

M.E.(Chemical)

1. A box contains six red balls and four green balls, one ball is randomly picked and then a second ball is picked without replacement of the first ball. The probability that both the balls are green is
A) 1/15 B) 2/25 C) 2/15 D) 4/25
2. The Taylor series expansion of the function: $F(x)=x/(1+x)$ around $x=0$ is
A) $x+x^2+x^3+x^4 \dots$ B) $1+x+x^2+x^3+x^4 \dots$
C) $2x+4x^2+8x^3+16x^4 \dots$ D) $x-x^2+x^3-x^4 \dots$
3. The function $f(x)=3x(x-2)$ has a
A) Minimum at $x=1$ B) Maximum at $x=1$
C) Minimum at $x=2$ D) maximum at $x=2$
4. The inverse Laplace transform of the function
$$f(s) = \frac{1}{s(1+s)}$$
 is
A) $1+e^t$ B) $1-e^t$ C) $1+e^{-t}$ D) $1-e^{-t}$
5. The differential equation $\frac{d^2y}{dx^2} + \sin x \frac{dy}{dx} + ye^x = \sinh x$ is
A) First order and linear B) First order and non linear
C) Second order and linear D) Second order and non linear
6. cSt(centistokes) is unit of
A) Absolute viscosity B) Kinematic viscosity
C) Pressure D) Surface tension
7. Air (79mol% nitrogen and 21mol% oxygen) is passed over a catalyst at high temperature. Oxygen completely reacts with nitrogen as shown below:
$$\begin{array}{lcl} 0.5N_2(g)+0.5O_2(g) & \longrightarrow & NO(g) \\ 0.5N_2(g)+O_2(g) & \longrightarrow & NO_2(g) \end{array}$$

The molar ratio of NO to NO₂ in the product stream is 2:1. The fractional conversion of nitrogen is
A) 0.13 B) 0.20 C) 0.27 D) 0.40
8. A 35wt% Na₂SO₄ solution in water, initially at 50°C, is fed to a crystallizer at 20°C. The product stream contains hydrated crystals Na₂SO₄.10H₂O in equilibrium with a 20wt% Na₂SO₄ solution. The molecular weights of Na₂SO₄ and Na₂SO₄.10H₂O are 142 and 322, respectively. The feed rate of the 35wt% solution required to produce 500kg/h of hydrated crystals is
A) 403 kg/h B) 603 kg/h C) 803 kg/h D) 1103 kg/h

9. The SI unit of C_p is
 A) J/kg.K B) J/kg C) W/kg.K D) J/m³.K
10. For endothermic reactions, the change in internal energy is
 A) Negative B) Positive C) Zero D) None of these
11. Boyle temperature is a temperature for which $\lim_{P \rightarrow 0} \left(\frac{\partial z}{\partial P} \right)_T = 0$. At the Boyle temperature,
 A) The second virial coefficient B is zero B) The third virial coefficient C is zero
 C) The second virial coefficient B is unity D) The third virial coefficient C is unity
12. For one mole of an ideal gas that is compressed isothermally from one to two atmospheres, the work required is equal to
 A) $RT \ln 2$ B) $RT \ln(1/2)$ C) $2RT$ D) RT
13. The number of degrees of freedom for a mixture of ice and water (liquid) is
 A) 2 B) 3 C) 1 D) 0
14. The fugacity of species i in an ideal gas mixture is equal to
 A) Its partial molar volume B) its partial pressure
 C) Total pressure D) its partial molar Gibbs energy

Common data Question No. 15-16

From a reservoir at 327 °C, 1000 J of heat is transferred to an engine that operates on the Carnot cycle. The engine rejects heat to a reservoir at 27 °C.

15. Thermal efficiency of the cycle will be
 A) 30% B) 40% C) 50% D) 60%
16. Work done by the engine will be
 A) 200 J B) 300 J C) 400 J D) 500 J
17. Reynolds number for pipe flow is given by
 A) $\frac{vD}{\nu}$ B) $\frac{vD\mu}{\delta}$ C) $\frac{vD\rho}{\mu}$ D) $\frac{vD}{\mu}$
18. Cavitation is caused by
 A) High velocity B) Low barometric pressure
 C) High pressure D) Low pressure
19. A hot wire anemometer is used for the measurement of
 A) Pressure of gases B) Velocity of gases
 C) Viscosity of gases D) Viscosity of liquids

20. Heaviest fluid is
 A) Air
 B) Castor oil
 C) Glycerine
 D) Carbon tetrachloride
21. Water at 20°C flowing through a 20 cm diameter pipe. Take kinematic viscosity of water at 20°C is 0.0101 stoke. Assume changes from laminar to turbulent at $Re = 2320$. The critical velocity will be
 A) 1.117 cm/s
 B) 11.17 cm/s
 C) 111.7 cm/s
 D) 0.117 cm/s
22. Water is flowing through a 20 cm diameter pipe with friction factor, $f=0.04$, the flow is
 A) Viscous
 B) Non viscous
 C) Both A and B
 D) None of these
23. The law which is applicable for fine grinding is
 A) Kick's law
 B) Rittinger's law
 C) Bond's law
 D) Fick's law
24. Size reduction mechanism used in jaw crushers is
 A) Attrition
 B) Compression
 C) Cutting
 D) Impact
25. Maximum slope of a belt conveyor can be
 A) 15°
 B) 30°
 C) 45°
 D) 60°
26. Cyclones are used primarily for separating
 A) Liquid from liquids
 B) Solids from fluids
 C) Solids from solids
 D) All of these
27. Most common filter aid is
 A) Diatomaceous earth
 B) Calcium silicate
 C) Sodium carbonate
 D) Silica gel
28. Opening of 200 mesh screen (Taylor series)
 A) 0.0074 cm
 B) 0.0074 mm
 C) 0.0047 cm
 D) 0.0034 cm
29. The advantage of backward feed multiple effect evaporators over forward feed is that
 A) Heat sensitive materials can be handle
 B) There is no additional cost of pumping
 C) Most concentrated liquor is at high temperature
 D) Equal heat transfer coefficients exist in various effects
30. According to Duhring's rule, the boiling point of a given solution is
 A) A linear function of the concentration of the solute
 B) A linear function of the boiling point of pure water at the same pressure
 C) A linear function of the pressure

D) An exponential function of the boiling point of pure water at the same pressure

31. Grashof number is defined as

A) $\frac{g\beta\Delta TL^3}{\mu^2}$

B) $\frac{g\beta\Delta T\rho^2 L^3}{\mu^2}$

C) $\frac{g\beta DT\mu^2 L^3}{\rho^2}$

D) $\frac{g\beta\Delta T\rho^3 L^3}{\mu^3}$

32. A 10 kg solid at 100 °C with a specific heat of 0.8 kJ/kg°C is immersed in 40 kg of 20 °C liquid with specific heat of 4 kJ/kg°C. The temperature after a long time if the container is insulated will be

A) 30 °C

B) 28 °C

C) 26 °C

D) 23.8 °C

33. A 20 cm diameter, 1.2 m long cylinder loses heat from its peripheral surface by convection. Surface temperature of the cylinder is constant at 100 °C and the fluid temperature is constant at 20 °C, the average convection heat transfer coefficient over the surface of the cylinder is 25 W/m² K. The heat transfer rate is

A) 120 π W

B) 240 π W

C) 320 π W

D) 480 π W

34. The product of Reynolds number and Prandtl number is called

A) Stanton number

B) Peclet number

C) Mach number

D) Biot number

35. Dimensionless group in mass transfer that is equivalent to Prandtl number in heat transfer is

A) Nusselt number

B) Sherwood number

C) Schmidt number

D) Stanton number

36. In an interface mass transfer process, the lesser the solubility of a given solute in a liquid, the higher are the chances that the transfer process will be

A) Liquid phase resistance controlled

B) gas phase resistance controlled

C) Impossible

D) driven by a non-linear driving force

37. According to the film theory of mass transfer, the mass transfer coefficient is proportional to

A) D

B) D²

C) D^{0.5}

D) 1/D

38. The relative volatility of a binary mixture at the azeotropic composition is

A) Zero

B) Unity

C) Infinity

D) one-half

39. The number of ideal stages required in a fractionating column is the least at

A) Minimum reflux ratio

B) Total reflux

C) Optimum reflux ratio

D) The reflux ratio of zero

40. When is the Lewis number of the mixture equal to one?

A) The mass diffusivity is equal to the momentum diffusivity

- B) The mass diffusivity is equal to the thermal conductivity
- C) The mass diffusivity is equal to the thermal diffusivity
- D) The mass diffusivity is equal to 1/thermal diffusivity

41. The rate of a chemical reaction depends upon

- A) Temperature
- B) Pressure
- C) Concentration
- D) All of these

42. Half-life period of a chemical reaction is

- A) The time required to reduce the concentration of the reacting substance to half of its initial value
- B) Half of the space time of a reaction
- C) Half of the residence time of a reaction
- D) None of these

43. The exit age distribution of fluid leaving a vessel is used to

- A) Study the reaction kinetics
- B) Study the extent of non-ideal flow in the vessel
- C) Study the reaction mechanism
- D) Know activation energy of a reaction

44. The dimensionless $\left(\frac{D}{uL}\right)$ is called the vessel dispersion number. For plug flow

- A) $\frac{D}{uL} = \infty$
- B) $\frac{D}{uL} = 0$
- C) $\frac{D}{uL} = 2100$
- D) $\frac{D}{uL} = 400$

45. For a reaction $2A+B \xrightarrow{k} C$

The rate equation is given as: $-r_A = KC_A^2 C_B$. The order of reaction will be

- A) One
- B) Two
- C) Three
- D) Four

46. Rate of a gaseous phase reaction is given by

$$-\frac{dp_A}{dt} = KP_A^2$$

The unit of rate constant is

- A) $(\text{atm})^{-1}$
- B) $(\text{h})^{-1}$
- C) $(\text{atm})^{-1} (\text{h})^{-1}$
- D) $\text{atm} (\text{h})^{-1}$

47. Time constant of mercury in glass thermometer (without covering or air gap) is

- A) $\frac{mc}{hA}$
- B) $\frac{hA}{mc}$
- C) $mchA$
- D) $1/mchA$

48. Accuracy is specified as $\pm 0.5\%$ of true value. At 5% of full scale, error of the instrument will be

- A) $\pm 0.025\%$
- B) $\pm 0.5\%$
- C) $\pm 2.5\%$
- D) $\pm 25\%$

49. Active transducer is

- A) Photo emissive cell
- B) Photo voltaic cell

C) Selsyl

D) All of these

50. In a platinum resistance thermometer which is used to measure temperature, if resistance temperature coefficient of platinum is $0.00392/^{\circ}\text{C}$, then its sensitivity at room temperature will be

A) $\frac{0.00392}{20} \Omega/^{\circ}\text{C}$

B) $\frac{0.00392}{2} \Omega/^{\circ}\text{C}$

C) $0.00392 \Omega/^{\circ}\text{C}$

D) $0.00784 \Omega/^{\circ}\text{C}$

51. A manometer uses transformer oil (sp.gr.=0.864) as measuring fluid. The scale is graduated in mm of water. The well has a bore of 20 mm and tube of bore 2 mm. When a pressure of 1 mm head of water (9.81 Pa) is applied to give an inclined deflection of 4 mm, the angle of inclination is

A) 8.33°

B) 16.66°

C) $\frac{\pi}{8} \text{ rad}$

D) $\frac{\pi}{6} \text{ rad}$

52. Which of the following controller has maximum offset?

A) P- controller

B) PI-controller

C) PD-controller

D) PID-controller

53. In a double pipe heat exchanger the ID and OD of the inner pipe are 4 cm and 5 cm respectively. The ID of the outer pipe is 10 cm with a wall thickness of 1 cm. Then, the equivalent diameters (in cm) of the annulus for heat transfer and pressure drop respectively are

A) 15, 5

B) 21, 6

C) 6, 19

D) 15, 21

54. To determine the performance of a compressor, a standardised test is performed. In the testing process, when the compressor is under operation, "shut off" term signifies

A) Maximum flow

B) Zero flow

C) Steady flow

D) Intermittent flow

55. Losses for flow through valves and fittings are expressed in terms of

A) Drag coefficient

B) equivalent length of a straight pipe

C) Shape factor

D) Roughness factor

56. For the case of single lump-sum capital expenditure of Rs.10 crores which generates a constant annual cashflow of Rs. 2 crores in each subsequent year, the payback period(in years), if the scrap value of the capital outlay is zero then

A) 10

B) 20

C) 1

D) 5

57. The relation between capital rate of return(CRR), net present value (NPV) and maximum cumulative expenditure (MCE) is

A) $\text{CRR} = \frac{\text{NPV}}{\text{MCE}}$

B) $\text{CRR} = \frac{\text{MCE}}{\text{NPV}}$

C) $\text{CRR} = \text{NPV} \times \text{MCE}$

D) $\text{CRR} = \frac{\text{MCE}}{\text{NPV} + \text{MCE}}$

58. A column costs Rs. 5 lakhs and has a useful life of ten years. Using the double declining balance depreciation method, the book value of the unit at the end of five years in lakhs of Rs. is

A) 1.21 B) 1.31 C) 1.64 D) 2.05

59. In petroleum refining operations, the process used for converting paraffins and naphthenes to aromatics is

- A) Catalytic reforming B) Catalytic cracking
C) Hydrocracking D) Alkylation

60. The active component of catalysts used in steam reforming of methane to produce synthesis gas is

- A) Nickel B) Iron C) Platinum D) Palladium

61. A suitable material of construction to use with fuming sulphuric acid is

- A) Carbon steel B) Stainless steel type 304
C) Nickel D) Monel

62. The refractory bricks in common use are composed of mixtures of

- A) Carbon and alumina B) Silica and carbon
C) Silica and alumina D) Iron and carbon

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

- A) $\sigma_h = \sigma_L$ B) $\sigma_h = 2 \sigma_L$ C) $\sigma_h = \sigma_L / 2$ (D) $\sigma_h = 1.41 \sigma_L$

64. Which one of the following works as the strongest head for pressure vessels?

- A) Torispherical head B) Ellipsoidal head
C) Flat plate and formed flat head D) hemispherical head

65. Double contact double absorption (DCDA) process is used for the manufacture of

- A) Nitric acid B) hydrochloric acid
C) Sulphuric acid D) Phosphoric acid

66. The chemical formula of urea is

- A) $\text{NH}_4\text{COONH}_2$ B) $\text{NH}_2\text{CONHCONH}_2$
C) NH_4OH D) NH_2CONH_2

67. Baking soda is

- A) Na_2CO_3 B) NaHCO_3 C) $\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$ D) $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$

68. Mainly styrene is produced from ethylbenzene by the process of

- A) Dehydrogenation B) Oxidation C) Alkylation D) Dehydration

69. Multiple effect evaporators are commonly used in the manufacture of

- P Paper Q Superphosphate

R Sugar

S Fats

A) P and Q

B) P and R

C) P and S

D) R and S

70. Prilling tower is used in the manufacture of

A) Cement

B) Potassium chloride

C) Urea

D) Triplesuper phosphate

71. The lowest layer of atmosphere is called the

A) Stratosphere

B) Troposphere

C) Ionosphere

D) None of these

72. Which of the following fine dust removal equipments is the most efficient?

A) Bag filter

B) Scrubber

C) Electrostatic precipitator

D) Cyclone separator

73. Higher concentration of nitrogen dioxide in atmospheric air causes

A) Cancer

B) Bronchitis

C) Asphyxiation

D) Corrosion

74. Black smoke coming out of the chimney of a furnace is an indication of the use of _____ in the furnace.

A) Low amount of excess combustion air

B) Large quantity of excess combustion air

C) Hydrocarbon fuel

D) Pulverised coal as fuel

75. Fluorosis is caused due to the presence of excessive amount of _____ in drinking water.

A) Mercury

B) Lead

C) Fluoride

D) Arsenic

x-x-x