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:

$N=6.022 \times 10^{23}$ $h=6.626 \times 10^{-34}$ J s $\dfrac{2.303 \, R \, T}{F} = 0.05916$ at 298K

$F=96500$ C $k=1.38 \times 10^{-23}$ J K^{-1}

$R=8.314$ J/K/mol $c= 3 \times 10^{8}$ m/s $\pi= 3.142$

SECTION-I

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

 (A) What is condensed phase rule? Explain its application to lead-silver system.   5

 (B) Explain the application of phase rule to sulphur system.   5

 (C) Define (i) Phase (ii) Number of components (iii) Degree of freedom.   5

 (D) Derive Van't Hoff's equation for Osmotic pressure.   5

 (E) Derive the equation $\Delta T_f = K_f \cdot m$ 5

(F) A solution containing 3 g solute in 60 g of water gave boiling point elevation   5
of 0.2. If K_b is 0.512 K kg mol^{-1}, calculate the molecular weight of the solute.

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

(A) Derive an expression for emf of electrode concentration cell reversible to cation.   5

 (B) Explain the use of glass electrode for determination of pH of a solution.   5

(C) Explain the origin of liquid junction potential.   5

(D) Derive an expression for electrolyte concentration without transference reversible   5
to cation.

(E) Calculate the mean activity coefficient of 0.2m CaCl$_2$.   (A=0.509)   5

(F) The emf of the cell SCE || solution saturated with QH | Pt   5

   is 0.350 V at 298K . Calculate the pH of the solution.

3. (A) State true or false 4

(a) For NaCl Vant Hoff's factor $i > 1$

(b) ΔT_b is elevation of boiling point.

(c) In water system, at triple point F=0.

(d) Pure lead melts at 600K.

<div align="center">OR</div>

(A) Match the following 4

(p) Osmosis	(i) Ebullioscopic constant
(q) k_b	(ii) semipermeable membrane
(r) One component system	(iii) lowering of vapour pressure
(s) Ternary system	(iv) Water system
	(v) plait point

3. (B) State true or false: 4

(a) Reduction is gain of electrons.

(b) For 1:1 type of electrolyte $a = m^2 \gamma^2$

(c) Salt bridge contains KNO_3

(d) For ideal solution $a = m$

<div align="center">OR</div>

(B) Match the following. 4

(p) Lead storage cell	(i) KCl
(q) Uni-univalent electrolyte	(ii) Galvanic cell
(r) Glass electrode	(iii) $Q / H_2Q = 1$
(s) Quinhydrone electrode	(iv) colloidal solution
	(v) Gas electrode

SECTION-II

4. Attempt any three of the following:

(A) Explain C_{3v} and $C_{\infty v}$ point groups with a suitable example for each.   5

(B) Explain, giving a suitable example, the $D_{\infty h}$ point group.   5

(C) Explain the following symmetry elements with a suitable example for each: 5

   (i) Identity

   (ii) Centre of symmetry

(D) Discuss the symmetry operations and assign the point group to BCl_3 molecule.   5

(E) Draw a neat labelled molecular orbital diagram for BeH_2 molecule, showing the distribution of electrons in various energy levels.   5

(F) Give the wave equations for the formation of molecular orbitals in trihydrogen ion and draw a neat labelled molecular orbital diagram for triangular H_3^+ ion.   5

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

(A) Explain the hydrolysis reactions of Cr^{3+} ion using predominance diagrams   5

(B) Explain the process of hydration of monoatomic cation. How does it render acidity to aqueous solution?   5

(C) Discuss the classification of oxoanions.   5

(D) What are ionizing and non-ionizing solvents? Explain with suitable examples   5

(E) With reference to liquid N_2O_4 as solvent, explain the following with balanced equations.   5

   (i) Autoionization reactions.

   (ii) Redox reactions

   (iii) Acid base reactions

(F) Write a note on `metal ammonia solutions'   5

OR

(B) State whether the following statements are **true or false**.   3

   (p) Using Latimer's equation, hydration energy of cations can be calculated.

   (q) The basicity of oxoanions increases with increasing number of oxo groups.

   (r) CH_3COOH in liquid NH_3 acts as a weak acid.

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