

APOLLO

Transition Metals

FBISE Chemistry Class 12 (HSSC-II)

Domain C: Inorganic Chemistry

35 questions | questions

Original FBISE question crops. National Curriculum 2022-23 topic.

iii.	How many ions are produced from $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$ in the solution?	3	4	5	6	☐ ☐ ☐ ☐
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vi.	A transition metal ion with a $3d^8$ electronic configuration commonly forms a four coordinate complex. Which geometry is most likely observed for such a complex?	Linear	Tetrahedral	Square Planar	Octahedral	☐ ☐ ☐ ☐
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xii.	Which one of the following is not a bidentate ligand?	Ethanedioate ion	Oxalate ion	Thiocyanate ion	1,2-Diaminoethane	☐ ☐ ☐ ☐
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OR	Copper and silver both are transition metals. Copper (I) and silver (I) compounds are colourless. Suggest your answer.	03
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Q.3	Consider a following reaction where stable complex is formed. $[\text{Cd}(\text{H}_2\text{O})_6]^{2+} + \text{EDTA}^{4-} \rightleftharpoons [\text{Cd}(\text{EDTA})]^{2-} + 6\text{H}_2\text{O}$ (a) Write an expression of K_{stab} for this reaction and state its unit. 02 (b) At equilibrium at 298K, concentration of $[\text{Cd}(\text{H}_2\text{O})_6]^{2+}$ and EDTA^{4-} was found to be $3 \times 10^{-8} \text{ mol dm}^{-3}$ and $4 \times 10^{-10} \text{ mol dm}^{-3}$. Calculate concentration of $[\text{Cd}(\text{EDTA})]^{2-}$ in this solution. K_{stab} of $[\text{Cd}(\text{EDTA})]^{2-}$ is 6.3×10^{19}. 04	
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Use the following E° values to predict whether a reaction will occur when the following pairs of aqueous solutions are mixed. If a reaction occurs, write a balanced equation and calculate the E° cell.	
OR	$\text{Fe}^{3+} + \text{e}^{-} \rightleftharpoons \text{Fe}^{2+} \quad E^{\circ} = 0.77 \text{ V}$
	$\text{Cl}_2 + 2\text{e}^{-} \rightleftharpoons 2\text{Cl}^{-} \quad E^{\circ} = 1.36 \text{ V}$
	$\text{Br}_2 + 2\text{e}^{-} \rightleftharpoons 2\text{Br}^{-} \quad E^{\circ} = 1.07 \text{ V}$
	$\text{I}_2 + 2\text{e}^{-} \rightleftharpoons 2\text{I}^{-} \quad E^{\circ} = 0.54 \text{ V}$
	$\text{Co}^{3+} + \text{e}^{-} \rightleftharpoons \text{Co}^{2+} \quad E^{\circ} = 1.82 \text{ V}$
	$\text{Cr}^{3+} + \text{e}^{-} \rightleftharpoons \text{Cr}^{2+} \quad E^{\circ} = -0.41 \text{ V}$
(i) $\text{Fe}^{3+}(\text{aq})$ and $\text{Cl}^{-}(\text{aq})$	02
(ii) $\text{Co}^{3+}(\text{aq})$ and $\text{Br}^{-}(\text{aq})$	02
(iii) $\text{Cr}^{2+}(\text{aq})$ and $\text{I}_2(\text{aq})$	02

First Annual 2025 | Section B Q2(i) OR | 3 marks

How Fe^{+2} act as a catalyst in given reaction? Write its two steps mechanism.	1x3
$\text{S}_2\text{O}_8^{2-} + 2\text{I}^{-} \xrightarrow{\text{Fe}^{+2}} 2\text{SO}_4^{2-} + \text{I}_2$	

First Annual 2025 | Section B Q2(ii) OR | 3 marks

Why group II-B and III-B are considered as non-typical transition elements?	03
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First Annual 2025 | Section B Q2(iv) OR | 3 marks

Beryllium (<i>Be</i>) differs from other alkaline earth metals in terms of its reactions with hydrogen and alkalis. Describe these differences and provide the relevant chemical equations.	03	OR	Write chemical reactions of KMnO_4 in acidic medium with: a. FeSO_4 b. Mohr's Salt (Balancing is not necessary)	03

First Annual 2025 | Section B Q2(i) OR | 3 marks

Justify the given statements: a. 2 nd electron affinity is endothermic. b. Electron affinity of chlorine is higher than fluorine.	03	OR	Why Group-II-B and III-B elements are called Non-typical transition elements?	03

First Annual 2025 | Section B Q2(ii) OR | 3 marks

OR	Write chemical reactions of $\text{K}_2\text{Cr}_2\text{O}_7$ in acidic medium with: a. Oxalic acid b. Mohr's salt (Balancing is not necessary)	03
	Identify the major products in the given reactions	

Second Annual 2025 | Section A Q5 | 1 mark

Which transition metal is used as a catalyst in Haber's process?	Cu	Ni	Pt	Fe
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Predict the shape of given coordination compounds based on coordination number.	1.5
i = $[Ag(NH_3)_2]^{+2}$	+
ii = $[Ni(CN)_6]^{-2}$	1.5

(vii)	Write names of given coordination compounds	1.5			
	$a = K_4[Fe(CN)_6]$ $b = [Cr(NO_2)_3]SO_4$	+	OR	How can acetic acid be prepared by Grignard reagent?	03
		1.5			

(viii)	Write chemical reaction of $KMnO_4$ with Iron (II) sulphate and oxalic acid in the presence of H_2SO_4 .
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Predict the shape, approximate bond angles and coordination number of $[Ag(NH_3)_2]^+$
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Why transition elements with d^{10} configuration are usually colourless?
Compare the enthalpy of hydrogenation of benzene

What are transition elements? Write trend of melting point and atomic radii from Ti to Cu in 3d series.

When phenol is treated with bromine water, a white precipitate is formed.

Zinc is not considered as a transition element because:	d-orbitals are completely filled	decreases It is a non-metal	It has no d-orbitals	It is highly reactive
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Write any three physical properties of transition elements.	1x3
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Q.4	Compare the arrangement of d-orbitals in octahedral and tetrahedral complexes. (Support your answer by drawing their diagrams of d-d splitting pattern).	3.5
		+
		3.5

- A characteristic peak pattern with a 1:1 intensity ratio at $m/z = 122$ and 124

Q1. Fill the relevant bubble against each question. Each part carries ONE mark.

S. No	Question	A	B	C	D	A	B	C	D
i.	In which of the following reactions is there the greatest change in oxidation number of nitrogen?	$4\text{NH}_3 + 5\text{O}_2 \rightarrow 4\text{NO} + 6\text{H}_2\text{O}$	$3\text{NO}_2 + \text{H}_2\text{O} \rightarrow 2\text{HNO}_3 + \text{NO}$	$2\text{NO} + \text{O}_2 \rightarrow 2\text{NO}_2$	$4\text{NH}_3 + 6\text{NO} \rightarrow 5\text{N}_2 + 6\text{H}_2\text{O}$	☐	☐	☐	☐
ii.	The base dissociation constants (K_b) for four bases are given below: W: 1.2×10^{-4} X: 3.5×10^{-2} Y: 6.8×10^{-6} Z: 2.1×10^{-3} Which base is the strongest?	W	Y	Z	X	☐	☐	☐	☐
iii.	How many ions are produced from $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$ in the solution?	3	4	5	6	☐	☐	☐	☐

- A characteristic peak pattern with a 1:1 intensity ratio at $m/z = 122$ and 124

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i.	In which of the following reactions is there the greatest change in oxidation number of nitrogen?	$4\text{NH}_3 + 5\text{O}_2 \rightarrow 4\text{NO} + 6\text{H}_2\text{O}$	$3\text{NO}_2 + \text{H}_2\text{O} \rightarrow 2\text{HNO}_3 + \text{NO}$	$2\text{NO} + \text{O}_2 \rightarrow 2\text{NO}_2$	$4\text{NH}_3 + 6\text{NO} \rightarrow 5\text{N}_2 + 6\text{H}_2\text{O}$	☐	☐	☐	☐
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iii.	How many ions are produced from $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$ in the solution?	3	4	5	6	☐	☐	☐	☐
iv.	Which of the following group 2 compounds is commonly used to diagnose disorders of the intestine and stomach.	Magnesium sulfate	Calcium carbonate	Barium sulfate	Strontium nitrate	☐	☐	☐	☐
v.	When benzene is nitrated, conc. Nitric and sulphuric acid react to form an intermediate which attack the benzene ring, which one of the following represents this intermediate?	NO^+	NO_2	NO_2^-	NO_2^+	☐	☐	☐	☐
vi.	A transition metal ion with a $3d^8$ electronic configuration commonly forms a four coordinate complex. Which geometry is most likely observed for such a complex?	Linear	Tetrahedral	Square Planar	Octahedral	☐	☐	☐	☐

Q2. Attempt the following questions

(i)	What is meant by coordination number? Complete the table for the following two complexes.	03												
	<table><tr><th>Central Metal ion</th><th>Ligand</th><th>Coordination number</th><th>Formula of complex ion</th></tr><tr><td>Fe^{3+}</td><td>CN^-</td><td></td><td>$\text{K}_3[\text{Fe}(\text{CN})_6]$</td></tr><tr><td>$\text{Pt}^{4+}$</td><td>$\text{NH}_2\text{CH}_2\text{CH}_2\text{NH}_2$</td><td></td><td>$[\text{Pt}(\text{NH}_2\text{CH}_2\text{CH}_2\text{NH}_2)_4]^{4+}$</td></tr></table>	Central Metal ion	Ligand	Coordination number	Formula of complex ion	Fe^{3+}	CN^-		$\text{K}_3[\text{Fe}(\text{CN})_6]$	Pt^{4+}	$\text{NH}_2\text{CH}_2\text{CH}_2\text{NH}_2$		$[\text{Pt}(\text{NH}_2\text{CH}_2\text{CH}_2\text{NH}_2)_4]^{4+}$	
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Fe^{3+}	CN^-		$\text{K}_3[\text{Fe}(\text{CN})_6]$											
Pt^{4+}	$\text{NH}_2\text{CH}_2\text{CH}_2\text{NH}_2$		$[\text{Pt}(\text{NH}_2\text{CH}_2\text{CH}_2\text{NH}_2)_4]^{4+}$											
(ii)	How can nylon-6,6 be prepared from	02												

Q.3	Consider a following reaction where stable complex is formed. $[\text{Cd}(\text{H}_2\text{O})_6]^{2+} + \text{EDTA}^{4-} \rightleftharpoons [\text{Cd}(\text{EDTA})]^{2-} + 6\text{H}_2\text{O}$ (a) Write an expression of K_{stab} for this reaction and state its unit. 02 (b) At equilibrium at 298K, concentration of $[\text{Cd}(\text{H}_2\text{O})_6]^{2+}$ and EDTA^{4-} was found to be $3 \times 10^{-8} \text{ mol dm}^{-3}$ and $4 \times 10^{-10} \text{ mol dm}^{-3}$. Calculate concentration of $[\text{Cd}(\text{EDTA})]^{2-}$ in this solution. K_{stab} of $[\text{Cd}(\text{EDTA})]^{2-}$ is 6.3×10^{19}. 04	
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(i) $\text{Fe}^{3+}(\text{aq})$ and $\text{Cl}^-(\text{aq})$	02

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(ii) $\text{Co}^{3+}(\text{aq})$ and $\text{Br}^- (\text{aq})$	02
(iii) $\text{Cr}^{2+}(\text{aq})$ and $\text{I}_2(\text{aq})$	02

Chemical reactivity:				
4. In the compound $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$, the coordination number of cobalt is:	3	4	6	9

The electronic configuration of Fe^{2+} ion is:	$[\text{Ar}] 3\text{d}^6$	$[\text{Ar}] 3\text{d}^5 4\text{s}^1$	$[\text{Ar}] 3\text{d}^4 4\text{s}^2$	$[\text{Ar}] 3\text{d}^7$
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- ii. Ammonia acts as a ligand and a base. Justify this statement by the reactions with copper ion. (1.5+1.5)

What are ligands? Give example of tridentate and hexadentate ligand. (1+1+1)

- vi. What is the oxidation number and coordination number of the metals in the following complexes? (1.5+1.5)
- (a) $[\text{Cr}(\text{H}_2\text{O})_4(\text{OH})_2]\text{NO}_3$ (b) $\text{K}_4[\text{Fe}(\text{CN})_6]$

Demonstrate the chemical reactions of $[\text{Fe}(\text{H}_2\text{O})_6]^{+3}$. With the following (2+2+2)

i. Sodium hydroxide ii. Sodium Carbonates iii. Ammonia

Question 2: Give answers to following questions.

i. . Draw structure of Nickel dimethyl glyoxime.

[01]
