

OCET 2011

Sr. No. :

Question Booklet Series : A

Important : Please consult your Admit Card / Roll No. Slip before filling your Roll Number on the Test Booklet and Answer Sheet.

Roll No.

In Figures

In Words

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O.M.R. Answer Sheet Serial No.

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Signature of the Candidate : _____

Subject : M.E. (Chemical)

Time : 90 minutes

Number of Questions : 75

Maximum Marks : 75

DO NOT OPEN THE SEAL ON THE BOOKLET UNTIL ASKED TO DO SO

INSTRUCTIONS

1. Write your Roll No. on the Question Booklet and also on the OMR Answer Sheet in the space provided and nowhere else.
2. Enter the Subject and Series Code of Question Booklet on the OMR Answer Sheet. Darken the corresponding bubbles with **Black Ball Point / Black Gel pen**.
3. Do not make any identification mark on the Answer Sheet or Question Booklet.
4. To open the Question Booklet remove the paper seal (s) gently when asked to do so.
5. Please check that this Question Booklet contains **75** questions. In case of any discrepancy, inform the Assistant Superintendent within 10 minutes of the start of test.
6. Each question has four alternative answers (A, B, C, D) of which only one is correct. For each question, darken only one bubble (A or B or C or D), whichever you think is the correct answer, on the Answer Sheet with **Black Ball Point / Black Gel pen**.
7. If you do not want to answer a question, leave all the bubbles corresponding to that question blank in the Answer Sheet. No marks will be deducted in such cases.
8. Darken the bubbles in the OMR Answer Sheet according to the Serial No. of the questions given in the Question Booklet.
9. Negative marking will be adopted for evaluation i.e., 1/4th of the marks of the question will be deducted for each wrong answer. A wrong answer means incorrect answer or wrong filling of bubble.
10. For calculations, use of simple log tables is permitted. Borrowing of log tables and any other material is not allowed.
11. For rough work only the sheets marked "Rough Work" at the end of the Question Booklet be used.
12. The Answer Sheet is designed for **computer evaluation**. Therefore, if you do not follow the instructions given on the Answer Sheet, it may make evaluation by the computer difficult. **Any resultant loss to the candidate on the above account, i.e., not following the instructions completely, shall be of the candidate only.**
13. After the test, hand over the Question Booklet and the Answer Sheet to the Assistant Superintendent on duty.
14. In no case the Answer Sheet, the Question Booklet, or its part or any material copied/noted from this Booklet is to be taken out of the examination hall. Any candidate found doing so, would be expelled from the examination.
15. A candidate who creates disturbance of any kind or changes his/her seat or is found in possession of any paper possibly of any assistance or found giving or receiving assistance or found using any other unfair means during the examination will be expelled from the examination by the Centre Superintendent/Observer whose decision shall be final.
16. **Telecommunication equipment such as pager, cellular phone, wireless, scanner, etc., is not permitted inside the examination hall. Use of calculators is not allowed.**

1. 10 kg of 70% aqueous NaOH solution is mixed with 16 kg of 80% aqueous H₂SO₄ solution to produce Na₂SO₄. The percent excess is approximately equal to :
 (A) 39 (B) 49
 (C) 59 (D) 69
2. Density of dry air at 100°C and 1.5 bar is approximately equal to :
 (A) 1.4 kg/m³ (B) 2.4 kg/m³
 (C) 3.4 kg/m³ (D) 4.4 kg/m³
3. Molarity of a 20% by weight aqueous solution of NaOH at 30°C having density equal to 1120 kg/m³ will be :
 (A) 4.6 (B) 7.6
 (C) 9.6 (D) 5.6
4. The vapour pressure in mmHg of water at 25°C (average molar latent heat of vaporization 9720 cal/mol) using Clausius-Clapeyron equation will be :
 (A) 27.69 (B) 63.76
 (C) 12.02 (D) 121.52
5. 200 kg of NH₄NO₃ charged to a reactor gave 70 kg of N₂O

$$\text{NH}_4\text{NO}_3 \rightarrow \text{N}_2\text{O} + 2\text{H}_2\text{O}$$
 The percent conversion is :
 (A) 43.6 (B) 63.6
 (C) 53.6 (D) 73.6
6. The total pressure of vapours at equilibrium at 30°C in contact with a liquid mixture containing 25 mol% benzene and 75 mol% toluene will be :
 (Take P_{C₆H₆}⁰ = 119 mm Hg, P_{C₇H₈}⁰ = 36.7 mm Hg),
 (A) 158 mm Hg (B) 57.27 mm Hg
 (C) 760 mm Hg (D) 48 mm Hg
7. For estimation of heat capacity of a solid compound, one can use :
 (A) Clapeyron's equation (B) Gibb's equation
 (C) Kopp's rule (D) Trouton's rule
8. 90 kg/hr of air is being compressed from 1 atm ($\hat{H} = 117$ kcal/kg) to 10 atm ($\hat{H} = 122$ kcal/kg). The exit velocity from the compressor is 60 m/s. Assuming adiabatic condition, what is the hp required for compression ?
 (A) 1.54 (B) 3.84
 (C) 0.76 (D) 10.36

9. The Reynolds number of a solid particle falling in a fluid is 1500. Drag coefficient will be :
- (A) 0.016 (B) 0.0107
(C) 0.44 (D) 0.064
10. The sphericity shape factor for a cylinder having diameter is length :
- (A) 1.0 (B) 0.874
(C) 0.806 (D) 0.60
11. An oil having density of 878 kg/m^3 is flowing through a pipe having 0.1541 m diameter in which a sharp edged orifice is installed. The pressure difference across the orifice is 93.2 kN/m^2 . The velocity of the oil in m/s corresponding to an orifice coefficient 0.61 is :
- (A) 8.97 (B) 89.7
(C) 0.897 (D) 897
12. Water at 50°C (density = 988 kg/m^3 , vapour pressure = 12.35 kPa) is in an open tank. The pump is 3.0 m above the open tank. The velocity in the pipe is 0.9 m/s . The available NPSH will be approximately :
- (A) 5.14 m (B) 10.28 m
(C) 7.14 m (D) 3.14 m
13. Pump efficiency of a typical centrifugal pump having 1000 gal/min capacity is :
- (A) 20% (B) 30%
(C) 50% (D) 85%
14. The Fanning friction factor for a flowing fluid having Reynolds number 1000 is :
- (A) 0.024 (B) 0.016
(C) 0.064 (D) 0.048
15. Heat loss per m^2 of surface area for an insulating wall composed of 25.4 mm thick fiber insulating board ($k = 0.048 \text{ W/(m)(k)}$), where the inside temperature is 352.7 k and the outside temperature is 297.1 k is approximately :
- (A) 105 W (B) 210 W
(C) 315 W (D) 420 W
16. Range of heat transfer coefficient in $\text{W/(m}^2\text{)(k)}$ for condensing steam is :
- (A) 6000–25000 (B) 300–500
(C) 50–200 (D) 10–50

17. In a shell and tube heat exchanger the tube side coefficient is $500 \text{ W}/(\text{m}^2)(\text{k})$ and the shell side coefficient is $2000 \text{ W}/(\text{m}^2)(\text{k})$. Neglecting all other resistances, the overall heat transfer coefficient will be :
- (A) 1500 (B) 2500
(C) 400 (D) 800
18. A 1–1 pass shell and tube heat exchanger is converted to a 1–2 pass, by how many times the tube side pressure drop will increase ?
- (A) 16 (B) 32
(C) 8 (D) 2
19. Grashoff number in natural convection heat transfer is :
- (A) $\frac{L^3 \rho g \beta \Delta T}{\mu^2}$ (B) $\frac{L^3 \rho^2 g \beta \Delta T}{\mu^2}$
(C) $\frac{L^3 \rho^2 g \beta \Delta T}{\mu^3}$ (D) $\frac{L^3 \rho^2 g \beta \Delta T}{\mu}$
20. Water is being pumped to an overhead tank, the range of discharge velocity in m/s should be :
- (A) 3–4 (B) 5–10
(C) 1–1.2 (D) 0.1–0.5
21. Total emissivity of polished aluminium surface is :
- (A) 0.04 (B) 0.75
(C) 0.95 (D) 0.01
22. Diffusion coefficient in m^2/s for dilute liquid solution of ethyl alcohol in water is :
- (A) 1.2×10^{-9} (B) 1.2×10^{-4}
(C) 1.2 (D) 1.2×10^4
23. Latent heat of saturated steam :
- (A) Increases with the increase in pressure (B) Decreases with the increase in pressure
(C) Is independent of pressure (D) Increases with the increase in temperature
24. Steam economy in evaporators is :
- (A) $\frac{\text{kg steam used}}{\text{kg water evaporated}}$ (B) $\frac{\text{kg water evaporated}}{\text{hr}}$
(C) $\frac{\text{kg steam used}}{\text{hr}}$ (D) $\frac{\text{kg water evaporated}}{\text{kg steam used}}$

25. The dry bulb temperature of air-water vapour system is 40°C. The partial pressure of water vapour is 23.8 mm Hg. Vapour pressure of water at 25°C is 23.8 mm Hg. The Dew point temperature of the system is :

- (A) < 25°C (B) > 25°C < 40°C
(C) 25°C (D) > 40°C

26. The relative volatility (α_{AB}) for an ideal binary liquid mixture of A and B at a given temperature is :

- (A) $\frac{P_B^O}{P_A^O}$ (B) $\frac{P_A^O}{P_B^O}$
(C) $\frac{P_A^O}{(1 - P_B^O)}$ (D) $\frac{(1 - P_A^O)}{P_B^O}$

Where P_A^O and P_B^O are vapour pressures

27. Entropy change of a system is zero in :

- (A) Reversible process (B) Adiabatic process
(C) Reversible adiabatic process (D) Isothermal process

28. The equation of state for a certain gas is given by $P(V - b) = RT$, where b is positive constant. The Joule-Thomson coefficient is :

- (A) Positive (B) Negative
(C) Zero (D) Positive within the inversion points

29. Which one of the following is incorrect ?

- (A) $dU = TdS - PdV$ (B) $dH = TdS - VdP$
(C) $dA = -SdT - PdV$ (D) $dG = -SdT + VdP$

30. Fugacity has the same dimensions as that of :

- (A) Gibbs free energy (B) Pressure
(C) Temperature (D) Fugacity is dimensionless

31. The volume coefficient of expansion β of an ideal gas equals :

- (A) 1/T (B) 1/P
(C) T (D) P

32. The net change in a state function is zero for :

- (A) A reversible process (B) An irreversible process
(C) Cyclic process (D) Non-cyclic process

- 33. As pressure approaches zero, the fugacity coefficient value tends to :**
- (A) Pressure (B) Zero
(C) Unity (D) Infinity
- 34. A Carnot cycle consists of the following steps :**
- (A) Two isothermals and two isentropics (B) Two isobaric and two isothermals
(C) Two isochorics and two isobarics (D) Two isothermals and two isochorics
- 35. The value of activity coefficient for an ideal solution is :**
- (A) One (B) Zero
(C) Equal to Henry's Law constant (D) Equal to vapour pressure
- 36. Which one of the following statements is true with reference to the minimum boiling azeotropes ?**
- (A) There is a minimum on the vapour pressure curve
(B) The solution exhibits positive deviation from ideality
(C) The dew point is greater than the bubble point
(D) The activity coefficients are less than unity
- 37. For a highly favourable chemical reaction, the standard free energy change is :**
- (A) Zero (B) Unity
(C) Positive (D) Negative
- 38. A mixture of benzene and water is agitated. The normal boiling point of benzene is 80°C and that of water is 100°C. At a pressure of 1 atm, the boiling point of the mixture is :**
- (A) 80°C (B) 100°C
(C) < 80°C (D) > 80°C < 100°C
- 39. Minimum reflux ratio in a distillation column results in :**
- (A) Optimum number of trays (B) Minimum size of reboiler
(C) Maximum condenser size (D) Minimum number of trays
- 40. Direct costs component of the fixed capital consists of :**
- (A) Contingency (B) Onsite and offsite costs
(C) Labour costs (D) Raw material costs
- 41. The variables required to be known in correlations used for estimating the horsepower of a centrifugal compressor and hence its cost are :**
- | | |
|----------------------------|--|
| P inlet pressure | Q Compressor RPM |
| R Delivery pressure | S Volumetric flow rate at inlet |
- (A) P, Q and R (B) P and R
(C) R and S (D) P, R and S

42. A pure drug is administered as a sphere and as a cube. The amount of drug is the same in two tablets. Assuming that the shape and size do not influence the mass transfer, the ratio of rate of dissolution in water at $t = 0$ for the cubic and the spherical tablet is :
- (A) 0.54 (B) 1.04
(C) 1.94 (D) 1.24
43. The number of degrees of freedom for an azeotropic mixture in a two component vapour liquid equilibria is/are :
- (A) Zero (B) One
(C) Two (D) Three
44. The depreciable fixed cost is Rs. 100 lakhs. The average profit per year is Rs. 15 lakhs. The average depreciation cost per year is Rs. 10 lakhs. What is the payment period in years, if there is no interest charge ?
- (A) 8 (B) 4
(C) 10 (D) 20
45. Match the variation of mass transfer coefficient given by the theory in Group I with the appropriate variation in Group II :
- | Group I | Group II |
|-------------------------|---------------------------|
| P Film theory | 1. $\propto D_{AB}$ |
| Q Penetration theory | 2. $\propto D_{AB}^{2/3}$ |
| R Boundary layer theory | 3. $\propto D_{AB}^{1/2}$ |
- (A) P-1, Q-2, R-3 (B) P-2, Q-1, R-3
(C) P-1, Q-3, R-2 (D) P-3, Q-2, R-1
46. Which of the following not employed in the commercial production of linear polyvinyl chloride ?
- (A) Emulsion Polymerization (B) Suspension Polymerization
(C) Additional Polymerization (D) Condensation Polymerization
47. Which of the following is a detergent ?
- (A) Benzene hexachloride (B) Cellulose nitrate
(C) Polyvinyl chloride (D) Alkyl benzene sulphonate
48. The chief raw material for the commercial production of methanol is :
- (A) Synthesis gas (B) Formaldehyde
(C) Acetic acid (D) Ethanol
49. For the liquid phase reaction $A \rightarrow P$, in a series of experiments in a batch reactor, the half-life $t_{1/2}$ was found to be inversely proportional to the square root of the initial concentration of A. The order of the reaction is :
- (A) $3/2$ (B) 1
(C) $+1/2$ (D) $-1/2$

50. Match the items in Group I with those in Group II :

Group I

- P Porous catalyst
- Q Parallel reactions
- R Non-ideal tubular reactor
- S Gas-solid non-catalytic reaction

Group II

- 1. Selectivity
- 2. Shrinking core model
- 3. Thiele modulus
- 4. Dispersion number

(A) P-3, Q-1, R-4, S-2

(B) P-1, Q-3, R-2, S-4

(C) P-1, Q-4, R-2, S-3

(D) P-3, Q-4, R-1, S-2

51. Baffles are used in heat exchangers in order to :

- (A) Increase the tube side fluid heat transfer coefficient
- (B) Promote vibration in the heat exchanger
- (C) Promote cross flow and turbulence in the shell side fluid
- (D) To prevent shell expansion due to thermal effects

52. For the case of a fuel gas undergoing combustion with air, if the air/fuel ratio is increased, the adiabatic flame temperature will :

- (A) Increase
- (B) Decrease
- (C) Increase or decrease depending on the fuel type
- (D) Not change

53. In petroleum refining, the process used for conversion of hydrocarbons to aromatics is :

- (A) Catalytic cracking
- (B) Catalytic reforming
- (C) Hydrotreating
- (D) Alkylation

54. Styrene is produced from ethylbenzene by the process of :

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

55. The operation of a rotameter is based on :

- (A) Variable flow area
- (B) Rotation of a turbine
- (C) Pressure drop across a nozzle
- (D) Pressure at a stagnation point

56. The absorption factor is defined as :

- (A) L/mG
- (B) G/mL
- (C) mL/G
- (D) LG/m

Where L = liquid flow rate, G = gas flow rate and m = slope of equilibrium line.

57. Pore diffusion resistance in a catalyst particle is considered negligible if Thiele Modulus is :

- (A) > 1
- (B) $< 1 > 0.5$
- (C) < 0.5
- (D) 1.0

- 58. Manipulated variable in water heater is :**
- (A) Flow rate of water (B) Temperature of outlet water
(C) Heat input (D) Inlet temperature of water
- 59. When a PI controller is used for controlling a process, the effect is :**
- (A) Large (B) Small
(C) Very very small (D) Zero
- 60. When the damping coefficient is unity, the system is :**
- (A) Over damped (B) Critically damped
(C) Under damped (D) Highly fluctuating
- 61. If the response of a control system is to be free of offset and oscillation, the most suitable controller is :**
- (A) P (B) PD
(C) PI (D) PID
- 62. In the case of absorption, if the resistance is in the gas and/or liquid film, then we require :**
- (A) Large interfacial area (B) Small interfacial area
(C) Large volume of liquid (D) Small volume of liquid
- 63. For a two phase feed, where 80% of the feed is vaporized under column conditions, the feed line slope in the McCabe-Thiele method for distillation column design is :**
- (A) $-1/4$ (B) $+1/4$
(C) $+4$ (D) -4
- 64. Hole diameters for Sieve trays are of the order of :**
- (A) 2 mm – 8 mm (B) 3 mm – 12.5 mm
(C) 5 mm – 15 mm (D) 10 mm – 25 mm
- 65. The solution of $\frac{\partial^2 z}{\partial y^2} = \sin(xy)$ is :**
- (A) $z = -x^2 \sin(xy) + y f(x) + \phi(x)$ (B) $z = -1/x^2 \sin(xy) + y f(x) + \phi(x)$
(C) $z = x^2 \sin(xy) + y f(x) + \phi(x)$ (D) $z = 1/x^2 \sin(xy) + y f(x) + \phi(x)$
- 66. For turbulent flow in a tube, the heat transfer coefficient is obtained from Dittus-Boelter correlation. If the tube diameter is halved and flow rate is doubled, then the heat transfer coefficient will change by a factor of :**
- (A) 1 (B) 1.74
(C) 6.1 (D) 37

67. The thickness of the shell as given by 'thin walled equation' is :
- (A) $Pd/2f$ (B) $Pd/4fE$
 (C) $Pd/4f$ (D) $Pd/4fE + C$
68. What is the range of BOD (mg/lit) of waste water from phenol plant ?
- (A) 1000 – 5000 (B) 100 – 1000
 (C) 50 – 100 (D) 1200 – 10000
69. Phase rule is defined as :
- (A) $P + F = C + 2$ (B) $P - F = C - 2$
 (C) $P + F = C - 2$ (D) $P - F = C + 2$
70. For a cylindrical container the minimum surface area to enclose a given volume is obtained when length to diameter ratio is :
- (A) 1.0 (B) 1.5
 (C) 2.0 (D) 3.0
71. Every equation of odd degree has :
- (A) At least one real root (B) At least two real roots
 (C) One pair of complex roots (D) No complex roots
72. Hydrochloric acid absorber is made of :
- (A) Stainless steel (B) Mild steel
 (C) Carbate (D) Monel
73. If the DOW Fire and Explosion index range is 40 – 60 then the degree of hazard is :
- (A) mild (B) heavy
 (C) moderate (D) extreme
74. Octane number is an important test for :
- (A) Lube oil (B) Diesel oil
 (C) Fuel oil (D) Gasoline
75. The fractional conversion is independent of initial concentration, the order of reaction will be :
- (A) Zero (B) 1
 (C) 2 (D) 1/2

ROUGH WORK