

Q.P. Code : 75257

(3 Hours)

[Total Marks : 100

- N.B. :** (1) All questions are compulsory.
(2) Figures to the right indicate full marks.
(3) Use of log table/non programmable calculator is allowed.
(4) Answer to the two sections must be written in separate answer books.

1. Physical constants :-

$$N_A = 6.023 \times 10^{23} \text{ mol}^{-1}$$

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

$$R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$$

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

$$c = 3 \times 10^8 \text{ ms}^{-1}$$

$$1 \text{ a.m.u.} = 1.66 \times 10^{-27} \text{ kg}$$

$$\frac{2.303 RT}{F} = 0.0592 \text{ at } 298 \text{ K}$$

SECTION - I

1. (a) Define the term molal depression constant. A solution containing 0.50 g of urea in 22.5g of water gave a boiling point elevation of 0.17K. Calculate the molal elevation constant of water. (Given : Mol.wt.of urea = 60). 5

OR

- (a) Adsorption of certain gas forms a complete monolayer on nickel adsorbent. The volume of gas adsorbed reduced to S.T.P. conditions was found to be 130 cm³ per gram of adsorbent nickel. Calculate the surface area of nickel if the area occupied by each gas molecule is $14.50 \times 10^{-20} \text{ m}^2$. 5

Attempt any three of the following :-

- (b) Explain the term osmotic pressure. Derive the van't Hoff equation, $\Pi = CRT$ 5
(c) Describe the application of the phase rule to water system with a neat labelled phase diagram. 5
(d) Explain in brief the origin of charge on colloidal particles. 5
(e) State the postulates of Langmuir adsorption isotherm. 5
2. (a) Calculate the ionic strength of the solution containingly 0.01M ZnCl₂ and 0.2M FeCl₃ 5

OR

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- (a) The frequency separation of successive lines in the rotational spectrum of HCl is $2 \times 10^3 \text{ m}^{-1}$. Calculate the rotational constant and bond length. [Atomic weight : H = 1 a.m.u. , Cl = 35 a.m.u.] 5

Attempt any three of the following :-

- (b) Describe the method of determination of the solubility product of a sparingly soluble salt by using a chemical cell. 5
- (c) What is isotopic shift ? How will you determine isotopic shift for the vibration-rotation spectrum. 5
- (d) Derive an expression for e.m.f. of an electrolyte concentration cell without transference reversible to cations. 5
- (e) Explain the rule of mutual exclusion of IR and Raman spectra using a suitable example. 5
3. (a) Explain Dorn effect. 3

OR

- (a) What is catalyst support ? Explain with suitable examples. 3
- (b) Calculate the degree of freedom of three component system having number of phases equal to one and two respectively. 2
- (c) Give the representation of a glass electrode. Why is it called ion-selective electrode. 3
- (d) Explain the term force constant. 2

OR

- (d) Give an example of electrode concentration cell without transference reversible to anions. 2

SECTION - II

4. Answer the following :-

- (a) Explain with a suitable diagram formation of tetrahedral voids. 3
- OR
- (a) Explain P-type of semiconductor on the basis of band theory. 3
- (b) Explain the term Identity. 3
- (c) Give any two applications of Uranium. 2
- (d) What are inner transition elements ? 2
- OR
- (d) Explain any one method of producing plutonium in nuclear reactors. 2

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5. (a) Show that the Atomic Packing Factor (A.P.F) for the face centered cubic structure is $\frac{\sqrt{2}\pi}{6}$ or 74% . 5

OR

- (a) Explain the terms :-
(i) Crystal lattice 2
(ii) Centre of symmetry with a suitable examples. 3

Answer any three of the following :-

- (b) Explain the point group along with symmetry element for BCl_3 molecule. 5
(c) Draw a neat labelled molecule orbital diagram for methane molecule showing distribution of electrons in various energy levels predicting its magnetic behaviour. 5
(d) Discuss the structure of sodium chloride with a suitable diagram. 5
(e) What are superconductors ? Give any three applications of superconductors. 5
6. (a) Discuss the principle involved in ion-exchange method for separation of lanthanides. 5

OR

- (a) How are monoatomic anions classified on the basis of their basicity ? Draw predominance diagrams for nonbasic anions and moderately basic anions. 5

Answer any three of the following :-

- (b) On the basis of electronic configuration of lanthanides, explain their variable oxidation states. 5
(c) With reference to dinitrogen tetroxide as non-aqueous solvent explain :- 5
(i) Acid - base reactions
(ii) Redox reactions.
(d) (i) Explain why yttrium has properties similar to lanthanides. 2
(ii) What are acidic, basic and amphoteric solvents? Give suitable examples. 3
(e) Discuss Drago-Wayland concept to measure reactivity of acids and bases. 5
