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Unique Paper Code:         32171101_OC

Name of the Paper:        Inorganic Chemistry I

Name of the Course:      B.Sc. (Hons) Chemistry

Semester:                        I

Duration:                        3 hours                                    Maximum Marks:  75

Instructions for Candidates:

Attempt any four QUESTIONS in all.

All Questions carry equal marks

The questions should be numbered in accordance with the number in the question paper.

Calculators and log tables may be used.

1. a) What do you mean by quantum numbers? Name different types of quantum numbers and their significance.
b) Give Allred and Rochow's scale of electronegativity. Calculate the electronegativity of silicon atom using this scale. The covalent radius of Si atom is 1.175 Å.
c) State the Pauli Exclusion Principle. How can this principle be used to fix the maximum capacity of the various energy levels in an atom?
d) Explain the trends in variation of valency in groups and periods of s and p block of elements.
e) Explain why the melting point of NaCl is higher than that of AlCl3?
(5,4,4,3,2.75)

2. a) What are Slater rules? Using Slater's Rules calculate Z* for the following elements:

i) 4s electron in Ca
ii) 4s electron in Sc
iii) 3d electron in Sc

b) Which sets of quantum numbers are not possible and why?

i) n = 5, l=4 m=0, ms = ½
ii) n =3, l=0, m =-1, ms = -1/2
iii) n=3, l=1, m =2, ms = ½
iv) n =2, l =2, m =0, ms =1/2
c) What is radius ratio? How can it help to predict the structure of an ionic compound? What are its limitations?
 d) What do you understand by equivalent and non-equivalent hybrid orbitals? Give one example of each.
e) What is Hund's rule of maximum multiplicity?
(5,4,4,3,2.75)

3. a) Derive the Schrodinger wave equation for H-atom starting with simple sine wave equation. Explain all the term associated with it.
b) Draw the MO energy level diagram for N+2. Discuss its bond order and magnetic

behaviour. Why is the bond order in N+2 less than in N2, molecule?
c) Using Pauling's method, calculate the radii of Na+ and F- ions. The observed internuclear distance in NaF crystal is 213 pm.
d) Define electronegativity. How the electronegativity (varies with s-character in different hybridisation of organic compounds?
e) Explain why properties of lithium resembles with those of magnesium?

(5,4,4,3,2.75)

4. a) Derive Born-Lande equation for lattice energy.
b) What is radial node? Calculate the number of radial nodes for 3s, 2p, 4d, and 5f orbitals.
c) What are isoelectronic ions? How effective nuclear charge affects the radii of isoelectronic ions: N3-, O2-, F-, Na+, Mg2+?
d) Give trends in melting point and hardness for the
i) LiCl and SrO and
ii) NaCl and BaO
e) Differentiate between Frankel and Schotkey defects.
(5,4,4,3,2.75)

5. a) Explain the terms polarization, polarizing power and polarizability. State giving reason, which cation will have greater polarizing power in the following:
i) Na+ or Mg2+
ii) Pb2+ or Pb4+

b) Calculate the value of Madelung constant A for MgO with given data r0 = 2.10 Å, n =7, N= 6.02 X 10 23 , U= -39-100 40 KJ/mole, e = 4.8 X 10 esu.

c) Both, NH a33nd H2O molecules are formed by SP hybridization but the bond angles are different. Explain on the basis of VSEPR theory.
d) Explain why:
i) Density of ice is less than that of water.
ii) o-nitrophenol is less soluble in water than p-nitrophenol
e) Which of the elements Na, Mg, Si & P will have the greatest difference between the first and second ionisation enthalpy? Explain.
(5,4,4,3,2.75)

6. a) Write a note on Band theory of metallic bonding.

b) The internuclear distance in HI is 1.62 Å. Assuming complete transfer of electron from H to I, calculate dipole moment of HI. If the measured dipole moment is 0.38 D, calculate the % ionic character of HI. Given e = electronic charge = 4.8 X 1010 e.s.u.
c) Give the shape and hybridization of following molecules or ions:
i) PCl3
ii) ICl-2
iii)ClF3
iv)PCl-6
d) Explain why orbitals like 1p, 2d and 3f are not possible?
e) Write a note on Bent's Rule.
(5,4,4,3,2.75)

Unique Paper Code : 32175915_OC

Name of the Paper : GE-3: Solutions, Phase Equilibrium, conductance,
Electrochemistry and Functional Group Organic Chemistry-II

Name of Course : B. Sc. (Hons.)

Semester : I / III

Duration : 3 hours

Maximum Marks : 75

Instructions for Candidates:

⬜ Use separate answer sheets for Section – A and Section – B and upload separately.
⬜ Both sections carry equal marks.
⬜ Attempt four questions in all, two questions from each section.
⬜ Each question carry 18.75 marks.

## Section A: Physical Chemistry
### (Attempt any two questions)

Q. 1

a) State Nernst distribution law. Give conditions under which it is valid. Also write its application.

b) What are azeotropes? Give its example. Is it possible to separate the components of an azeotropic mixture by simple distillation? Explain

c) Define congruent point. Justify the statement that it is an invariant point. Draw and discuss a well-labelled phase diagram of FeCl3-H2O system.

d) Define critical solution temperature (CST). Give degree of freedom at CST and under the curve. Explain the effect of addition of sodium chloride and succinic acid on CST of water-phenol system with well labelled diagram.

(3.75, 3, 6, 6)

Q. 2

a) State and explain Kohlrausch's law of independent migration of ions. Also, explain the variation of specific conductance, molar and equivalent conductance at infinite dilution of weak and strong electrolytes with suitable graph.

b) Give the principle of potentiometric titration. Also give the advantages of potentiometric titration over volumetric titrations using indicators. Why do we prefer potentiometer for the measurement of EMF of a cell over voltmeter?

c) Transport number of Na+ is 0.463 (dilute solution of NaCl in methanol). Calculate transport number for H+ (dilute solution of HCl in methanol) if Λ∞ for (NaCl in methanol) is 96.9 ohm-1cm2mol-1 and Λ∞ for (HCl in methanol) is 192 ohm-1cm2mol-1 respectively.

d) 100 g each of ethanol and methanol are mixed at 20°C to prepare an ideal binary mixture.

The vapour pressure of pure methanol is 88.7 mm Hg and that of pure ethanol is 44.5 mm Hg at 20°C. Calculate (i) total vapour pressure of the solution, (ii) partial vapour pressures of ethanol and methanol and composition of the vapour phase.
(6, 6, 3, 3.75)

Q. 3

a) Write the thermodynamic criteria of phase equilibrium of a system and also drive the mathematical expression of Gibbs phase rule at constant pressure for a reactive and non-reactive system.

b) Differentiate between reversible and irreversible electrochemical cells giving examples.

c) An electrochemical cell consist of two half-cell reaction as

$$AgCl(s) + e^- \longrightarrow Ag(s) + Cl^-(aq)$$
$$Cu(s) \longrightarrow Cu^{2+} + Cl^-$$
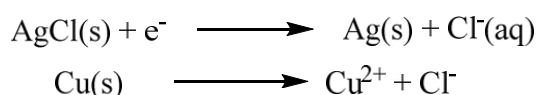
Calculate the mass of copper deposited on passing 0.5A current for 1 hour.

d) What is salt bridge? Write its functions emphasizing on its role in eliminating the liquid junction potential in an electrochemical cell.

e) Derive the expression to determine the pH value of an unknown solution by using hydrogen electrode with well labelled diagram.
(5, 2, 3, 3.75, 5)

## Section B: Organic Chemistry
(Attempt any two questions)

Q.4

a) How can a mixture of arginine and aspartic acid be separated by electrophoresis using a buffer solution having a pH=6.0?
b) Outline the chemistry of Hinsberg test?

c) How ethylacetoacetate is synthesized using Claisen condensation? Give the mechanism.

d) Write short note on the following:
i) Secondary structures of proteins
ii) Hell-Volhard-Zelinsky reaction.

e) Explain why D-fructose reduces Fehling's solution although it is a ketohexose.

(3, 3, 3, 5, 4.75)

Q.5

a) Give a detailed account of Hofmann elimination and compare it with Satyzeff Elimination.

b) What is mutarotation? Give its mechanism using α-D-glucopyranose as an example.

c) Giving reasons, arrange the following in order of their increasing basicity: o-nitroaniline, m-nitroaniline and p-nitroaniline.

d) Convert:
i. Phenylacetic acid to Benzylamine
ii. Aniline to p-bromoaniline

e) Explain Edman degradation method for the determination of N-terminal amino acid of peptide.

f) How do maltose and cellobiose differ in their structures?

(3, 3, 3, 4, 3.75, 2)

Q. 6

a) Synthesize dipeptide ala-val by using t-BOC &DCC. Give the name and structure of protecting and activating groups.

b) Complete the following reaction and predict the structure of compounds A,B,C,D

i) C6H5CHO + (CH3CO)2O→ A+B

ii) BrCH2COOC2H5 + CH3COCH3 — C

iii) C6H5NH2+ C6H5COCl —— D

c) Discuss the basicity order of the following and arrange them in order of increasing basic strength.
C6H5NH2, C6H5NHCH3, CH3NH2, CH3CH2NH2

d) How will you convert D-arabinose to D-glucose and D-mannose.

e) Give suitable explanation, arrange the following in increasing order of their reactivity with phenol: Acetyl Chloride, Acetamide, Methyl acetate

(4.75, 4, 4, 3, 3)

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