

Single correct :

- Q.1 Which of the following combination of reagents form colourless diamagnetic complex ion ?
 (A) $\text{Ni}(\text{OH})_2 + \text{excess NH}_3$ solution (B) $\text{BiI}_3 + \text{excess KI}$ solution
 (C) $\text{CuS} + \text{excess KCN}$ solution (D) $\text{ZnS} + \text{excess NH}_3$ solution
- Q.2 CaCO_3 is used in the extraction of lead from low grade galena by carbon reduction. The role of CaCO_3 is **not** related to
 (A) It acts as flux
 (B) It prevents the formation of PbSiO_3
 (C) It helps in the roasting of PbS into PbSO_4
 (D) All
- Q.3 Sulphide of which of the following the cation can exist in aqueous medium
 (A) $\text{Cr}^{3+}(\text{aq})$ (B) $\text{Mg}^{2+}(\text{aq})$ (C) $\text{Fe}^{3+}(\text{aq})$ (D) $\text{Cu}^{2+}(\text{aq})$
- Q.4 Solution of chloride of element 'A' is coloured. Element 'A' can be found in group.....of periodic table
 (A) 8th group (B) 15th group (C) 2nd group (D) 12th group
- Q.5 "The strongest known oxidising agent in practical life" is
 (A) F_2 (B) O_3 (C) KMnO_4/H^+ (D) Electric current
- Q.6 Which reagent **does not** give red colouration with $\text{Fe}^{3+}(\text{aq})$
 (A) CH_3COO^- (B) $\text{K}_3[\text{Fe}(\text{CN})_6]$ (C) SCN^- (D) CN^- (excess)
- Q.7 A suffocating colourless acidic gas gives white turbidity when dissolved in baryta-water, when H_2O_2 is added to same solution, white ppt is obtained. Which given acid can dissolve white ppt ?
 (A) Conc. HCl (B) Conc. HNO_3 (C) Conc. H_2SO_4 (D) None of these
- Q.8 Which of the following reagent gives HSO_4^- from $\text{S}_2\text{O}_3^{2-}(\text{aq})$?
 (A) $\text{KMnO}_4/\text{OH}^-$ (B) KMnO_4/H^+ (C) Excess Cl_2 (D) I_2
- Q.9 Which species remains unreactive in dil. H_2SO_4 ?
 (A) $\text{Na}_2\text{S}_2\text{O}_5$ (B) $\text{Na}_2\text{S}_2\text{O}_3$ (C) Na_2SO_3 (D) None of these
- Q.10 Which salt does not give SO_2 with dilute HCl ?
 (A) $\text{Na}_2\text{S}_2\text{O}_5$ (B) $\text{Na}_2\text{S}_2\text{O}_3$ (C) Na_2SO_3 (D) $\text{Na}_2\text{S}_2\text{O}_7$
- Q.11 Element 'U' + $\text{NaOH} \rightarrow \text{Gas 'W'} + \text{Salt 'X'}$
 Salt 'X' + $\text{HCl} \rightarrow \text{Acid 'Y'} + \text{NaCl}$
 Acid 'Y' + $\text{AgCl} \rightarrow \text{Ag}\downarrow + \text{HCl} + \text{acid 'Z'}$
 Gas 'W' is weakly basic having rotten fish smell
 Select correct order of oxidation state of atom 'U' in Substance U to Z
 (A) $\text{W} < \text{U} < \text{X} < \text{Z}$ (B) $\text{U} < \text{W} < \text{X} < \text{Z}$ (C) $\text{Z} < \text{W} < \text{X} < \text{U}$ (D) $\text{W} < \text{Z} < \text{X} < \text{U}$

Match the ColumnQ.20 **Column I**

- (A) $\text{Pb}(\text{NO}_3)_2$
 (B) ZnCO_3
 (C) $\text{Ag}_2\text{C}_2\text{O}_4$
 (D) CrSO_4

Column II**(Properties of products formed on heating)**

- (P) Atleast one product reacts with NaOH
 (Q) Atleast one product is paramagnetic
 (R) Atleast one product reacts with HCl
 (S) Residue is coloured in hot condition
 (T) Change in oxidation state of any atom

Q.21 **Column-I****(Aqueous solution of salt)**

- (A) K_2CrO_4
 (B) BaBr_2
 (C) NaNO_2
 (D) $\text{Na}_2\text{S}_2\text{O}_3$

Column-II**(Reaction with salt)**

- (P) Observable change with dil. HCl
 (Q) Precipitate with AgNO_3 solution
 (R) Observable change with Cl_2 gas
 (S) Reacts with acidified FeSO_4 solution
 (T) Reacts with H_2O_2 in acidic medium

Subjective

Q.22 Find out total number of substance(s) that undergo disproportionation in warm NaOH solution
 $\text{Hg}_2(\text{NO}_3)_2$, I_2 , NO_2 , CrO_3 , P_4 , ClO_2 , CaOCl_2 , SO_2 , XeO_3

Q.23 Which of the following metal cation(s) produce coloured bead in microcosmic salt bead test :
 $\text{Al}^{3+}(\text{aq})$, $\text{Pb}^{2+}(\text{aq})$, $\text{Cr}^{3+}(\text{aq})$, $\text{Mn}^{2+}(\text{aq})$, $\text{Zn}^{2+}(\text{aq})$, $\text{Ba}^{2+}(\text{aq})$, $\text{Fe}^{3+}(\text{aq})$, $\text{Cu}^{2+}(\text{aq})$

Q.24 Find total number of pairs of given reactants (X, Y) respectively where X (aq.) gives coloured ppt with Y and coloured ppt dissolves in excess Y and gives coloured solution.
 $(\text{Cu}^{2+}, \text{NH}_4\text{OH})$, $(\text{Bi}^{3+}, \text{KI})$, $(\text{Ni}^{2+}, \text{NH}_4\text{OH})$, $(\text{Zn}^{2+}, \text{NaOH})$, $(\text{Ag}^+, \text{KCN})$, $(\text{Cu}^{2+}, \text{KCN})$,
 $(\text{Cr}^{3+}, \text{NaOH})$, $(\text{HgCl}_2, \text{SnCl}_2)$, $(\text{Pb}^{2+}, \text{S}_2\text{O}_3^{2-})$, $(\text{Hg}^{2+}, \text{KI})$

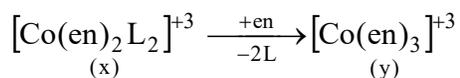
Q.25 Find the value of expression $[X - Y]$ for following compounds
 Excess CO_2 , CuSO_4 , BiCl_3 , I_2 , HIO_3 , $\text{Pb}(\text{OAc})_2$, $\text{Hg}(\text{NO}_3)_2$, Na_2O_2 , $\text{Fe}_2(\text{SO}_4)_3$,
 where X : Total number of compound(s) which undergo redox reaction with hypo solution.
 Y : Total number of compounds which can form complex compounds with excess of hypo solution.

Single correct :

- Q.1 What will be the change in number of stereoisomers for complex $[Ma_2b_2c_2]^{n\pm}$, if its two different monodentate ligands are replaced with one symmetrical bidentate ligand?
 (A) 3 (B) 2 (C*) 0 (D) 1
- Q.2 Select the **incorrect** property for $Fe_4[Fe(CN)_6]_3$ complex
 (A) d^2sp^3 hybridisation of coordinated Fe atom (B*) Blue colour due to ligand to metal charge transfer
 (C) Six electrons are present in t_{2g} orbital (D) More bond length of (C – N) than in $Fe[Fe(CN)_6]$
- Q.3 Which of the following process involves decrease in magnetic moment of underlined atom?
 (A) $Na_2[\underline{Fe}(CN)_5NO] + Na_2S \rightarrow$ (B) $\underline{Fe}SO_4(\text{solid}) + H_2O \rightarrow$
 (C*) $\underline{Fe}SO_4(\text{aq}) + NO \rightarrow$ (D) $\underline{Zn}(CN)_2 + KCN \xrightarrow{\text{excess}}$
- Q.4 Which of the following complex involves d_{z^2} orbital in hybridisation of central metal atom/ion?
 (A) $[CuCl_4]^{3-}$ (B) $[Cu(CN)_4]^{3-}$ (C*) $[FeF_6]^{3-}$ (D) $KMnO_4$
- Q.5 When K_2CrO_4 is added to $CuSO_4$ solution, there is formation of $CuCrO_4$ as well as $CuCr_2O_7$ on crystallisation. The formation of $CuCr_2O_7$ is due to
 (A) Basic nature of $CuSO_4$ solution (B*) Acidic nature of $CuSO_4$ solution
 (C) $CuSO_4$ oxidizes CrO_4^{2-} to $Cr_2O_7^{2-}$ (D) Basic hydrolysis reaction take place
- Q.6 For Mn^{3+} ion, the electron pairing energy (P) per pair is 28000 cm^{-1} , Δ_0 values for its two homoleptic octahedral complexes (X) and (Y) are 21000 cm^{-1} and 38500 cm^{-1} respectively. Select the **correct** option
 (A) Complex (X) is low spin complex
 (B) Complex (Y) is diamagnetic in nature
 (C*) If complex (X) is violet coloured then complex (Y) could be red coloured
 (D) Complex (X) and (Y) have strong field ligand and weak field ligand respectively
- Q.7 Select **incorrect** match for $[M(H_2O)_6]^{2+}$ complex
- | Metal Ions | Electronic Configuration | CFSE |
|----------------|--------------------------|----------------|
| (A) Mn^{2+} | $t_{2g}^3 e_g^2$ | $0\Delta_0$ |
| (B) V^{2+} | $t_{2g}^3 e_g^0$ | $-1.2\Delta_0$ |
| (C*) Ni^{2+} | $t_{2g}^6 e_g^2$ | $-1.6\Delta_0$ |
| (D) Ti^{2+} | $t_{2g}^2 e_g^0$ | $-0.8\Delta_0$ |
- Q.8 Two transition metals (X) and (Y) have their IE_1 717 kJ/mol and 762 kJ/mol respectively and IE_3 equal to 3260 kJ/mol and 2962 kJ/mol respectively. Then (X) and (Y) could be
 (A) Sc, Ti (B) Mn, Cr (C*) Mn, Fe (D) Cu, Ni

- Q.9 Select the **incorrect** match regarding the use of d-block compounds in manufacturing of compounds.
 (A*) V_2O_5 : Oxidation of sulphur to SO_2 in Contact process
 (B) $Fe_2O_3 \cdot xH_2O$: Arsenic purifier in Contact process
 (C) Fe_2O_3 : As catalyst in attainment of equilibrium in Haber's process
 (D) $Fe_2(SO_4)_3$: As catalyst in reaction between I^- and persulphate ion
- Q.10 Which of the following elements have low value of E° (Electrode potential) for M^{+3}/M^{+2} conversion ?
 (A) Fe (B) Mn (C*) Cr (D) Co
- Q.11 Select **incorrect** statement for $[Cr(en)_3]^{3+}$ and $[Cr(gly)_3]$ complexes
 (A) Both show stereo isomerism (B*) Both has same crystal field stabilization energy
 (C) Both are inner orbital complex (D) Both has equal magnetic moment
- Q.12 Structural isomerism is exhibited by
 (A) $[Fe(dmgl)_2]$ (B) $[Be_4O(NO_3)_6]$
 (C*) $[Pt(H_2O)_4(ox)] [CuCl_4]$ (D) $[Co(ox)(H_2O)_4]Br$
- Q.13 Select **incorrect** match
- | Hexa co-ordinated complex of cation | Characteristic of complexes |
|-------------------------------------|------------------------------|
| (A) Cr^{3+} | Always inner orbital complex |
| (B) Ni^{2+} | Always outer orbital complex |
| (C) Pt^{4+} | Always diamagnetic complex |
| (D*) Co^{3+} | Always paramagnetic complex |
- Q.14 $\nu_{(CO)}$ of $trans-[IrCl(CO)L_2]$ in complexes w, x, y, z are respectively 1992, 1953, 1938, 1929 in cm^{-1} .
 Select **correct** set of "L" in w, x, y, z respectively
 (A*) $P(C_6F_5)_3, PPh_3, PMe_3, PEt_3$ (B) $PPh_3, PMe_3, PEt_3, P(C_6F_5)_3$
 (C) $PMe_3, PEt_3, P(C_6F_5)_3, PPh_3$ (D) $PEt_3, P(C_6F_5)_3, PPh_3, PMe_3$
- Q.15 Which pair of catalysts is used to convert $C=C$ bonds to $C-C$ bonds ?
 (A*) Zeigler-Natta and Wilkinson's catalyst (B) Cis-platin and Zeigler-Natta
 (C) Cis-platin and Wilkinson's catalyst (D) Vanadium pentaoxide and cis-platin
- Q.16 $[Fe(H_2O)_6]^{2+}$ $\xrightarrow{\text{excess KCN} + O_2}$ $[Fe(CN)_6]^{3-}$
 (x) (y)
 Magnetic property of x, y are respectively
 (A*) Paramagnetic, paramagnetic (B) Paramagnetic, diamagnetic
 (C) Diamagnetic, paramagnetic (D) Diamagnetic, diamagnetic
- Q.17 Which is not the property of product of given reaction
 $CuSO_4$ solution + $4NH_4OH \rightarrow$
 (A*) Copper cation is bounded with oxygen atoms
 (B) Blue colour compound
 (C) Paramagnetic solution
 (D) Geometry around copper cation is square planar

Q.18 Which statement must be **correct** for given reaction ?



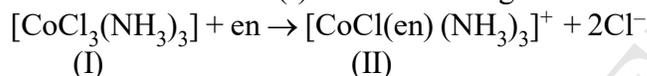
- (A*) x and y both are optically active
 (B) x is optically active while y is optically inactive
 (C) x is optically inactive while y is optically active
 (D) x and y both are optically inactive

Q.19 Complex $[\text{NiL}_x]^{y\pm}$ has energy of $3d_{x^2-y^2} > 3d_{z^2}$, surrounding ligand 'L' is

- (A*) CN^- (B) Cl^- (C) H_2O (D) NH_3

More than one may be correct

Q.20 The **correct** statement(s) for the following reaction is/are



- (A*) If complex compound-I is a cis isomer, then complex ion-II will also be cis-isomer
 (B) If the complex compound-I is a trans isomer, then two isomers are produced
 (C) If complex compound-I is a cis isomer, then complex ion-II exhibits optical activity
 (D*) If complex compound-I is a trans isomer then complex ion-II does not show optical activity.

Q.21 Correct statement(s) for complex compound $[\text{Co}(\text{en})(\text{H}_2\text{O})_2(\text{NH}_3)_2](\text{NO}_2)_3$ is/are :

- (A*) Number of optical isomers are equal to four
 (B*) it exhibits hydrate isomerism
 (C) It exhibits co-ordination isomerism
 (D*) It is diamagnetic and coloured

Q.22 Which of the complex(es) has higher stability as compared to its linkage isomer.

- (A*) $[\text{Cr}(\text{NH}_3)_5\text{NO}_2]^{2+}$ (B*) $[\text{Fe}(\text{CN})_6]^{4-}$
 (C) $[\text{Pt}(\text{NH}_3)_4(\text{SCN})_2]^{2+}$ (D*) $[\text{Pd}(\text{NCO})_4]^{2-}$

Match List Type

Q.23 **List-I (Complex)**

- (P) $[\text{Co}(\text{CN})_6]^{3-}$
 (Q) $[\text{Co}(\text{NH}_3)_6]^{3+}$
 (R) $[\text{Co}(\text{NH}_3)_5(\text{H}_2\text{O})]^{3+}$
 (S) $[\text{Co}(\text{NH}_3)_5\text{Cl}]^{2+}$

Codes:

- | | P | Q | R | S |
|------|---|---|---|---|
| (A) | 3 | 2 | 1 | 4 |
| (B) | 4 | 3 | 2 | 1 |
| (C*) | 2 | 1 | 4 | 3 |
| (D) | 1 | 2 | 3 | 4 |

List-II (Colour of complex)

- (1) Yellow-orange
 (2) Yellow
 (3) Violet
 (4) Red

Q.24

List - I

- (P) $S_2C_2O_2^{2-}$
 (Q) NO_2^-
 (R) CH_3COO^-
 (S) CN^-

Codes:

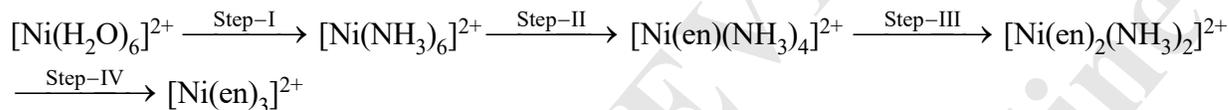
	P	Q	R	S
(A)	3	2	1	4
(B*)	4	3	2	1
(C)	2	1	4	3
(D)	1	2	3	4

List-II

- (1) Only ambidentate
 (2) Only flexidentate
 (3) Ambidentate with flexidented character
 (4) Ambidentate with bidentate character

Match the column

Q.25 Consider the following steps of reaction and match the following



Column I

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

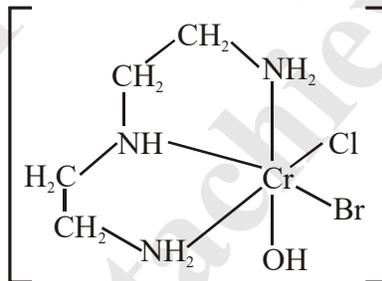
Column II

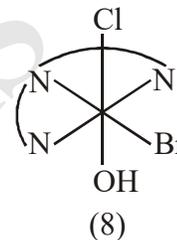
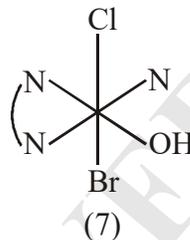
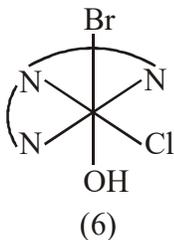
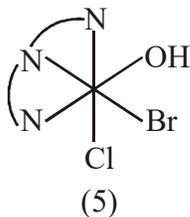
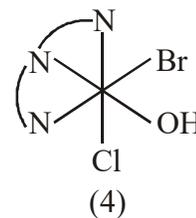
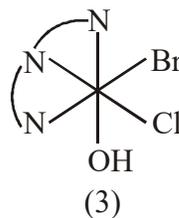
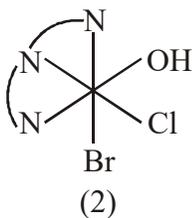
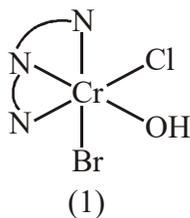
- (P) Stability of product complex increases
 (Q) No change in magnetic moment
 (R) Change in colour
 (S) Either reactant or product show stereo-isomerism
 (T) Neither reactant nor product show stereo-isomerism

[Ans. (A) PQRT (B) PQRT (C) PQRS (D) PQRS]

Subjective

Q.26 Find total number of complexes (Given 1 to 8) which are geometrical isomer of given complex compound





Ans. 7

Q.27 For complex ions $[\text{CoBr}_2(\text{H}_2\text{O})_2(\text{NH}_3)_2]^+$ and $[\text{Co}(\text{acac})(\text{H}_2\text{O})_2(\text{NH}_3)_2]^{2+}$, find the value of expression $|X + Y|$ where, X = total number of geometrical isomers of both complex ions which can exhibit optical activity phenomena.

Y = Difference in their number of trans geometrical isomers.

Ans. 4

Q.28 Find total number of mononuclear neutral complex which follow EAN rule, form by Cr, Mn^+ , Fe^{2+} , Co^{3+} with ligands.



Ans. 7

Q.29 Find out total number of compound(s)/complex(s) in which at least one non axial d-orbital has been used in bond formation :

IF_7 ; CrO_4^{2-} ; $\text{Cr}(\text{CO})_6$; $[\text{Ni}(\text{dmg})_2]$; $[\text{PtCl}_3(\pi\text{-CH}_2 = \text{CH}_2)]^-$; $[\text{NiCl}_2(\text{PPh}_3)_2]$; $[\text{Fe}(\text{H}_2\text{O})_5(\text{NO})]^{2+}$; $[\text{Ni}(\text{en})_3]^{2+}$; $\text{BH}_3 \cdot \text{CO}$

Ans. 7

Q.30 Find total number of bidentate ligands 'X' for which complex $\text{M}(\text{X})_3$ can show geometrical as well as optical isomerism.

en, ox^{2-} , dipy, phen, gly⁻, acac⁻, bcac⁻, pn

Ans. 3 (gly⁻, bcac⁻, pn)