T.Y.B.SC. SEMESTER- III

CHEMISTRY PAPER – II (CH – 332 - INORGANIC CHEMISTRY)

QUESTION BANK

CHAPTER 1 – MOLECULAR ORBITAL THEORY

Q1) Answer the following 1 marks each

a) Give the bond order of H₂⁺ ion
b) Write molecular orbital electronic configuration of Li₂ molecule
c) Write the stabilization energy of Be₂ molecule
d) What is the magnetic nature of C₂ molecule?
e) What is bond order of B₂ molecule on the basis of MOT?
f) Give the symmetry symbol for s & p orbitals.
g) Give LCAO equation
h) What is the magnetic nature of H₂⁺ ion?
i) Give the symmetry symbol for dxy, dyz and dxz orbitals.
j) Write M. O. electron configuration of B₂ molecule
k) Write M. O. electron configuration of F₂ molecule
l) What is the magnetic nature of NO⁺ ion molecule?
m) Write the stabilization energy of N₂ molecule
n) Write the LCAO equation for formation of molecular orbitals
o) Draw the diagram for combination of p-p orbital for pi bond formation

Q2) Answer the following 2/3 marks each

1) Ne₂ molecule does not exist? Why? Explain with MO diagram
2) Be₂ and Ne₂ molecule does not exists. Explain on the basis of M.O.T.
3) Distinguish between BMO and ABMO
4) Draw the diagrams and Explain formation of σ and π molecular orbitals by LCAO
5) Explain the formation of $C_2$ molecule on the basis of MOT
6) Distinguish between double salt and complex salt
7) Distinguish between atomic orbital and molecular orbital
8) Write the rules for linear combination of atomic orbitals
9) Discuss the formation of $H_2$ molecule on the basis of MOT
10) Discuss the formation of $Li_2$ molecule on the basis of MOT
11) Explain the formation of $N_2$ molecule on the basis of MOT
12) Explain the formation of $B_2$ molecule on the basis of MOT
13) Explain the formation of $F_2$ molecule on the basis of MOT

Q3 Answer the following 4/5/6 marks each

1) Discuss the formation of $NO_2$ molecule on the basis of M.O.T.
2) Explain the formation of $O_2$ molecule on the basis of MOT. How bond order vary in $O^{2-}$ and $O^{2+}$ molecule?
3) Discuss the formation of $CO$ molecule on the basis of MOT
4) Discuss the formation of $NO$ & $NO^+$ ion molecule on the basis of M.O.T.
5) Discuss the formation of $CO_2$ molecule on the basis of M.O.T.
CHAPTER – 2 INTRODUCTION TO COORDINATION CHEMISTRY

Q1) Give IUPAC nomenclature of the following coordinate complexes. 5 Marks

a) \([\text{Co (NH}_3\text{)}_5 \text{Br}] \text{SO}_4\)

b) \([\text{Co (en)}_2 (\text{H}_2\text{O}) \text{Cl}] \text{Cl}_2\)

c) \([\text{Co(en)}_2 \text{Cl}_2]\text{Cl}\)

d) \([\text{Co(NH}_3\text{)}_5 \text{ONO}] \text{Cl}_2\)

e) \(\text{K}_4[\text{Fe (CN)}_6]\)

Q2) Define the following terms 5 Marks

1) Coordination Number

2) Central ion

3) Ligand

4) First coordination sphere

5) Co-ordinate bond

Q3) Discuss with suitable examples the factors which affect the stability of a Complex 5 Marks

Q4) Explain the term 'stepwise stability constant and overall stability Constants. 'How are they related? 5 Marks
CHAPTER – 3 & 4 WERNER’S THEORY & EAN RULE

Q1) Answer the following  1 Marks each

a) Determine the EAN of the metal ion in complex [Cr(H2O)6]3+ ion?
b) Calculate EAN of [FeCl6]3-.
c) Calculate the EAN of [Fe(CO)5].
d) Give disadvantages of Sedgwick’s model.
e) Calculate EAN of [Cu (NH3)2 Cl2] complex.
f) What is EAN rule?
g) Calculate EAN of [Ni(CO)4]
h) How many secondary valencies are present in K2[PtCl6].
i) How many primary valencies are present in [Cr(H2O)6] Br3?
j) What are possible geometrics for coordination number 4?

Q2) Answer the following  3 Marks each

1) State wether the following complexes obeys EAN rule or not?
   1) [Cu(en)2] SO4   2) [Pt Cl2 (NH3)2]  3) (NH4)2 [Fe Br5. H2O]
   2) Give merits and demerits of Sidgwick model.
   3) State whether following complexes obey or do not obey EAN rule.
      1) [Pt(NH3)4 Br2]Cl2  2) [Co(en)2 H2O. Cl]Cl2  3) [Ti (H2O)6]3+
   4) State whether following complexes obey or do not obey E.A.N. Rule.
      1) [Cr (CO)6]  2) Na3 [Cu (CN)4]  3) [Pt (NH3)4]4+
   5) State whether following complexes obeyes EAN Rule or not.
      a) [Fe (CO)3]  b) Na3 [Fe (CN)6]  c) Na [Ag (CN)2]
   6) State whether following complexes obeys EAN Rule or Not?
      1) K2 [Ni (CN)4]  2) [Fe (NH3)6]Cl3  3) [Cr(CO)6]

Q3) Answer the following  2 Marks each

1) State wether EAN rule is obeyed in the following Complexes
   1) [Cu(CN)4]2–  2) [V(CO)6]
   2) What are the postulates of Werner’s coordination theory?
   3) Discuss the factors affecting the stability of complexes.
   4) What do you mean by primary and secondary valency? Explain the concept with the help of suitable example.
   5) Explain first and second coordination sphere according to Werner’s theory.
   6) Give assumptions of Werners theory
CHAPTER – 5 ISOMERISM IN COORDINATION COMPLEXES

Q1) Answer the followings 1 Marks each

a) What type of structural isomerism is shown by [Pt(NH₃)₂Br₂] and [Pt(NH₃)₄] [Pt Br₄]?

b) Mention the type of isomerism shown by [Co (NH₃)₅ONO]Cl₂ and [CoCNH₃]₅NO₂]Cl₂.

c) Explain hydrate isomerism with suitable example.

d) What type of isomerism is shown by [Cr (H₂O)₆] Cl₃ and [Cr (H₂O)₅Cl] Cl₂.H₂O?

e) How many ions are given by [Cu(NH₃)₄]SO₄ on ionisation.

f) What type of isomerism is shown by [Cr(NH₃)₅Cl]SO₄ & [Cr(NH₃)₅]SO₄]Cl

Q2) Answer the following 3 Marks each

1) Define geometrical isomerism? Draw the geometrical isomers of [Co (en)₂ Cl₂]⁺ ion.

2) Explain ligand and linkage isomerism with suitable examples.

3) Draw the possible geometries of complexes having C.N. 4.

4) Define geometrical isomerism. Draw all possible geometrical isomers of [Ma₂b₂c₂]

5) Draw cis & trans isomer of [Cr(NH₃)₅ Cl₃]

6) Draw all possible geometrical isomers of [pt(NH₃)₂(Py)₂(Cl)₂] complex. Which isomers shows optical activity?

7) What type of isomerism is present in following pair of complexes?
   1) [Co (NH₃)₆] [Cr (CN)₆] and [Cr (NH₃)₆] [Co (CN)₆]
   2) [Pt (NH₃)₃ Cl₂] Br₂ and [Pt (NH₃)₃ Br₂] Cl₂
   3) [Co (H₂O)₃ NO₂] Cl₂ and [Co (H₂O)₅ ONO] Cl₂

CHAPTER - 6 VALENCED BOND THEORY (VBT)

Q1) Answer the following
1 Marks each

a) What type of hybridization is shown by the complex ion \([CuCl_5]^{3-}\) ion?

b) What type of hybridization is shown by \(K_3[Co(CN)_6]\)?

c) Define ‘Inner orbital complex’.

d) What type of hybridisation is present in \([NiCl_4]^{2-}\)?

e) Define electroneutrality principle.

Q2) Answer the following
3 Marks each

1) Explain the formation of \([FeF_6]^{3-}\) complex ion on the basis of V.B.T

2) Explain inner orbital complex with suitable example.

3) Discuss the formation of \([NiCl_4]^{2-}\) ion on the basis of V.B.T.

4) What type of hybridization is shown by \([Ni(CN)_5]^{3-}\) ion?

5) Explain formation of \([MnCl_4]^{2-}\) ion on the basis of VBT \([\mu=5.92\ Bm]\)

6) Explain Electroneutrality principle with suitable example

Q2) Answer the following
2 Marks each

1) Give any four assumptions of VBT.

2) Write note on ‘multiple bonding’.

3) Write a note on spectrochemical series

4) Explain outer orbital complexes with suitable example

---

Dr. R.P. DHOK, Savitribai Phule Pune University Affiliated, Dept. of Chemistry, Shardabai Pawar Mahila Mahavidyalaya, Shardanagar, Baramati, Pune
CHAPTER – 7 CRYSTAL FIELD THEORY (CFT)

Q1) Answer the following: 1 Marks each

a) Define : C. F. S. E.

b) Draw crystal field splitting diagram for tetrahedral complex.

c) Give the symmetry symbol for dxy, dyz and dxz orbitals.

d) What is the effect of size of d-orbitals on 10 Dq value?

e) How many unpaired electrons are present in weak field octahedral d\textsuperscript{6} system?

f) How many unpaired electrons are present in d\textsuperscript{6} strong field octahedral complex?

g) Give the symmetry symbols of d-orbital.

h) What is 10 Dq?

i) Calculate CFSE for d\textsuperscript{8} ion in octahedral complex.

j) Find the number of unpaired electrons in d\textsuperscript{7} weak field octahedral complex.

k) Give the symmetry symbol for s orbital.

l) Define spectrochemical series.

m) Calculate CFSE for d\textsuperscript{6} ion in strong octahedral field.

n) Give the symmetry symbol for d_x^2 – y^2 and d_z^2 orbitals.

o) Give any two limitations of CFT.

p) How many unpaired electrons are present in d\textsuperscript{5} strong field octahedral complex?

q) Calculate CFSE of [Ti (H\textsubscript{2}O)_6]SO\textsubscript{4}

r) Calculate CFSE for d\textsuperscript{5} ion in strong field weak field octahedral complex.

s) Calculate C.F.S.E. of d\textsuperscript{4} ion in strong and weak octahedral ligand field

t) Calculate the CFSE of d\textsuperscript{9} ion in strong and weak octahedral ligand field

Q2) Answer the following: 3 Marks each

Write note on ‘Nephelauxetic effect’

2) ‘Tetrahedral complex are always high spin’, Explain.

3) Calculate CFSE of K\textsubscript{4}[Fe(CN)\textsubscript{6}] & K\textsubscript{4}[CrCl\textsubscript{6}]

4) Give the Crystal field splitting diagram for square planer complex

5) For [Cr(H\textsubscript{2}O)_6]\textsuperscript{2+} and [Cr(CN)\textsubscript{6}]\textsuperscript{2-} Δo values are 17830 Cm\textsuperscript{-1} and 26280 Cm\textsuperscript{-1} respectively. The pairing energy is 23520 Cm\textsuperscript{-1}. Calculate i) No. of unpaired electrons and ii) Magnetic properties in complex

6) Discuss the application of CFT to tetrahedral complexes

7) [Mn(NH\textsubscript{3})\textsubscript{6}]\textsuperscript{3+} complex ion, electron pairing energy is 28000 cm\textsuperscript{-1}. The value of 10Dq is 38500 cm\textsuperscript{-1}. Calculate the CFSE
8) Give assumptions of CFT. Explain its applications for octahedral complexes

9) What are the factors affecting magnitude of 10 Dq?

10) For the $[\text{Cr(H}_2\text{O)}_6]^{3+}$ and $[\text{Cr(CN)}_6]^{4-}$ the $\Delta o$ values are 17830 cm$^{-1}$ and 26280 cm$^{-1}$ respectively. The pairing energy is 23520 cm$^{-1}$. Calculate the number of unpaired electrons and magnetic moment in complex

CHAPTER – 8 MOLECULAR ORBITAL THEORY (MOT)

Q1) Answer the following 1 Marks each

a) Give the types of charge transfer spectra.

b) How many metal orbitals are participate in octahedral complex according to MOT?

Q2) Answer the following 3 Marks each

1) Discuss the formation of $[\text{Ni(NH}_3)_6]^{2+}$ complex ion without $\pi$ bonding on the basis of MOT

2) Explain the formation of $[\text{Ni(CN)}_4]^{2-}$ ion on the basis of VBT

3) Explain the formation of $[\text{Co(CN)}_6]^{3+}$ ion without $\pi$ bonding on the basis of MOT

4) Discuss the formation of $[\text{FeF}_6]^{3-}$ ion without $\pi$ bonding on the basis of MOT

5) Discuss the formation of $[\text{Zn(NH}_3)_6]^{2+}$ ion without ‘pi’ bonding on the basis of MOT.

6) Discuss the formation of $[\text{CO (NH}_3)_6]^{3+}$ ion without $\pi$ bonding on basis of MOT