

CSM : 14

CHEMISTRY

PAPER - I

Time Allowed : 3 hours

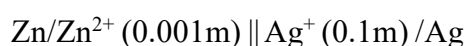
Full Marks : 100

Marks for each question is indicated against it.

Attempt any 5 (five) questions taking not more than 3 (three) questions from each Part.

PART A

1. (a) Derive Bragg's equation for the diffraction of X-rays by crystal lattice. (5)
(b) Draw and explain the phase diagram for sulfur system and mention its salient features. (5)
(c) What is radius ratio? How does Coordination number vary with the radius ratio? (1+4=5)
(d) Iron (II) oxide, FeO, crystal has a cubic structure and each edge of the unit cell is 5.0 Å. Considering the density of the oxide as 4.0 gcm⁻³, calculate the number of Fe²⁺ and O²⁻ ions present in each unit cell. (5)
2. (a) Discuss in details Maxwell's distribution of molecular velocities. (6)
(b) Calculate the root mean square velocity of nitrogen at 27°C and 70cm pressure. Density of Hg = 13.6 gcm⁻³. (4)
(c) How does free energy change with temperature and pressure? (5)
(d) What is Joule-Thomson Effect? Show that Joule-Thomson coefficient is zero in an ideal gas while it has a positive value in the case of a real gas. (1+4=5)
3. (a) Differentiate between physical and chemical adsorption, giving suitable example. (4)
(b) Derive the equation for Langmuir adsorption isotherm. (5)
(c) What are concentration cells? Derive an expression for e.m.f. of a concentration cell without transference. (1+5=6)
(d) Mention the advantages of hydrogen-oxygen fuel cells. (2)
(e) Calculate the e.m.f. of the cell : (3)



$$\text{Given : } E_{\text{Zn}^{2+}/\text{Zn}}^0 = -0.76 \text{ v and } E_{\text{Ag}^+/\text{Ag}}^0 = 0.80 \text{ v}$$

4. (a) Discuss the kinetics of consecutive reaction, taking a suitable example. (4)
- (b) What is a first order reaction? Derive an expression for the rate constant of a first order reaction. (1+4=5)
- (c) Discuss the kinetics of photochemical decomposition of HI. (6)
- (d) The decomposition of an aqueous solution of ammonium nitrite was studied by placing the apparatus in a thermostat maintained at particular temperature. The volume of nitrogen gas collected at different intervals of time was as follows:
- | | | | | | |
|--------------------------------|------|------|-------|-------|----------|
| Time (Minutes): | 10 | 15 | 20 | 25 | ∞ |
| Volume of N ₂ (mL): | 6.25 | 9.00 | 11.40 | 13.65 | 35.05 |
- From the above data prove that the reaction is of the first order. (5)

PART B

5. (a) What are the main conditions which ψ must satisfy to give meaningful solutions of Schrodinger wave equation? (5)
- (b) Discuss neutron-proton ratio and its relation to nuclear stability. (5)
- (c) Explain the variation of electron affinity in a group and along the period of p-block elements. (4)
- (d) What is meant by tracer technique? Write two applications of this technique. (1+2=3)
- (e) Calculate the de Broglie wavelength of an electron moving with a velocity of $6 \times 10^5 \text{ ms}^{-1}$ (mass of electron = $9.1 \times 10^{-31} \text{ kg}$, $h = 6.62 \times 10^{-34} \text{ Js}$). (3)
6. (a) Explain the hybridization and structure of SF₄ molecule. (3)
- (b) Draw molecular orbital energy level diagram of oxygen molecule and comment on the bond order and magnetic properties of O₂ and O₂⁺ ion. (3+2=5)
- (c) Write the effect of hydrogen bonding on the physical properties of the compounds containing hydrogen bonds citing suitable example. (4)
- (d) Explain the structural aspects of haemoglobin. (5)
- (e) Discuss the role of alkaline earth metals in biological systems with special reference to Ca²⁺ ions. (3)

7. (a) What is inert pair effect? How does it affect the oxidation states of p-block elements? (1+4=5)
- (b) Explain giving appropriate reasons: (3×2=6)
- (i) BCl_3 exists as a monomer whereas AlCl_3 is dimerised.
 - (ii) LiCl is more covalent in nature than the other alkali metal chloride.
 - (iii) Cu(I) is colourless but Cu(II) is deep blue in colour.
- (c) Why do transition metals form complexes? (4)
- (d) Compare the oxidation states of 4d transition elements with their 3d analogues. (5)
8. (a) What do you mean by number average molecular weight of polymers? Describe osmotic pressure method used to determine the molecular weight of polymers. (2+4=6)
- (b) Give reasons why the separation of Lanthanides is difficult. (4)
- (c) Discuss the oxidizing properties of KMnO_4 in acidic and alkaline medium. (4)
- (d) How will you prepare linear silicones? Mention the advantages of silicone rubbers. (4+2=6)

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