PHYSICAL / INORGANIC CHEMISTRY

DPP
DAILY PRACTICE PROBLEMS

DPP No. 10

Total Marks : 51

Max. Time : 54 min.

Topic : Coordination Compounds

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.4	(3 marks, 3 min.)	[12, 12]
Multiple choice objective ('–1' negative marking) Q.5 to Q.7	(4 marks, 4 min.)	[12, 12]
Subjective Questions ('–1' negative marking) Q.8	(4 marks, 5 min.)	[4, 5]
Comprehension ('–1' negative marking) Q.9 to Q.11	(3 marks, 3 min.)	[9, 9]
Match the Following (no negative marking) Q. 12	(8 marks, 10 min.)	[8, 10]
Assertion and Reason (no negative marking) Q. 13 to Q. 14	(3 marks, 3 min.)	[6, 6]

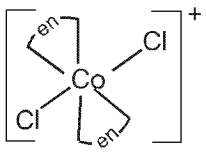
1. Which of the following is true :
(A) $[Zn(Cl)_2 (NH_3)_2]$ will exist in cis and trans forms
(B) [Pt(Br) (Cl) (NH_3) (Py)] is an optically active compound
(C) The brown ring complex $[Fe(H_2O)_5NO^+]^{2+}$ is paramagnetic
(D) All the above are true

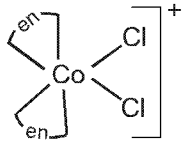
2. Which of the following is true about the complex $[PtCl_2(NH_3)(OH_2)]$; [Atomic no. of Pt = 78]
(i) It will have two geometrical isomeric forms, cis and trans
(ii) The hybridisation state of Pt(II) is sp^3
(iii) It is a square planar complex
(iv) It is a diamagnetic complex
(v) It can show hydrate isomerism
(vi) It is a tetrahedral complex
(A) (i), (iii),(iv) (B) (ii),(iv),(v) (C) (ii),(v),(vi) (D) (i),(v),(vi)

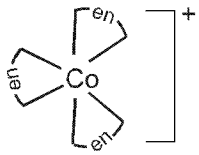
3. The octahedral complex $[Rh(NO_2) (SCN) (en)_2]^+$ can exist in a total number of isomeric forms including stereoisomers :
(A) 2 (B) 4 (C) 8 (D) 12

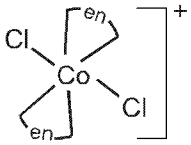
4. Total number of geometrical isomers of Ma_3b_3 type of octahedral complex are
(A) Two (B) four (C) Six (D) Zero

5. Which of the following ions are optically active ?

I 

II 

III 

IV 

(A) I (B) II (C) III (D) IV

6. Which is/are correct statement (s) ?
(A) $[Co(en)_3] [Cr(CN)_6]$ will display coordination isomerism.
(B) $[Mn(CO)_5(SCN)]$ will display linkage isomerism.
(C) $[Co(NH_3)_5(NO_3)]SO_4$ will display ionisation isomerism
(D) None is correct.

7. The compound Na_2IrCl_6 reacts with triphenylphosphine in diethyleneglycol in an atmosphere of CO to give $[IrCl(CO)(PPh_3)_2]$, known as 'Vaska's compound'.(Atomic number of Ir = 77)
Which of the following statements is /are correct?
(A) The IUPAC name of the complex is carbonylchloridobis(triphenylphosphine)iridium(I).
(B) The hybridisation of the metal ion is sp^3 .
(C) The magnetic moment (spin only) of the complex is zero.
(D) The complex shows geometrical as well as ionization isomerism.

8. Write a series of equations to show the stepwise displacement of H_2O ligands in $[Fe(H_2O)_6]^{3+}$ by ethylene-diamine (en) for which log K_1 = 4.44 ; log K_2 = 3.41 and log K_3 = 2.15. What is overall formation constant for the complex $[Fe(en)_3]^{3+}$?

Comprehension # (Q. 9 to Q.11)

A research-guide instructed his two students to synthesize complex

$$[Co(NH_3)_5(NO_2)]Cl_2$$

They synthesised the complexes with identical molecular formula, molar mass, geometry, conductance and spin, but they differed in colour. Based on the above facts answer the following questions.

9. The difference in colour is due to :

(A) optical isomerism (B) geometrical isomerism

(C) linkage isomerism (D) nuclear isomerism

10. Which of the ligands can show ambident property ?

(A) NO_2^- (B) NH_3 (C) H_2O (D) CO_3^{2-}

11. Complexes synthesized can be :

(A) $[Co(NH_3)_5(NO_2)]Cl_2$ (B) $[Co(NH_3)_5(ONO)]Cl_2$

(C) $[Co(NH_3)_5Cl_2]NO_2$ (D) (A) & (B) both.

12.

	Column – I		**Column – II**
(A)	$[Cr(NH_3)_6]^{3+}$	(p)	d^2sp^3
(B)	$[Co(en)_3]^{3+}$	(q)	CFSE = – 1.2 Δ_0
(C)	$[Co(NO_2)_6]^{4-}$	(r)	Paramagnetic
(D)	$[Co(H_2O)_6]^{2+}$	(s)	sp^3d^2

13. **Statement-1 :** Tetrahedral complexes do not show geometrical isomerism
Statement-2 : All the bond angles in tetrahedral geometry are 109°.28'.

(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1
(C) Statement-1 is True, Statement-2 is False
(D) Statement-1 is False, Statement-2 is True
(E) Statement-1 is False, Statement-2 is False

14. **Statement-1 :** Out of $[NiF_6]^{4-}$ and $[NiF_6]^{2-}$ one can be high spin complex and other a low spin complex.
Statement-2 : F^- is a weak field ligand.

(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.
(C) Statement-1 is True, Statement-2 is False.
(D) Statement-1 is False, Statement-2 is True.

Answer Key

DPP No. # 10

1.	C	**2.**	A	**3.**	D	**4.**	A	**5.**	BC
6.	ABC	**7.**	AC	**8.**	$K_1 = 10^{10}$.	**9.**	C	**10.**	A
11.	D	**12.**	[A - p,q,r] ; [B - p]; [C - p,r] ; [D - s,r]	**13.**	A	**14.**	B		

Hints & Solutions

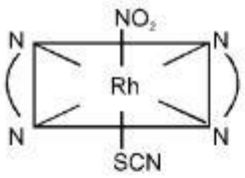
PHYSICAL / INORGANIC CHEMISTRY

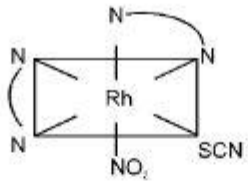
DPP No. # 10

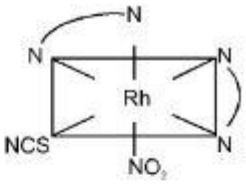
1. (A) is tetrahedral. So, No G.I.
(B) is square planar [Pt(II) complex]. So, No optical isomerism
(C) is Fe(I) complex, contains three unpaired e^-s.

2. Pt(II) is $5d^8$, forms square planar complex which is diamagnetic. $[PtCl_2(NH_3)(OH_2)]$ will show geometrical isomerism.

3.







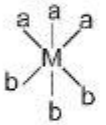
(1) NO_2 / SCN
(2) ONO / SCN
(3) NO_2 / NCS
(4) ONO NCS

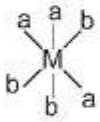
(5) NO_2 / SCN
(6) ONO / SCN
(7) NO_2 / NCS
(8) ONO / NCS

(9)
(10)
(11)
(12)
} Mirror images of (5), (6), (7), (8)

* Only cis isomer is optically active.

4.



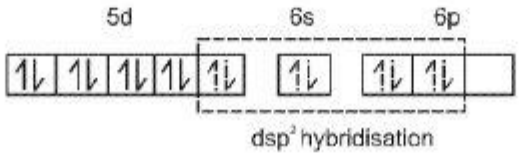


5. I and IV have POS.

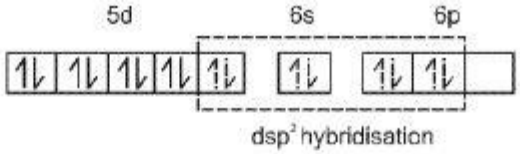
6. (A) Both cation & anion are complex.
(B) SCN^- is ambidentate ligand. So, linkage isomerism.
(C) Anion are acting as ligand. So, it can show ionization isomerism.

7. (A) $[IrCl(CO)(PPh_3)_2]$ carbonylchloridobis(triphenylphosphine)iridium(I).
(B) Coordination number of Ir is four. Ir is in (+1) oxidation state with $4d^8$ configuration. It is trans isomer, so its geometry should be square planar.

$[IrCl(CO)(PPh_3)_2]$

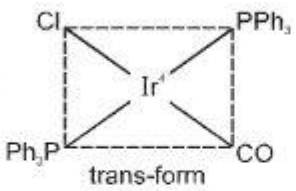


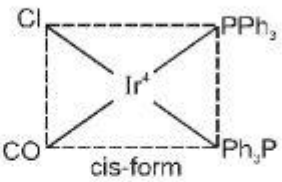
$[IrCl(CO)(PPh_3)_2]$



(C) All electrons are paired ; so magnetic moment is zero.

(D)





The complex has plane of symmetry, so it does not show optical isomerism.

8.
$[Fe(H_2O)_6]^{3+} + en \rightarrow [Fe(H_2O)_4en]^{3+}$ $K_{eq} = K_1$
$[Fe(H_2O)_4 en]^{3+} + en \rightarrow [Fe(H_2O)_2 (en)_2]^{3+}$ $K_{eq} = K_2$
$[Fe(H_2O)_2 (en)_2]^{3+} + en \rightarrow [Fe (en)_3]^{3+}$ $K_{eq} = K_3$
$[Fe(H_2O)_6]^{3+} + 3en \rightarrow [Fe (en)_3]^{3+}$ $K_f = K_1 \times K_2 \times K_3$
$\log K_f = \log K_1 + \log K_2 + \log K_3$
$= 4.44 + .41 + 2.15 = 10 \quad \Rightarrow K_f = 10^{10}$

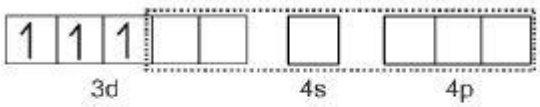
9. $[Co(NH_3)_5(NO_2)]Cl_2$ & $[Co(NH_3)_5(ONO)]Cl_2$ have different color

10. In this, donor atom can be 'N' or 'O' i.e. NO_2^-, ONO^-

11. NO_2^-, ONO^- are ambidentate ligands.

12. (A) $[Cr(NH_3)_6]^{3+}$

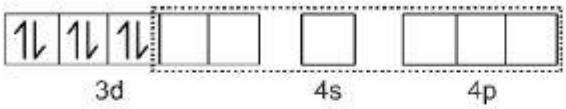
$Cr^{3+} \longrightarrow 3d^3, 4s^0$



(B) $[Co(en)_3]^{3+}$

$Co^{3+} \longrightarrow 3d^6, 4s^0$

en is a SFL. so, pairing will take place.

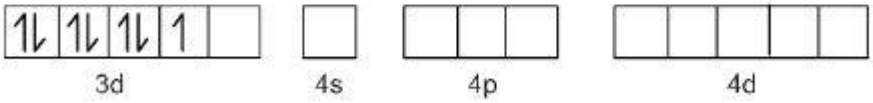


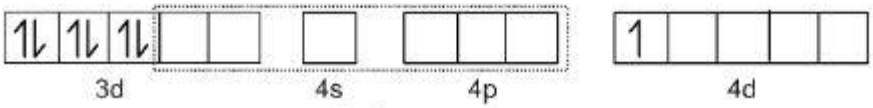
$CFSE = 6 \times (-0.4\ \Delta_0) + 2p = -1.2\ \Delta_0 + 2p$

(C) $[Co(NO_2)_6]^{4-}$

$Co^{2+} \longrightarrow 3d^7, 4s^0$

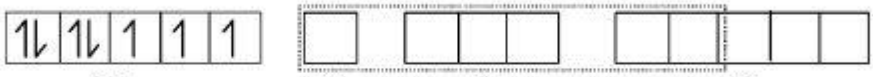
NO_2^- is a SFL, so, pairing will take place and 1 electron is promoted to higher d-orbitals





(D) $[Co(H_2O)_6]^{2+}$

$Co^{2+} \longrightarrow 3d^7, 4s^0$



sp^3d^2 Paramagnetic

13. In Tetrahedral All bond angle are 109°.28′ So It is symmetrical

14. $[NiF_6]^{4-} \longrightarrow F^-$ is a weak ligand, so high spin complex with two unpaired electron.

$[NiF_6]^{2-} \longrightarrow$ Low spin complex even with weak field ligands. On d^6 arrangment with +4 oxidation state will have higher CFSE leading to pairing of electrons and complex will be diamagnetic.