (D) Neither 'a' nor 'b'

Answer: Option C

74. (L_e/D) for 90° elbow (medium radius) and 90°square elbow would be respectively around

- (A) 25 and 60
- (B) 3 and 5
- (C) 100 and 250
- (D) 250 and 600

Answer: Option A

75. Maximum acceptable total liquid gradient over a tray is about _____ mm.

- (A) 5.5

- (B) 12.5
- (C) 30.5
- (D) 45.5

Answer: Option B

76. Baffle spacing is generally _____ the I.D. of the shell.

- (A) More than
- (B) Not greater than
- (C) Not less than one fifth of
- (D) Both (B) and (C)

Answer: Option D

77. A minimum clearance of about _____ mm is maintained between the distillation column wall and the bubble cap.

- (A) 19
- (B) 38
- (C) 67
- (D) 95

Answer: Option B

78. The dust collection efficiency of a cyclone separator

- (A) Decreases with increase in gas flow rate
- (B) Is inversely proportional to the mass of the dust particle
- (C) Is directly proportional to the radius of the dust particle path
- (D) None of these

Answer: Option D

79. Seamless pipe is made

- (A) From rolled strips formed into cylinders and seam-welded
- (B) By extrusion & casting into static and centrifugal molds
- (C) By forging a solid round, piercing it by simultaneously rotating & forcing it over a piercer point and further reducing it by rolling gas drawing
- (D) Both (B) and (C)

Answer: Option D

80. Log mean temperature difference in case of multi-pass shell and tube heat exchanger is always

- (A) Less than arithmetic mean value
- (B) More than arithmetic mean value
- (C) More than geometric mean value
- (D) Both (B) & (C)

Answer: Option A

81. For annular flow of a fluid, the ratio of the equivalent diameter for pressure drop calculation to the equivalent diameter for heat transfer calculation is

- (A) $d_1/(d_1 + d_2)$
- (B) $d_2/(d_1 + d_2)$
- (C) $(d_1 + d_2)/d_1$
- (D) $(d_1 + d_2)/d_2$

Answer: Option A

82. In distillation columns, bubble caps are held in place over trays by

- (A) Rivets
- (B) A hold down bar
- (C) Bolts
- (D) Both (B) and (C)

Answer: Option D

83. Optimum economic pipe diameter for fluid flow is determined by the

- (A) Viscosity of the fluid
- (B) Density of the fluid
- (C) Total cost considerations (pumping cost plus fixed cost of the pipe)
- (D) None of these

Answer: Option C

- 84. The necessary wall thickness for a metallic storage vessel is a function of the**
(A) Ultimate tensile strength (or yield point) of the material and operating temperature
(B) Operating pressure and welding/joint efficiency
(C) Diameter of the vessel
(D) All (A), (B) and (C)
Answer: Option D

- 85. The ratio for the rate of washing to the final rate of filtration in a washing type of plate and frame filter is**
(A) 0.25
(B) 0.50
(C) 0.75
(D) 1.25
Answer: Option A

- 86. Cylindrical shell thickness of rotary drier is generally _____ mm.**
(A) 2-3
(B) 18-22
(C) 6-8
(D) 12-15
Answer: Option C

- 87. Pick out the wrong statement pertaining to 'Horton sphere' used for the storage of liquid ammonia.**
(A) Diameter of Horton sphere is normally 6 to 25 metres and it is supported by 6 to 12 nos. tubular or rolled section column
(B) Thickness of spherical shell is half that of the cylindrical vessel under same operating pressure condition. Besides, the ratio of surface area to volume is less for sphere than any other shape; hence insulation required is less
(C) Horton sphere is used for the storage of gases and volatile liquid at a moderate pressure of 1 to 10 kg/cm²
(D) Horton sphere is used for the storage of liquid at sub-zero temperature at very high pressure upto 200 kg/cm²
Answer: Option D

- 88. The length of straight rectangular weir used on cross-flow trays is generally _____ the column diameter.**
(A) 0.6-0.8 times
(B) Equal to
(C) Twice
(D) 2 ft irrespective of (for column > 3 ft diameter)
Answer: Option A

- 89. Pressure differential maintained across a continuous rotary vacuum filter is in the range of _____ mm Hg column.**
(A) 50 to 100
(B) 100 to 150
(C) 250 to 500
(D) 600 to 700
Answer: Option C

- 90. In a shell and tube heat exchanger, the clearance of the tube is generally**
(A) Not less than one-fourth of the tube diameter or 3/16"
(B) More than the tube diameter
(C) Equal to the tube diameter
(D) More in case of triangular pitch as compared to the square pitch tube layout
Answer: Option A

- 91. The wall thickness of thin cylindrical shell with hemispherical ends is _____ that of the spherical ends.**
(A) Equal to
(B) More than
(C) Less than
(D) Either (B) or (C); depends on maximum permissible internal pressure
Answer: Option B

92. Frame thickness in the plate and frame filter press is normally in the range of _____ inches.

- (A) 0.25 to 4
- (B) 0.25 to 8
- (C) 1 to 5
- (D) 1 to 12

Answer: Option B

93. In a shell and tube heat exchanger, the overall heat transfer co-efficient is proportional to the tube side (volumetric flow rate)^{0.8}. This is valid, only when the ratio of the tube side film resistance to the total resistance is almost equal to

- (A) ∞
- (B) 1
- (C) 20.8
- (D) 2

Answer: Option B

94. In case of saddle packing (e.g., berl and intralox saddles), the maximum size of the packing should not exceed _____ of the column diameter.

- (A) 1/5th
- (B) 1/15th
- (C) 1/30th
- (D) 1/50th

Answer: Option B

95. Souders Brown equation given by, $U = K_v \sqrt{(\rho_l - \rho_v)/\rho_v}$, is used for the calculation of the _____ in a continuous distillation column.

- (A) Diameter of the bubble cap column
- (B) Diameter of the sieve plate column
- (C) Tray pressure drop
- (D) Residence time in the downcomer for the disengagement of entrained vapour

Answer: Option A

96. At the following point for a given packing and set of fluids, the pressure drop per metre of packed height, with variation in fluid rates and operating pressure

- (A) Increases
- (B) Decreases
- (C) Remain same
- (D) May increase or decrease depending upon the solubility of the gas in the liquid

Answer: Option C

97. A certain pressure vessel manufacturer avoids doing reinforcements calculations for openings by always providing a reinforcing pad extending upto double the diameter of the opening and of the same material and thickness as that of the shell wall. If area compensation is accepted as a code guideline, his approach leads to safe design

- (A) Only if the opening is on spherical vessel
- (B) Only if the opening is on a vertical cylindrical vessel
- (C) Only if the opening is on a horizontal cylindrical vessel
- (D) Irrespective of the shape of the vessel

Answer: Option D

98. In a double pipe (concentric) heat exchanger, the hydraulic radius for heat transfer (for a fluid flowing through the annulus) would be

- (A) Same as that for fluid flow
- (B) Less than that for fluid flow
- (C) More than that for fluid flow
- (D) $D_2 - D_1$ (D_1 and D_2 are I.D. of inner and outer pipes respectively)

Answer: Option C

99. (L_e/D) for a Tee (used as elbow, entering branch) would be

- (A) Less than that for Tee (used as elbow, entering run)
- (B) More than that for Tee (used as elbow, entering run)
- (C) Around 90
- (D) Both (B) and (C)

Answer: Option D

100. A/an _____ is used for changing the direction of a pipeline.

- (A) Elbow
- (B) Union
- (C) Flange
- (D) Disc compensator

Answer: Option A

101. Mc Cable Thiele method used for finding theoretical stages in a distillation column assumes that the

- (A) Sensible heat differences are small, because the temperature changes from tray to tray is small
- (B) Trouton's rule is applicable
- (C) Liquid/vapor loading across the column remains constant
- (D) All (A), (B) and (C)

Answer: Option D

102. Low pressure steam (with saturation temperature between 105 to 120°C) is usually used in the vacuum evaporators, which normally employ a vacuum of about _____ mm Hg (referred to a 760 mm mercury barometer).

- (A) 250
- (B) 450
- (C) 650
- (D) 750

Answer: Option C

103. Typical static submergence for bubble cap plate column operating at atmospheric pressure may be around

- (A) 2.5"
- (B) 0.5"
- (C) 5"
- (D) 50% of the plate spacing

Answer: Option B

104. Elastic failure of a material occurs, when the tensile stress equals yield strength, yield point or the elastic limit. Also, the elastic failure occurs according to maximum strain theory, when the maximum tensile strain equals (where, σ = yield strength and E = modulus of elasticity)

- (A) E
- (B) σ
- (C) σ/E
- (D) E/σ

Answer: Option C

105. Which of the following types of reactors is the safest from operation point of view?

- (A) A vapor phase reactor
- (B) Pot type reactor
- (C) A liquid phase reactor
- (D) A liquid phase catalytic reactor

Answer: Option A

106. A 'rupture disc' is provided in chemical equipments as an accessory meant for

- (A) Relieving excess pressure
- (B) Creating turbulence
- (C) Enhancing mixing rate
- (D) Avoiding vortex formation

Answer: Option A

107. The distance between the centres of a rivet hole to the nearest edge of the plate is called

- (A) Pitch
- (B) Margin
- (C) Back pitch
- (D) None of these

Answer: Option B

108. The minimum shell thickness for tank ≤ 15 metres diameter is limited to _____ mm, for reasons of elastic stability.

- (A) 2
- (B) 5
- (C) 10
- (D) 15

Answer: Option B

109. To avoid the tearing off the plate of an edge, the margin (i.e., the minimum distance from the centre of the rivet hole to the nearest edge of the plate) should be equal to

- (A) $0.5 d$
- (B) d
- (C) $1.5 d$
- (D) $2.5 d$

Answer: Option C

110. _____ shaped roof is the most commonly used roof for cylindrical storage tanks.

- (A) Conical
- (B) Flat
- (C) Dome
- (D) Umbrella

Answer: Option A

111. When one of the fluids is highly corrosive and has fouling tendency, it should

- (A) Preferably flow inside the tube for its easier internal cleaning
- (B) Preferably flow outside the tube
- (C) Flow at a very slow velocity
- (D) Flow outside the tube, when the flow is counter-current and inside the tube when the flow is co-current

Answer: Option A

112. Filtration rate is affected by the

- (A) Pressure drop across the cake & filter medium
- (B) Cake & filter medium resistance
- (C) Area of filtering surface & the viscosity of filtrate
- (D) All (A), (B) and (C)

Answer: Option D

113. In a bag filter, the pressure drop increases directly as the

- (A) Density of the gas, but is independent of the viscosity of the gas
- (B) Density of the gas and inversely as viscosity of the gas
- (C) Viscosity of the gas and inversely as density of the gas
- (D) None of these

Answer: Option B

114. Normally, the length to diameter ratio of rotary dryers varies from 4 to 10 and for its economic operation; the number of transfer units (NTU) for such dryers varies from

- (A) 1.5-2.5
- (B) 3.5-5.5
- (C) 7.5-10.0
- (D) 10-15

Answer: Option A

115. In a shell and tube heat exchanger for a given heat transfer surface area, smaller diameter tubes are favoured as compared to larger diameter ones; because the smaller diameter tubes

- (A) Are easier to clean
- (B) Are less prone to fouling
- (C) Can be fitted into a smaller shell diameter hence the cost of the heat exchanger would be less
- (D) None of these

Answer: Option C

116. Pick out the wrong statement

- (A) In a flanged and standard dished head, the crown radius is \leq shell outside diameter
- (B) In a flanged and shallow dished head, the crown radius is $>$ shell outside diameter
- (C) Flat head covers are most suitable for larger vessels operating at very high pressure

(D) Flanged only head is a type of flat head in which gradual change in the shape at the centre results in reduced local stresses

Answer: Option C

117. In a vertical short tube evaporator (Calandria type), the

(A) Tube dia of 2.5-7.5 cms, tube length of 75-200 cms and cylindrical drum dia of 1-6 metres are normally used

(B) Area of central downtake is equal to 40 to 100% of total cross-sectional area of the surrounding tube

(C) Liquor is inside the tube while the steam is outside the tube

(D) All (A), (B) & (C)

Answer: Option D

118. The ratio of volumes of the mixed reactor to the plug flow reactor (for identical feed composition, flow rate, conversion, and for all positive reaction orders) is always

(A) 1

(B) < 1

(C) > 1

(D) Equal to the order of reaction

Answer: Option C

119. For a given fluid, as the pipe diameter increases, the pumping cost

(A) Decreases

(B) Increases

(C) Remain unaffected

(D) May increase or decrease depending upon whether the fluid is Newtonian or non-Newtonian

Answer: Option A

120. In a _____ riveted joint, the number of rivets decreases from the innermost row to the outermost row.

(A) Chain

(B) Diamond

(C) Zig-zag

(D) None of these

Answer: Option B

121. Movement of pipeline caused by thermal expansion is taken care by providing

(A) Expansion joint

(B) Changes in its direction

(C) Change in the shape of pipeline

(D) All (A), (B) and (C)

Answer: Option D

122. A binary liquid Azeotropic mixture has boiling point lower than either of the components, when it shows _____ deviation from Raoult's Law.

(A) Positive

(B) Negative

(C) No

(D) None of these

Answer: Option A

123. The clearance between two tubes in a shell and tube heat exchanger is known as 'ligament', whose minimum value is _____ the outside diameter of the tube, but in no case it should be less than 4.5 mm.

(A) Equal to

(B) Half

(C) One fourth

(D) Three fourth

Answer: Option C

124. In most of the shell and tube heat exchangers, the tube pitch is generally _____ the tube diameter.

(A) Less than

(B) 1.25-1.50 times

(C) 2.5 times

(D) one-fourth of
Answer: Option B

125. Which of the following is the most common type of baffle used in industrial shell and tube heat exchanger?

- (A) 75% cut segmental baffle
- (B) 25% cut segmental baffle
- (C) Orifice baffle
- (D) Disk and doughnut baffle

Answer: Option B

126. Any shell opening greater than 5 cms for a storage tank must be reinforced for reason of

- (A) Preventing the local overstressing of the shell around the opening
- (B) Reduction of discontinuity in shape at the junction
- (C) Making the joint leak proof
- (D) None of these

Answer: Option A

127. _____ is the determining factor for the number of bubble caps to be used per tray.

- (A) Permissible slot velocity
- (B) Tray diameter
- (C) Liquid load
- (D) Vapor load

Answer: Option A

128. The centre to centre distance between two consecutive baffles in a shell and tube heat exchanger is called the baffle pitch or baffle spacing, which is more than 1/5th the I.D. of the shell. Which of the following is not a function of the baffles?

- (A) To increase the residence time of shell side fluid
- (B) To provide support to the tube bundle
- (C) To reduce the induced vibration in the tubes
- (D) To increase the tube side heat transfer co-efficient by inducing turbulence

Answer: Option D

129. The buckling tendency of compression members is always in the direction of the

- (A) Least radius of gyration
- (B) Axis of the load
- (C) Perpendicular to the axis of the load
- (D) None of these

Answer: Option A

130. In the design of a paddle agitator, the ratio (paddle dia/tank dia) is normally taken as

- (A) 0.1
- (B) 0.8
- (C) 0.25
- (D) 0.5

Answer: Option B

131. The equivalent diameter for fluid flow through a channel of constant non-circular cross section of area 'A' is given by (where, P = perimeter of the channel in contact with the fluid)

- (A) $4 A/P$
- (B) A/P
- (C) $4 P/A$
- (D) \sqrt{A}

Answer: Option A

132. Hoop (circumferential) stress induced in a thin walled 'Horton Sphere' used for the storage of liquid ammonia under pressure is

- (A) $pD/2T$
- (B) $pD/4T$
- (C) $pD/3T$
- (D) $pD/6T$

Answer: Option A

133. Accidents in chemical plants are mostly due to

- (A) Inadequate equipment design
 - (B) Faulty operating procedures
 - (C) Improper layout of the equipments
 - (D) Failure of equipments
- Answer: Option B

134. In case of 1.5" heat exchanger tubes, the inside flow area _____ with decrease in BWG.

- (A) Increases
 - (B) Decreases
 - (C) Remains same
 - (D) None of these
- Answer: Option B

135. Liquid redistribution should be done in a packed tower packed with raschig rings every 6 metres or _____ times the column diameter, whichever is lower.

- (A) 2.5-3.0
 - (B) 5-7.5
 - (C) 10-12.5
 - (D) 15-20
- Answer: Option A

136. Hole diameter of the sieve trays in the distillation column ranges from _____ mm.

- (A) 1 to 3
 - (B) 4 to 8
 - (C) 3 to 12.5
 - (D) 12.5 to 18.5
- Answer: Option C

137. The ratio of linear stress to linear strain is termed as the

- (A) Modulus of elasticity
 - (B) Modulus of rigidity
 - (C) Bulk modulus
 - (D) None of these
- Answer: Option A

138. Pick out the wrong statement pertaining to the design of the distillation column.

- (A) Generally, a skirt clearance of 0.5" to 1.5' is recommended to prevent plugging of the slots by residue build up
 - (B) The purpose of the slot is to disperse the gas into the liquid in the form of small bubbles
 - (C) If sufficient slot area is not provided, the gas may pass through the skirt clearance
 - (D) None of these
- Answer: Option D

139. A perforated plate has holes of diameter d_h arranged in a pitch p_h . Each hole has a tube of I.D. d_t passing through it. The ligament efficiency is given by

- (A) $(p_h - d_h)/p_h$
 - (B) $(p_h - d_h \cdot d_t/2)/p_h$
 - (C) $(p_h - d_t)/p_h$
 - (D) $(p_h - d_h)/d_h$
- Answer: Option C

140. The force due to wind load acting on a tall vessel depends upon its

- (A) Shape
 - (B) Outside diameter
 - (C) Height
 - (D) All (A), (B) & (C)
- Answer: Option D

141. The thermal stress in a metallic bar does not depend upon the

- (A) Changes in temperature
 - (B) Cross-sectional area
 - (C) Both (A) and (B)
 - (D) Neither (A) nor (B)
- Answer: Option B

142. Brass valves are usually made for pipe sizes _____ inches.

- (A) ≤ 1
- (B) ≤ 2
- (C) > 2.5
- (D) > 3.5

Answer: Option B

143. Diameter of rivet hole (d , mm) and the plate thickness (t , mm) are related by Unwin's formula as

- (A) $d = 1.1 t$
- (B) $d = 1.6 \sqrt{t}$
- (C) $d = 1.5 t$
- (D) $d = 3 \sqrt{t}$

Answer: Option B

144. The normal range of velocity of water in pipes is _____ m/sec.

- (A) 0.1-0.5
- (B) 1-2
- (C) 10-50
- (D) 15-30

Answer: Option B

145. Steam is preferred to be used as a heating medium in heat exchangers, because of its

- (A) Low cost
- (B) High latent heat
- (C) Non-corrosive condensate
- (D) High film co-efficient

Answer: Option B

146. What is the minimum recommended ligament for square pitch arrangement in case of heat exchangers?

- (A) 6.5 cms
- (B) 6.5 mm
- (C) Equal to tube I.D
- (D) Equal to tube O.D

Answer: Option B

147. Poisson's ratio of a material is the ratio of unit lateral strain to the unit axial elongation within its elastic limit. The value of Poisson's ratio for structural and pressure vessel steel may be taken as

- (A) 0.01
- (B) 0.3
- (C) 0.75
- (D) 0.95

Answer: Option B

148. Pick out the wrong statement about routing of fluids in a shell and tube heat exchanger.

- (A) The corrosive and fouling fluid should be preferably routed through the tubes
- (B) The viscous fluid should be routed through the shell side
- (C) Lower flow rate fluid should be routed through the shell side
- (D) Higher pressure fluid stream should be routed through the shell side

Answer: Option D

149. The approximate liquid depth in an agitation tank is equal to (where, d = tank diameter)

- (A) $0.5 d$
- (B) $0.75 d$
- (C) d
- (D) $2 d$

Answer: Option C

150. Rate of filtrate delivery is inversely proportional to the

- (A) Filtering area & the pressure difference driving force
- (B) Viscosity of filtrate
- (C) Cake & filter medium resistance

(D) Both (A) and (B)
Answer: Option D

151. Lug support is meant for supporting _____ vessels.

- (A) Large horizontal cylindrical
- (B) Tall but empty
- (C) Small
- (D) Thick walled tall

Answer: Option C

152. Ponchon Savarit method is based on the use of enthalpy concentration diagram, which contains the bubble point curve (saturated liquid curve), dew point curve (saturated vapour curve) and equilibrium tie lines. As compared to McCabe-Thiele's method, this method

- (A) is more accurate in finding the number of equilibrium stages
- (B) accounts for the enthalpy changes in the process
- (C) Facilitates direct calculation of heat load on reboiler & condenser from, the diagram used in this method
- (D) All 'a', 'b' & 'c'

Answer: Option D

153. In a rotary drier, the average retention time of solid is (where Z = length of the drier, metres ρ = apparent solid density, kg/m^3 L = flow rate of dry solids, kg/see. m^2 drier cross-section H = hold up of solid.)

- (A) $Z.H.\rho/L$
- (B) $L/Z.H.\rho$
- (C) $H.\rho/L$
- (D) $Z.H/\rho L$

Answer: Option A

154. The safe height (h) to diameter (d) ratio (i.e., h/d) for liquid/petro fuel storage tank of capacity more than 45 kilolitres is less than

- (A) 1
- (B) 2
- (C) 3
- (D) 3.5

Answer: Option A

155. Optimum reflux ratio in a continuous distillation column is determined by the

- (A) Maximum permissible vapour velocity
- (B) Flooding limit of the column
- (C) Total cost consideration (fixed cost of the column plus the cooling water & steam cost)
- (D) None of these

Answer: Option C

156. What is the slope of the operating line in the stripping section of a distillation column ?

- (A) 0
- (B) ∞
- (C) > 1
- (D) < 1

Answer: Option C

157. Bubble cap diameter used for the distillation column having diameter ranging from 1.5 to 4.5 metres is about _____ mm.

- (A) 10
- (B) 50
- (C) 100
- (D) 200

Answer: Option C

158. Cylindrical storage tanks used for the storage of volatile liquids (e.g., naphtha) have _____ roofs.

- (A) Conical
- (B) Flat
- (C) Floating
- (D) Fixed

Answer: Option C

159. Thin spherical shells subjected to internal pressure, develop _____ stresses.

- (A) Radial
- (B) Circumferential
- (C) Both (A) & (B)
- (D) Neither (A) nor (B)

Answer: Option A

160. A forced circulation long tube vertical evaporator as compared to the natural circulation evaporator

- (A) Is economical in operation
- (B) Employs high velocity, high heat transfer rate and less heating surface requirement
- (C) Employs a centrifugal pump placed between external downtake from vapor drum and inlet to tube bundle
- (D) Both (B) & (C)

Answer: Option D

161. A single pass air heater is connected to a two pass unit. For the air flow rate and other conditions remaining the same, the film heat transfer co-efficient for air will vary in the ratio of

- (A) 2
- (B) $2^{0.8}$
- (C) $2^{0.2}$
- (D) None of these

Answer: Option B

162. An adequate clearance between the tray and the shell wall of a distillation column is provided to

- (A) Drain the liquid from the tray when the unit is not in operation
- (B) Allow for thermal expansion and facilitate installation
- (C) Avoid back-trapping
- (D) None of these

Answer: Option B

163. Pick out the correct statement.

- (A) It is preferred to use a vertical condenser for condensation of vapor from a distillation column without sub-cooling
- (B) Draining of residual liquid on tray during shut down of distillation column is facilitated by weep holes
- (C) Random packing a packed tower offers the advantage of lower pressure drop and higher throughput of fluids as compared to regular/stacked packing
- (D) Risers are generally not connected to the plate in a distillation column by bolts, rivets or welding

Answer: Option D

164. Safety valves are provided in chemical equipments to guard against excessive

- (A) Temperature
- (B) Pressure/pressure fluctuation
- (C) Turbulence
- (D) Noise

Answer: Option B

165. Pick out the wrong statement:

- (A) The tensile strength of a brittle material is less than its compressive strength
- (B) The compressive strength of a ductile material is less than its tensile strength
- (C) In a thick cylindrical shell, the hoop stress is maximum at the inner radius
- (D) The value of crushing load is more than that of buckling load for long columns

Answer: Option D

166. Theoretically calculated diameter of the stripping section of the continuous rectification column is _____ that of the enriching section.

- (A) Less than
- (B) More than
- (C) Same as
- (D) Either more or less (depending upon relative volatility)

Answer: Option B

167. A cylindrical pressure vessel of volume $6\pi\text{m}^3$ has to be designed to withstand a maximum internal pressure of 10 atm. The allowable design stress of the material is 125N/mm^2 and corrosion allowance is 2 mm. The thickness of the vessel for a length/diameter ratio of 3 will be close to

- (A) 5 mm
- (B) 6 mm
- (C) 8 mm
- (D) 10 mm

Answer: Option D

168. Floating head heat exchangers are used for the

- (A) Heat transfer between corrosive fluids
- (B) Cases where temperature difference between the shell and the tubes is more ($>50^\circ\text{C}$)
- (C) Co-current heat transfer systems
- (D) Counter-current heat transfer systems

Answer: Option B

169. The ratio of down take area to cross-sectional area of the tube, for calandria type evaporator ranges from

- (A) 0.5 to 1
- (B) 1 to 1.5
- (C) 1.5 to 2
- (D) 2 to 2.5

Answer: Option A

170. Welded joint efficiency in the design of chemical process equipment is taken as

- (A) 0.55
- (B) 0.75
- (C) 0.85
- (D) 0.95

Answer: Option C

171. The thickness of heat transfer plates used in the plate type heat exchanger ranges from _____ mm, pressed in a single piece provided with grooves & corrugations.

- (A) 0.3 to 0.8
- (B) 1.25 to 3.125
- (C) 3.5 to 7.0
- (D) 8 to 12

Answer: Option B

172. In common bubble cap distillation column design practice, riser area is approximately equal to (where, A_a = Annular passage area, and S_a = Slot area)

- (A) $A_a = S_a$
- (B) $1.2 A_a = 1.2 S_a$
- (C) $S_a = 1.5 A_a$
- (D) $A_a = 1.5 S_a$

Answer: Option A

173. Pick out the wrong statement.

- (A) Riveting provides a permanent fastening method
- (B) The joint made by overlapping of one plate over the other, and then riveting the two plates together with two rows of rivets is called 'double riveted butt joint'
- (C) Shank diameter of the rivets should be less than the size of the hole drilled in the plate for riveting
- (D) The efficiency of a riveted joint is the ratio of the strength of the riveted joint to the strength of the solid plate

Answer: Option B

174. Needle valves are generally not used for

- (A) Very large diameter pipes
- (B) High pressure throttling service
- (C) Very accurate flow control
- (D) Smaller sizes of pipe

Answer: Option A

175. Circumferential (hoop) stress in a thin cylindrical vessel under internal pressure is _____ the longitudinal stress.

- (A) Half
- (B) Equal to
- (C) Twice
- (D) Eight times

Answer: Option C

176. Larger depth of liquid on the trays of a distillation column

- (A) Leads to high tray efficiency
- (B) Results in higher pressure drop per tray
- (C) Both (A) & (B)
- (D) Neither (A) or (B)

Answer: Option C

177. The optimum size ratio for two mixed reactors in series depends on the kinetics of the reaction and the conversion level. For reaction orders more than one, the

- (A) Equal sized reactors are the best
- (B) Smaller reactor should come first
- (C) Larger reactor should come first
- (D) None of these

Answer: Option B

178. In a cylindrical vessel subjected to internal pressure, the longitudinal stress σ_L and the circumferential stress, σ_h are related by

- (A) $\sigma_h = 2 \sigma_L$
- (B) $\sigma_h = \sigma_L$
- (C) $\sigma_h = \sigma_L/2$
- (D) No relation exists

Answer: Option A

179. For turbine agitator, the impeller diameter is about

- (A) 0.3 to 0.5 d
- (B) 0.1 to 0.2 d
- (C) 0.65 to 0.85 d
- (D) 0.95 d

Answer: Option A

180. Minimum recommended baffle spacing in a shell and tube heat exchanger is about (where, D = shell diameter)

- (A) 0.2 D
- (B) 0.5 D
- (C) 0.66 D
- (D) 0.80 D

Answer: Option A

181. Commercial packed scrubbers are normally designed for a pressure drop range of _____ mm water column per metre of packed height.

- (A) 4-8
- (B) 17-34
- (C) 52-68
- (D) 88-105

Answer: Option B

182. The distance between the top of the slots and the liquid surface when the static liquid is just ready to flow over the overflow weir is called

- (A) Downcomer liquid seal
- (B) Static submergence
- (C) Skirt clearance
- (D) None of these

Answer: Option B

183. The slope of operating line in the rectifying section of a distillation column is unity, if the reflux ratio is

- (A) 0
- (B) ∞
- (C) 1
- (D) Minimum

Answer: Option B

184. With increase in temperature drop (in a shell and tube heat exchanger), the $LMTD$ correction factor, F_T

- (A) Decreases very rapidly
- (B) Increases very rapidly
- (C) Remains constant
- (D) Increases linearly

Answer: Option A

185. Overall mass transfer co-efficient in case of absorption of _____ in water is based on the gas film co-efficient only, as the mass transfer process is gas film (phase) controlling.

- (A) CO_2
- (B) SO_2
- (C) NH_3
- (D) None of these

Answer: Option C

186. Multiple blade paddle agitator is used for mixing high viscosity liquids/paste in which the paddle diameter is commonly 0.8 times the tank diameter. However, the width of the blade is in the range of _____ times the paddle diameter.

- (A) 0.1 to 0.25
- (B) 0.3 to 0.5
- (C) 0.5 to 0.6
- (D) 0.65 to 0.80

Answer: Option A

187. Minimum baffle spacing recommended in a shell and tube heat exchanger is equal to

- (A) 5 cms
- (B) 40% of the I.D. of the shell
- (C) 25 cms
- (D) I.D. of the shell

Answer: Option A

188. Bubble cap plate column is

- (A) A finite stage contactor
- (B) Used only for distillation, not for absorption
- (C) A differential stage contactor
- (D) A continuous contactor

Answer: Option A

189. The most common standard size of bubble caps used in industrial operation is

- (A) 1" dia cap with 0.5" dia riser
- (B) 6" dia cap with 4" dia riser
- (C) 8" dia cap with 1" dia riser
- (D) 4" dia cap with 8" dia riser

Answer: Option B

190. Shortest distance between two tubes is

- (A) Called tube pitch
- (B) Called tube clearance
- (C) More in case of triangular pitch as compared to square pitch of tube layout
- (D) None of these

Answer: Option B

191. Pick out the wrong statement.

- (A) Plate efficiency increases with increase in superficial vapour velocity till entrainment limit
- (B) Increase in depth of the liquid about the slots increases the plate efficiency, particularly if the liquid depth is $< 1''$

- (C) Too small a plate spacing can cause a low efficiency, if the vapour velocity is greater than the allowable value
(D) None of these
Answer: Option D

192. Rivets are generally specified by the

- (A) Head diameter
(B) Shank diameter
(C) Overall length
(D) None of these
Answer: Option B

193. Heat transfer co-efficient, h_G ($K_{cal}/hr.m^2 . ^\circ C$) and mass velocity of air, G ($kg/hr.m^2$) for air flow parallel to the surface in case of constant drying rate in batch drying is related as $h_G = 0.0176G^{0.8}$. But when the flow of air perpendicular to the surface is encountered, this equation changes to

- (A) $h_G = 1.004G^{0.37}$
(B) $1.004G^{0.8}$
(C) $h_G = 0.0176G^{0.37}$
(D) $0.0176G^{1.37}$
Answer: Option A

194. If a single tube pass heat exchanger is converted to two passes; for the same flow rate, the pressure drop per unit length in tube side will _____ times.

- (A) Increase by 1.8
(B) Decrease by 2^2
(C) Increase by $2^{1.6}$
(D) None of these
Answer: Option C

195. Height equivalent to a theoretical plate (HETP) is the height of packing that will give the same separation as one theoretical plate in gas-liquid mass transfer operations like distillation, absorption/stripping and humidification/dehumidification. HETP which is experimentally determined, depends upon the

- (A) Flow rates of each fluid
(B) Type and size of packing
(C) Concentration of each fluid
(D) All a, b & c
Answer: Option D

196. For storing hazardous chemicals in large storage tanks, the minimum safe distance between the two tanks should range between _____ times the tank diameter.

- (A) 1 to 1.5
(B) 2.5 to 3.5
(C) 4 to 5
(D) 6 to 8
Answer: Option A

197. Liquid gradient over the tray results due to the

- (A) Resistance offered to flow of liquids by caps & risers and the flow of gas
(B) Low gas velocity
(C) Large plate spacing
(D) Large reflux ratio
Answer: Option A

198. Which of the following is not a graphical method (but is an analytical method) for the calculation of theoretical number of stages in case of continuous binary distillation?

- (A) Sorel-Lewis method
(B) McCabe-Thiele's method
(C) Ponchon-Savarit method
(D) None of these
Answer: Option A

199. The ratio of tube length to shell diameter in case of liquid shell and tube heat exchanger ranges from

- (A) 2 to 3
- (B) 3 to 5
- (C) 4 to 8
- (D) 6 to 12

Answer: Option C

200. Fouling factor must be included in the calculation of overall design heat transfer coefficient, when the liquid

- (A) Containing suspended solids flows at low velocity
- (B) Containing suspended solids flows at high velocity
- (C) Is highly viscous
- (D) Is of high specific gravity

Answer: Option A

201. The slope of the feed line in distillation operation is given by (where, q = fraction of the feed stream that is liquid.)

- (A) $-q$
- (B) $-q/(1-q)$
- (C) $-q/(q-1)$
- (D) None of these

Answer: Option B

202. An increase in the liquid resistance to interphase mass transfer and a resultant reduction in plate efficiency is caused by

- (A) An increase in liquid viscosity
- (B) An increase in relative volatility for rectification columns
- (C) Decrease in gas solubility for absorbers
- (D) All (A), (B) and (C)

Answer: Option D

203. _____ head is the most economical for cylindrical vessels designed for operating at high pressure (> 15 atm.).

- (A) Hemispherical
- (B) Dished
- (C) Ellipsoidal
- (D) Conical

Answer: Option C

204. Overall tray efficiency of a distillation column is the ratio of the number of

- (A) Overall gas transfer units to the number of ideal trays required
- (B) Ideal trays required to the number of real trays required
- (C) Real trays required to the number of ideal trays required
- (D) None of these

Answer: Option B

205. Vertical condenser is advantageous to the horizontal condenser from operation point of view, when

- (A) Hydrostatic head is required for refluxing the condensate
- (B) Only the function of condensation is to be carried out
- (C) Sub-cooling of condensate is desired
- (D) Both the functions of condensation & sub cooling are carried out in a single unit

Answer: Option D

206. Pick out the wrong statement.

- (A) In practical operation, distillation towers having diameter 3-6 metres equipped with bubble cap (round) size of 15 cms are used
- (B) Height of packing in a packed tower is about 3 times the column diameter for raschig rings and about 5 to 10 times the column diameter for saddle packing
- (C) In a sieve tray, the minimum hole diameter is equal to the tray thickness
- (D) In a stainless steel sieve tray, the minimum hole diameter is equal to 10 times the plate thickness

Answer: Option D

207. The circumferential (hoop) stress in a thin walled cylindrical vessel under internal pressure is

- (A) $pd/2t$
- (B) $pd/4t$
- (C) pd/t
- (D) $pd/3t$

Answer: Option A

208. The testing pressure of storage tanks and pressure vessels designed as per Indian standard codes should be about _____ times the design pressure.

- (A) 1.5 to 2
- (B) 3 to 4
- (C) 4 to 5
- (D) > 5

Answer: Option A

209. Pick out the correct statement

- (A) Centre to centre distance between two consecutive rivets in a row is called the pitch
- (B) A riveted joint made in overlapping plates is called butt joint
- (C) Hole size drilled in riveted plates is less than the actual size of the rivet
- (D) None of these

Answer: Option A

210. Which of the following factors affect the pressure drop in a co-current gas-liquid absorption packed tower?

- (A) Size, shape, orientation and surface of the packing particles
- (B) Density and viscosity of fluids
- (C) Fluid flow rates
- (D) All (A), (B) and (C)

Answer: Option D

211. In the agitators, the power required will be changed with the increase of diameter of agitator (D) as

- (A) D^2
- (B) D^5
- (C) D
- (D) D^9

Answer: Option B

212. Which of the following packing materials provides for maximum mass transfer?

- (A) Raschig rings
- (B) Raschig rings
- (C) Cross-partition rings
- (D) All give the same value

Answer: Option C

213. Pick out the wrong statement.

- (A) Safety valves are provided in heat exchangers for removal of non-condensable
- (B) Liquid metals and Dowtherm are used for very high temperature heating
- (C) In a shell and tube heat exchanger, high pressure fluid is generally routed through the tube
- (D) A loop seal or U-seal is provided in a vertical condenser sub-cooler to prevent quick draining of the condensate

Answer: Option A

214. The absorption factor is defined as (where, S_1 = slope of the equilibrium curve, S_2 = slope of the operating line)

- (A) S_1/S_2
- (B) $S_1.S_2$
- (C) S_2/S_1
- (D) $1/S_1.S_2$

Answer: Option A

215. Pressure drop per tray in the atmospheric distillation column is about _____ psi.

- (A) 0.01 - 0.5
- (B) 0.07 - 0.12
- (C) 0.5 - 1.0
- (D) 1 - 3

Answer: Option B

216. In a shell and tube heat exchanger, tube side _____ of the mass velocity.

- (A) Heat transfer co-efficient is proportional to 0.8th power
- (B) Pressure drop is proportional to the square
- (C) Both 'a' & 'b'
- (D) Neither 'a' nor 'b'

Answer: Option C

217. In a thin cylindrical shell, the hoop stress is _____ stress.

- (A) Radial
- (B) Circumferential tensile
- (C) Compressive
- (D) Longitudinal

Answer: Option B

218. In sieve plate column, holes are drilled or punched in sizes ranging from 2.5 to 12 mm (5 mm being widely used). The hole pitch is normally _____ times the hole diameter to give the required hole area.

- (A) 0.5 to 1.5
- (B) 2.5 to 4.0
- (C) 5 to 10
- (D) 10 to 15

Answer: Option B

219. The maximum liquid gradient over a tray must not exceed

- (A) 0.5" -1.25"
- (B) 2"-3.5"
- (C) 5"
- (D) Half the tray spacing

Answer: Option A

220. "A claming section" before the liquid flows into the downcomer is provided to

- (A) Permit release of entrained vapour in the liquid
- (B) Reduce the discharge fluctuation
- (C) Ensure better vapour-liquid contact
- (D) Cool the liquid before it flows down

Answer: Option A

221. In the downcomer of a distillation column, the minimum recommended residence time is about _____ seconds.

- (A) 2.5
- (B) 5
- (C) 12.5
- (D) 17.5

Answer: Option B

222. With increase in pressure drop (for a given particle size), the dust collection efficiency of a cyclone separator will

- (A) Increase
- (B) Decrease
- (C) Remain unaffected
- (D) Increase or decrease depending on the nature of the dust

Answer: Option A

223. Flanges are connected to pipes by

- (A) Screwing
- (B) Welding
- (C) Brazing
- (D) All (A), (B) and (C)

Answer: Option D

224. Most of the storage vessels/tanks are made cylindrical, because of the fact that a cylinder

- (A) Has greater structural strength
- (B) Is easy to fabricate

- (C) Both (A) and (B)
 - (D) Neither (A) nor (B)
- Answer: Option C

225. Pick out the wrong statement pertaining to the comparative evaluation of performance of the packed tower and the plate tower.

- (A) Plate tower is preferred, if interstage cooling is required to remove heats of reaction or solution
- (B) Plate tower is preferred over packed tower, if the operation involves liquids containing dispersed solids
- (C) The total weight of a dry plate tower is usually much more than that of a dry packed tower designed for the same duty
- (D) In operations involving large temperature changes. (e.g. distillation), plate towers are preferred over packed towers as the packing may be crushed due to large temperature changes

Answer: Option C

226. Apex angle of conical heads used in the bottom heads of chemical process equipments is usually

- (A) 30°
- (B) 45°
- (C) 60°
- (D) 75°

Answer: Option C

227. Cylindrical pressure vessels in horizontal condition is generally supported on a _____ support.

- (A) Lug
- (B) Skirt
- (C) Saddle
- (D) Guy wire

Answer: Option C

228. Length to diameter ratio of most rotary driers is in the range of

- (A) 1 to 2
- (B) 4 to 10
- (C) 10 to 20
- (D) 20 to 30

Answer: Option B

229. In case of design of a shell and tube heat exchanger,

- (A) Minimum cleaning lane of 6.5 mm is provided, when tubes are on a square pitch
- (B) Minimum tube sheet thickness (in which tubes are fixed) is equal to the O.D. of the tube upto 15 mm tube diameter; and for > 15 mm tube diameter, tube sheet thickness is smaller than tube diameter
- (C) O.D. of the tube is 6 to 40 mm while the tube lengths used are 0.5, 2.5, 3.0, 4.0, 5.0, 6 metres
- (D) All (A), (B) & (C)

Answer: Option D

230. For identical situation, condensing film coefficient in case of a horizontal condenser is almost _____ the value expected in case of vertical condenser.

- (A) Half
- (B) Twice
- (C) Thrice
- (D) Five times

Answer: Option C

231. With increase in gas flow rate to fabric surface area ratio ($\text{Nm}^3/\text{hr}/\text{m}^2$ fabric surface area), the size & the cost of a bag filter

- (A) Increases
- (B) Decreases
- (C) Remain unaffected
- (D) None of these

Answer: Option B

232. The difficulty of liquid distribution in packed towers is accentuated, when the ratio of tower diameter to packing diameter is

- (A) < 30
- (B) < 7
- (C) $> 7 < 15$
- (D) $> 20 < 50$

Answer: Option B

233. The equivalent diameter for pressure drop is _____ that for heat transfer.

- (A) Smaller than
- (B) Greater than
- (C) Equal to
- (D) Not related with

Answer: Option D

234. Cooling water fouling factors vary in the range of 0.001 to 0.003

- (A) $(\text{BTU}/\text{hr} \cdot \text{ft}^2 \cdot ^\circ\text{F})^{-1}$
- (B) $(\text{kcal}/\text{hr} \cdot \text{m}^2 \cdot ^\circ\text{C})^{-1}$
- (C) $(\text{W}/\text{m}^2 \cdot ^\circ\text{K})^{-1}$
- (D) $(\text{kcal}/\text{hr} \cdot \text{m} \cdot ^\circ\text{C})^{-1}$

Answer: Option A

235. _____ liquor is best handled in a long tube vertical evaporator.

- (A) Foamy
- (B) Scaling
- (C) Viscous
- (D) Salting

Answer: Option A

236. Which tube arrangement in a heat exchanger would facilitate highest heat transfer rate?

- (A) Triangular pitch
- (B) Square pitch
- (C) Diagonal square pitch
- (D) Heat transfer rate is independent of tube arrangement

Answer: Option A

237. Pick out the wrong statement about the design of a sieve plate column.

- (A) An increased weir height improves the tray efficiency at the cost of high plate pressure drop; optimum weir height being 40-90 mm for column pressure above atmospheric and 6-12 mm for vacuum columns
- (B) For segmental downcomers, the chord length is 60-80% of the column diameter. An initial value of downcomer area of 12% is taken in the design
- (C) Width of the calming section provided at the inlet and outlet sides of the plate is 75 mm for column diameter below 1.5 metres and 100 mm for larger diameter columns
- (D) Minimum recommended downcomer residence time for the disengagement of entrained vapour is the same for both foaming and non-foaming liquids, which is about 20 seconds

Answer: Option D

238. A binary liquid Azeotropic mixture has boiling point higher than either of the components, when it shows _____ deviation from Raoult's Law.

- (A) Positive
- (B) Negative
- (C) No
- (D) None of these

Answer: Option B

239. In which of the following evaporators, steam is fed inside the tube while the liquor is outside the tube?

- (A) Long tube vertical evaporator
- (B) Short tube vertical evaporator
- (C) Horizontal tube evaporator
- (D) None of these

Answer: Option C

240. LMTD correction factor is used in heat exchanger design for

- (A) Double pipe heat exchanger
 - (B) Multipass shell and tube heat exchanger
 - (C) Fouling fluids
 - (D) Counter flow of hot and cold fluids
- Answer: Option D

241. Pressure drop due to pipe fittings can be estimated by the equation, $\Delta P/\rho = 4f, (L_e/D) (V^2/2gc)$ where, L_e = equivalent length of straight pipeline which will incur the same frictional loss as the fitting and D = diameter of the fitting. The value of (L_e/D) (dimensionless) for 45° elbow and 180° close return bends would be respectively around

- (A) 5 and 10
- (B) 45 and 75
- (C) 180 and 300
- (D) 300 and 500

Answer: Option B

242. The thickness of segmental baffles (25 -35% cut truncated plates usually) is generally _____ the tube wall thickness.

- (A) Equal to
- (B) Twice
- (C) Four times
- (D) Half

Answer: Option B

243. In a distillation column, the minimum residence time for liquid in the downspout is about _____ seconds.

- (A) 1
- (B) 8
- (C) 80
- (D) 180

Answer: Option B

244. In a double pipe concentric heat exchanger, the equivalent diameter of annulus for heat transfer would be (where, D_1 and D_2 are I.D. of inner and outer pipes)

- (A) $(D_2^2 - D_1^2)/D_1^2$
- (B) $D_2 - D_1$
- (C) $(D_2^2 - D_1^2)/D_2^2$
- (D) None of these

Answer: Option A

245. In a multipass shell and tube heat exchanger, the baffles on shell side is primarily provided for

- (A) Reducing scale deposition
- (B) Increasing pressure drop
- (C) Fixing the tubes
- (D) Creating turbulence

Answer: Option D

246. A head comprises of straight flange section, corner torus, section and central dished section. Crown radius and knuckle radius in a head is related respectively to the

- (A) Central dished section and corner torus section
- (B) Corner torus section and central dished section
- (C) Central dished section and straight flange section
- (D) Straight flange section and corner torus section

Answer: Option A

247. _____ dished head is the strongest of all.

- (A) Hemispherical
- (B) Elliptical
- (C) Torispherical
- (D) None of these

Answer: Option A

248. _____ of water makes it a widely used coolant in heat exchangers.

- (A) Low corrosiveness

- (B) Low dirt factor
 - (C) High specific heat
 - (D) Low viscosity
- Answer: Option C

249. Speed of industrial paddle agitator ranges from _____ rpm.

- (A) 1 to 5
- (B) 20 to 100
- (C) 500 to 750
- (D) 1000 to 2000

Answer: Option B

250. Hold up of material in a operating rotary drier is in the range of

- (A) 0.05 to 0.15
- (B) 0.25 to 0.50
- (C) 0.5 to 0.8
- (D) 0.8 to 0.9

Answer: Option A

251. In a shell and tube heat exchanger having triangular pitch, the shell side equivalent diameter is given by

- (A) $4(0.86P^2 - \pi d^2/4)/\pi d$
- (B) $(P^2 - \pi d^2/4)/\pi d$
- (C) $4(0.86P^2 - \pi d^2)/\pi d$
- (D) $(4P^2 + \pi d^2/4)/\pi d$

Answer: Option A

252. Generally, elliptical dished heads

- (A) Are manufactured on 2:1 ratio of major to minor axis and is recommended to be used for pressure vessels operating above a pressure of 1.5 MN/m^2
- (B) Resist half the pressure rating compared to hemi spherical head provided on the cylindrical shell of the same thickness and diameter
- (C) Are approximately as strong as seamless cylindrical shell having the corresponding I.D and O.D
- (D) All (A), (B) and (C)

Answer: Option D

253. A pressure vessel is said to be made of 'thick' shell, if the ratio of its diameter to wall thickness is

- (A) < 10
- (B) > 10
- (C) > 20
- (D) < 20

Answer: Option B

254. For given number of passes, pitch & tube diameter, the maximum number of tubes that can be accommodated in a shell of tripled inside diameter will be _____ times.

- (A) About 9
- (B) Considerably more than 9
- (C) Considerably less than 9
- (D) About 3

Answer: Option B

255. In case of a continuous distillation column, increase in reflux ratio may result in the

- (A) Lower fixed charges for the column
- (B) Greater cost for the reboiler heat supply
- (C) Greater cost for the condenser coolant
- (D) All (A), (B) and (C)

Answer: Option D

256. The retention time of material in a rotary dryer depends upon its

- (A) rpm
- (B) Slope & length
- (C) Flights arrangement
- (D) All (A), (B) and (C)

Answer: Option D

257. Pick out the wrong statement pertaining to the design of a long tube vertical evaporator.

- (A) Tube dia is 3-6 cms, while tube length in 3-6 metres
- (B) Steam is fed to the shell, whereas the liquor is filled inside the tube
- (C) Liquor level is maintained at 1/3rd to 1/2 of the height of the tube
- (D) None of these

Answer: Option D

258. Number of evaporators which can be used in service in a multiple effect evaporation system is limited by the

- (A) Practical limit reached, due to low heat transfer rate because of inadequate temperature difference
- (B) Economic limit reached, when the plant cost exceeds the saving of steam
- (C) Both (A) & (B)
- (D) Neither (A) nor (B)

Answer: Option C

259. The units of Young's modulus of elasticity and _____ are the same.

- (A) Strain
- (B) Stress
- (C) Modular ratio
- (D) None of these

Answer: Option B

260. A high vapour velocity is required for high plate efficiency in a sieve plate column. The satisfactory value of operating vapor velocity for design purpose in sieve plate column is about _____ percent of the flooding velocity.

- (A) 45
- (B) 60
- (C) 80
- (D) 95

Answer: Option C

261. Vertical vessels are not supported by

- (A) Brackets
- (B) Skirts
- (C) Columns
- (D) Saddles

Answer: Option D

262. Tube side heat transfer co-efficient for turbulent flow of liquid through tubes is proportional to

- (A) $G^{0.2}$
- (B) $G^{0.5}$
- (C) $G^{0.8}$
- (D) $G^{1.5}$

Answer: Option C

263. Baffle width is normally taken as _____ times the tank diameter.

- (A) 0.1-0.12
- (B) 0.4-0.5
- (C) 0.45-0.6
- (D) 0.2-0.45

Answer: Option A

264. Thickness of the frame of a plate and frame filter as compared to that of plates is

- (A) Less
- (B) Same
- (C) More
- (D) Either (A) or (B)

Answer: Option C

265. Rotary driers are most economically designed for the number of heat transfer units (HTU) from

- (A) 0.01 to 1
- (B) 1.5 to 2.5
- (C) 5 to 10
- (D) 10 to 20

Answer: Option B

266. Lap joints are preferred for plates having thickness _____ mm.

- (A) < 12.5
- (B) > 3
- (C) > 5
- (D) 5-10

Answer: Option B

267. Spherical shaped pressure vessel is considered to be the most ideal, because it can

- (A) Withstand higher pressure for a given metallic shell thickness
- (B) Be fabricated very easily
- (C) Be designed without wind load considerations
- (D) Be supported very easily

Answer: Option A

268. Hazards associated with the relief valve leakage for extremely hazardous material storage can be taken care of by providing

- (A) Rupture diaphragm
- (B) Dikes
- (C) Surge chamber
- (D) None of these

Answer: Option A

269. A cylindrical storage tank can have a self supported conical roof,

- (A) If its diameter is less than 15-20metres
- (B) If its diameter is more than 50 meters
- (C) If the thickness of the roof is more than that of the cylindrical shell
- (D) Irrespective of its diameter

Answer: Option A

270. Compensation against openings in process vessels for giving inlet and outlet connections, for providing sight glasses and manholes etc. is provided for strength and rigidity. The most efficient type of compensation is of _____ type.

- (A) Nozzle or rim
- (B) Flared out
- (C) Fluid in
- (D) Ring plate

Answer: Option A

271. The dust collection efficiency of electrostatic precipitator increases with increase in the

- (A) Gas flow rate
- (B) Electrode area
- (C) Both (A) & (B)
- (D) Neither (A) nor (B)

Answer: Option B

272. The wall thickness for a large high pressure pipeline is determined by the consideration of the

- (A) Axial tensile stress in the pipe
- (B) Forces exerted by static and dynamic action at bends
- (C) Circumferential pipe-wall tension
- (D) Temperature stresses

Answer: Option C

273. Which of the following is used to set the diameter of the distillation column?

- (A) Number of theoretical plates
- (B) Static submergence
- (C) Allowable vapour velocity
- (D) Length of straight rectangular weir on cross-flow tray

Answer: Option C

274. The normal range of velocity of steam in pipes is _____ m/sec.

- (A) 0.1-0.5
- (B) 1-5
- (C) 10-20
- (D) 80-100

Answer: Option D

275. For pipe flows, head is proportional to _____ at constant capacity (where D = pipe diameter).

- (A) $1/D$
- (B) $1/D^2$
- (C) $1/D^5$
- (D) D^2

Answer: Option C

276. Generally, no corrosion allowance in wall thickness of a part is required, if the thickness is more than _____ mm.

- (A) 10
- (B) 20
- (C) 30
- (D) 5

Answer: Option C

277. Which of the following factors determine the amount of entrainment in a distillation column?

- (A) Plate spacing
- (B) Depth of liquid above the bubble cap slots
- (C) Vapour velocity in the volume between the plates
- (D) All (A), (B) and (C)

Answer: Option D

278. Longitudinal stress induced in a thin walled cylindrical storage vessel is

- (A) $pD/2t$
- (B) $pD/4t$
- (C) $pD/3t$
- (D) $pD/6t$

Answer: Option B

279. Saddle supports are used for supporting _____ vessels.

- (A) Horizontal cylindrical
- (B) Tall vertical
- (C) Thick walled vertical
- (D) Thick spherical

Answer: Option A

280. In the design of a bag filter, the gas temperature is an important consideration, as it affects the

- (A) Gas density
- (B) Gas viscosity
- (C) Fibre selection
- (D) All (A), (B) & (C)

Answer: Option D

281. Normally, the plate thickness of the bottoms and roofs of vertically cylindrical storage vessels as compared to that of the cylindrical shell is

- (A) More
- (B) Less
- (C) Same
- (D) More or less depending upon the pressure & temperature inside the vessel and the nature of the fluid contained therein

Answer: Option B

282. With increase in the reflux ratio for a fixed production from a continuous binary distillation column, the _____ decreases.

- (A) Fixed charges initially
 - (B) Running cost of cooling water for condenser
 - (C) Vapour & liquid load both
 - (D) Running cost of steam for reboiler
- Answer: Option A

283. In shell and tube heat exchangers, straight tie rods are used to

- (A) Hold baffle in space
 - (B) Fix the tubes in position
 - (C) Account for thermal strain
 - (D) None of these
- Answer: Option A

284. In packed towers provided with pall rings liquid redistributors are positioned at heights of every 6 metres or 5-10 times the column diameter, whichever is less. Maximum size of the pall rings should not exceed _____ of the column diameter.

- (A) 1/10-1/15th
 - (B) 1/5-1/10th
 - (C) 1/20-1/30th
 - (D) 1/2 to 1/4th
- Answer: Option A

285. The diameter of a propeller agitator used in agitation tank ranges from _____ percent of the tank diameter and its peripheral speed is normally 300 to 500 metres/minute.

- (A) 5 to 10
 - (B) 15 to 30
 - (C) 40 to 50
 - (D) 55 to 75
- Answer: Option B

286. In the design of a shell and tube heat exchanger, the corrosion allowance

- (A) Need not be provided for non-pressure parts like tie rods, spacers, baffles, supports etc.
 - (B) For carbon steel and cast iron pressure parts is 1.5 mm (except for tubes) and for severe conditions it is 3 mm
 - (C) For internal cover and tube sheet is provided on both the sides
 - (D) All (A), (B) & (C)
- Answer: Option D

287. Vapor velocity in a distillation column for non-foaming mixture is in the range of _____ times the flooding velocity.

- (A) 0.1 to 0.3
 - (B) 0.6 to 0.7
 - (C) 0.85 to 0.95
 - (D) 1.5 to 2
- Answer: Option B

288. _____ strain is measured using a 'strain rosetter'.

- (A) Volumetric
 - (B) Shear
 - (C) Linear
 - (D) None of these
- Answer: Option C

289. Nominal size of a pipe is an indication of its _____ diameter.

- (A) Inner
 - (B) Outer
 - (C) Approximate
 - (D) None of these
- Answer: Option C

290. The minimum plate spacing in most of the petroleum refinery distillation columns (of dia > 3 ft) is normally _____ inches.

- (A) 6
- (B) 12
- (C) 18

(D) 36
Answer: Option C

291. In packed towers provided with saddle packing, liquid redistributors are positioned at every _____ times column diameter or 6 metres whichever is less.

- (A) 2-3
- (B) 5-8
- (C) 10-15
- (D) 20-25

Answer: Option B

292. _____ shaped roof is most commonly used for cylindrical tanks.

- (A) Cone
- (B) Dome
- (C) Umbrella
- (D) Flat

Answer: Option A

293. The ideal size of round bubble caps to be used in industrial distillation column having a diameter of 3-6 metres is _____ cms.

- (A) 5
- (B) 15
- (C) 7.5
- (D) 50

Answer: Option B

294. (L_c/D) for fully open gate valves would be

- (A) Much more than that for fully open globe valves
- (B) Much less (say 2% than that for fully open globe valves)
- (C) Around 7
- (D) Both (B) and (C)

Answer: Option D

295. Excessive liquid gradient on a tray may result in the

- (A) Maldistribution of gas
- (B) Back trapping
- (C) Gas blowing beneath cap skirt
- (D) All (A), (B) and (C)

Answer: Option D

296. Smoker's equation for the calculation of number of equilibrium stages in a continuous binary distillation column is used, when the

- (A) Relative volatility is close to one (e.g., separation of close boiling isomers)
- (B) Feed is not at its bubble point
- (C) Number of equilibrium stages in only stripping section is to be calculated
- (D) Number of equilibrium stages required is likely to be very small

Answer: Option A

297. An under-designed steam trap will

- (A) Waste steam
- (B) Destroy itself of acceleration wear due to rapid recycling
- (C) Back up condensate and cause water hammer in steam line
- (D) None of these

Answer: Option C

298. In actual operation of a bubble cap distillation tower, the _____ at the bottom of the tower is more than that at the top of the tower.

- (A) Molal flow rate of vapour
- (B) Vapour molecular weight
- (C) Pressure and temperature
- (D) All (A), (B) and (C)

Answer: Option D

299. Baffles may be eliminated for

- (A) Low viscosity liquids (< 200 poise)

- (B) High viscosity liquids (> 600 poise)
 - (C) Large diameter tanks
 - (D) None of these
- Answer: Option B

300. In a _____ riveted joint, the rivets in the various rows are opposite to each other.

- (A) Zig-zag
- (B) Chain
- (C) Diamond
- (D) None of these

Answer: Option B

301. Normally, the ratio of the total riser area to the tower cross sectional area (for bubble cap towers of diameter more than 3 ft) is around

- (A) 0.4-0.6
- (B) 0.35-0.75
- (C) 0.1-0.2
- (D) 0.55-0.85

Answer: Option C

302. Pick out the wrong statement pertaining to the use of valve tray, sieve tray and bubble cap trays in continuous distillation column.

- (A) Bubble cap trays though most expensive are the best in situations, where low vapour rates is to be handled and a positive liquid seal is essential at all flow rates
- (B) Murphree efficiency of all the three trays are nearly equal, however the peak efficiency is generally higher for sieve and valve trays than the bubble cap
- (C) Maintenance cost for valve and sieve trays are comparatively more than bubble cap tray due to their relatively complicated construction features
- (D) Valve trays have the highest turn down ratio (i.e. the ratio of the highest to the lowest vapour flow rates) and thus provide the maximum flexible operating range

Answer: Option C

303. Maximum allowable vapour velocity in a bubble cap tower is determined by the

- (A) Entrainment considerations
- (B) Vapour density
- (C) Diameter of the column
- (D) None of these

Answer: Option A

304. Overall distillation column efficiency for most of the refinery columns can be given by (for $\mu = 0.07 - 1.4$ cp and relative volatility < 4) (where η = overall column efficiency, % μ = molal average viscosity of feed at average column temperature and pressure, cp Δp = pressure drop per tray, psi)

- (A) $\eta = 17 - 61.1 \log \mu$
- (B) $\eta = 24.6 (\Delta p/\mu)$
- (C) $\eta = 1.66 - 0.25 \log \mu$
- (D) $\eta = 0.25 \log \mu - 1.67$

Answer: Option A

305. In condenser, the cooling water is passed in the tube side in a pass arrangement, because

- (A) It reduces heat transfer area
- (B) More thinner tubes can be used
- (C) Pressure drop is reduced
- (D) It makes condenser compact

Answer: Option A

306. It is not desirable to design a heat exchanger for *LMTD* correction factor, F_T , of less than

- (A) 0.99
- (B) 0.95
- (C) 0.80
- (D) 0.55

Answer: Option C

307. Joint efficiency (J) for a seamless pipe is

- (A) 1

- (B) 0.85
- (C) 1.5
- (D) < 0.5

Answer: Option A

308. Pick out the wrong statement

- (A) For all the cylindrical process vessels operating above atmospheric pressure, formed heads are used for closing the vessel
- (B) Fouling factor of river water is less than that of sea water
- (C) Risers provided in bubble cap trays in the distillation column facilitate the flow of both liquid and vapor
- (D) Both (B) and (C)

Answer: Option D

309. In a distillation column, minimum clearance to be maintained between the overflow weir and the last row of the bubble caps is _____ cms.

- (A) 2.5
- (B) 7.5
- (C) 15
- (D) 20

Answer: Option B

310. The operating velocity in the absorption tower is usually 40-50% of the flooding velocity. Packed absorption towers are normally designed for a pressure drop of about _____ mm of water column per metre height of packing.

- (A) 1-5
- (B) 20-40
- (C) 100-150
- (D) 1000-1500

Answer: Option B

311. For a cylindrical internally pressurised vessel, which of the following closure types would withstand highest pressure, if each closure is of the same material and thickness?

- (A) Hemispherical
- (B) Ellipsoidal (2 : 1)
- (C) Conical
- (D) Flat plate

Answer: Option B

312. Pick out the correct statement.

- (A) When highly corrosive fluids are to be handled, the plate towers prove to be cheaper and easier to construct than packed tower
- (B) Packed towers are generally preferred over plate towers, if the liquids have a foaming tendency
- (C) The pressure drop through the packed towers is generally more than the pressure drop through plate towers designed for same duty
- (D) None of these

Answer: Option B

313. The minimum tray spacing in distillation column of diameter less than 3 ft is normally _____ inches.

- (A) 6
- (B) 18
- (C) 24
- (D) 34

Answer: Option A

314. Pressure drop (Δp) and the superficial gas mass velocity (G) in case of packed absorption tower operating in the preloading range are related as

- (A) $\Delta p = G$
- (B) $\Delta p = G^{0.5}$
- (C) $\Delta p = G^2$
- (D) $\Delta p = 1/G^{0.6}$

Answer: Option C

315. The practical representative values of HETP for a number of commercial operations lies within a range of _____ metre.

- (A) 0.1-0.2
- (B) 0.2-0.5
- (C) 0.4-0.9
- (D) 1.2-1.5

Answer: Option C

316. Fresh water carrying pipelines in chemical industries are coloured with _____ color.

- (A) Sea green
- (B) Brown
- (C) Yellow
- (D) Red

Answer: Option A

317. For a given design of bubble cap, the number of bubble caps to be used per tray is set by the

- (A) Allowable gas velocity through the slots
- (B) Plate spacing
- (C) Diameter of the column
- (D) All (A), (B) and (C)

Answer: Option A

318. Holes of a sieve tray are arranged in triangular pitch of _____ times the hole diameter.

- (A) 1.5 to 2
- (B) 2.5 to 5
- (C) 5 to 10
- (D) 10 to 15

Answer: Option B

319. A pipe is generally made of circular cross-section, because a circular cross-section has the

- (A) Higher structural strength
- (B) Lowest surface area requirement for a given volume
- (C) Both (A) & (B)
- (D) None of these

Answer: Option C

320. Tube side pressure drop in a 1-2 heat exchanger (for turbulent flow of fluids through the tubes) is about _____ times, that in a 1-1 heat exchanger having the same size & number of tubes and operated at the same liquid flow rate.

- (A) 2
- (B) $\frac{1}{2}$
- (C) 4
- (D) 8

Answer: Option D

321. In the case of a shell and tube heat exchanger, the logarithmic mean temperature difference

- (A) Is always less than arithmetic average value
- (B) Is always more than arithmetic mean value and the geometric mean value
- (C) Is always less than arithmetic mean value, but more than geometric mean value
- (D) May be either more or less than geometric mean and arithmetic mean value depending upon whether the flow of stream is co-current or counter-current

Answer: Option A

322. In a multipass shell and tube heat exchanger, the shell side cross flow area does not depend upon

- (A) Baffle spacing
- (B) Clearance
- (C) Pitch
- (D) None of these

Answer: Option D

323. Maximum size of the raschig rings used in a packed tower is about _____ of the column diameter.

- (A) 1/10th
- (B) 1/20th
- (C) 1/30th
- (D) 1/50th

Answer: Option C

324. Correct use of 'factor of safety' is very important in equipment design. It is defined as the ratio of the

- (A) Ultimate stress to breaking stress
- (B) Ultimate stress to working stress
- (C) Working stress to ultimate stress
- (D) None of these

Answer: Option B

325. Width and depth of grooves in the tube sheet holes normally are _____ inch respectively.

- (A) 1/8 and 1/64
- (B) 1/64 and 1/8
- (C) 1/2 and 8
- (D) 1/2 and 5

Answer: Option A

326. For laminar flow ($N_{Re} < 2100$) in steel pipe, the optimum inside pipe diameter is given by

- (A) $D_{i, opt} = 3 Q^{0.36} \rho^{0.18}$
- (B) $D_{i, opt} = 3.9 Q^{0.45} \rho^{0.23}$
- (C) $D_{i, opt} = 7.6 Q^{0.36} \rho^{0.9}$
- (D) $D_{i, opt} = 3 Q^{0.36} \rho^{1.86} \mu^{0.08}$

Answer: Option A

327. The shell side pressure drop in a shell and tube heat exchanger is maximum for _____ baffle.

- (A) Disk and ring
- (B) Segmental
- (C) Orifice
- (D) Independent of the type of

Answer: Option C

328. Pick out the wrong statement.

In an agitated vertical cylindrical reaction vessel, the

- (A) Ratio of liquid depth to tank diameter (i.e. the filling ratio) recommended for most purposes is 1
- (B) Filling ratio for dispersing gas in a liquid is 2 for sufficiently long contact period
- (C) Flat bottom and conical bottom vessels have low agitation efficiency for agitation of heavy solids in liquids
- (D) Dished bottom vessel has very high power consumption

Answer: Option D

329. Equivalent diameter for heat transfer calculation for a duct of square cross-section having each side as 'd' will be

- (A) d
- (B) \sqrt{d}
- (C) $\sqrt{(2\pi d)}$
- (D) $\sqrt{(2d)}$

Answer: Option A

330. Which of the following material is seldom used for pressure vessel construction?

- (A) Rimmed still
- (B) Mild steel
- (C) Killed steel
- (D) Semi-killed steel

Answer: Option A

331. Friction factor for turbulent flow in a new pipe is given by

- (A) $f = 16/N_{Re}$
- (B) $f = 0.04/(N_{Re})^{0.16}$

(C) $f = 0.22 N_{Re}^{0.5}$

(D) $f = 25/N_{Re}$

Answer: Option B

332. The stress developed in a material without any permanent set is called the

- (A) Ultimate stress
- (B) Yield stress
- (C) Elastic limit
- (D) Breaking stress

Answer: Option C

333. To keep the power input constant for a stirred vessel operating under fully developed turbulent flow conditions (constant power number), if the impeller diameter is increased by 20%, the impeller speed should be decreased by a factor of

- (A) $(1.2)^{3/2}$
- (B) $(1.2)^{3/5}$
- (C) $(1.2)^{2/3}$
- (D) $(1.2)^{5/3}$

Answer: Option D

334. Corrosion allowance in the design of pressure vessel/chemical equipment is not necessary, if

- (A) Plain carbon steel and cast iron parts are used
- (B) Wall thickness is > 30 mm
- (C) Material of construction is high alloy steel
- (D) Both (B) & (C)

Answer: Option D

335. Triangular pitch tube layout as compared to square pitch in a shell and tube heat exchanger

- (A) Permits the use of less tubes in a given shell diameter
- (B) Facilitates comparatively easier external cleaning because of large clearance
- (C) Permits the use of more tubes in a given shell diameter
- (D) Both (B) and (C)

Answer: Option C

336. Height of the flights in the rotary drier is in the range of

- (A) 0.08 to 0.12 d
- (B) 0.02 to 0.05 d
- (C) 0.2 to 0.5 d
- (D) 0.5 to 0.6 d

Answer: Option A

337. Smaller sized packings are generally dumped to the packed columns, and the large ones of size greater than _____ mm are stacked individually, which provides better control over bed porosity and offers lower gas pressure drop.

- (A) 25
- (B) 50
- (C) 75
- (D) 150

Answer: Option C

338. The function of manholes provided in the shell of a distillation column is to

- (A) Keep a check on the liquid gradient over the plate by direct visual observation
- (B) Give access to the individual trays for cleaning, maintenance and installation
- (C) Guard against foaming & entrainment by dumping antifoaming agent through it
- (D) All (A), (B) and (C)

Answer: Option B

339. 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.

- (A) Flat plate
- (B) Hemispherical
- (C) Torispherical
- (D) Ellipsoidal

Answer: Option D

340. Column support for the roof of cylindrical storage tank must be provided for

- (A) Small diameter tanks
- (B) Large diameter tanks
- (C) Small diameter tall tanks
- (D) All tanks irrespective of their heights and diameters

Answer: Option B

341. A stuffing box is used for

- (A) Absorbing the contraction/expansion of pipeline due to temperature changes
- (B) Prevention of fluid leakage around moving parts
- (C) Facilitating smooth opening and closing of a valve
- (D) Reducing the resistance of fluid flow

Answer: Option B

342. Pick out the wrong statement about the design of sieve plate column and the bubble cap column.

- (A) The downcomer design and the residence time in the downcomer is almost same for sieve plate and bubble cap columns
- (B) Weir length for a bubble cap plate is the same as that for the sieve plate
- (C) Weir height for a bubble cap plate column is the same as that for a sieve plate column
- (D) Weir height in case of a bubble cap plate ranges from 50 to 150 mm and is higher than the sieve plate

Answer: Option C

343. The ratio of shear stress to shear strain is called

- (A) Bulk modulus
- (B) Shear modulus
- (C) Modulus of rigidity
- (D) Modulus of elasticity

Answer: Option B

344. Back-trapping in a distillation column results due to

- (A) Low gas velocity
- (B) High gas velocity
- (C) Excessive liquid gradient over the tray
- (D) Low reflux ratio

Answer: Option C

345. In case of a shell and tube heat exchanger, the minimum shell thickness for carbon steel (inclusive of corrosion allowance) depends on shell diameter and is in the range of _____ mm.

- (A) 3-5
- (B) 5-11
- (C) 8-15
- (D) 12-18

Answer: Option B

346. For high pressure process equipments/vessels, the connected nozzle should be

- (A) Welded
- (B) Screwed
- (C) Flanged
- (D) Brazed

Answer: Option C

347. In case of bubble cap distillation column of diameter greater than 1.2 metres, the cap diameter is roughly about _____ cms.

- (A) 10
- (B) 20
- (C) 30
- (D) 35

Answer: Option A

348. Generally, as the length of the liquid path on a tray is increased beyond 5 ft, the overall column efficiency

- (A) Increases
- (B) Decreases
- (C) Remain same
- (D) May increase or decrease depending upon the plate spacing

Answer: Option A

349. _____ tray arrangement is recommended for distillation column having diameter upto 4 ft.

- (A) Radial flow
- (B) Cross flow
- (C) Split flow
- (D) Cascade

Answer: Option B

350. Of the pressure vessels, with same thickness but different diameters, which one withstands higher pressure?

- (A) Larger dia vessel
- (B) Smaller dia vessel
- (C) Larger dia long vessel
- (D) Strength of the vessel is same irrespective of the diameter

Answer: Option B

351. Wall thickness of schedule 40 pipe as compared to that of schedule 80 pipe is

- (A) More
- (B) Less
- (C) Same
- (D) Either (A) or (B); depends upon the I.D. of the pipe

Answer: Option B

352. For a cylindrical vessel of moderate height, the weld joint efficiency for joints parallel to the cylindrical axis is given as 1.0; while for joints along the girth (circumference) it is given as 0.8. In calculating the shell wall thickness using code formula for an internally pressurised cylindrical vessel, what value of weld joint efficiency should be used?

- (A) 0.8
- (B) 0.9
- (C) 1.0
- (D) $(0.8)^{0.5}$

Answer: Option A

353. Speed of the drum of the rotary vacuum filter normally ranges from _____ rpm.

- (A) 0.1 to 2
- (B) 5 to 7
- (C) 3 to 8
- (D) 8 to 15

Answer: Option A

354. 25 per cent cut segmental baffle means that the baffle

- (A) Height is 75% of the I.D. of the shell
- (B) Height is 25% of the I.D. of the shell
- (C) Spacing is 75% of its height
- (D) Width is 25% of its height

Answer: Option A

355. In a continuous distillation column, the optimum reflux ratio ranges from _____ times the minimum reflux ratio.

- (A) 1.1 to 1.5
- (B) 1.6 to 2
- (C) 2.2 to 2.6
- (D) 2.7 to 3

Answer: Option A

356. In a shell and tube heat exchanger, the 'tube pitch' is defined as the

- (A) O.D. of the tube for square pitch
- (B) Shortest distance between two adjacent tube holes
- (C) Shortest centre to centre distance between adjacent tubes

(D) None of these
Answer: Option C

357. The type of stress developed in a metallic bar on subjecting it to a change in temperature without allowing it to be deformed is _____ stress.

- (A) Shear
- (B) Tensile
- (C) Compressive
- (D) Thermal

Answer: Option D

358. A riveted joint does not fail by _____ of rivets.

- (A) Tearing
- (B) Shearing
- (C) Tearing of the plate across a row
- (D) None of these

Answer: Option D

359. Reflux ratio variation in a distillation column is between

- (A) Zero and infinity
- (B) Zero and one
- (C) Minimum and infinity
- (D) None of these

Answer: Option C

360. Shell side heat transfer co-efficient in case of square pitch as compared to the triangular pitch under similar condition of fluid flow and tube size is

- (A) More
- (B) Same
- (C) Less
- (D) Twice

Answer: Option C

361. Pick out the wrong statement pertaining to the design of a basket type evaporator.

- (A) It is used for high viscosity liquor having large rate of scaling
- (B) The tube bundle is suspended on bracket
- (C) There is no central downtake
- (D) Downtake is formed by the annular space between the bundle and the shell

Answer: Option A

362. Diameter of bubble caps used in high pressure columns is _____ as compared to that used in identical vacuum columns.

- (A) Less
- (B) More
- (C) Same
- (D) Either (A) or (B); no generalisation can be made

Answer: Option B

363. Liquid/petroleum fuel storage tanks are built underground (as in case of petrol pumps), when the storage capacity is less than _____ kilolitres.

- (A) 20
- (B) 30
- (C) 45
- (D) 85

Answer: Option C

364. In packed absorption tower, onset of flooding usually occurs at a pressure drop of about _____ mm of water column per metre height of packing.

- (A) 25-50
- (B) 50-75
- (C) 200-250
- (D) 750-1000

Answer: Option B

365. In a heat exchanger, shell side fluid velocity can be changed by changing the tube

- (A) Layout
 - (B) Pitch
 - (C) Both (A) & (B)
 - (D) Neither (A) nor (B)
- Answer: Option C

366. Which of the following lengths of heat exchanger tubes are normally not used in practice?

- (A) 2.5 metres
- (B) 6 metres
- (C) 10 metres
- (D) 0.5 metre

Answer: Option C

367. Steam side heat transfer co-efficient for design consideration under ordinary condition can be assumed to be about _____ kcal/hr.m².°C.

- (A) 1250
- (B) 2500
- (C) 7500
- (D) 15000

Answer: Option C

368. The operating pressure drop range in a bag filter is about _____ mm water gauge.

- (A) 50-150
- (B) 5-10
- (C) 500-1500
- (D) 1500-2500

Answer: Option A

369. The safe distance of habitation from a hazardous chemical plant (TLV of its product < 1000 ppm) should be about _____ kms.

- (A) 1
- (B) 5
- (C) 15
- (D) 25

Answer: Option D

370. (L_o/D) for fully open globe valve may be around

- (A) 10
- (B) 25
- (C) 75
- (D) 300

Answer: Option D

371. In case of a shell and tube heat exchanger, the effect of L/D on inside film heat transfer co-efficient (h_i) vanishes after a Reynold number of

- (A) 1000
- (B) 3000
- (C) 5000
- (D) 10000

Answer: Option D

372. The value of fouling factor depends upon the

- (A) Characteristic of process fluid
- (B) Velocity of process fluid containing suspended solids
- (C) Suspended solids in the fluid
- (D) All (A), (B) and (C)

Answer: Option D

373. Pick out the wrong statement pertaining to a shell and tube heat exchanger.

- (A) The minimum value of baffle spacing is 50 mm
- (B) The maximum value of baffle spacing is equal to the I.D. of the shell
- (C) The maximum unsupported tube span is generally about 75 times tube diameter, but is reduced to about 60 times for aluminium, copper & alloys of these
- (D) Disk and doughnut baffle is the most commonly used baffle

Answer: Option D