

① Chemical bonding

② Co-ordination

③ d and f - BLOCK

(4) Periodic table / Quantum numbers

(S) P - Block

(7) S, p, d, f

COORDINATION COMPOUNDS

(2023)

1. Given below are two statements, one is labelled as Assertion A and the other is labelled as Reason R.

$$\text{Fe}^{+3} = 3d^5$$

$$\text{Fe}^{+3} = 3d^5$$

Assertion A: The spin only magnetic moment value for $[\text{Fe}(\text{CN})_6]^{3-}$ is 1.74BM,
whereas for $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$ is 5.92BM.



4-p.e

μ
1.73
2.80

Reason B : In both complexes, Fe is present in +3 oxidation state.

$\frac{1}{2}$

In the light of the above statements, choose the correct answer from the options given below:

(A) A is false but R is true

1111

3

3.87

(B) A is true but R is false

5.92

4

4.90

(C) Both A and R are true but R is NOT the correct explanation of A

77767

1.73

5

5.92

(D) Both A and R are true and R is the correct explanation of A

COORDINATION COMPOUNDS

2. Number of ambidentate ligands in a representative metal complex

[M(en)(SCN)₄] is . [en = ethylenediamine]



Bidentate ligand

COORDINATION COMPOUNDS

3. The IUPAC name of $K_3[Co(C_2O_4)_3]$ is:

- (A) Potassium tris(oxalato)cobaltate(III)
- (B) Potassium tris(oxalato)cobalt(III)
- (C) Potassium trioxalatocobalt(III) X
- ✓ (D) Potassium trioxalatocobaltate(III)

Potassium tri oxalato Cobaltate (III)

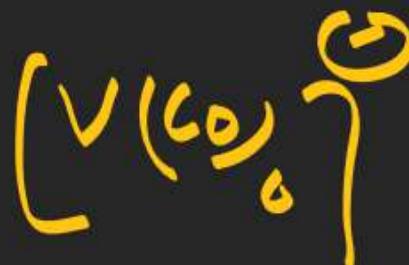
COORDINATION COMPOUNDS

4. Given below are two statements: one is labelled as "Assertion A" and the other is labelled as "Reason R" Assertion A : In the complex $\text{Ni}(\text{CO})_4$ and $\text{Fe}(\text{CO})_5$, the metals have zero oxidation state.

Reason R : Low oxidation states are found when a complex has ligands capable of π -donor character in addition to the σ -bonding.

In the light of the above statements, choose the most appropriate answer from the options given below

- (A) A is correct but R is not correct
- (B) A is not correct but R is correct
- (C) Both A and R are correct but R is NOT the correct explanation of A
- (D) Both A and R are correct and R is the correct explanation of A



COORDINATION COMPOUNDS

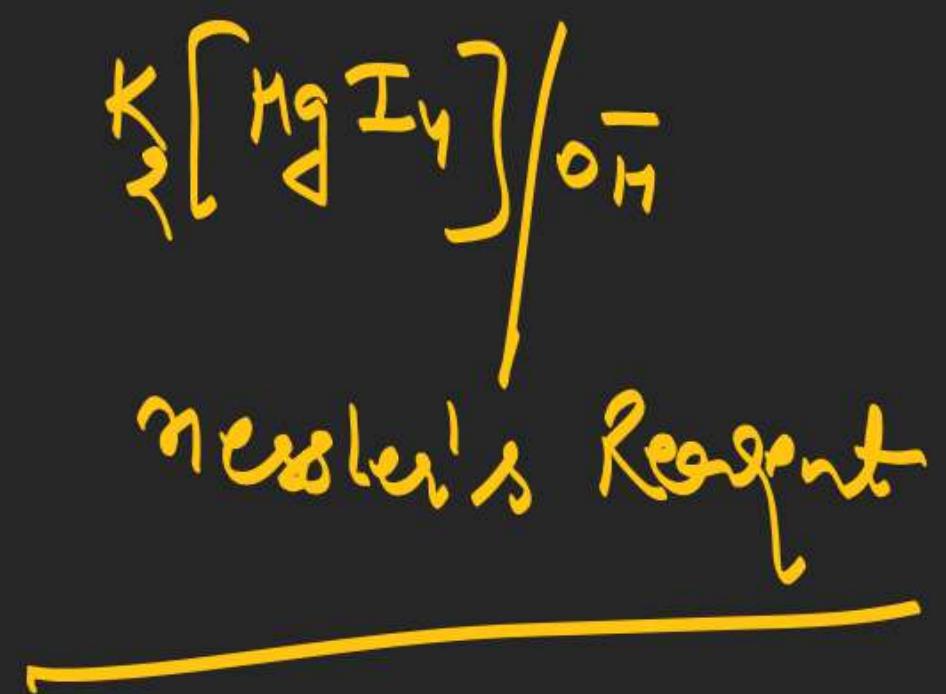
5. Element not present in Nessler's reagent is

(A) N

(B) Hg

(C) I

(D) K



COORDINATION COMPOUNDS

6. Which of the following complex is octahedral, diamagnetic and the most stable?



most

stable



because

Co⁺ better S.F. than among

COORDINATION COMPOUNDS

7. The correct order of spin only magnetic moments for the following complex ions is $\mu = \frac{+3}{\sigma} - \frac{5}{\sigma}$

- (A) $[\text{Fe}(\text{CN})_6]^{3-}$ < $[\text{CoF}_6]^{3-}$ < $[\text{MnBr}_4]^{2-}$ < $[\text{Mn}(\text{CN})_6]^{3-}$
- (B) $[\text{CoF}_6]^{3-} < [\text{MnBr}_4]^{2-} < [\text{Fe}(\text{CN})_6]^{3-} < [\text{Mn}(\text{CN})_6]^{3-}$
- ~~(C) $[\text{Fe}(\text{CN})_6]^{3-} < [\text{Mn}(\text{CN})_6]^{3-} < [\text{CoF}_6]^{3-} < [\text{MnBr}_4]^{2-}$~~
- (D) $[\text{MnBr}_4]^{2-} < [\text{CoF}_6]^{3-} < [\text{Fe}(\text{CN})_6]^{3-} < [\text{Mn}(\text{CN})_6]^{3-}$

$$\mu_s = \frac{+3}{\sigma} - \frac{5}{\sigma}$$



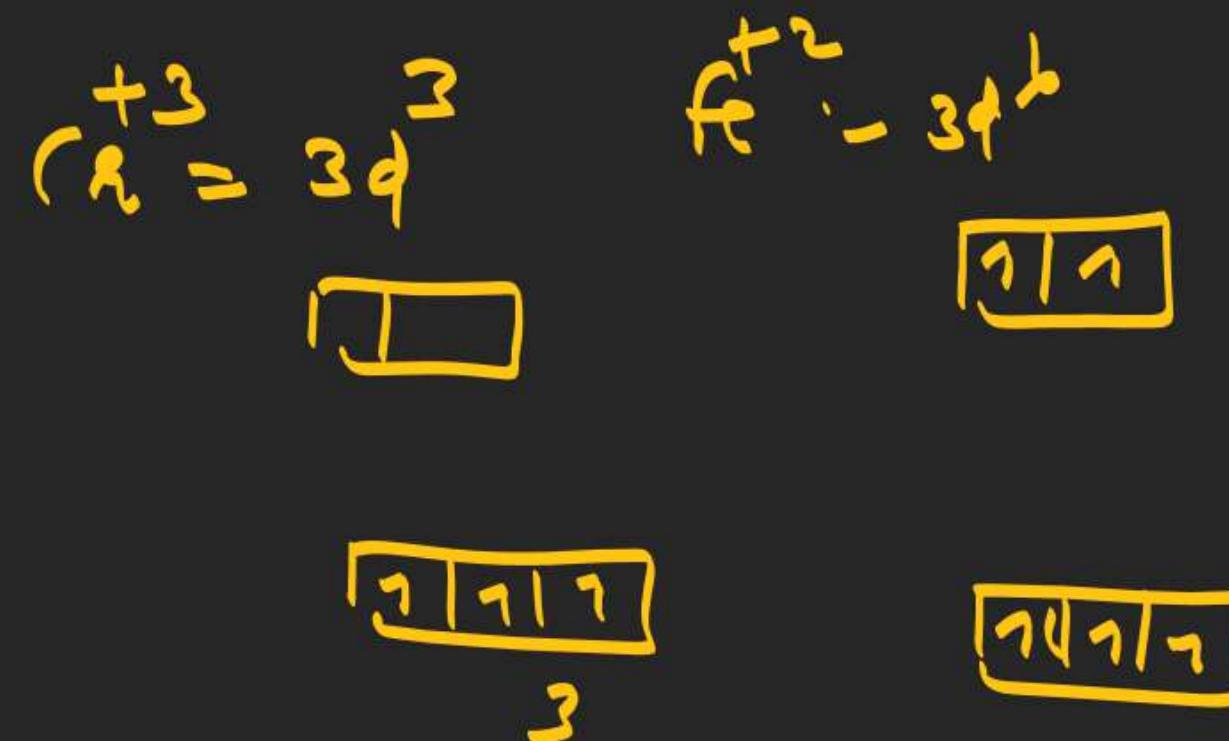
1
2

3
4

COORDINATION COMPOUNDS

8. Match List-I with List-II

	LIST-I Coordination Complex		LIST-II Number of unpaired electrons
A.	$[\text{Cr}(\text{CN})_6]^{3-}$	I.	0
B.	$[\text{Fe}(\text{L}_2\text{O})_6]^{2+}$	II.	3
C.	$[\text{Co}(\text{NH}_3)_6]^{3+}$	III.	2
D.	$[\text{Ni}(\text{NH}_3)_6]^{2+}$	IV.	4



Choose the correct answer from the options given below:

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

COORDINATION COMPOUNDS

9. The observed magnetic moment of the complex $[\text{Mn}(\text{NCS})_6]^{x-}$ is 6.06BM. The numerical value of x is

$$\varrho_m = \underline{\underline{5}}$$

$$\text{Mn} = 3d^5 4s^2$$

$$\text{Mn}^+ = 3d^5 4s^1$$

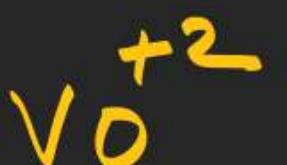
COORDINATION COMPOUNDS

10. The sum of oxidation state of the metals in $\text{Fe}(\text{CO})_5$, VO^{2+} and WO_3 is



O

Anm



$$x + (-2) = +2$$

$$x = +4$$

$$0 + 4 + 6 = \underline{10}$$



$$x + 3(-2) = 0$$

$$x = +6$$

COORDINATION COMPOUNDS

11. The octahedral diamagnetic low spin complex among the following is

- ~~(A)~~ $[\text{Co}(\text{NH}_3)_6]^{3+}$ (B) $[\text{CoF}_6]^{3-}$ (C) $[\text{CoCl}_6]^{3-}$ (D) $[\text{NiCl}_4]^2-$

COORDINATION COMPOUNDS

12. In potassium ferrocyanide, there are _____ pairs of electrons in the t_{2g} set of orbitals.



$$Fe^{+2} = 3d^6$$



COORDINATION COMPOUNDS

13. Match List-I with List-II.

List-I Complex	List-II Crystal Field splitting energy (Δ_0)
A. $[\text{Ti}(\text{H}_2\text{O})_6]^{2+}$	I. 1.2
B. $[\text{V}(\text{H}_2\text{O})_6]^{2+}$	II. -0.6
C. $[\text{Mn}(\text{H}_2\text{O})_6]^{3+}$	III. 0
D. $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$	IV. -0.8



$$\text{C.F.S.E} = -0.4x^2 \Delta_0 + 0.6 \Delta_0 y + m p$$

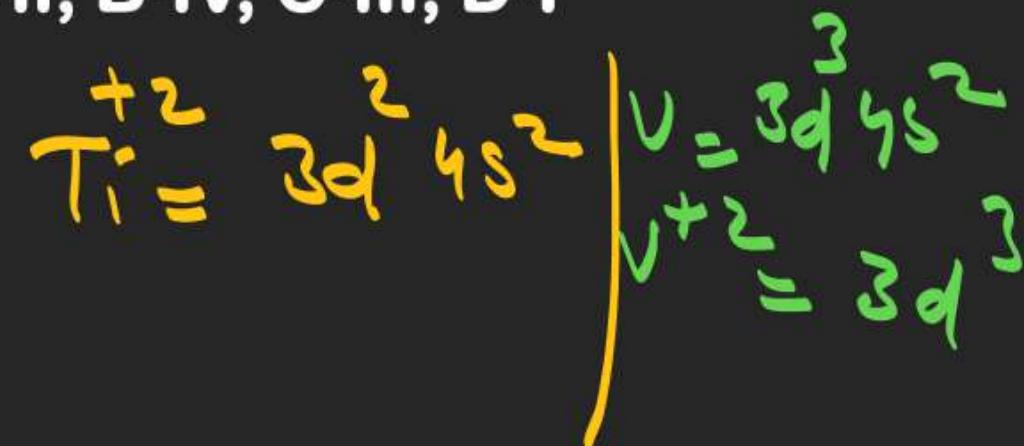
$$-0.4 \times 3 \Delta_0 =$$

$m = \text{pair of } e^-$

$p = \text{pairing energy}$

Choose the correct answer from the options given below:

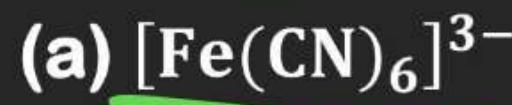
- (A) A-II, B-IV, C-I, D-III
- (B) A-IV, B-I, C-III, D-II
- ~~(C) A-IV, B-I, C-II, D-III~~
- (D) A-II, B-IV, C-III, D-I



COORDINATION COMPOUNDS

14. The correct order of the number of unpaired electrons in the given complexes

is



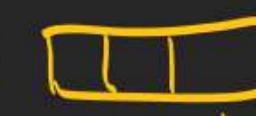
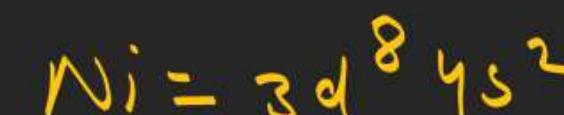
Choose the correct answer from the options given below:

(A) E < A < D < C < B

(B) E < A < B < D < C

(C) A < E, C < B < D

(D) A < E < D < C < B



Co is S.F.L hence it will pair up 4.p.e



COORDINATION COMPOUNDS

15. The complex that dissolves in water is

- (A) $(\text{NH}_4)_3[\text{As}(\text{Mo}_3\text{O}_{10})_4]$ yellow ppt
- (B) $\text{Fe}_4[\text{Fe}(\text{CN})_6]_3$ Prussian Blue
- (C) $\text{K}_3[\text{Co}(\text{NO}_2)_6]$
- (D) $[\text{Fe}_3(\text{OH})_2(\text{OAc})_6]\text{Cl}$ →
fisher salt
yellow ppt

COORDINATION COMPOUNDS

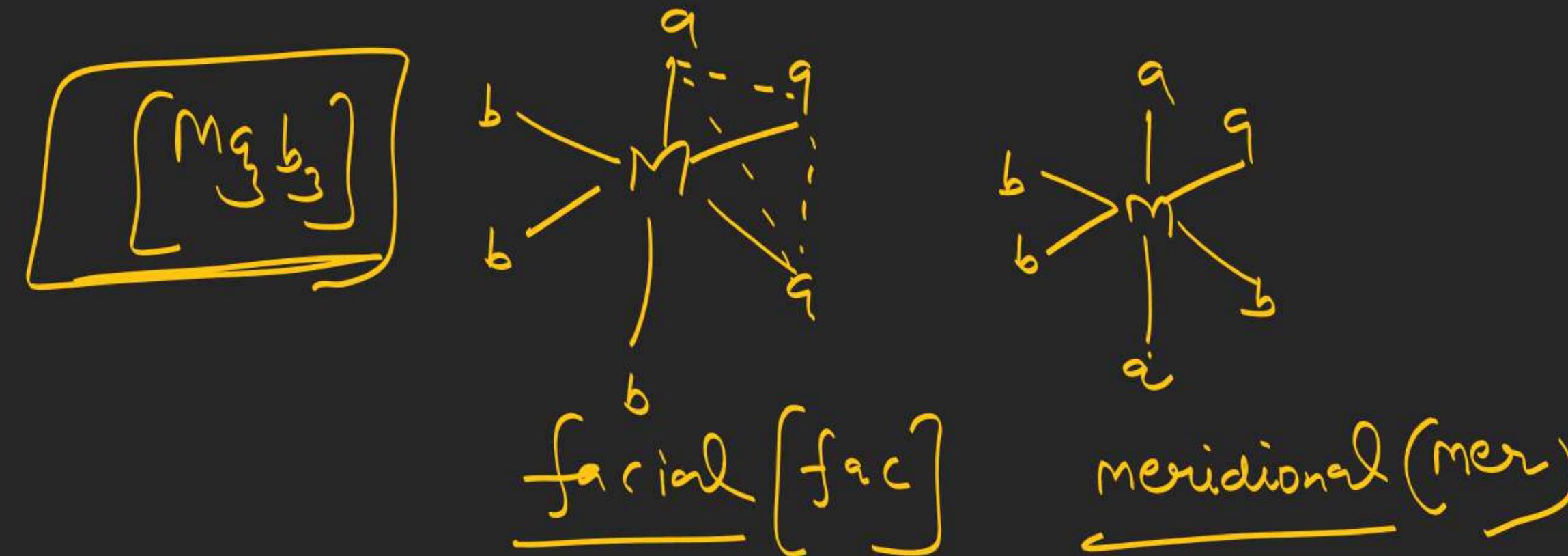
16. The set which **does not have ambidentate ligand(s)** is

- (A) ~~$\text{C}_2\text{O}_4^{2-}$, ethylene diammine, H_2O~~ (B) EDTA^{4-} , NCS^- , $\text{C}_2\text{O}_4^{2-}$
(C) NO_2^- , $\text{C}_2\text{O}_4^{2-}$, EDTA^{4-} (D) $\text{C}_2\text{O}_4^{2-}$, NO_2^- , NCS^-

COORDINATION COMPOUNDS

17. Which of the following complex has a possibility to exist as meridional isomer?

- (A) $[\text{Co}(\text{NH}_3)_3(\text{NO}_2)_3]$ (B) $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$
(C) $[\text{Co}(\text{en})_2\text{Cl}_2]$ (D) $[\text{Co}(\text{en})_3]$



COORDINATION COMPOUNDS

18. The ratio of spin-only magnetic moment values $\mu_{\text{eff}}[\text{Cr}(\text{CN})_6]^{3-}/\mu_{\text{eff}}[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$ is

(1)

$$\text{Cr}^{+3} = 3d^3$$

$$\text{Cr}^{+3} = \underline{3d^3}$$

$$\frac{3.81}{3.81} = 1$$

COORDINATION COMPOUNDS

19. If Ni^{2+} is replaced by Pt^{2+} in the complex $[\text{NiCl}_2\text{Br}_2]^{2-}$, which of the following properties are expected to get changed?

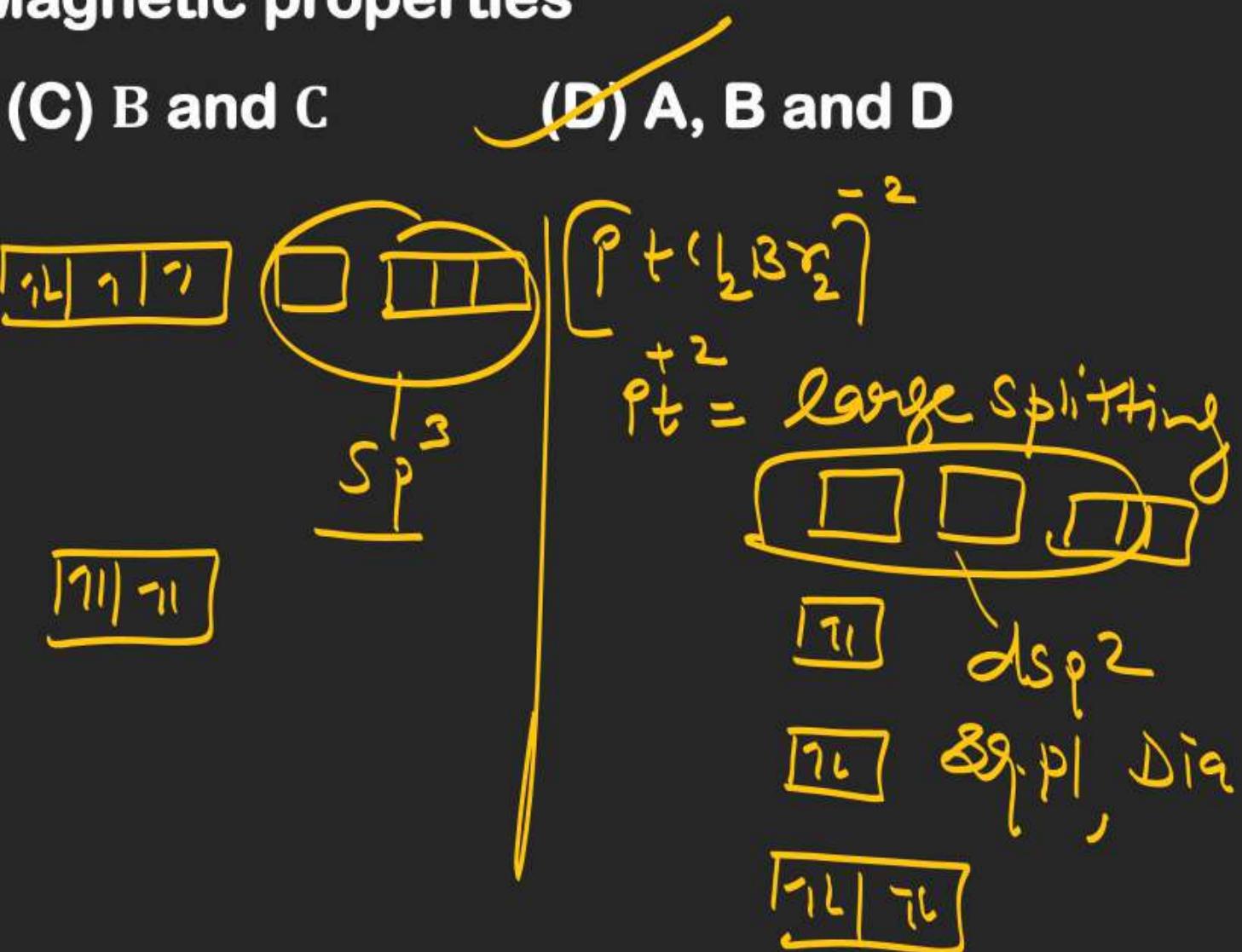
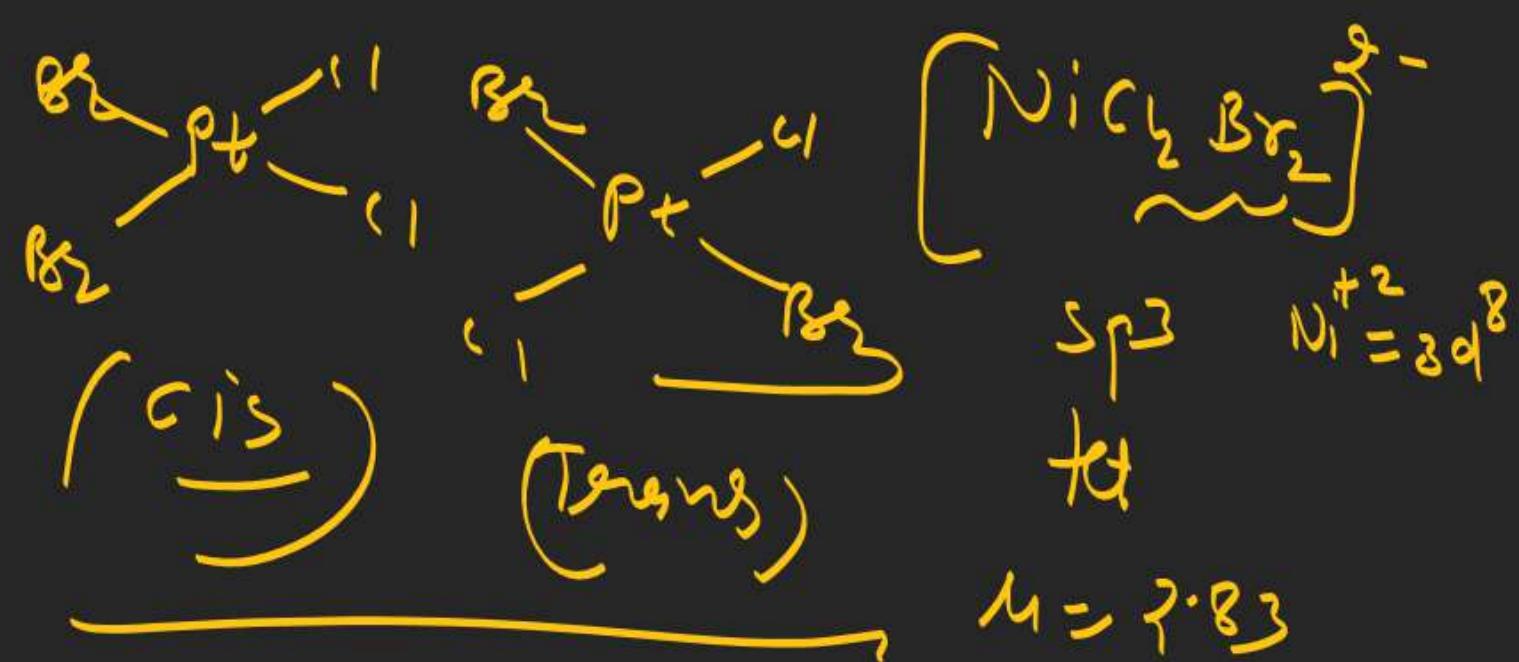
- A. Geometry
 - B. Geometrical isomerism
 - C. Optical isomerism
 - D. Magnetic properties

(A) A and D

(B) A, B and C

(C) B and C

(D) A, B and D



COORDINATION COMPOUNDS

20. Match List I with List II

	LIST-I Complex		LIST-II Colour
A.	$Mg(NH_4)PO_4$	I.	brown
B.	$K_3[Co(NO_2)_6]$	II.	white
C.	$MnO(OH)_2$	III.	yellow
D.	$Fe_4[Fe(CN)_6]_3$	IV.	blue

Choose the correct answer from the options given below:

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

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

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

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

COORDINATION COMPOUNDS

21. Given below are two statements, one is labelled as assertion A and the other is

labelled as Reason R.

Mallede donor < Oxygen donor < Nitrogen < Carbon

assertion A: $[\text{CoCl}(\text{NH}_3)_5]^{2+}$ *w.f.l* absorbs at lower wavelength of light with respect to
 $[\text{Co}(\text{NH}_3)_5(\text{H}_2\text{O})]^{3+}$ *s.f.l*

Reason R : It is because the wavelength of light absorbed depends on the oxidation state of the metal ion.

In the light of the above statements, choose the correct answer from the options given below:

- (A) A is false but R is true
- (B) A is true but R is false
- (C) Both A and R are true and R is the correct explanation of A
- (D) Both A and R are true and R is NOT the correct explanation of A

COORDINATION COMPOUNDS

22. The magnetic moment is measured in Bohr Magneton (BM). Spin only magnetic moment of Fe in $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$ and $[\text{Fe}(\text{CN})_6]^{3-}$ complexes respectively is: [2023 (11 Apr Shift 2)] $\frac{\text{Fe}^{+3} \equiv 3d^5}{5} \quad 3d^5$

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COORDINATION COMPOUNDS

23.

Match List I with List II

	List I Complex		List II CFSE (Δ_0)
A.	$[\text{Cu}(\text{NH}_3)_6]^{2+}$	I.	-0.6
B.	$[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$	II.	-2.0
C.	$[\text{Fe}(\text{CN})_6]^{3-}$	III.	-1.2
D.	$[\text{NiF}_6]^{4-}$	IV.	-0.4

$$\begin{aligned} \text{Cu}^{+2} &= 3d^9 \\ &+ 0.6\Delta_0 \quad \boxed{111} \\ &- 0.4\Delta_0 \quad \uparrow \quad \downarrow \quad - \\ &\equiv -0.4 \times 6 + 0.6 \times 3 \\ &\equiv -2.4 + 1.8 \end{aligned}$$

$$\begin{aligned} \text{Fe}^{+3} &= 3d^5 \\ &\quad \boxed{11111} \\ &0.4 \times 5 \\ &\equiv -2.0 \end{aligned}$$

Choose the correct answer from the options given below:

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

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

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

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

$$\begin{aligned} \text{Ti}^{+3} &= 3d^1 \\ &- 0.4 \times 1 + 0.6 \times 1 \end{aligned}$$

COORDINATION COMPOUNDS

24. The mismatched combinations are

A. Chlorophyll- Co

B. Water hardness-EDTA

C. Photography- $[\text{Ag}(\text{CN})_2]^-$

D. Wilkinson catalyst – $[(\text{Ph}_3\text{P})_3\text{RhCl}]$

E. Chelating ligand-D-Penicillamine

Choose the correct answer from the options given below.

(A) A, C and E only

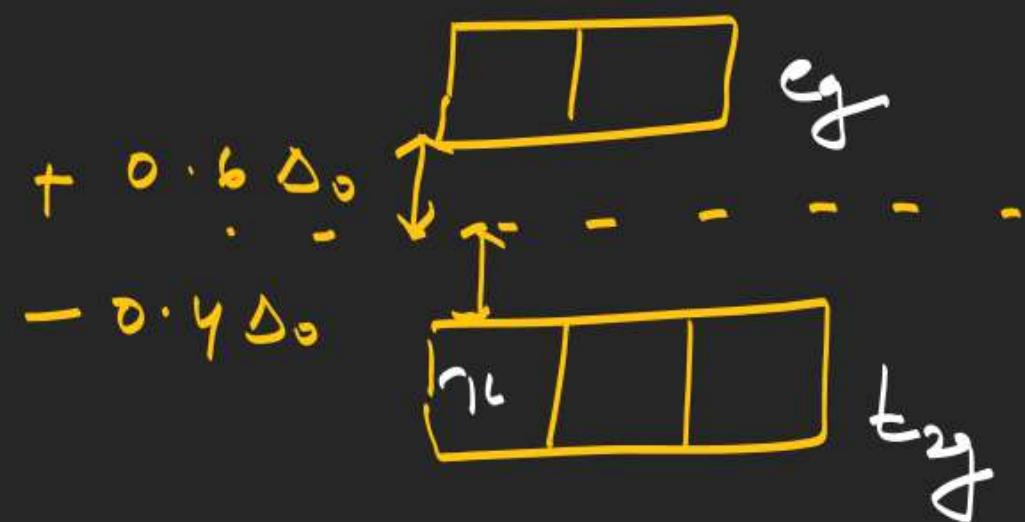
(B) A and C only

(C) A and E only

(D) D and E only



C.F.S.E



$$C.F.S.E = -0.4 \Delta_0 x + 0.6 \Delta_0 y + m p$$

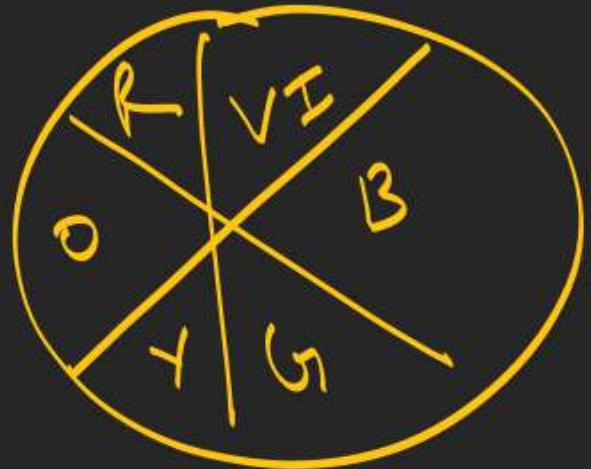
x = number of e^- in t_{2g} orbital

y = no. of e^- in e_g orbital

m = number of pairs

p = pair energy

$$\uparrow E = \frac{hc}{\lambda}$$



Colour

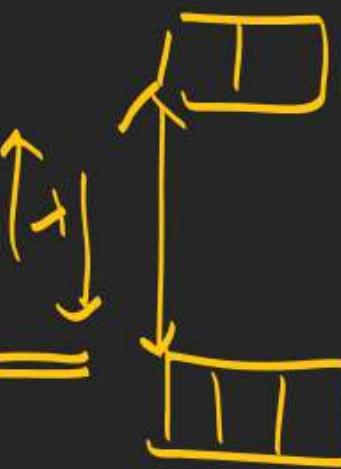
d^1 to d^9 → colour

$(F_1 F_6)^{-3} \Rightarrow$ colourless

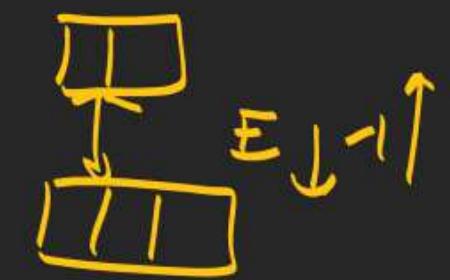
d^n and d^{10-n} same col.

d^0 and d^{10} colourless

S.F.L



W.F.L



VIBGYOR
→ ↑ E ↓ ν ↓

Keypoint

S.F.L then low ↓ absorbed