DPP - Daily Practice Problems

Name :

Date :

Start Time :

End Time :

CHEMISTRY 45

SYLLABUS : Coordination Compounds

Max. Marks : 120 **Time : 60 min.**

GENERAL INSTRUCTIONS

- The 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.
- You have to evaluate your Response Grids youself with the help of solution booklet.
- Each correct answer will get you 4 marks and 1 mark shall be deduced for each incorrect answer. No mark will be given/ deducted if no bubble is filled. Keep a timer in front of you and stop immediately at the end of 60 min.
- The sheet follows a particular syllabus. Do not attempt the sheet before you have completed your preparation for that syllabus. Refer syllabus sheet in the starting of the book for the syllabus of all the DPP sheets.
- After completing the sheet check your answers with the solution booklet and complete the Result Grid. Finally spend time to analyse your performance and revise the areas which emerge out as weak in your evaluation.

DIRECTIONS (Q.1-Q.21) : There are 21 multiple choice questions. Each question has 4 choices (a), (b), (c) and (d), out of which ONLY ONE choice is correct.

Q.1 Which is the example of hexadentate ligand?

(a) 2, 2- dipyridyl

(b) Dimethyl glyoxime

(c) Aminodiacetate ion

(d) Ethylene diammine tetraacetate ion (EDTA)

Q.2 In the extraction of which of the following, complex ion is formed?

(a) Cu (b) Ag

(c) Fe (d) Na

Q.3 EDTA has coordination number

(a) 3 (b) 4 (c) 5 (d) 6

Q.4 Given the molecular formula of the hexa-coordinated complexes (A) $CoCl_3.6NH_3$, (B) $CoCl_3$. $5NH_3$ and (C) $CoCl_3.4NH_3$. If the number of co-ordinated NH_3 molecules in A, B and C respectively are 6,5 and 4, the primary valency in (A), (B) and (C) respectively are:

(a) 6, 5, 4 (b) 3, 2, 1 (c) 0, 1, 2 (d) 3,3,3

Q.5 The formula of alum is

(a) $K_2SO_4.Al_2(SO_4)_3.24H_2O$

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

(c) $K_2SO_4.Al_2(SO_4)_3.6H_2O$

(d) $Na_2CO_3.10H_2O$

RESPONSE GRID	1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ	4. ⓐⓑⓒⓓ	5. ⓐⓑⓒⓓ

Space for Rough Work

Q.6 The oxidation number of chromium in sodium tetrafluoro-oxochromate complex is

(a) II

(b) IV

(c) VI

(d) III

Q.7 The EAN of iron in potassium ferricyanide is

(a) 18

(b) 54

(c) 35

(d) 23

Q.8 The chemical formula of diammine silver (I) chloride is

(a) $[Ag(NH_3)]Cl$

(b) $[Ag(NH_3)_2]Cl$

(c) $[Ag(NH_3)_3]Cl$

(d) $[Ag(NH_4)_2]Cl$

Q.9 The IUPAC name of $[Cr(NH_3)_6]^{3+}$ is

(a) Hexamminechromium (VI) ion

(b) Hexamminechromium (III) ion

(c) Hexamminechromium (II) ion

(d) Hexamminechloride

Q.10 The IUPAC name of the coordination compound $K_3[Fe(CN)_6]$ is

(a) Potassium hexacyanoferrate (II)

(b) Potassium hexacyanoferrate (III)

(c) Potassium hexacyanoiron (II)

(d) Tripotassium hexacyanoiron (II)

Q.11 $[Co(NH_3)_5NO_2]Cl_2$ and $[Co(NH_3)_5(ONO)]Cl_2$ are related to each other as

(a) geometrical isomers

(b) optical isomers

(c) linkage isomers

(d) coordination isomers

Q.12 Amongst $Ni(CO)_4$, $[Ni(CN)_4]^{2-}$ and $[NiCl_4]^{2-}$

(a) $Ni(CO)_4$ and $[NiCl_4]^{2-}$ are diamagnetic and $[Ni(CN)_4]^{2-}$ is paramagnetic

(b) $[NiCl_4]^{2-}$ and $[Ni(CN)_4]^{2-}$ are diamagnetic and $Ni(CO)_4$ is paramagnetic

(c) $Ni(CO)_4$ and $[Ni(CN)_4]^{2-}$ are diamagnetic and $[NiCl_4]^{2-}$ is paramagnetic

(d) $Ni(CO)_4$ is diamagnetic and $[NiCl_4]^{2-}$ and $[Ni(CN)_4]^{2-}$ are paramagnetic

Q.13 $[Co(NH_3)_4Cl_2]^+$ exhibits

(a) Geometrical isomerism

(b) Optical isomerism

(c) Bonding isomerism

(d) Ionisation isomerism

Q.14 Magnetic moment of $[Cu(NH_3)_4]^{2+}$ ion is

(a) 1.414

(b) 1.73

(c) 2.23

(d) 2.38

Q.15 The type of magnetism exhibited by $[Mn(H_2O)_6]^{2+}$ ion is

(a) Paramagnetism

(b) Diamagnetism

(c) Both (a) and (b)

(d) None of these

Q.16 (i) $K_4[Fe(H_2O)_6]$

(ii) $K_3[Cr(CN)_6]$

(iii) $K_3[Fe(CN)_6]$

(iv) $K_2[Ni(CN)_4]$

Choose the complex which is paramagnetic

(a) (i), (ii) and (iii)

(b) (i), (iii) and (iv)

(c) (ii), (iii), and (iv)

(d) (i), (ii) and (iv)

Q.17 Which of the following is an outer orbital complex ?

(a) $[Fe(CN)_6]^{4-}$

(b) $[Mn(CN)_6]^{4-}$

(c) $[Co(NH_3)_6]^{3+}$

(d) $[Ni(NH_3)_6]^{2+}$

Q.18 CN^- is a strong field ligand. This is due to the fact that

(a) It can accept electron from metal species

(b) It forms high spin complexes with metal species

(c) It carries negative charge.

(d) It is a pseudohalide

Q.19 A co-ordination complex compound of cobalt has the molecular formula containing five ammonia molecules, one nitro group and two chlorine atoms for one cobalt atom. One mole of this compound produces three mole ions in an aqueous solution; on reacting with excess of $AgNO_3$, AgCl is precipitated. The ionic formula for this complex would be:

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

(b) $[Co(NH_3)_5Cl][Cl(NO_2)]$

(c) $[Co(NH_3)_4(NO_2)Cl][(NH_3)Cl]$

(d) $[Co(NH_3)_5][NO_2)_2Cl_2]$

RESPONSE GRID	5. ⓐⓑⓒⓓ	6. ⓐⓑⓒⓓ	7. ⓐⓑⓒⓓ	8. ⓐⓑⓒⓓ	9. ⓐⓑⓒⓓ
	10. ⓐⓑⓒⓓ	11. ⓐⓑⓒⓓ	12. ⓐⓑⓒⓓ	13. ⓐⓑⓒⓓ	14. ⓐⓑⓒⓓ
	15. ⓐⓑⓒⓓ	16. ⓐⓑⓒⓓ	17. ⓐⓑⓒⓓ	18. ⓐⓑⓒⓓ	19. ⓐⓑⓒⓓ

Space for Rough Work

Q.20 Which reagent can be used to identify nickel ion?

(a) Resorcinol

(b) Dimethyl glyoxime [DMG]

(c) Diphenyl benzidine

(d) Potassium ferrocyanide

Q.21 Which of the following does not have a metal carbon bond?

(a) K [Pt (C_2H_4)Cl_3] (b) Ni $(CO)_4$

(c) Al $(OC_2H_5)_3$ (d) C_2H_5 MgBr

DIRECTIONS (Q.22-Q.24) : In the following questions, more than one of the answers given are correct. Select the correct answers and mark it according to the following codes:

Codes :

(a) 1, 2 and 3 are correct

(b) 1 and 2 are correct

(c) 2 and 4 are correct

(d) 1 and 3 are correct

Q.22 Which of the following are true for ligand-metal complex ?

(1) Larger the ligand, the more stable is the metal-ligand bond.

(2) Larger the permanent dipole moment of ligand, the more stable is the bond.

(3) Greater the ionization potential of central metal, the stronger is the bond.

(4) Highly charged ligand forms strong bond.

Q.23 Which of the following statements are correct?

(1) Absorption peak for $[Cr^{III}(NH_3)_6]^{3+}$ is 21680 cm^{-1}.

(2) Crystal field stabilization energy of d^2 in weak ligand field is $(-)0.8\Delta_0$.

(3) Example of weak ligand field for d^5 configuration is $[Mn^{II}F_6]^{4-}$.

(4) Effective atomic number of Pt in $[PtCl_6]^{2-}$ is 84.

Q.24 Which of the following are true for metal carbonyls?

(1) The oxidation state of the metal in the carbonyls is zero.

(2) The secondary carbonyls are obtained from photodecomposition.

(3) Metal carbonyls are single bonded species.

(4) $d\pi - p\pi$ overlap is observed in metal carbonyls.

DIRECTIONS (Q.25-Q.27) : Read the passage given below and answer the questions that follows :

The coordination number of Ni^{2+} is 4.

$$NiCl_2 + KCN(excess) \longrightarrow A \text{ (cyano complex)}$$

$$NiCl_2 + Conc.\ HCl(excess) \longrightarrow B \text{ (chloro complex)}$$

Q.25 The IUPAC name of A and B are

(a) Potassium tetracyanonickelate (II), potassium tetrachloronickelate (II)

(b) Tetracyanopotassiumnickelate (II), tetrachloropotassiumnickelate (II)

(c) Tetracyanonickel (II), tetrachloronickel (II)

(d) Potassium tetracyanonickel (II), potassium tetrachloronickel (II)

Q.26 Predict the magnetic nature of A and B

(a) Both are diamagnetic

(b) A is diamagnetic and B is paramagnetic with one unpaired electron

(c) A is diamagnetic and B is paramagnetic with two unpaired electrons

(d) Both are paramagnetic

RESPONSE GRID					
	20.ⓐⓑⓒⓓ	21.ⓐⓑⓒⓓ	22.ⓐⓑⓒⓓ	23.ⓐⓑⓒⓓ	24.ⓐⓑⓒⓓ
	25.ⓐⓑⓒⓓ	26.ⓐⓑⓒⓓ			

Q.27 The hybridization of A and B are

(a) dsp^2, sp^3

(b) sp^3, sp^3

(c) dsp^2, dsp^2

(d) sp^3d^2, d^2sp^3

DIRECTIONS (Q. 28-Q.30) : Each of these questions contains two statements: Statement-1 (Assertion) and Statement-2 (Reason). Each of these questions has four alternative choices, only one of which is the correct answer. You have to select the correct choice.

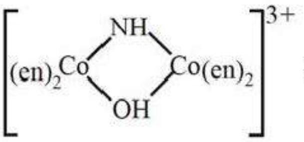
(a) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

(b) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.

(c) Statement - 1 is False, Statement-2 is True.

(d) Statement - 1 is True, Statement-2 is False.

Q.28 Statement -1 :



is named as tetrakis (ethylenediamine) μ - hydroxo- imido dicobalt (III) ion.

Statement-2 : In naming polynuclear complexes i.e., containing two or more metal atoms joined by bridging ligands, the word μ is added with hyphen before the name of such ligands.

Q.29 Statement-1 : $[Fe(CN)_6]^{3-}$ is weakly paramagnetic while $[Fe(CN)_6]^{4-}$ is diamagnetic.

Statement-2 : $[Fe(CN)_6]^{3-}$ has +3 oxidation state while $[Fe(CN)_6]^{4-}$ has +2 oxidation state.

Q.30 Statement-1 : $[Ti(H_2O)_6]^{3+}$ is coloured while $[Sc(H_2O)_6]^{3+}$ is colourless.

Statement-2 : *d-d*–Transition is not possible in $[Sc(H_2O)_6]^{3+}$

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

DAILY PRACTICE PROBLEM SHEET 45 - CHEMISTRY

Total Questions	30	Total Marks	120
Attempted		Correct	
Incorrect		Net Score	
Cut-off Score	36	Qualifying Score	56
Success Gap = Net Score – Qualifying Score			
Net Score = (Correct × 4) – (Incorrect × 1)			

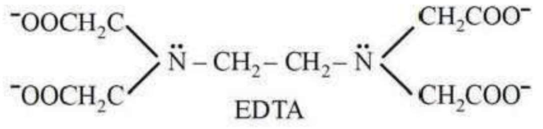
Space for Rough Work

DAILY PRACTICE PROBLEMS

CHEMISTRY SOLUTIONS

45

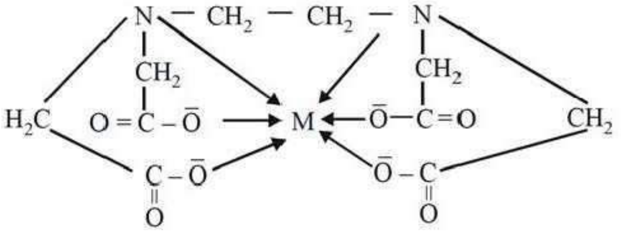
1. **(d)**



2 **(b)** $Ag_2S + 4NaCN \rightleftharpoons 2Na\underset{\text{Sodium dicynoargentate}}{\left[Ag(CN)_2\right]} + Na_2S$

$2Na\left[Ag(CN)_2\right] + Zn \rightarrow \underset{\text{Sodium tetracynozincate (ppt)}}{Na_2\left[Zn(CN)_4\right]} + 2Ag\downarrow$

3. **(d)** The number of atom of the ligand that are directly bound to the central metal atom or ion by coordinate bonds is known as the coordinate number of the metal or ion. It is actually the number of chemical bonds which the ligand form with the central metal atom or ion.



4. **(b)** The complexes can be written as follows

$\underset{(A)}{[Co(NH_3)_6]Cl_3}$; $\underset{(B)}{[Co(NH_3)_5Cl]Cl_2}$; $\underset{(C)}{[Co(NH_3)_4Cl_2]Cl}$

Hence, number of primary valencies are 3,2 and 1 respectively.

5. **(a)** General formula for alum is
$M_2SO_4 . M'_2(SO_4)_3 . 24H_2O$
M = monovalent cation (K^+, Na^+.....)
M ′ = Trivalent cation (Al^{+3}, Fe^{+3})
Hence, $K_2SO_4 . Al_2(SO_4)_3 . 24H_2O$ represent an alum.

6. **(b)** $[CrF_4O]^{2-}$
$x + 4(-1) + (-2) = -2$
$x - 6 = -2$
$x = +4.$

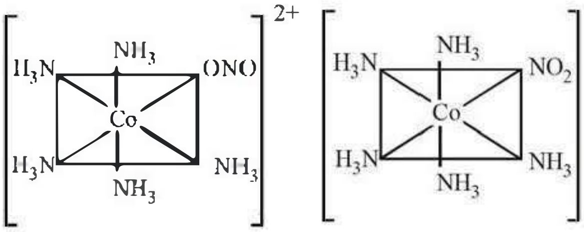
7. **(c)** EAN of a central metal ion = (atomic no. of central atom) – oxidation state + no. of ligands × 2
EAN of Fe in $[Fe(CN)_6]^{3-}$
$= 26 - 3 + (6 \times 2) = 23 + 12 = 35$

8. **(b)** It is clear from the chemical formula that Ag is central metal atom and ligands are 2 ammonia molecules. Hence, compound is $[Ag(NH_3)_2]Cl$.

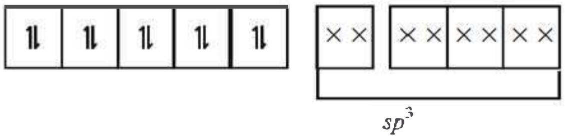
9. **(b)** In the given ion $[Cr(NH_3)_6]^{3+}$, the oxidation state of chromium is +3 and here $6NH_3$ ligands are attached to the central metal atom. Therefore, its IUPAC name is hexamminechromium (III) ion.

10. **(b)** Potassium hexacyanoferrate (III).

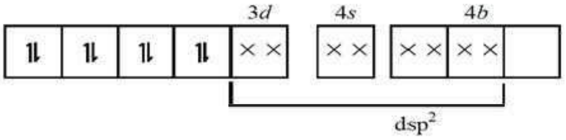
11. **(c)**



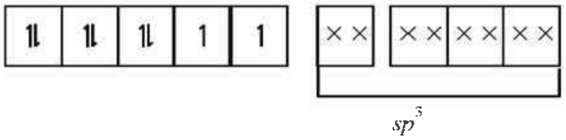
12. **(c)** The electronic configuration of Ni in
Ni in $[Ni(CO)_4]$



Ni^+ in $[Ni(CN)_4]^{2-}$

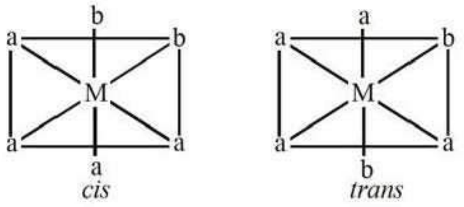


Ni^{2+} in $[Ni(Cl_4)]^{2-}$



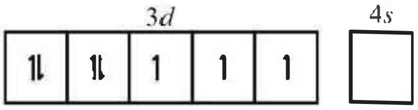
CN^- is strong ligand so it induces pairing of electrons so the complex is diamagnetic while Cl^- is a weak ligand so it does not induce the pairing of electrons so its complex is paramagnetic.

13. **(a)** $[Co(NH_3)_4Cl_2]^+$ is the Ma_4b_2 type complex.



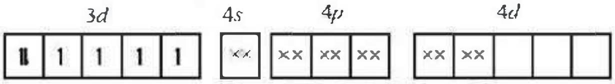
14. **(a)** Magnetic moment of $[Cu(NH_3)_4]^{2+}$ ion is 1.414 due to the presence of one unpaired electron.

15. **(a)** Mn^{2+}



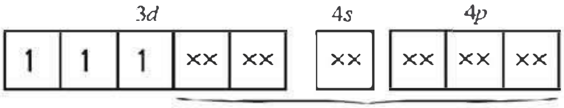
In presence of H_2O which is a weak ligand, no pairing occurs which results in unpaired electrons left in the compound, due to which it shows paramagnetism.

16. **(a)** (i) $[Fe(H_2O)_6]^{4-}$



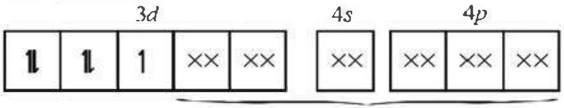
sp^3d^2, Paramagnetic

(ii) $[Cr(CN)_6]^{3-}$



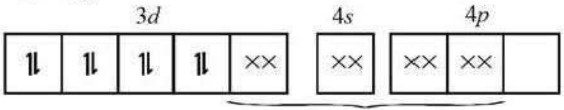
d^2sp^3, Paramagnetic

(iii) $[Fe(CN)_6]^{3-}$



d^2sp^3, Paramagnetic

(iv) $[Ni(CN)_4]^{2-}$



dsp^2, Diamagnetic

Thus complexes (i), (ii) and (iii) are paramagnetic species.

17. **(d)** $[Fe(CN)_6]^{4-}$: Fe (II) – $3d^6$; inner orbital complex (d^2sp^3) ; $n = 0$

$[Mn(CN)_6]^{4-}$: Mn (II) – $3d^5$; inner orbital complex (d^2sp^3) ; $n = 1$

$[Co(NH_3)_6]^{3+}$: Co^{3+} – $3d^6$; inner orbital complex (d^2sp^3) ; $n = 0$

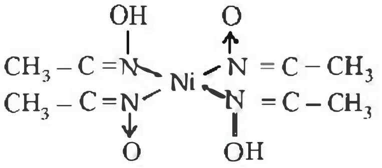
$[Ni(NH_3)_6]^{2+}$: Ni^{2+} – $3d^8$; NH_3 although a strong ligand, can't make all 3d electrons paired, hence two 3d electrons are present, thus outer orbital complex (sp^3d^2) ; $n = 2$

18. **(d)** Cyanide ion is strong field ligand because it is a pseudohalide ion, pseudohalide ions are stronger coordinating ligands & they have the ability to form σ bond (from the pseudohalide to the metal) and π bond (from the metal to pseudohalide).

19. **(a)** The most probable complex which gives three mole ions in aqueous solution may be $[Co(NH_3)_5NO_2]Cl_2$.

$$[Co(NH_3)_5(NO_2)]Cl_2 \rightarrow [Co(NH_3)_5NO_2]^{2+} + 2Cl^-$$

20. **(b)** Ni reacts with dimethylglyoxime to give red ppt. of nickel - diethylglyoxime complex.



21. **(c)** Al $(OC_2H_5)_3$ contains bonding through O and thus it does not have metal-carbon bond.

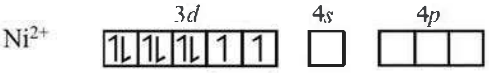
22. **(a)** The charge does not decide the formation of bond but availability of lone pair decides the formation of coordination bond.

23. **(a)** EAN of Pt in $[PtCl_6]^{2-} = 80$

24. **(a)** Metal carbonyls do not show overlapping.

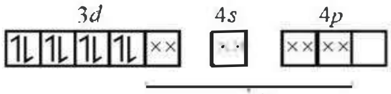
25. **(a)** $Ni^{2+} \xrightarrow[\text{excess}]{KCN} K_2[Ni(CN)_4]$; $Ni^{2+} \xrightarrow[\text{(excess)}]{KCl} K_2[NiCl_4]$

26. **(c)** For $[Ni(CN)_4]^{2+}$; Ni = $[Ar]3d^84s^2$; $Ni^{2+} = [Ar]3d^8$



However, CN^- is a strong field ligand so it forces the 3d electrons to pair up and hence the effective configuration in this case will be

Ni^{2+} in presence of CN^-

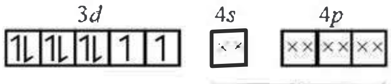


dsp^2

Thus $[Ni(CN)_4]^{2-}$ exhibits dsp^2 hybridization and square planar shape. Since here number of unpaired electrons is zero the complex will be *diamagnetic*.

In case of $[NiCl_4]^{2-}$, Cl^- is a weak field ligand, so the effective configuration of Ni^{2+} in this complex will be as follows :

Ni^{2+} in presence of Cl^-

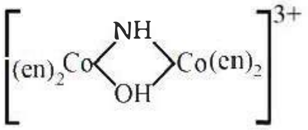


sp^3

So here Ni^{2+} is sp^3 hybridised and thus tetrahedral in shape. Since the complex has two unpaired electrons, it will be *paramagnetic*.

27. **(a)** Discussed above.

28. **(c)** Statement-1 is false but Statement-2 is true.



is named as tetrakis (ethylenediamine) - μ -hydroxo - μ - imido dicobalt (III) ion. For more than one bridging group the word μ is repeated before each bridging group.

29. **(b)** $[Fe(CN)_6]^{3-}$ possesses unpaired electron to show paramagnetic nature while $[Fe(CN)_6]^{4-}$ possesses no unpaired electron and thus shows diamagnetic nature.

30. **(a)** $[Sc(H_2O)_6]^{3+}$ has no unpaired electron in its d-subshell and thus d -d transition is not possible whereas $[Ti(H_2O)_6]^{3+}$ has one unpaired electron in its d-dubshell which gives rise to d - d transition to impart colour.