

JEE MAIN COORDINATION COMPOUNDS — VALENCE BOND THEORY (VBT) IN COORDINATION COMPOUNDS — PYQS

Max. Marks: 64
Questions: 16

Section A (MCQ) — 13 questions

Q.1 Which of the following sequences of hybridisation, geometry and magnetic nature are correct for the given coordination compounds ?

- A. $[\text{NiCl}_4]^{2-}$ – sp^3 , tetrahedral, paramagnetic
 B. $[\text{Ni}(\text{NH}_3)_6]^{2+}$ – sp^3d^2 , octahedral, paramagnetic
 C. $[\text{Ni}(\text{CO})_4]$ – sp^3 , tetrahedral, paramagnetic
 D. $[\text{Ni}(\text{CN})_4]^{2-}$ – dsp^2 , square planar, diamagnetic
- Choose the correct answer from the options given below : [JEE Main 2026 (Online) 6th April Evening Shift]

- (1) A, B, C and D (2) B, C and D only
 (3) A, C and D only (4) A, B and D only

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Q.2 The correct statement among the following is:

[JEE Main 2026 (Online) 28th January Morning Shift]

- (1) $[\text{Ni}(\text{CN})_4]^{2-}$ and $[\text{NiCl}_4]^{2-}$ are diamagnetic and $\text{Ni}(\text{CO})_4$ is paramagnetic.
 (2) $\text{Ni}(\text{CO})_4$ is diamagnetic and $[\text{NiCl}_4]^{2-}$ and $[\text{Ni}(\text{CN})_4]^{2-}$ are paramagnetic.
 (3) $\text{Ni}(\text{CO})_4$ and $[\text{NiCl}_4]^{2-}$ are diamagnetic and $[\text{Ni}(\text{CN})_4]^{2-}$ is paramagnetic.
 (4) $\text{Ni}(\text{CO})_4$ and $[\text{Ni}(\text{CN})_4]^{2-}$ are diamagnetic and $[\text{NiCl}_4]^{2-}$ is paramagnetic.

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Q.3 Given below are two statements :

Statement-I: Hybridisation, shape and spin only magnetic moment of $\text{K}_3[\text{Co}(\text{CO}_3)_3]$ is sp^3d^2 , octahedral and 4.9 BM respectively.

Statement-II: Geometry, hybridisation and spin only magnetic moment values (BM) of the ions $[\text{Ni}(\text{CN})_4]^{2-}$, $[\text{MnBr}_4]^{2-}$ and $[\text{CoF}_6]^{3-}$ respectively are square planar, tetrahedral, octahedral; dsp^2 , sp^3 , sp^3d^2 and 0, 5.9, 4.9.

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

[JEE Main 2026 (Online) 24th January Morning Shift]

- (1) Both Statement-I and Statement-II are false
 (2) Statement-I is true but Statement-II is false
 (3) Both Statement-I and Statement-II are true
 (4) Statement-I is false but Statement-II is true

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Q.4 Given below are two statements:

Statement-I: The number of paramagnetic species among $[\text{CoF}_6]^{3-}$, $[\text{TiF}_6]^{3-}$, V_2O_5 and $[\text{Fe}(\text{CN})_6]^{3-}$ is 3.

Statement-II: $\text{K}_4[\text{Fe}(\text{CN})_6] < \text{K}_3[\text{Fe}(\text{CN})_6] < [\text{Fe}(\text{H}_2\text{O})_6]\text{SO}_4 \cdot \text{H}_2\text{O} < [\text{Fe}(\text{H}_2\text{O})_6]\text{Cl}_3$ is the correct order in terms of number of unpaired electron(s) present in the complexes.

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

[JEE Main 2026 (Online) 24th January Morning Shift]

- (1) Statement-I is true but Statement-II is false
 (2) Both Statement-I and Statement-II are false
 (3) Statement-I is false but Statement-II is true
 (4) Both Statement-I and Statement-II are true

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Q.5 Identify the CORRECT set of details from the following :

Choose the correct answer from the options given below :

- A. $[\text{Co}(\text{NH}_3)_6]^{3+}$: Inner orbital complex; d^2sp^3 hybridized
 B. $[\text{MnCl}_6]^{3-}$: Outer orbital complex; sp^3d^2 hybridized
 C. $[\text{CoF}_6]^{3-}$: Outer orbital complex; d^2sp^3 hybridized
 D. $[\text{FeF}_6]^{3-}$: Outer orbital complex; sp^3d^2 hybridized
 E. $[\text{Ni}(\text{CN})_4]^{2-}$: Inner orbital complex; sp^3 hybridized

[JEE Main 2026 (Online) 23rd January Evening Shift]

- (1) C & D Only (2) A, C & E Only
 (3) A, B, C, D & E (4) A, B & D Only

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Q.6 Given below are two statements :

Statement-I: Among $[\text{Cu}(\text{NH}_3)_4]^{2+}$, $[\text{Ni}(\text{en})_3]^{2+}$, $[\text{Ni}(\text{NH}_3)_6]^{2+}$ and $[\text{Mn}(\text{H}_2\text{O})_6]^{2+}$, $[\text{Mn}(\text{H}_2\text{O})_6]^{2+}$ has the maximum number of unpaired electrons.

Statement-II: The number of pairs among $\{[\text{NiCl}_4]^{2-}, [\text{Ni}(\text{CO})_4]\}$, $\{[\text{NiCl}_4]^{2-}, [\text{Ni}(\text{CN})_4]^{2-}\}$ and $\{[\text{Ni}(\text{CO})_4], [\text{Ni}(\text{CN})_4]^{2-}\}$ that contain only diamagnetic species is two.

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

[JEE Main 2026 (Online) 21st January Morning Shift]

- (1) Statement-I is false but Statement-II is true
 (2) Both Statement-I and Statement-II are false
 (3) Both Statement-I and Statement-II are true
 (4) Statement-I is true but Statement-II is false

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Q.7 Match the **LIST-I** with **LIST-II**

LIST-I (Complex/Species)		LIST-II (Shape & magnetic moment)	
A.	$[\text{Ni}(\text{CO})_4]$	I.	Tetrahedral, 2.8 BM
B.	$[\text{Ni}(\text{CN})_4]^{2-}$	II.	Square planar, 0 BM
C.	$[\text{NiCl}_4]^{2-}$	III.	Tetrahedral, 0 BM
D.	$[\text{MnBr}_4]^{2-}$	IV.	Tetrahedral, 5.9 BM

Choose the **correct** answer from the options given below: [JEE Main 2025 (Online) 8th April Evening Shift]

- (1) A-I, B-II, C-III, D-IV (2) A-IV, B-I, C-III, D-II
 (3) A-III, B-II, C-I, D-IV (4) A-III, B-IV, C-II, D-I

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Q.8 The number of species from the following that are involved in sp^3d^2 hybridization is :

$[\text{Co}(\text{NH}_3)_6]^{3+}$, SF_6 , $[\text{CrF}_6]^{3-}$, $[\text{CoF}_6]^{3-}$, $[\text{Mn}(\text{CN})_6]^{3-}$, and $[\text{MnCl}_6]^{3-}$

[JEE Main 2025 (Online) 8th April Evening Shift]

- (1) 4 (2) 3 (3) 5 (4) 6

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Q.9 The correct order of $[\text{FeF}_6]^{3-}$, $[\text{CoF}_6]^{3-}$, $[\text{Ni}(\text{CO})_4]$ and $[\text{Ni}(\text{CN})_4]^{2-}$ complex species based on the number of unpaired electrons present is:

[JEE Main 2025 (Online) 4th April Evening Shift]

- (1) $[\text{CoF}_6]^{3-} > [\text{FeF}_6]^{3-} > [\text{Ni}(\text{CO})_4] > [\text{Ni}(\text{CN})_4]^{2-}$
 (2) $[\text{FeF}_6]^{3-} > [\text{CoF}_6]^{3-} > [\text{Ni}(\text{CN})_4]^{2-} > [\text{Ni}(\text{CO})_4]$
 (3) $[\text{FeF}_6]^{3-} > [\text{CoF}_6]^{3-} > [\text{Ni}(\text{CN})_4]^{2-} = [\text{Ni}(\text{CO})_4]$
 (4) $[\text{Ni}(\text{CN})_4]^{2-} > [\text{FeF}_6]^{3-} > [\text{CoF}_6]^{3-} > [\text{Ni}(\text{CO})_4]$

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Q.10 Identify the diamagnetic octahedral complex ions from below ;

- A. $[\text{Mn}(\text{CN})_6]^{3-}$ B. $[\text{Co}(\text{NH}_3)_6]^{3+}$
 C. $[\text{Fe}(\text{CN})_6]^{4-}$ D. $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$

Choose the correct answer from the options given below: [JEE Main 2025 (Online) 3rd April Evening Shift]

- (1) B and C Only (2) A and C Only
 (3) B and D Only (4) A and D Only

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Q.11 The type of hybridization and the magnetic property of $[\text{MnCl}_6]^{3-}$ are,

[JEE Main 2025 (Online) 2nd April Evening Shift]

- (1) sp^3d^2 , paramagnetic with four unpaired electrons.
 (2) d^2sp^3 , paramagnetic with four unpaired electrons.
 (3) sp^3d^2 , paramagnetic with two unpaired electrons.
 (4) d^2sp^3 , paramagnetic with two unpaired electrons.

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Q.12 Match **List - I** with **List - II**.

List - I Complex		List - II Hybridisation & Magnetic characters	
A.	$[\text{MnBr}_4]^{2-}$	I.	d^2sp^3 & diamagnetic
B.	$[\text{FeF}_6]^{3-}$	II.	sp^3d^2 & paramagnetic
C.	$[\text{Co}(\text{C}_2\text{O}_4)_3]^{3-}$	III.	sp^3 & diamagnetic
D.	$[\text{Ni}(\text{CO})_4]$	IV.	sp^3 & paramagnetic

Choose the correct answer from the options given below :

[JEE Main 2025 (Online) 29th January Morning Shift]

- (1) (A)-(III), (B)-(I), (C)-(I), (D)-(IV)
 (2) (A)-(III), (B)-(II), (C)-(III), (D)-(IV)
 (3) (A)-(IV), (B)-(II), (C)-(I), (D)-(III)
 (4) (A)-(IV), (B)-(I), (C)-(II), (D)-(III)

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Q.13 Match **List - I** with **List - II**.

List - I (Complex)		List - II (Hybridisation of central metal ion)	
A.	$[\text{CoF}_6]^{3-}$	I.	d^2sp^3
B.	$[\text{NiCl}_4]^{2-}$	II.	sp^3
C.	$[\text{Co}(\text{NH}_3)_6]^{3+}$	III.	sp^3d^2
D.	$[\text{Ni}(\text{CN})_4]^{2-}$	IV.	dsp^2

Choose the correct answer from the options given below:

[JEE Main 2025 (Online) 28th January Evening Shift]

- (1) (A)-(I), (B)-(II), (C)-(III), (D)-(IV)
 (2) (A)-(III), (B)-(IV), (C)-(I), (D)-(II)
 (3) (A)-(I), (B)-(IV), (C)-(III), (D)-(II)
 (4) (A)-(III), (B)-(II), (C)-(I), (D)-(IV)

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Section B (Numerical) — 3 questions

- Q.14** Total number of unpaired electrons present in the central metal atoms/ions of $[\text{Ni}(\text{CO})_4]$, $[\text{NiCl}_4]^{2-}$, $[\text{PtCl}_2(\text{NH}_3)_2]$, $[\text{Ni}(\text{CN})_4]^{2-}$ and $[\text{Pt}(\text{CN})_4]^{2-}$ is _____.

[JEE Main 2026 (Online) 23rd January Evening Shift]

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- Q.15** The number of paramagnetic complexes among $[\text{FeF}_6]^{3-}$, $[\text{Fe}(\text{CN})_6]^{3-}$, $[\text{Mn}(\text{CN})_6]^{3-}$, $[\text{Co}(\text{C}_2\text{O}_4)_3]^{3-}$, $[\text{MnCl}_6]^{3-}$, and $[\text{CoF}_6]^{3-}$, which involve d^2sp^3 hybridization is _____.

[JEE Main 2025 (Online) 7th April Morning Shift]

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- Q.16** The number of paramagnetic metal complex species among $[\text{Co}(\text{NH}_3)_6]^{3+}$, $[\text{Co}(\text{C}_2\text{O}_4)_3]^{3-}$, $[\text{MnCl}_6]^{3-}$, $[\text{Mn}(\text{CN})_6]^{3-}$, $[\text{CoF}_6]^{3-}$, $[\text{Fe}(\text{CN})_6]^{3-}$ and $[\text{FeF}_6]^{3-}$ with same number of unpaired electrons is _____.

[JEE Main 2025 (Online) 7th April Evening Shift]

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ANSWER KEY

Section A (MCQ) — 13 questions

Ques.	1	2	3	4	5	6	7	8	9	10	11
Ans.	4	4	3	4	4	4	3	2	3	1	1
Ques.	12	13									
Ans.	3	4									

Section B (Numerical) — 3 questions

Ques.	14	15	16								
Ans.	2	2	2								