	INDIAN SCHOOL AL WADI AL KABIR	
Class: XII	**DEPARTMENT: SCIENCE 2025 – 26** **SUBJECT: CHEMISTRY**	**Date: 20/11/2025**
Worksheet No: 10 **WITH ANSWERS**	**TOPIC: COORDINATION COMPOUNDS**	**Note:** **A4 FILE FORMAT**
NAME OF THE STUDENT	**CLASS & SEC:**	**ROLL NO.**

MULTIPLE CHOICE QUESTIONS

1. Arrange the following complexes in the increasing order of conductivity of their solution: **(MARCH 2025)**

$[Cr(NH_3)_3C1_3]$, $[Cr(NH_3)_6]Cl_3$, $[Cr(NH_3)_5C1]Cl_2$

a) $[Cr(NH_3)_3C1_3] < [Cr(NH_3)_6]Cl_3 < [Cr(NH_3)_5C1]Cl_2$

b) $[Cr(NH_3)_3C1_3] < [Cr(NH_3)_5C1]Cl_2 < [Cr(NH_3)_6]Cl_3$

c) $[Cr(NH_3)_5C1]Cl_2 < [Cr(NH_3)_6]Cl_3 < [Cr(NH_3)_3C1_3]$

d) $[Cr(NH_3)_6]Cl_3 < [Cr(NH_3)_3C1_3] < [Cr(NH_3)_5C1]Cl_2$

2. Coordination number of $[Ni(C_2O_4)_2]^{2-}$ is ……………….

a) 4 b) 2 c) 3 d) 6

3. Identify the heteroleptic complex from the following:

a) $[Cu(CN)_4]^{3-}$ b) $[Co(NH_3)_6]^{3+}$

c) $[Co(NH_3)_4Cl_2]^{+}$ d) $[PtCl_4]^{2-}$

4. The oxidation number of iron in $[Fe(NH_3)_4Cl_2]^{+}$ is …………..

a) +1 b) +2 c) +3 d) -2

5. IUPAC name of $[Cr(NH_3)_3(H_2O)_3]Cl_3$ is …………….

a) Triamminetriaquachromium(II) chloride

b) Triamminetriaquachromium(III) chloride

c) Triamminetriaquachromium(I) chloride

d) Triaminetriaquachromium(III) chloride

6. The formula of Potassium trioxalatoaluminate(III) is ……………

a) $K[Al(C_2O_4)_3]$ b) $K_2[Al(C_2O_4)_3]$

c) $K_3[Al(C_2O_4)_3]$ d) $K_3[Al_3(C_2O_4)]$

7. Identify the possible hybridization of a complex if its coordination number is 6.

a) sp^3 b) dsp^2 c) sp^3d d) sp^3d^2

8. In spectrochemical series, which of the following ligand has greatest field strength?

a) I^- b) NH_3 c) OH^- d) CO

9. On the basis of CFT, the electronic configuration for d^6 ion, if $\Delta_o > P$ is ……….

a) $t_{2g}^6\ e_g^0$ b) $t_{2g}^4\ e_g^2$ c) $t_{2g}^5\ e_g^1$ d) $t_{2g}^3\ e_g^3$

10. Which of the following statements is not true about Valence Bond Theory.

a) It involves a number of assumptions.

b) It distinguishes between weak and strong ligands.

c) It does not give quantitative interpretation of magnetic data.

d) It does not explain the colour exhibited by coordination compounds.

Read the given passage and answer the questions that follow:

According to Valence Bond Theory theory, the metal atom or ion under the influence of ligands can use its (n-1)d, ns, np or ns, np, nd orbitals for hybridisation to yield a set of equivalent orbitals of definite geometry such as octahedral, tetrahedral, square planar and so on. These hybridised orbitals are allowed to overlap with ligand orbitals that can donate electron pairs for bonding. It is usually possible to predict the geometry of a complex from the knowledge of its magnetic behaviour on the basis of the valence bond theory.

11. Is $[Co(NH_3)_6]^{3+}$ an inner orbital or outer orbital complex?

12. Identify the magnetic behaviour of the complex $[Ni(CO)_4]$

13. Calculate the spin only magnetic moment of $[MnBr_4]^{2-}$

Assertion and Reason Type

14. Assertion: $[CoF_6]^{3-}$ is called outer orbital or high spin complex.
Reason: It uses outer orbital (4d) in hybridization.

a) Both assertion and reason are correct statements, and reason is the correct explanation of the assertion.
b) Both assertion and reason are correct statements, but reason is not the correct explanation of the assertion.
c) Assertion is correct, but reason is wrong statement.
d) Assertion is wrong, but reason is correct statement.

15. Assertion: $[Fe(CN)_6]^{4-}$ is a heteroleptic complex.

Reason: It is a complex ion in which the metal is bound to only one kind of donor groups.

a) Both assertion and reason are correct statements, and reason is the correct explanation of the assertion.
b) Both assertion and reason are correct statements, but reason is not the correct explanation of the assertion.
c) Assertion is correct, but reason is wrong statement.
d) Assertion is wrong, but reason is correct statement.

16. Assertion: $[Ni(CO)_4]$ has tetrahedral geometry.

Reason: IUPAC name of $[Ni(CO)_4]$ is Tetracarbonylnickel(0)

a) Both assertion and reason are correct statements, and reason is the correct explanation of the assertion.
b) Both assertion and reason are correct statements, but reason is not the correct explanation of the assertion.
c) Assertion is correct, but reason is wrong statement.
d) Assertion is wrong, but reason is correct statement.

Question – Answer Type:

17. Write IUPAC name of the complex $[Pt(en)_2Cl_2]$. **1**

18. Using valence bond theory, predict the hybridization and magnetic character of the complex, $[Co(NH_3)_6]^{3+}$ **1**

19. Write the electronic configuration of d^5 on the basis of crystal field theory when: **1**

(i) $\Delta_O < P$ (ii) $\Delta_O > P$

20. (a) One mole of $CrCl_3.4H_2O$ precipitates one mole of AgCl when treated with excess of $AgNO_3$ solution. Write (i) the structural formula of the complex, and (ii) the secondary valency of Cr. **(MARCH 2025)** **2**

(b) What is the difference between a complex and a double salt?

21. Using IUPAC norms write the formulae for the following: **2**

(i) Hexaamminecobalt(III) sulphate

(ii) Potassium trioxalatochromate(III)

22. Although both $[NiCl_4]^{2-}$ and $[Ni(CO)_4]$ have sp^3 hybridization yet $[NiCl_4]^{2-}$ is paramagnetic and $[Ni(CO)_4]$ is diamagnetic. Give reason. **2**
(Atomic no. of Ni = 28)

23. Write the hybridization and number of unpaired electrons in the complex $[CoF_6]^{3-}$ (Atomic No. of Co = 27) **2**

24. Write the IUPAC names of the following coordination compounds: **3**

a) $[Pt(NH_3)_2Cl(NO_2)]$ b) $K_2[PdCl_4]$ c) $K_3[Fe(C_2O_4)_3$

25. Write the hybridization and magnetic character of the following complexes: **3**

(i) $[Fe(H_2O)_6]^{2+}$ (ii) $[Ni(CN)_4]^{2-}$ [Atomic number : Fe = 26, Ni = 28]

26. Draw structures of geometrical isomers of: **3**

(i) $Pt(NH_3)_2Cl_2$ (ii) $[Co(NH_3)_4Cl_2]^+$ (iii) $[Fe(NH_3)_2(CN)_4]^-$

27. (a) Indicate the types of isomerism exhibited by the following complexes: **3**

(i) $[Co(en)_3]Cl_3$
(ii) $[Cr(H_2O)_6]Cl_3$

(b) Give evidence that $[Mn(NH_3)_5Cl]NO_3$ and $[Mn(NH_3)_5(NO_3)]Cl$ are ionisation isomers.

28. (a) Write the formula for the following coordination compound : **3**

Potassium tetrahydroxidozincate (II)

(b) Arrange the following complexes in the increasing order of conductivity of their solution :

$[Cr(NH_3)_5Cl]Cl_2$, $[Cr(NH_3)_3Cl_3]$, $[Cr(NH_3)_6]Cl_3$

(c) Identify the type of isomerism exhibited by the following complexes

(i) $[Co(NH_3)_5NO_2]^{2+}$

(ii) $[Co(en)_3]Cl_3$

29. Passage based question. (4)

The Valence Bond Theory (VBT) explains the formation, magnetic behaviour and geometrical shapes of coordination compounds whereas 'The crystal Field Theory' for coordination compounds is based on the effect of different crystal fields (provided by ligands taken as point charges), on the degeneracy of d-orbital energies of the central metal atom/ion. The splitting of the d-orbitals provides different electronic arrangements in strong and weak crystal fields. The crystal field theory attributes the colour of the coordination compounds to d-d transition of the electron. Coordination compounds find extensive applications in metallurgical processes, analytical and medicinal chemistry.

Answer the following questions:

(a) What is crystal field splitting energy ?

(b) Give reason for the violet colour of the complex $[Ti(H_2O)_6]^{3+}$ on the basis of crystal field theory.

(c) $[Cr(NH_3)_6]^{3+}$ is paramagnetic while $[Ni(CN)_4]^{2-}$ is diamagnetic. Explain why. [Atomic No. : Cr = 24, Ni = 28]

OR

(c) Explain why $[Fe(CN)_6]^{3-}$ is an inner orbital complex, whereas $[Fe(H_2O)_6]^{3+}$ is an outer orbital complex.

[Atomic No. : Fe = 26]

30. Answer the following questions: (5)

(a) How is the crystal field splitting energy for octahedral complex (Δ_o) related to that of tetrahedral complex (Δ_t)?

(b) Write the IUPAC name of the following complex: $[PtCl_2(en)_2](NO_3)_2$

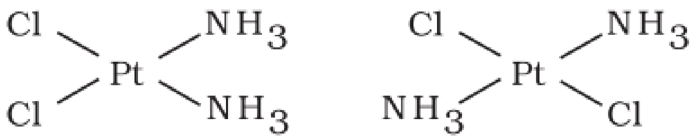
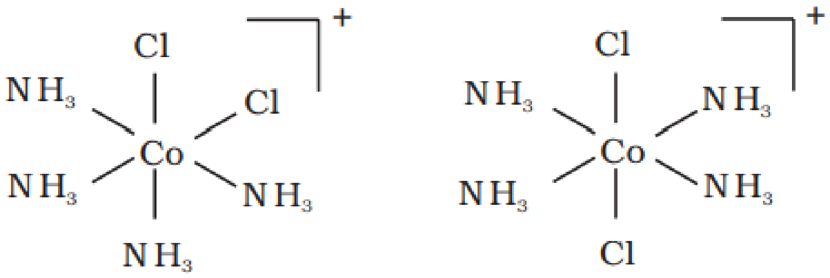
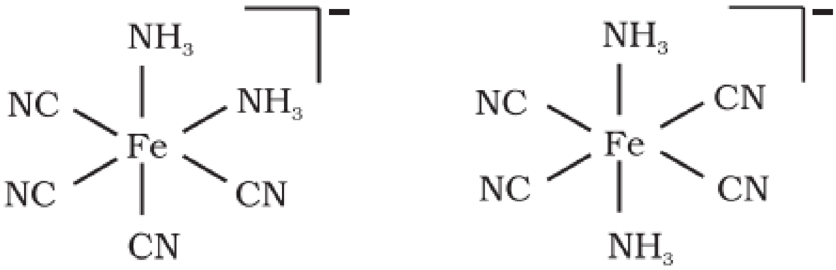
(c) Write the geometry and magnetic behaviour of the complex $[Ni(CO)_4]$ on the basis of Valency Bond Theory (VBT).

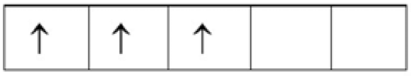
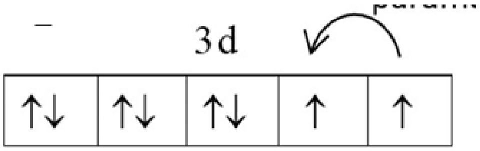
(d) What type of isomerism is shown by the complex $[Co(NH_3)_6][Cr(CN)_6]$?

(e) Out of $[Co(NH_3)_6]^{3+}$ and $[Co(NH_3)_4Cl_2]^{+}$, which complex is heteroleptic and why?

ANSWERS

1.	b
2.	a
3.	c
4.	c
5.	b
6.	c
7.	d
8.	d
9.	a
10.	b
11.	Inner orbital complex.
12.	Diamagnetic.
13.	$n = 5$ $\mu = \sqrt{n(n+2)}$ $= 5.9$ BM
14.	a) Both assertion and reason are correct statements, and reason is the correct explanation of the assertion.
15.	d) Assertion is wrong, but reason is correct statement.
16.	b) Both assertion and reason are correct statements, but reason is not the correct explanation of the assertion.
17.	Bis(ethane-1,2-diamine)dichloridoplatinum (II)
18.	d^2sp^3, diamagnetic.
19.	i) $t_{2g}^3 e_g^2$ ii) $t_{2g}^5 e_g^0$
20.	(a) (i) $[Cr(H_2O)_4Cl_2]Cl$ (ii) 6 (b) Double salt dissociates into simple ions completely when dissolved in water while Complex salt does not.
21.	i) $[Co(NH_3)_6]_2(SO_4)_3$ ii) $K_3[Cr(C_2O_4)_3]$
22.	In $[NiCl_4]^{2-}$, Cl^- is a weak field ligand due to which there are two unpaired electrons in 3d orbital whereas in $[Ni(CN)_4]^{2-}$, CN^- is a strong field ligand due to which pairing leads to no unpaired electron in 3d- orbital.
23.	Hybridization is $sp^3 d^2$ Number of unpaired electrons = 4 (Explain)

24.	a) Diamminechloridonitrito-N-platinum(II) b) Potassium tetrachloridopalladate(II) c) Potassium trioxalatoferrate(III)
25.	(i) sp^3d^2, paramagnetic (ii) dsp^2, diamagnetic (Explain)
26.	(i)  *cis* *trans* (ii)  *cis* *trans* (iii)  *cis* *trans*
27.	(a) (i) $[Co(en)_3]Cl_3$ - Optical isomerism (ii) $[Cr(H_2O)_6]Cl_3$ - Solvate Isomerism (b) $[Mn(NH_3)_5(NO_3)]Cl$ forms white ppt with silver nitrate solution whereas $[Mn(NH_3)_5Cl]NO_3$ doesn't form a ppt with silver nitrate solution.
28.	a) $K_2[Zn(OH)_4]$ (b)$[Cr(NH_3)_3Cl_3] < [Cr(NH_3)_5Cl]Cl_2 < [Cr(NH_3)_6]Cl_3$ (c) (i) Linkage isomerism (ii) Optical isomerism

29.	(a) The energy used in the splitting of degenerate d- orbitals due to the presence of ligands in a definite geometry is called Crystal Field Splitting Energy. (b) Ti^{3+}= $3d^1$ i.e. $t_{2g}{}^1 e_g^0$ Due to d – d transition. (c) Cr^{3+} = $3d^3$  Due to stable $t_{2g}{}^3$ configuration, henceparamagnetic.  Ni^{2+} = $3d^8$ CN^- being strong field ligand pair up the electrons and hence diamagnetic. OR (c) CN^- being a strong ligand leads to the pairing of electrons in $[Fe(CN)_6]^{3-}$ leading to d^2sp^3 hybridization.H_2O being a weak ligand does not lead to the pairing of electrons in $[Fe(H_2O)_6]^{3+}$ leading to sp^3d^2 hybridization. / In $[Fe(CN)_6]^{3-}$, (n-1)d orbitals of central metal ion are used in hybridization (d^2sp^3). Hence inner orbital complex whereas in $[Fe(H_2O)_6]^{3+}$ n d orbitals of central metal ion are used in hybridization (sp^3d^2).
30.	(a) $\Delta_t = \left(\frac{4}{9}\right)\Delta_o$ (b) Dichloridobis(ethane −1, 2− diamine)platinum(IV) nitrate (c) sp^3, diamagnetic (d) Coordination isomerism (e) $\left[Co(NH_3)_4Cl_2\right]^+$ as the metal is bound to more than one donor group (ligand)

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