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

Max. Marks: 68 **Questions:** 17

Section A (MCQ) — 14 questions

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

A. $[NiCl_4]^{2-}$ – sp^3, tetrahedral, paramagnetic

B. $[Ni(NH_3)_6]^{2+}$ – sp^3d^2, octahedral, paramagnetic

C. $[Ni(CO)_4]$ – sp^3, tetrahedral, paramagnetic

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

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

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

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

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Q.3 Given below are two statements :

Statement-I: Hybridisation, shape and spin only magnetic moment of $K_3[Co(CO_3)_3]$ is sp^3d^2, octahedral and 4.9 BM respectively.

Statement-II: Geometry, hybridisation and spin only magnetic moment values (BM) of the ions $[Ni(CN)_4]^{2-}$, $[MnBr_4]^{2-}$ and $[CoF_6]^{3-}$ 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 $[CoF_6]^{3-}$, $[TiF_6]^{3-}$, V_2O_5 and $[Fe(CN)_6]^{3-}$ is 3.

Statement-II: $K_4[Fe(CN)_6]$ < $K_3[Fe(CN)_6]$ < $[Fe(H_2O)_6]SO_4 \cdot H_2O$ < $[Fe(H_2O)_6]Cl_3$ 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. $[Co(NH_3)_6]^{3+}$: Inner orbital complex; d^2sp^3 hybridized

B. $[MnCl_6]^{3-}$: Outer orbital complex; sp^3d^2 hybridized

C. $[CoF_6]^{3-}$: Outer orbital complex; d^2sp^3 hybridized

D. $[FeF_6]^{3-}$: Outer orbital complex; sp^3d^2 hybridized

E. $[Ni(CN)_4]^{2-}$: 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 $[Cu(NH_3)_4]^{2+}$, $[Ni(en)_3]^{2+}$, $[Ni(NH_3)_6]^{2+}$ and $[Mn(H_2O)_6]^{2+}$, $[Mn(H_2O)_6]^{2+}$ has the maximum number of unpaired electrons.

Statement-II: The number of pairs among $\{[NiCl_4]^{2-}, [Ni(CO)_4]\}$, $\{[NiCl_4]^{2-}, [Ni(CN)_4]^{2-}\}$ and $\{[Ni(CO)_4], [Ni(CN)_4]^{2-}\}$ 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.	$[Ni(CO)_4]$	I.	Tetrahedral, 2.8 BM
B.	$[Ni(CN)_4]^{2-}$	II.	Square planar, 0 BM
C.	$[NiCl_4]^{2-}$	III.	Tetrahedral, 0 BM
D.	$[MnBr_4]^{2-}$	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 :
$[Co(NH_3)_6]^{3+}$, SF_6, $[CrF_6]^{3-}$, $[CoF_6]^{3-}$, $[Mn(CN)_6]^{3-}$, and $[MnCl_6]^{3-}$

[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 $[FeF_6]^{3-}$, $[CoF_6]^{3-}$, $[Ni(CO)_4]$ and $[Ni(CN)_4]^{2-}$ complex species based on the number of unpaired electrons present is:

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

(1) $[CoF_6]^{3-} > [FeF_6]^{3-} > [Ni(CO)_4] > [Ni(CN)_4]^{2-}$

(2) $[FeF_6]^{3-} > [CoF_6]^{3-} > [Ni(CN)_4]^{2-} > [Ni(CO)_4]$

(3) $[FeF_6]^{3-} > [CoF_6]^{3-} > [Ni(CN)_4]^{2-} = [Ni(CO)_4]$

(4) $[Ni(CN)_4]^{2-} > [FeF_6]^{3-} > [CoF_6]^{3-} > [Ni(CO)_4]$

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

A. $[Mn(CN)_6]^{3-}$ B. $[Co(NH_3)_6]^{3+}$

C. $[Fe(CN)_6]^{4-}$ D. $[Co(H_2O)_3F_3]$

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 $[MnCl_6]^{3-}$ 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.	$[MnBr_4]^{2-}$	I.	d^2sp^3 & diamagnetic
B.	$[FeF_6]^{3-}$	II.	sp^3d^2 & paramagnetic
C.	$[Co(C_2O_4)_3]^{3-}$	III.	sp^3 & diamagnetic
D.	$[Ni(CO)_4]$	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.	$[CoF_6]^{3-}$	I.	d^2sp^3
B.	$[NiCl_4]^{2-}$	II.	sp^3
C.	$[Co(NH_3)_6]^{3+}$	III.	sp^3d^2
D.	$[Ni(CN)_4]^{2-}$	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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Q.14 From the magnetic behaviour of $[NiCl_4]^{2-}$ (paramagnetic) and $[Ni(CO)_4]$ (diamagnetic), choose the correct geometry and oxidation state.

[JEE Main 2025 (Online) 22nd January Morning Shift]

(1) $[NiCl_4]^{2-}$: Ni(0), tetrahedral $[Ni(CO)_4]$: Ni(0), square planar

(2) $[NiCl_4]^{2-}$: Ni^{II}, tetrahedral $[Ni(CO)_4]$: Ni(0), tetrahedral

(3) $[NiCl_4]^{2-}$: Ni^{II}, tetrahedral $[Ni(CO)_4]$: Ni^{II}, square planar

(4) $[NiCl_4]^{2-}$: Ni^{II}, square planar $[Ni(CO)_4]$: Ni(0), square planar

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Section B (Numerical) — 3 questions

Q.15 Total number of unpaired electrons present in the central metal atoms/ions of $[Ni(CO)_4]$, $[NiCl_4]^{2-}$, $[PtCl_2(NH_3)_2]$, $[Ni(CN)_4]^{2-}$ and $[Pt(CN)_4]^{2-}$ is _____.

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

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Q.16 The number of paramagnetic complexes among $[FeF_6]^{3-}$, $[Fe(CN)_6]^{3-}$, $[Mn(CN)_6]^{3-}$, $[Co(C_2O_4)_3]^{3-}$, $[MnCl_6]^{3-}$, and $[CoF_6]^{3-}$, which involve d^2sp^3 hybridization is _____.

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

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Q.17 The number of paramagnetic metal complex species among $[Co(NH_3)_6]^{3+}$, $[Co(C_2O_4)_3]^{3-}$, $[MnCl_6]^{3-}$, $[Mn(CN)_6]^{3-}$, $[CoF_6]^{3-}$, $[Fe(CN)_6]^{3-}$ and $[FeF_6]^{3-}$ with same number of unpaired electrons is _____.

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

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ANSWER KEY

Section A (MCQ) — 14 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	14								
Ans.	**3**	**4**	**2**								

Section B (Numerical) — 3 questions

Ques.	15	16	17								
Ans.	**2**	**2**	**2**								