

Subject: Chemical Engineering

01. The friction factor for smooth pipes with turbulent flow ( $N_{Re} = 1 \times 10^6$ ) is nearly equal to

- A. 0                      B. 0.01                      C. 0.1                      D. 1

02. Froude number can be expressed as

- A.  $\frac{\text{Surface forces}}{\text{Gravity forces}}$                       B.  $\frac{\text{Inertia forces}}{\text{Viscous forces}}$   
C.  $\frac{\text{Inertia forces}}{\text{Gravity forces}}$                       D.  $\frac{\text{Viscous forces}}{\text{Surface forces}}$

03. For a fluid flowing in x-direction between two parallel stationary plates at different temperatures under steady-state, the correct starting equation to be used for finding out the temperature profile in the situation is

A.  $v_x \frac{\partial T}{\partial x} + v_y \frac{\partial T}{\partial y} = \alpha \left( \frac{\partial^2 T}{\partial x^2} \right)$

B.  $\frac{\partial T}{\partial \theta} + v_x \frac{\partial T}{\partial x} = \alpha \left( \frac{\partial^2 T}{\partial x^2} \right)$

C.  $v_x \frac{\partial T}{\partial x} = \alpha \left( \frac{\partial^2 T}{\partial x^2} \right)$

D.  $v_x \frac{\partial T}{\partial x} = \alpha \left( \frac{\partial^2 T}{\partial y^2} \right)$

04. Momentum diffusivity is

- A. kinematic viscosity                      B. dynamic viscosity  
C. mass diffusivity/density                      D. none of above

05. The hydraulic radius of a piece of rectangular cross-section of size 'a × b' is

A. $\frac{(ab)^2}{a+b}$	B. $\frac{a+b}{ab}$	C. $\frac{ab}{2(a+b)}$	D. $\frac{(ab)^2}{2(a+b)}$
-------------------------	---------------------	------------------------	----------------------------

06. In forced vortex, the velocity

- |                                     |  |
|-------------------------------------|--|
| A. increases with increasing radius | B. increases with decreasing radius        |
| C. decreases with decreasing radius | D. remains constant with respect to radius |

07. NB of a pipe stands for

- |                           |                    |
|---------------------------|--------------------|
| A. Nominal outer diameter | B. Nominal bore    |
| C. Normal bore            | D. Normal bit size |

08. If the cake compressibility coefficient increases for different solids at same pressure, the rate of filtration

- |              |              |                     |                    |
|--------------|--------------|---------------------|--------------------|
| A. increases | B. decreases | C. remains constant | D. varies randomly |
|--------------|--------------|---------------------|--------------------|

09. Grinding efficiency of a ball mill is of the order of

- |             |             |
|-------------|-------------|
| A. 1 – 5%   | B. 40 – 50% |
| C. 75 – 80% | D. 90 – 95% |

10. A particle attains its terminal settling velocity when

- A. gravity force + drag force = buoyancy force
- B. gravity force = buoyancy force
- C. buoyancy force + drag force = gravity force
- D. drag force = buoyancy force

11. The angle of nip decreases when coefficient of friction of the material to be crushed,

- |              |              |                     |                    |
|--------------|--------------|---------------------|--------------------|
| A. increases | B. decreases | C. remains constant | D. varies randomly |
|--------------|--------------|---------------------|--------------------|

12. You have been given with the following equipment for crushing of solid mass:

- (i) Fine crusher    (ii) Ultrafine grinder    (iii) Coarse crusher    (iv) Intermediate crusher.

Select suitable equipment for crushing of solid to obtain particles of 0.5 mm and 1 μm sizes, respectively.

- |               |               |               |                |
|---------------|---------------|---------------|----------------|
| A. (ii), (iv) | B. (iii), (i) | C. (iv), (ii) | D. (iii), (ii) |
|---------------|---------------|---------------|----------------|

13. For a H<sub>2</sub>SO<sub>4</sub> solution of specific gravity 1.5, the concentration in terms of % is

- |          |          |          |          |
|----------|----------|----------|----------|
| A. 68.42 | B. 24.18 | C. 48.33 | D. 54.82 |
|----------|----------|----------|----------|

14. (GCV – NCV) indicates the

- A. volatile matter in fuel  
C. heat available for heating
- B. ash content in fuel  
D. moisture content in fuel
15. Catalyst is used for manufacturing methanol from CO and H<sub>2</sub>, and the catalyst fouling during operation is avoided by
- A. feeding excess H<sub>2</sub>  
C. maintaining low pressure
- B. maintaining low temperature  
D. feeding N<sub>2</sub> along with the reactants
16. For which type of the following polymerization reactions, solution polymerization method is usually adopted?
- A. high pressure  
C. highly exothermic
- B. highly endothermic  
D. slow rate
17. Which of the following is used as a raw material for production of pentaerythritol?
- A. Ethanol      B. Benzene      C. Formaldehyde      D. Acetone
18. Which one of the following is used in vulcanization of rubber?
- A. Acetone      B. Styrene      C. Butanol      D. Aniline
19. Deodourization of oil is done under vacuum as
- A. boiling point of odour causing components is high  
B. to prevent degradation of heat sensitive oil  
C. the odour causing components are heat sensitive  
D. to remove hexane readily
20. In the spinnerette operation involved in production of rayon fibre, the major problem is
- A. treating acidic pulp  
C. foric balancing
- B. handling basic pulp  
D. clogging
21. With increase in temperature for most of the liquids, the thermal conductivity
- A. decreases      B. increases      C. remains constant      D. cannot be predicted
22. Ratio of heat transfer rate to the rate at which heat would be conducted within the fluid under a temperature gradient, is known as
- A. Reynolds number  
C. Prandtl number
- B. Nusselt number  
D. Grashoff number
23. Identify the heat exchanger out of the following for which the correction factor,  $F_T$  is required to be calculated:

- A. Cross-flow heat exchanger  
C. Parallel flow heat exchanger
- B. Counter-flow heat exchanger  
D. Mixed flow heat exchanger
24. The range of wave length in the electromagnetic wave spectrum important for radiative heat transfer is approximately from
- A.  $10^{-7}$  to  $10^{-4}$     B.  $10^{-9}$  to  $10^{-5}$     C.  $10^5$  to  $10^8$     D.  $10^{-1}$  to  $10^2$
25. In a simple evaporator, if one can get the thick liquor's weight as 50%, then the solvent evaporated will be
- A. 50%    B. between 50 to 100%    C. < 50%    D. 83.33%
26. Which type of multiple-effect evaporator is preferable when viscous liquors are used as feed?
- A. feed-forward    B. Mixed-feed  
C. Feed-backward    D. Parallel -feed
27. If a body transmits all radiations incident on it, then it is known as
- A. black body    B. transparent body  
C. white body    D. grey body
28. Which of the following effects states that a concentration difference can be created by a temperature difference?
- A. Dufour effect    B. Higbie effect    C. Soret effect    D. Chapman effect
29. Match the approximate mass diffusivity ranges for the following:
- (1) Gas    (i)  $10^{-5}$  to  $10^{-6}$  cm<sup>2</sup>/s.  
(2) Liquid    (ii)  $10^{-8}$  to  $10^{-10}$  cm<sup>2</sup>/s.  
(iii) 0.1 to 1 cm<sup>2</sup>/s.
- A. (1) – (iii), (2) – (i)    B. (1) – (iii), (2) – (ii)  
C. (1) – (i), (2) – (ii)    D. (1) – (ii), (2) – (iii)
30. Minimum liquid rate to be used in a counter-current absorption tower corresponds to an operating line
- A. having a slope of unity    B. having a slope of 0.1  
C. tangential to the equilibrium curve    D. having a slope of – 1
31. The overall mass transfer co-efficient for absorption of SO<sub>2</sub> from air using dilute sodium hydroxide solution can be substantially increased by
- A. increasing the gas film co-efficient

- B. increasing the liquid film co-efficient  
 C. increasing the total pressure  
 D. decreasing the total pressure
32. For high Schmidt number the boundary layer theory predicts that the mass transfer coefficient varies as proportional to  
 A.  $D_v$                       B.  $D_v^{1/3}$                       C.  $D_v^{2/3}$                       D.  $D_v^{3/2}$
33. The mass transfer flux in gases is generally higher than that in liquids in the order of  
 A. 10 times more                      B. 100 times more  
 C. 1000 times more                      D.  $10^5$  times more
34. For solvent economy in liquid-liquid extraction, the distribution coefficient must be  
 A. less than one                      B. equal to one  
 C. greater than one                      D. as large as possible
35. In a batch drying operation one can get the rate of drying in constant drying period as  $2.8 \text{ kg H}_2\text{O/hr. m}^2$  at an air inlet temperature of  $60^\circ\text{C}$  with a wet-bulb temperature of  $35^\circ\text{C}$ . If same air is used at an inlet temperature of  $80^\circ\text{C}$  and wet-bulb temperature of  $38^\circ\text{C}$ , the rate of drying will be  
 A.  $2.8 \text{ kg. H}_2\text{O/hr. m}^2$                       B.  $3.85 \text{ kg. H}_2\text{O/hr. m}^2$   
 C.  $4.704 \text{ kg. H}_2\text{O/hr. m}^2$                       D.  $6.146 \text{ kg. H}_2\text{O/hr. m}^2$
36. Because of tortuous micropores within the membranes, the diffusivity of the gas in the membrane  
 A. gets appreciably increased                      B. gets appreciably reduced  
 C. remains unchanged                      D. either (A) or (B)
37. A carbonaceous porous catalyst is used for conversion of nitrogen oxide in effluent air to carbon monoxide and nitrogen. The catalyst pellet is of radius  $4.8 \times 10^{-3} \text{ m}$ , while the effective diffusivity of NO in air in the pores is found to be  $4.6 \times 10^{-8} \text{ m}^2/\text{s}$  and the external mass transfer coefficient to be  $5 \times 10^{-5} \text{ m/s}$ . The 'Biot number' for mass transfer will be  
 A. 0.869                      B. 1.739                      C. 2.017                      D. 3.802
38. The activation energy of a bimolecular gas decomposition reaction is  $25,000 \text{ cal/mol}$ . The fraction of molecules that have sufficient energy to decompose at  $30^\circ\text{C}$  will be  
 A.  $7.29 \times 10^{-19}$                       B.  $8.07 \times 10^{-19}$                       C.  $8.98 \times 10^{-19}$                       D.  $9.27 \times 10^{-19}$
39. Overall order of reaction for which rate constant has units of  $[(\text{mol/lit})^{-3/2} \cdot \text{s}^{-1}]$  is  
 A.  $-3/2$                       B.  $1/2$   
 C.  $3/2$                       D.  $5/2$

40. For a laminar flow reactor, the expression for  $C [= dF/dt]$  considering RTD equation can be written as

$$A. C = \frac{e^{-t/\tau}}{\tau} \quad B. C = 1 - e^{-t/\tau} \quad C. C = \frac{\tau^2}{2t^3} \quad D. C = \frac{\tau}{2t^2}$$

where 'F' represents ratio of volume and volumetric rate.

41. If a negligible temperature difference is observed in between the catalyst pellet centre and the pellet surface, then

- A. pore diffusion does not control
- B. pore diffusion controls
- C. surface film mass transfer resistance does not control
- D. reaction step resistance does not control

42. The assumptions made for the Clausius-Clapeyron equation are

- (i) the vapour acts as ideal gas
- (ii) applicable near the critical point
- (iii) enthalpy of vapourization varies with temperature
- (iv) the vapours are real gases
- (v) applicable below and away from the critical point
- (vi) enthalpy of vapourization is independent of temperature

- A. (i), (ii), (iii)
- B. (i), (v), (vi)
- C. (iv), (v), (vi)
- D. (ii), (iv), (vi)

43. The degree of freedom of an azeotropic mixture of ethanol and water in a VLE system is

- A. 0
- B. 1
- C. 2
- D. 3

44. For azeotropic formation

$$A. \gamma_1/\gamma_2 = 1 \quad B. \gamma_1/\gamma_2 = 0 \quad C. \gamma_1/\gamma_2 = P_1^0/P_2^0 \quad D. \gamma_1/\gamma_2 = P_2^0/P_1^0$$

where  $\gamma_i$  represents activity coefficient of component 'i', and  $P_i^0$  represents vapour pressure of component 'i'.

45. For a cylindrical pin fin for long fins, the fin efficiency is proportional to

- A. L
- B.  $1/\sqrt{L}$
- C.  $L^2$
- D.  $\sqrt{L}$

where L is the length of fin.

46. The overall plate efficiency of a plate column is the ratio of

- A. number of theoretical plates to the number of actual plates required
- B. number of actual plates required to the number of theoretical plates

- C. number of actual plates required to the number of overall gas-phase transfer units
- D. number of theoretical plates to the number of overall liquid-phase transfer units

47. For steam pipelines with thermal stresses induced in them, the best pipe support is
- A. Foundation support
  - B. Spring hanger support
  - C. Hanger support
  - D. Roller support
48. If a pump costs Rs. 2000 in 2010, what will be cost of the pump of same capacity in 2016?  
(Given: In 2010, cost index is 250 and in 2016, cost index is 300)
- A. Rs. 2400
  - B. Rs. 2750
  - C. Rs. 3000
  - D. Rs. 3500
49. If a plant producing 4 kton/annum fertilizer costing Rs. 20/kg. is analyzed for a new proposed plant of double the capacity, find the capital investment for proposed plant.  
(Assume turn-over ratio as 1)
- A. Rs. 16,000.00
  - B. Rs. 40,000.00
  - C. Rs.  $1.6 \times 10^4$
  - D. Rs.  $1.6 \times 10^8$
50. The discount factor is written as the ratio of
- A. Present worth and Future worth
  - B. Future worth and Present worth
  - C. Present worth and Premium
  - D. Premium and Present worth
51. A fully depreciable plant of Rs. 8000,000 has a estimated service life of 20 years. If 40% of the initial plant value is to be depreciated in first 4 years, the annual depreciation in Rs. /year using straight line method will be
- A. Rs. 400,000
  - B. Rs. 800,000
  - C. Rs. 2000,000
  - D. Rs. 160000,000
52. LD<sub>50</sub> stands for
- A. Lethal dose of a toxic chemical in which 50% of test animals survive and remaining die
  - B. Length to diameter ratio for a pipeline carrying a fluid at a pressure of 50 MPa
  - C. Legal dose of a toxic chemical in which 50 test animals die
  - D. Length to diameter ratio for a reactor operating at 50 MPa.
53. If BOD/COD = 1, which of the following methods you will recommend for waste treatment?
- A. Chemical
  - B. Biological
  - C. Physical
  - D. Thermal
54. Laplace transform of the function ( $t^2e^{2t}$ ) using the first shift theorem is
- A.  $\frac{e^{25}}{5^3}$
  - B.  $\frac{2}{(5-2)^2}$
  - C.  $5^3e^{35}$
  - D.  $\frac{2}{(5-2)^3}$
55. A proportional controller takes in error signal in temperature range 80 to 200<sup>0</sup>C and produces electrical output in standard range of 4 to 20 mA. What will be the gain of the controller?
- A. 0.1333
  - B. 0.2382
  - C. 0.332
  - D. 0.3864

