

Q. P. Code: 38694

Duration: 2 1/2 hrs.

Marks: 75

- N.B. 1. All questions are compulsory.
 2. Figures to the right indicate full marks.
 3. Use of log tables / non-programmable calculator is allowed.
 4. Answers to the two sections must be written in separate answer books and submitted separately

Physical constants:

$$N = 6.022 \times 10^{23}$$

$$h = 6.626 \times 10^{-34} \text{ J s}$$

$$\frac{2.303 R T}{F} = 0.05916 \text{ at } 298\text{K}$$

$$F = 96500 \text{ C}$$

$$k = 1.38 \times 10^{-23} \text{ J K}^{-1}$$

$$F$$

$$R = 8.314 \text{ J/K/mol}$$

$$c = 3 \times 10^8 \text{ m/s}$$

$$\pi = 3.142$$

SECTION-I1. Attempt **any three** of the following:

- (A) Explain the phase diagram of lead-silver system. 5
 (B) Explain the application of phase rule to water system. 5
 (C) Explain the terms binodal curve and plait point. 5
 (D) Derive the equation $\pi \cdot V = n R T$ 5
 (E) Derive the equation $\Delta T_e = K_b \cdot m$ 5
 (F) A solution containing 2 g solute in 80 g of water gave boiling point elevation of 0.2. If K_b is $0.512 \text{ K kg mol}^{-1}$, calculate the molecular weight of the solute. 5

2. Attempt **any three** of the following:

- (A) Derive an expression for emf of electrode concentration cell reversible to anion. 5
 (B) Explain the use of quinhydrone electrode for determination of pH of a solution. 5
 (C) What is liquid junction potential? How is it eliminated? 5
 (D) Explain (i) ionic strength (ii) Debye-Huckel limiting law 5
 (E) Calculate the mean activity coefficient of $0.3\text{m Na}_2\text{SO}_4$. ($A=0.509$) 5

Q. P. Code: 38694

(F) Calculate emf of the cell	Ag / AgNO ₃ AgNO ₃ / Ag	5
	m=0.01 m=0.1	
	γ =0.50 γ =0.85	

if transport number of silver is 0.46.

3. (A) State true or false 4

- (a) For ideal solution Vant Hoff's factor is 1.
- (b) ΔT_f is depression of freezing point.
- (c) Sulphur exists in four phases.
- (d) Ternary system is expressed by triangular phase diagram

OR

(A) Match the following 4

- | | |
|--------------------------|-----------------------------------|
| (p) Raoult's law | (i) Cryoscopic constant |
| (q) k_f | (ii) π |
| (r) One component system | (iii) lowering of vapour pressure |
| (s) Ternary system | (iv) Sulphur system |
| | (v) Acetone-water-phenol |

3. (B) State true or false: 4

- (a) Oxidation is loss of electrons.
- (b) $a = m \cdot \gamma$
- (c) Salt bridge contains agar-agar.
- (d) All glass electrodes do not have same E^0_G .

OR

(B) Match the following. 4

- | | |
|---------------------------|--------------------|
| (p) Galvanic cell | (i) μ |
| (q) Ionic strength | (ii) Daniel cell |
| (r) Glass electrode | (iii) pH range 1-8 |
| (s) Quinhydrone electrode | (iv) ion-selective |
| | (v) SCE |

Q. P. Code: 38694

SECTION-II

4. Attempt any three of the following:

- (A) Explain C_{2v} and $C_{\infty v}$ point groups, giving suitable examples. 5
- (B) Explain the following with a suitable example: 5
- (i) Inversion Centre
- (ii) Improper rotational axis
- (C) Identify the symmetry elements and assign the point group to BCl_3 molecule. 5
- (D) Discuss the symmetry operations and assign the point group to H_2 molecule. 5
- (E) Give the wave equations for the formation of molecular orbitals in BeH_2 molecule. (MO diagram not expected) 5
- (F) Draw a neat labelled molecular orbital diagram for H_2O molecule, showing the distribution of electrons in various energy levels. 5

5. Attempt **any three** of the following:

- (A) Define Hydration energy. Explain the hydration of cation and anion in an aqueous medium. 5
- (B) What are predominance diagrams? Explain the predominance diagrams for (a) Weakly acidic cations, (b) Strongly acidic cations. 5
- (C) Write a note on 'polyatomic anions'. 5
- (D) Explain (i) acidic, (ii) basic, (iii) amphoteric solvents with suitable examples. 5
- (E) With reference to liquid NH_3 as solvent, explain the following with balanced equations. 5
- (i) Autoionization reactions.
- (ii) Redox reactions
- (iii) Acid base reactions
- (F) Justify the following statements: 5
- (a) Solvents with high dielectric constant are better solvents for ionic compounds.
- (b) Dipole moment of acetic acid is zero.

Q. P. Code: 38694

6. Attempt the following:

(A) Select and write the appropriate answer. 4

(a) The operation that leaves the molecule unchanged is called _____.

(i) centre of symmetry (ii) identity (iii) centre of gravity

(b) The order of the rotational axis in H₂O molecule is _____.

(i) 1 (ii) 2 (iii) 3

(c) Point group assigned to NH₃ molecule is _____.

(i) C_{2v} (ii) C_{3v} (iii) C_{2h}

(d) Structure of H₃⁺ ion is _____.

(i) linear (ii) planar triangular (iii) tetrahedral

OR

(A) State whether the following statements are **true** or **false**. 4

(p) Symmetry element identity is denoted by the symbol I.

(q) Trans dichloroethylene molecule possess dihedral plane of symmetry.

(r) A group is a collection of symmetry elements which are related to one another by certain rules.

(s) Water molecule shows two bands in its photoelectron spectrum.

6.(B) Select and write the appropriate answer. 3

(a) The anions with pK_b values between _____ are weakly basic anions.

(i) -4 and 1 (ii) 1 and 6 (iii) 6 and 11.5

(b) One of the products of autoionization reaction of dinitrogen tetroxide is _____.

(i) NO⁺ (ii) NO₂ (iii) NO₃²⁻

(c) Dilute solution of metal ammonia show _____ conductivity.

(i) low (ii) high (iii) no

OR

Q. P. Code: 38694

(B) State whether the following statements are **true or false**.

3

- (p) Hydrolysis of hydrated cation renders the solution basic.
- (q) Ionising solvents are non polar in nature.
- (r) Liquid N_2O_4 is a poor solvent for ionic compounds.
