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M.SC DEGREE EXAMINATION, Model QP

Chemistry - First Semester

Inorganic Chemistry-I

Time : Three hours **Maximum : 70 marks**

Answer ALL Questions.

Unit-I

1) a) How does VSEPR theory explain the structures of NH_3 and PCl_5? [4]

or

b) What are non-valence cohesive forces? Explain with examples.

2) a) Explain molecular orbital theory for triatomic molecules using BeH_2 and NO_2^- as examples. [10]

or

b) Discuss the role of d-orbitals in bonding in both transition and non-transition metal compounds.

Unit-II

3) a) Distinguish between static and dynamic Jahn-Teller effects. [4]

or

b) What is the nephelauxetic effect? Why is it important?

4) a) Compare high-spin and low-spin complexes of d^6 and d^7 ions. Calculate their CFSE values. [10]

or

b) Discuss the applications and limitations of Crystal Field Theory in explaining properties of transition metal complexes.

Unit-III

5) a) How does MOT explain π-bonding in metal complexes? [4]

or

b) Explain resonance in homoatomic and heteroatomic molecules.

6) a) Discuss experimental evidence for both σ and π bonding in transition metal complexes. [10]

or

b) Compare MOT with Crystal Field Theory. What advantages does MOT offer?

Unit-IV

7) a) What is the Irving-Williams series? Explain its significance. [4]

or

b) How does electronegativity relate to the HSAB principle?

8) a) Describe Bjerrum's method for determining formation constants. Compare it with Job's method. [10]

or

b) Explain the structure and metal-binding properties of macrocyclic ligands. How do they achieve selectivity?

Unit-V

9) a) Explain polyhedral skeletal electron pair theory for borane structures. [4]

or

b) Describe the preparation and structure of any two heteropolyanions.

10) a) Discuss the preparation, structures, and applications of boron-nitrogen ring compounds. [10]

or

b) Compare and contrast the structures of phosphorus-oxygen and phosphorus-sulfur cage compounds.

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M.SC DEGREE EXAMINATION, Model QP

Chemistry - First Semester

Organic Chemistry-I

Time : Three hours **Maximum : 70 marks**

Answer ALL Questions.

Unit-I

1) a) Explain aromaticity in fulvenes and azulenes. [4]

or

b) Describe the structure and aromatic character of cyclooctatetraenyl dianion.

2) a) Elaborate on the concept of aromaticity in benzenoid and non-benzenoid compounds with suitable examples and explain their stability. [10]

or

b) Discuss the aromatic character of cyclopentadienyl anion and fullerenes. Explain their structural features and stability.

Unit-II

3) a) Describe the synthesis and properties of pyrazole and imidazole. [4]

or

b) Explain the structure and medicinal importance of β-carotene.

4) a) Discuss the synthesis, properties, and reactions of quinoline, and isoquinoline. Explain their applications. [10]

or

b) Elaborate on the general methods of structure determination of terpenes. Discuss the synthesis and structure of α-terpeniol.

Unit-III

5) a) Explain E-Z nomenclature with examples. [4]

or

b) Describe the stereochemistry of compounds containing nitrogen and sulfur.

6) a) Discuss dissymmetric and asymmetric molecules. Explain the stereochemistry of compounds with more than one chiral center. [10]

or

b) Elaborate on the spectral and chemical methods for determining the configuration of geometrical isomers. Provide suitable examples.

Unit-IV

7) a) Explain attractive and repulsive interactions in conformational equilibrium. [4]

or

b) Describe the conformational effects on reactivity of diastereomers in cyclic molecules.

8) a) Discuss the steric and stereoelectronic factors affecting conformational stability. Explain with examples. [10]

or

b) Elaborate on the conformational analysis of butane, and ethylene glycol. Explain their energy profiles.

Unit-V

9) a) Explain the conformations of propylene and 1-butene. [4]

or

b) Describe the steric strain due to unavoidable crowding with examples.

10) a) Discuss the boat and twist boat conformations of cyclohexane. Compare their stability with the chair conformation. [10]

or

b) Elaborate on the conformational analysis of sugars. Explain its importance in understanding their biological properties.

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M.SC DEGREE EXAMINATION, Model QP

Chemistry - First Semester

Foundation for Chemistry

Time : Three hours **Maximum : 70 marks**

Answer ALL Questions.

Unit-I

1) a) Describe the principle of precipitation titrations with an example. [4]

or

b) What are the characteristics of an ideal indicator in titrimetric analysis?

2) a) Explain the types of complexometric titrations with special reference to EDTA titrations. Discuss their applications in analytical chemistry. [10]

or

b) Compare and contrast different types of titrimetric methods (acid-base and precipitation). Discuss their principles, advantages, and limitations.

Unit-II

3) a) Explain the F-test and its application in comparing the precision of two methods. [4]

or

b) Describe the measures of central tendency in analytical data.

4) a) Elaborate on statistical methods used for validation of analytical data. Discuss standard deviation, relative standard deviation, and confidence intervals. [10]

or

b) Explain the concept of significance testing in analytical chemistry. Discuss the applications of Student's t-test and F-test with numerical examples.

Unit-III

5) a) Compare the structure and reactivity of carbenes and benzyne. [4]

or

b) Explain the concept of cross-conjugation with examples.

6) a) Discuss free radicals and their involvement in organic reactions. Explain their generation, stability, and reactivity with suitable examples. [10]

or

b) Explain the role of electrophiles and nucleophiles in organic reactions. Give examples of different types of catalysts and describe their mechanisms of action.

Unit-IV

7) a) Explain the relationship between the order of a finite group and its subgroup. [4]

or

b) What are character tables and how are they used in group theory?

8) a) Elaborate on the symmetry elements and symmetry operations. Classify molecules according to their point groups with examples. [10]

or

b) Discuss the mathematical basis of group theory and explain how character tables are constructed. Illustrate with examples how they are applied to molecular problems.

Unit-V

9) a) Classify environmental segments with examples. [4]

or

b) Explain the chemistry of purines and pyrimidines.

10) a) Discuss the different types of environmental pollution. Elaborate on their sources, effects, and control measures. [10]

or

b) Describe the structure, classification, and functions of enzymes. Explain how their structure relates to their catalytic activity with suitable examples.

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M.SC DEGREE EXAMINATION, Model QP

Chemistry - First Semester

Physical Chemistry-I

Time : Three hours **Maximum : 70 marks**

Answer ALL Questions.

Unit-I

1) a) Define free energy functions and explain the Gibbs-Helmholtz equation. [4]

or

b) Explain the concept of partial molar quantities and the Gibbs-Duhem equation.

2) a) Discuss the entropy changes in reversible and irreversible processes. Explain entropy of mixing of ideal gases and the relationship between entropy and disorder. [10]

or

b) Derive Van't Hoff reaction isotherm and explain how it relates to free energy changes in chemical reactions. Discuss the thermodynamic derivation of Raoult's law.

Unit-II

3) a) Explain the Young-Laplace equation and its significance in understanding pressure differences across curved surfaces. [4]

or

b) Describe the principles of X-ray fluorescence spectroscopy and its applications.

4) a) Derive the Kelvin equation and explain its importance in understanding the vapor pressure of small droplets. Discuss capillary action in relation to surface tension. [10]

or

b) Explain the BET equation and how it is used for estimation of surface area. Discuss the catalytic activity of surfaces.

Unit-III

5) a) Define critical micelle concentration (CMC) and explain the factors affecting the CMC of surfactants. [4]

or

b) Differentiate between microemulsions and reverse micelles.

6) a) Classify surface active agents and explain the process of micellization in detail. [10]

or

b) Describe hydrophobic interactions and their role in the formation and stability of micelles.

Unit-IV

7) a) Explain liquid junction potential and methods for its determination. [4]

or

b) Write about concentration cells with and without transference.

8) a) Derive the Nernst equation and explain how equilibrium constants and pH can be determined from EMF data. [10]

or

b) Describe the Debye-Hückel-Onsagar equation, its verification, and limitations. Explain the anomalous behavior of strong electrolytes.

Unit-V

9) a) Explain the steric factor in collision theory and its significance. [4]

or

b) Describe the primary and secondary salt effects in reactions in solutions.

10) a) Discuss the Lindemann mechanism for unimolecular reactions and the Lindemann-Hinshelwood theory. [10]

or

b) Explain chain reactions with reference to the rate laws of H_2-Br_2 reaction and the Rice-Herzfeld mechanism for the decomposition of acetaldehyde.