

QUESTION BANK

B.Sc III Year CHEMISTRY - 5

SEMESTER- V

Unit-I Inorganic Chemistry**Chap-1- COORDINATION COMPOUNDS-II****Short answer questions:**

1. Explain the magnetic behaviour of Ti^{4+} and Cu^{2+} ion on the basis of electronic configuration.?
2. Briefly explain kinetic stability of a complex compounds?
3. Give an example of bridge ligand and write its IUPAC name?
4. Distinguish between diamagnetism and paramagnetism?
5. How the magnetic properties are helpful in knowing the number of unpaired electrons in an atom of an element?
6. Cupric salts are blue coloured while cuprous salts are colourless. Why?
7. Discuss the steric effect and the backbonding effect of ligands which decide the stability of a metal complex?
8. How will you determine the composition of a complex by Job's method. Write the limitations of this method ?

Long Answer Questions:

1. What is meant by crystal field splitting ? Describe the splitting of d-orbitals in octahedral, tetrahedral and square planar field ?
2. The complexes formed by chelating ligands are more stable than their monodentate analogs. Explain with suitable examples ?

3. **a)** Give the spectra of $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$. Explain ? www.FirstRanker.com
- b)** Give Gouy's method for determining the magnetic susceptibility ?
4. Discuss the formation of coordination compounds on the basis of kinetics stability concept ?
5. What do you understand by the term stability constant ? Mention the various factors that effect the stability constant of a complex ion ?
6. **a)** What are inert and labile complexes ? Discuss kinetically inert but thermodynamically stable complexes ?
- b)** What is the difference between thermodynamically stable and kinetically inert complexes ?
7. What is meant by crystal field theory ? What are the postulates of crystal field theory ?

Chap-2- BORANES AND CARBORANES

SHORT ANSWER QUESTIONS:

1. Define the terms
 - a)** Clusture
 - b)** Boranes
 - c)** Carboranes
2. Write a short note on Wade's Rule ?
3. Give a brief account of bonding in boranes ?
4. Write the structures of
 - i)** Closo
 - ii)** Nido-carborane
 - iii)** Monocarboranes

LONG ANSWER QUESTIONS:

1. Draw and explain the structure of tetraborane (B_4H_{10}) ?

3. Explain the structure of pentaborane ?

4. Explain the following with examples.

i) Diborane

ii) Carboranes

UNIT-II ORGANIC CHEMISTRY

Chap-1- AMINES, CYANIDES AND ISOCYANIDES

SHORT ANSWER QUESTIONS:

1. Write the classification of amines with examples. Give two examples of diamines ?

2. Explain Gabriel Phthalimide reaction ?

3. Give the nucleophilic substitution reactions of nitrobenzene ?

4. Write a note on the basic character of amines ?

5. How aniline reacts with :

i) Picric acid

ii) Acetyl chloride

iii) Chloroform and OH

6. Give the mechanism of the nitration of Benzene ?

7. Write reactions to distinguish between primary, secondary and tertiary amines ?

8. Write a note on Hofmann elimination ?

9. Write the mechanism of Hofmann bromamide reaction ?

10. Write the methods for the preparation of each of the following :

a) Methyl Cyanide

b) Methyl Isocyanide

11. Write a note on Carbylamine reaction ?

1. What is ortho effect ? How does it effect the basicity of aromatic amines?
2. Compare the behaviour of aniline, N-methyl aniline and NN-Dimethylaniline
towards each of the following :
 - i) Dil.HCl
 - ii) $\text{NaNO}_2 + \text{HCl}$
 - iii) Acetic anhydride
3. Write the mechanism and the reagents needed in the preparation of the following :
 - i) Aniline from Benzamide
 - ii) Isobutylene from isobutylamine
4.
 - a) Explain the preparation of Benzene diazonium chloride ?
 - b) Describe the synthetic uses of benzene diazonium chloride ?
5. Write down the chemical equations for the reduction of nitrobenzene with the following reducing agents.
 - i) $\text{Sn} + \text{HCl}$
 - ii) $\text{Zn} + \text{NaOH}$
 - iii) $\text{Zn} - \text{NH}_4\text{Cl}$
6. Explain the following :
 - a) Amine salts as phase transfer catalysts.
 - b) Libermann's nitroso reaction.
 - c) Separation of a mixture of primary, secondary and tertiary amines.
7.
 - a) Amines are more basic than alcohols. Explain ?
 - b) Write the properties and uses of methyl isocyanide ?
8.
 - a) Explain the mechanism of Diazotisation ?
 - b) Aliphatic amines are more basic than ammonia. Explain ?

c) Describe the synthetic applications of Aryl diazonium salts ?

9. Write a detailed note on cope rearrangement ?

a) Give an example to illustrate cope elimination ?

b) Write structural formula and reaction condition for the following conversions. i) m-chlorobromo benzene from m-chloroaniline

ii) Bromo benzene from chloro aniline.

10. How are primary aromatic amino compounds prepared ? Starting from aniline , how would you obtain the following compounds ?

i) Sulphanilic acid

ii) p-Nitroaniline

Chap-2- HETEROCYCLIC COMPOUNDS

SHORT ANSWER QUESTIONS:

1. Define heterocyclic compounds and give their classification ?
2. How do you prepare pyrrole by Paul-norr synthesis ?
3. Give the brief description of pyridine ?
4. Briefly explain the aromaticity of Furan, Thiophene and Pyrrole ?
5. Explain why thiophene is less reactive than pyrrole and furan for electrophilic substitution reactions ?
6. Give one method of preparation of each of Furan, Thiophene and pyrrole?
7. Explain, an energy level diagram about the electrophilic substitution of thiophene and pyrrole ?

LONG ANSWER QUESTIONS:

1. Give any two methods for the synthesis of pyridine ?
2. Explain the following reactions :

i) Pyrrole + $\text{CHCl}_3/\text{NaOH}$ ----->

ii) Thiophene + $3\text{H}_2 + \text{Ni}$ (heat) ----->

3. Using qualitative test tube experiments, how can the following be distinguished.

i) Benzene from pyrrole

ii) Furan from thiophene

4. a) Elucidate the structure of Furan.

b) How furan reacts with

i) Pyridine-Sulphur trioxide

ii) HCl - HCN

iii) Maleic anhydride
nicel

iv) Hydrogen in presence of

5. Give explanations for the following observations :

i) Furan shows a great deal of dienyl character inspite of its aromatic nature

ii) Pyrrole is a weak acid rather than a strong base

iii) Thiophene is more reactive than benzene towards electrophilic aromatic substitutions.

6. a) Give three methods for the synthesis of pyrrole and write its reactivity.

b) Give two addition reactions in pyrrole.

c) Electrophilic substitution in pyrrole, furan and thiophene occurs preferentially at 2nd position.

7. Give the valence bond description of furan, thiophene and pyrrole ?

8. By writing the resonating structures, locate the reactive position in thiophene for electrophilic attack ?

UNIT-III PHYSICAL CHEMISTRY

Chap-1- CHEMICAL KINETICS

SHORT ANSWER QUESTIONS:

1. Define rate of reaction. How will you differentiate between the reaction rate and rate constant ?
2. Give two methods for determining the order of reaction ?
3. How does the collision theory of reaction rates explain the effect of temperature on the rate constant ? Explain.
4. Draw well labelled energy level diagram for
 - i) An exothermic reaction
 - ii) An endothermic reaction
5. Discuss the Arrhenius equation for temperature dependence of reaction rates. Show how it is possible to obtain the value of activation energy of a reaction ?

LONG ANSWER QUESTIONS:

1. What is second order reaction ? Deduce an equation giving the velocity constant of a second order reaction. What are the characteristics of a second order reaction ?
2. Write a detailed note on activation energy of a reaction ?
3. **a)** Write the points of difference between order of reaction and molecularity.
b) How will you proceed to calculate the order as well as the molecularity of a complex reaction ? Explain by taking an examples ?
4. Derive an expression for the kinetics of the first order reaction ?
5. Discuss the factors which influence the rate of a reaction ?
6. Describe in detail about the collision theory of reaction ?

PROBLEMS:

1. Derive $\ln \frac{a}{a-x} = \frac{k}{2.303} t$. Explain what is meant by energy of activation.

A first order reaction is 40% complete in 50 minutes. What is the value of the rate constant in sec^{-1} ?

2. Briefly explain the theories of reaction rates. The rate constants of a first order reaction at 298 and 318 are $1.25 \times 10^{-4} \text{ sec}^{-1}$ and $8.5 \times 10^{-5} \text{ sec}^{-1}$ respectively. Calculate the activation energy of the reaction ?

3. A second order reaction in which the initial concentration of both reactants

are same is 25% complete in 600 seconds. How long will it take for the reaction to 75% completion ?

4. Calculate the activation energy of a reaction whose rate constant is tripled

by a 10°C rise in temperature ?

5. In the thermal decomposition of malonic acid

$\text{CH}_2(\text{COOH})_2 \longrightarrow \text{CH}_3\text{COOH} + \text{CO}_2$, the pressure at different time intervals are :

t (min.)	10	20	35	56	---
p (mm)	37	67	108	155	303

What is the order of the reaction ?

UNIT-IV GENERAL CHEMISTRY

Chap-1- MOLECULAR SPECTROSCOPY

SHORT ANSWER QUESTIONS:

1. What do you mean by absorption of radiation in the spectrum or a record ?
2. Why is methanol a good solvent for UV and not for IR ?
3. Give a brief account of stretching and bending vibrations which occur in a compound when exposed to infrared radiations ?
4. Define the term Spectroscopy ? How will you determine the bond length of a diatomic molecule by Rotational spectroscopy ?

5. What do you mean by electromagnetic spectra ? Enlist the different types of radiations along with frequency ranges and sources ?
6. Define electronic spectroscopy. What is its range ? Write the relationship between wavelength, frequency and wave number ?
7. Describe the effect of inter-molecular and intra-molecular hydrogen bonding on the position of absorption frequency of a compound. Give an example ?
8. Describe some characteristic absorption bands with their probable region and intensity for the following functional groups.
- a) - OH (alcoholic)
 - b) Carbonyl group
 - c) Aromatic compounds
9. a) Explain the term probability.
- b) Write the physical significance of molar extinction coefficient.
10. Explain the selection rules for Electronic spectra ?
11. Write the characteristic stretching absorption bands of ethanol and p-amines ?
12. Explain the Chromophore and Auxochrome concept ?

LONG ANSWER QUESTIONS:

1. Define infra-red spectroscopy ? Describe the various molecular vibrations in the technique. What is the major requirement for infra-red absorption ?
2. a) Define and explain the laws governing the absorption of light , i.e. Beer's law and Lambert's law.
- b) Describe the limitations of Beer-Lambert law.
3. Give the characteristic absorption of aldehydes and aliphatic amines by taking one example in each case ?
4. Write a note on the modes of vibrations in diatomic and polyatomic

5. Explain the following by taking examples in each case.
- i) Absorption and intensity shifts.
 - ii) Solvent effects.
 - iii) Bonding and antibonding molecular orbitals.
6. a) What are absorption law ? How is an ultraviolet spectrum plotted ?
- b) Explain quantisation of energy ?
7. Explain the chemistry of electronic spectroscopy ? Give the various types of transitions involved in this technique with one example in each case ?
8. a) Write the types of spectrometers. Describe double beam spectrophotometer in brief.
- b) Describe the advantages of double beam spectrophotometer.
9. Give an explanatory account of the energy levels of molecular orbitals and also write the order of increasing energies of molecular orbitals.
10. Discuss the following statements :
- i) Hydrogen bonding raises the wavelength of absorption.
 - ii) The process of -I effect raises the wave number of absorption.
 - iii) Conjugation raises the wavelength of absorption of a particular group.

Chap-2- PHOTOCHEMISTRY

SHORT ANSWER QUESTIONS:

1. Define photochemistry ? What is the difference between photochemical reactions and thermochemical reactions ?
2. a) Define Beer's law and Lambert's law ?
- b) Define and explain the term Quantum efficiency ?
3. Explain Grotthus-Draper principle of photochemical activation ?

4. Write short note on phosphorescence and fluorescence ?
5. What do you understand by primary process in photochemical process and photochemical equilibrium ?
6. Discuss the photochemistry of hydrogen-bromine reaction ?
7. Discuss the photochemistry of hydrogen-chloride reaction ?

LONG ANSWER QUESTIONS :

1. Define and explain Star-Einstein's law of photochemical equivalence ?
2. Draw a well labelled Jablonsi diagram and explain the following from it.
 - i) ISC (inter system crossing/conversion)
 - ii) IC (internal crossing/conversion)
 - iii) Radiative and non-radiative
 - iv) spin state
 - v) Phosphorescence
 - vi) Fluorescence
3. Define quantum yield. Explain abnormal quantum yields giving atleast two examples ?
4. Explain the laws of photochemistry i) Lambert's law and ii) Beer's law ?
What are its limitations ?
5. What do you understand by photosensitized reactions and photosensitization ? Explain .
6. Write notes on :
 - a) Photosynthesis
 - b) Luminescence
 - c) Chemiluminescence
7. Distinguish between the primary and secondary process in a photochemical reaction ?

8. Define quantum efficiency ? Explain experimental determination of quantum yield ?

PROBLEMS :

1. Calculate the value of einstein corresponding to radiation of wavelength $6000 \text{ \AA}$?
2. What is the absorption coefficient of a solution which absorbs 90% of a certain wavelength of light beam passed through a 1cm cell containing 0.25M solution ?
3. A sample of acetone absorbs monochromatic radiation at the rate of $4.5 \times 10^{20} \text{ quanta sec}^{-1}$. The number of moles of acetone decomposed in one second is 1.35×10^{-4} . Calculate the quantum yield of photolysis of acetone ?
4. A certain system absorbs 3×10^{16} quanta of light per second. On irradiation for 10 minutes, 0.002 mole of the reactant was found to have reacted. Calculate the quantum efficiency of the process ?