DPP - Daily Practice Problems

Date : | **Start Time :** | **End Time :**

CHEMISTRY CC23

SYLLABUS : Coordination Compounds

Max. Marks : 120 **Marking Scheme :** + 4 for correct & (–1) for incorrect **Time : 60 min.**

INSTRUCTIONS : This Daily Practice Problem Sheet contains 30 MCQ's. For each question only one option is correct. Darken the correct circle/ bubble in the Response Grid provided on each page.

1. Which of the following is incorrect regarding spectrochemical series?

(a) $NH_3 > H_2O$ (b) $F^- > C_2O_4^{2-}$

(c) $NCS^- > SCN^-$ (d) en > $edta^{4-}$

2. $C_{63}H_{88}CoN_{14}O_{14}P$ is the formulae of the Cyanocobalamine, (vitamin B_{12}) it contain CN^- and CN^- is very poisonous, than why this compound does not prove to be fatal for us? (it inhibit the electron transport chain ?

(a) CN^- forms covalent bond

(b) CN^- is coordinating to the cobalt as the ligand

(c) CN^- hydrolysis immediately

(d) All of these

3. An example of double salt is

(a) Bleaching powder

(b) $K_4[Fe(CN)_6]$

(c) Hypo

(d) Potash alum

4. Nickel (Z = 28) combines with a uninegative monodentate ligand X^- to form a paramagnetic complex $[NiX_4]^{2-}$. The number of unpaired electron(s) in the nickel and geometry of this complex ion are, respectively :

(a) one, square planar

(b) two, square planar

(c) one, tetrahedral

(d) two, tetrahedral

RESPONSE GRID	1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ	4. ⓐⓑⓒⓓ

5. The crystal field splitting energy for octahedral (Δ_0) and tetrahedral (Δ_t) complexes is related as

(a) $\Delta_t = -\frac{1}{2}\Delta_0$ (b) $\Delta_t = -\frac{4}{9}\Delta_0$

(c) $\Delta_t = -\frac{3}{5}\Delta_0$ (d) $\Delta_t = -\frac{2}{5}\Delta_0$

6. A square planar complex is formed by hybridisation of which atomic orbitals?

(a) s, p_x, p_y, d_{yz} (b) $s, p_x, p_y, d_{x^2-y^2}$

(c) s, p_x, p_y, d_{z^2} (d) s, p_y, p_z, d_{xy}

7. Consider the following complex $[Co(NH_3)_5CO_3]ClO_4$. The coordination number, oxidation number, number of *d*-electrons and number of unpaired *d*-electrons on the metal are respectively

(a) 6, 3, 6, 0 (b) 7, 2, 7, 1

(c) 7, 1, 6, 4 (d) 6, 2, 7, 3

8. How many EDTA (ethylenediaminetetraacetic acid) molecules are required to make an octahedral complex with a Ca^{2+} ion?

(a) One (b) Two

(c) Six (d) Three

9. Which of the following are inner orbital complex (i.e., involving d^2sp^3 hybridisation) and is paramagnetic in nature?

(a) $[Mn(CN)_6]^{3-}$, $[Fe(CN)_6]^{3-}$, $[Co(C_2O_4)_3]^{3-}$

(b) $[MnCl_6]^{3-}$, $[FeF_6]^{3-}$, $[CoF_6]^{3-}$

(c) $[Mn(CN)_6]^{3-}$, $[Fe(CN)_6]^{3-}$

(d) $[MnCl_6]^{3-}$, $[Fe(CN)_6]^{3-}$, $[Co(C_2O_4)_3]^{3-}$

10. Which of the following is organo-metallic compound ?

(a) $Ti(C_2H_4)_4$ (b) $Ti(OC_2H_5)_4$

(c) $Ti(OCOCH_3)_4$ (d) $Ti(OC_6H_5)_4$

11. Which is not π - bonded complex ?

(a) Zeise's salt (b) Ferrocene

(c) Dibenzene chromiun (d) Tetraethyl lead

12. A solution containing 2.675 g of $CoCl_3 . 6\ NH_3$ (molar mass = 267.5 g mol^{-1}) is passed through a cation exchanger. The chloride ions obtained in solution were treated with excess of $AgNO_3$ to give 4.78 g of AgCl (molar mass = 143.5 g mol^{-1}). The formula of the complex is

(At. mass of Ag = 108 u)

(a) $[Co(NH_3)_6]Cl_3$ (b) $[CoCl_2(NH_3)_4]Cl$

(c) $[CoCl_3(NH_3)_3]$ (d) $[CoCl(NH_3)_5]Cl_2$

13. The type of isomerism present in Pentaminenitrochromium (III) chloride is

(a) optical (b) linkage

(c) ionisation (d) polymerisation.

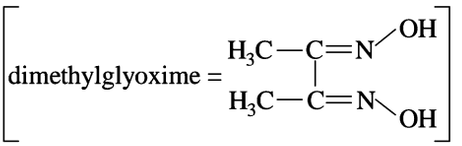
14. Red precipitate is obtained when ethanol solution of dimethylglyoxime is added to ammoniacal Ni(II). Which of the following statements is not true ?

(a) Red complex has a square planar geometry.

(b) Complex has symmetrical H-bonding

(c) Red complex has a tetrahedral geometry.

(d) Dimethylglyoxime functions as bidentate ligand.

dimethylglyoxime = 

RESPONSE GRID					
5. ⓐⓑⓒⓓ	**6.** ⓐⓑⓒⓓ	**7.** ⓐⓑⓒⓓ	**8.** ⓐⓑⓒⓓ	**9.** ⓐⓑⓒⓓ
10. ⓐⓑⓒⓓ	**11.** ⓐⓑⓒⓓ	**12.** ⓐⓑⓒⓓ	**13.** ⓐⓑⓒⓓ	**14.** ⓐⓑⓒⓓ

15. An excess of $AgNO_3$ is added to 100 mL of a 0.01 M solution of dichlorotetraaquachromium (iii) chloride. The number of moles of AgCl precipitated would be :

(a) 0.002 (b) 0.003

(c) 0.01 (d) 0.001

16. Magnetic moment of Gd^{3+} ion (Z = 64) is

(a) 3.62 BM (b) 9.72 BM

(c) 7.9 BM (d) 10.60 BM

17. Which of the following species represent the example of dsp^2 - hybridisation ?

(a) $[Fe(CN)_6]^{3-}$ (b) $[Ni(CN)_4]^{2-}$

(c) $[Ag(CN)_2]^-$ (d) $[Co(CN)_6]^{3-}$

18. Which one of the following has largest number of isomers ?

(a) $[Ir(PR_3)_2H(CO)]^{2+}$ (b) $[Co(NH_3)_5Cl]^{2+}$

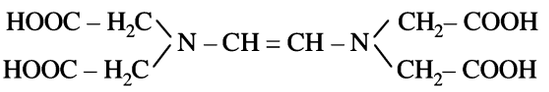
(c) $[Ru(NH_3)_4Cl_2]^+$ (d) $[Co(en)_2Cl_2]^+$

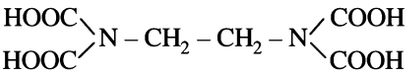
19. In $Fe(CO)_5$, the Fe – C bond possesses

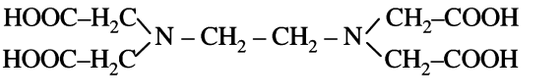
(a) ionic character (b) σ-character only

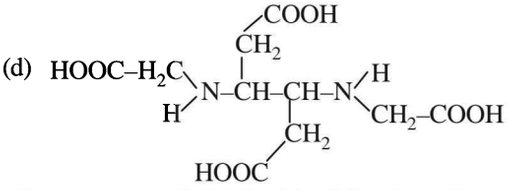
(c) π-character (d) both σ and π characters

20. The correct structure of ethylenediaminetetraacetic acid (EDTA) is

(a) 

(b) 

(c) 

(d) 

21. The structure of which of the following chloro species can be explained on the basis of dsp^2 hybridization ?

(a) $PdCl_4^{2-}$ (b) $FeCl_4^{2-}$

(c) $CoCl_4^{2-}$ (d) $NiCl_4^{2-}$

22. The octahedral complex of a metal ion M^{3+} with four monodentate ligands L_1, L_2, L_3 and L_4 absorb wavelengths in the region of red, green, yellow and blue, respectively. The increasing order of ligand strength of the four ligands is:

(a) $L_4 < L_3 < L_2 < L_1$ (b) $L_1 < L_3 < L_2 < L_4$

(c) $L_3 < L_2 < L_4 < L_1$ (d) $L_1 < L_2 < L_4 < L_3$

23. Which one of the following coordination compounds is used to inhibit the growth of tumours?

(a) Trans-platin (b) EDTA complex of calcium

(c) $[(Ph_3P)_3RhCl]$ (d) Cis-platin

24. $[NiCl_2\{P(C_2H_5)_2(C_6H_5)\}_2]$ exhibits temperature dependent magnetic behaviour (paramagnetic/diamagnetic). The coordination geometries of Ni^{2+} in the paramagnetic and diamagnetic states are respectively

(a) tetrahedral and tetrahedral

(b) square planar and square planar

(c) tetrahedral and square planar

(d) square planar and tetrahedral

RESPONSE GRID					
	15. ⓐⓑⓒⓓ	**16.** ⓐⓑⓒⓓ	**17.** ⓐⓑⓒⓓ	**18.** ⓐⓑⓒⓓ	**19.** ⓐⓑⓒⓓ
	20. ⓐⓑⓒⓓ	**21.** ⓐⓑⓒⓓ	**22.** ⓐⓑⓒⓓ	**23.** ⓐⓑⓒⓓ	**24.** ⓐⓑⓒⓓ

25. Which will give a white precipitate with $AgNO_3$ in aqueous solution

(a) $[Co(NH_3)_5Cl](NO_2)_2$ (b) $[Pt(NH_3)_6]Cl_4$

(c) $[Pt(en)Cl_2]$ (d) $[Cu(NH_3)_4]SO_4$

26. Which of the following name formula combinations is not correct?

Formula		
(a)	K2[Pt(CN)4]	Potassium tetracyanoplatinate (II)
(b)	[Mn(CN)5]2–	Pentacyanomagnate (II) ion
(c)	K[Cr(NH3)2Cl4]	Potassium diammine tetrachlorochromate (III)
(d)	[Co(NH3)4(H2O)I]SO4	Magnetron value.

27. Nickel (Z = 28) combines with a uninegative monodentate ligand to form a diamagnetic complex $[NiL_4]^{2-}$. The hybridisation involved and the number of unpaired electrons present in the complex are respectively:

(a) sp^3, two (b) dsp^2, zero

(c) dsp^2, one (d) sp^3, zero

28. Which of the following species is not expected to be a ligand?

(a) NO (b) NH_4^+

(c) $NH_2CH_2CH_2NH_2$ (d) Both (a) and (b)

29. Which of the following organometallic compound is σ and π -bonded ?

(a) $[Fe(\eta^5-C_5H_5)_2]$ (b) $[PtCl_3(\eta^2-C_2H_4)]$

(c) $[Co(CO)_5NH_3]^{2+}$ (d) $Al(CH_3)_3$

30. The most stable complex among the following is

(a) $K_3[Al(C_2O_4)_3]$ (b) $[Pt(en)_2]Cl$

(c) $[Ag(NH_3)_2]Cl$ (d) $K_2[Ni(EDTA)]$

RESPONSE GRID	25. ⓐⓑⓒⓓ 26. ⓐⓑⓒⓓ 27. ⓐⓑⓒⓓ 28. ⓐⓑⓒⓓ 29. ⓐⓑⓒⓓ 30. ⓐⓑⓒⓓ

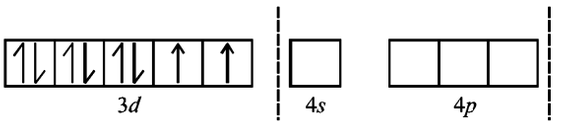
DAILY PRACTICE PROBLEM DPP CHAPTERWISE 23 - CHEMISTRY			
Total Questions	30	Total Marks	120
Attempted		Correct	
Incorrect		Net Score	
Cut-off Score	36	Qualifying Score	54
Success Gap = Net Score – Qualifying Score			
Net Score = (Correct × 4) – (Incorrect × 1)			

1. **(b)** According to spectrochemical series $C_2O_4^{2-} > F^-$.

2. **(b)** CN^- is coordinated to cobalt as the ligand and coordinated compounds have different properties than the individual species.

3. **(d)**

4. **(d)** $[Ni\,X_4]^{2-}$, the electronic configuration of Ni^{2+} is



It contains two unpaired electrons and the hybridisation is sp^3 (tetrahedral).

5. **(b)** The crystal field splitting in tetrahedral complexes is lower than that in octahedral complexes, and $\Delta_t = -\frac{4}{9}\Delta_0$.

6. **(b)**

7. **(a)** $[Co(NH_3)_5CO_3]ClO_4$. Six monodentate ligands are attached to Co hence C. N. of Co = 6;

O. N. $= x + 5 \times (0) + 1 \times (-2) + 1 \times (-1) = 0 \therefore x = +3$; electronic configuration of Co^{3+}[Ar] $3d^6 4s^0$ hence number of d electrons is 6. All d electrons are paired due to strong ligand hence unpaired electron is zero.

8. **(a)** EDTA has hexadentate four donor O atoms and 2 donor N atoms and for the formation of octahedral complex one molecule is required

9. **(c)** $[Mn(CN)_6]^{3-}$ and $[Fe(CN)_6]^{3-}$ are inner orbital complexes and paramagnetic while $[Co(C_2O_4)_3]^{3-}$ is diamagnetic in nature.

10. **(a)** $Ti(C_2H_4)_4$ is an organometallic compound due to Ti directly attached to C- atom

11. **(d)** Tetraethyl lead $Pb(C_2H_5)_4$ is not π bonded complex. It is σ bonded organometallic compound

12. **(a)** $\underset{2.675g}{CoCl_3.6NH_3} \longrightarrow xCl^-$

$xCl^- + AgNO_3 \longrightarrow \underset{4.78g}{x\,AgCl\downarrow}$

Number of moles of the complex

$= \frac{2.675}{267.5} = 0.01$ moles

Number of moles of AgCl obtained

$= \frac{4.78}{143.5} = 0.03$ moles

$\therefore$ No. of moles of AgCl obtained

$= 3 \times$ No. of moles of complex

$\therefore n = \frac{0.03}{0.01} = 3$

13. **(b)** The chemical formula of Pentaminenitrochromium (III) chloride is

$[Cr(NH_3)_5NO_2]Cl_2$

It can exist in following two structures

$[Cr(NH_3)_5NO_2]Cl_2$ and

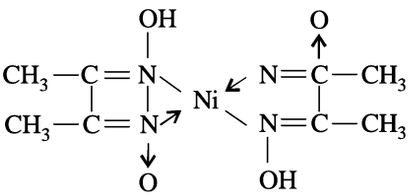
$[Cr(NH_3)_5ONO]Cl_2$

Therefore the type of isomerism found in this compound is linkage isomerism as nitro group is linked through N as $-NO_2$ or through O as – ONO.

14. **(c)** Nickel ions are frequently detected by the formation of red precipitate of the complex of nickel dimethylglyoxime, when heated with dimethylglyoxime.

$CH_3-C=NOH$
$\quad\quad\quad|$
$CH_3-C=NOH$ $+ Ni^{++} \longrightarrow$

Dimethylglyoxime



Nickel dimethylglyoxime

15. **(d)** $[Cr(H_2O)_4Cl_2]\,Cl + AgNO_3 \longrightarrow AgCl + [Cr(H_2O)_4Cl_2]NO_3$

$\text{Molarity} = \frac{\text{wt}}{\text{mol. mass}} \times \frac{1000}{\text{vol.}}$

$\frac{\text{wt}}{\text{mol. mass}} = \text{molarity} \times \frac{\text{vol.}}{1000} = \frac{0.01 \times 100}{1000}$

$= 0.001$

16. **(c)** Gd (64) = [Xe] $4f^7\,5d^1\,6s^2$

Gd^{3+} = [Xe] $4f^7\,5d^0\,6s^0$

i.e. no. of unpaired electrons = 7

$\mu = \sqrt{n(n+2)} = \sqrt{7(7+2)}$

$= \sqrt{63} = 7.93$ BM

17. **(b)**

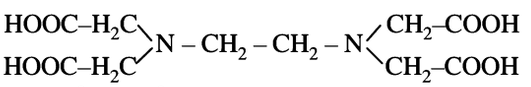
18. **(d)** isomers

$$\underset{\text{cis and trans}}{[Ru(NH_3)_4Cl_2]^+},\underset{\text{none}}{[Co(NH_3)_5Cl]^{2+}},$$

$$\underset{\text{cis and trans}}{[Ir(PR_3)_2H(CO)]^{2+}},\underset{\text{cis and trans and optical isomers}}{[Co(en)_2Cl_2]^+}$$

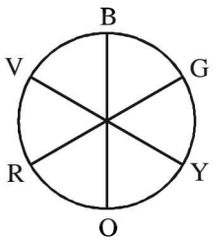
19. **(d)** Due to some backbonding by sidewise overlapping between d-orbitals of metal and p-orbital of carbon, the F–C bond has σ and π character.

20. **(c)** The correct structure of EDTA is



21. **(a)** $[PdCl_4]^{2-}$ is dsp^2 hybridized and square planar in shape.

22. **(b)**



For a given metal ion, weak field ligands create a complex with smaller Δ, which will absorbs light of longer λ and thus lower frequency. Conserverly, stronger field ligands create a larger Δ, absorb light of shorter λ and thus higher ν i.e. higher energy.

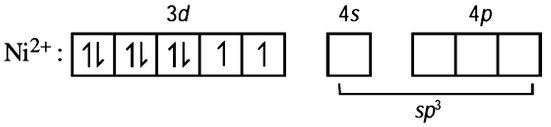
$$\underset{\lambda = 650\text{ nm}}{\text{Red}} < \underset{570\text{ nm}}{\text{Yellow}} < \underset{490\text{ nm}}{\text{Green}} < \underset{450\text{ nm}}{\text{Blue}}$$

So order of ligand strength is

$$L_1 < L_3 < L_2 < L_4$$

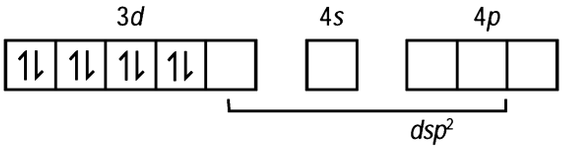
23. **(d)**

24. **(c)** In both states (paramagnetic and diamagnetic) of the given complex, Ni exists as Ni^{2+} whose electronic configuration is [Ar] $3d^8 4s^0$.



In the above paramagnetic state the geometry of the complex is sp^3 giving tetrahedral geometry.

The diamagnetic state is achieved by pairing of electrons in 3d orbital.



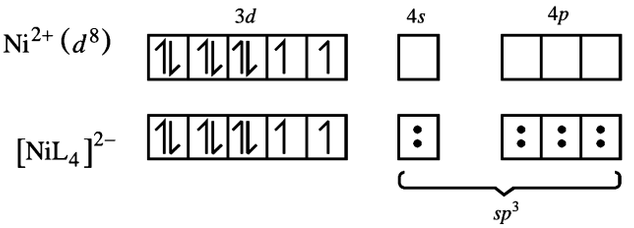
Thus the geometry of the complex will be dsp^2 giving square planar geometry.

25. **(b)** $\left[Pt(NH_3)_6\right]Cl_4 \rightleftharpoons \left[Pt(NH_3)_6\right]^{4+} + 4Cl^-;$

$$Ag^+ + \bar{C}l \rightarrow AgCl \text{ (ppt)}$$

26. **(b)** The correct IUPAC Name of $[Mn(CN)_5]^{2-}$.
Pentacyanomangnate (III).

27. **(a)** $[NiL_4]^{2-}$



i.e, no. of unpaired electron = 2
hybridization – sp^3.

28. **(b)**

29. **(c)** In $[Co(CO)_5NH_3]^{2+}$ CO is bonded to cobalt through σ and π bonding.

30. **(d)** K_2[Ni(EDTA)]. Since EDTA is hexadentate and chelating and coordinates from six sides forming more stable complex.