

The d and f block elements & coordination compounds

SUBJECTIVE PROBLEMS:

Q 1.

A certain inorganic compound (A) on heating loses its water of crystallization. On further heating, a blackish brown powder (B) and two oxides of sulphur (C and D) are obtained. The powder (B) on boiling with hydrochloric acid gives a yellow solution (E). When H_2S is passed in (E) a white turbidity (F) and an apple green solution (G) are obtained. The solution (E) on treatment with thiocyanate ions gives a blood red coloured compound (H). Identify compounds from (A) to (H). (IIT JEE 1978 - 4 Marks)

Q 2.

A white amorphous powder (A) on heating yields a colourless, non-combustible gas (B) and a solid (C). The latter compound assumes a yellow colour on heating and changes to white on cooling. 'C' dissolves in dilute acid and the resulting solution gives a white precipitate on adding $K_4Fe(CN)_6$ solution.

'A' dissolves in dilute HCl with the evolution of gas which is identical in all respects with 'B'. The gas 'B' turns lime water milky, but the milkiness disappears with the continuous passage of gas. The solution of 'A', as obtained above, gives a white precipitate (D) on the addition of excess of NH_4OH and passing H_2S . Another portion of the solution gives initially a white precipitate (E) on the addition of sodium hydroxide solution, which dissolves on further addition of the base. Identify the compounds A, B, D, and E. (IIT JEE 1979 - 4 Marks)

Q 3.

State with balanced equations, what happens when

(i) Silver is treated with hot concentrated sulphuric acid.

(ii) Ammonium dichromate is heated.

(iii) Hydrogen sulphide is passed through a solution of potassium permanganate acidified with dilute sulphuric acid. (IIT JEE 1979 - 2 Marks)

Q 4.

A solution of $FeCl_3$ in water gives a brown precipitate on standing. (IIT JEE 1980 - 1 Marks)

Q 5.

Complete the following equation (no balancing is needed) :



Q 6.

An unknown solid mixture contains one or two of the following: $CaCO_3$, $BaCl_2$, $AgNO_3$, Na_2SO_4 , $ZnSO_4$ and $NaOH$. The mixture is completely soluble in water and the solution gives pink colour with phenolphthalein. When dilute hydrochloric acid is gradually added to the above solution, a precipitate is produced which dissolves with further addition of the acid. What is/are present in the solid? Give equations to explain the appearance of the precipitate and its dissolution.

(IIT JEE 1981 - 2 Marks)

Q7.

State with balanced equations what happens when :

(i) Sulphur dioxide gas is bubbled through an aqueous solution of copper sulphate in presence of potassium thiocyanate. (IIT JEE 1982 – 1 Marks)

(ii) aqueous solution of ferric sulphate and potassium iodide are mixed. (IIT JEE 1984 – 2 Marks)

(iii) aqueous solution of potassium manganate and acid are mixed. (IIT JEE 1984 – 2 Marks)

(iv) aqueous solution of potassium chromate and acid are mixed. (IIT JEE 1981 – 2 Marks)

(v) potassium permanganate interacts with manganese dioxide in presence of potassium hydroxide; (IIT JEE 1985 – 1 Marks)

(vi) potassium Ferro cyanide is heated with concentrated sulphuric acid; (IIT JEE 1985 – 1 Marks)

(vii) Gold is dissolved in aqua regia. (IIT JEE 1987 – 1 Marks)

(viii) Write balanced equations for the extraction of silver from silver glance by cyanide process. (IIT JEE 1988 – 1 Marks)

(ix) Silver chloride is treated with aqueous sodium cyanide and the product thus formed is allowed to react with zinc in alkaline medium. (IIT JEE 1989 – 1 Marks)

(x) Cobalt(II) solution reacts with KNO_2 in acetic acid medium. (IIT JEE 1989 – 1 Marks)

(xi) Write balanced equations for the extraction of copper from copper pyrites by self-reduction. (IIT JEE 1990 – 2 Marks)

(xii) A mixture of potassium dichromate and sodium chloride is heated with concentrated H_2SO_4 . (IIT JEE 1990 – 1 Marks)

(xiii) Iron reacts with cold dilute nitric acid. (IIT JEE 1990 – 1 Marks)

(xiv) Potassium permanganate is added to a hot solution of manganese sulphate. (IIT JEE 1990 – 1 Marks)

(xv) Copper reacts with HNO_3 to give NO and NO_2 in molar ratio of 2 : 1. (IIT JEE 1992 – 1 Marks)

$\text{Cu} + \text{HNO}_3 \rightarrow \dots\dots\dots + \text{NO} + \text{NO}_2 + \dots\dots\dots$

(xvi) Na_2CO_3 is added to a solution of copper sulphate. (IIT JEE 1992 – 1 Marks)

$\text{CuSO}_4 + \text{Na}_2\text{CO}_3 + \text{H}_2\text{O} \rightarrow \dots\dots\dots + \text{Na}_2\text{SO}_4 + \dots\dots\dots$

(xvii) Potassium dichromate and concentrated hydrochloric acid are heated together. (IIT JEE 1992 – 1 Marks)

(xviii) $\text{AgBr} + \text{Na}_2\text{S}_2\text{O}_3 \rightarrow \dots\dots\dots + \dots\dots$ (IIT JEE 1993 – 1 Marks)

(xix) $(\text{NH}_4)_2\text{S}_2\text{O}_8 + \text{H}_2\text{O} + \text{MnSO}_4 \rightarrow \dots\dots + \dots\dots + \dots\dots$ (IIT JEE 1993 – 1 Marks)

(xx) $[\text{MnO}_4]^{2-} + \text{H}^+ \rightarrow \dots\dots\dots + [\text{MnO}_4]^- + \text{H}_2\text{O}$ (IIT JEE 1993 – 1 Marks)

(xxi) $\text{SO}_2(\text{aq}) + \text{Cr}_2\text{O}_7^{2-} + 2\text{H}^+ \rightarrow \dots\dots\dots + \dots\dots\dots + \dots\dots\dots$ (IIT JEE 1994 – 1 Marks)

(xxii) Write a balanced equation for the reaction of argentite with KCN and name the products in solution. (IIT JEE 1996 – 1 Marks)

(xxiii) Write balanced equations for the oxidation of cuprous oxide to cupric hydroxide by alkaline KMnO_4 . (IIT JEE 1997C – 1 Marks)

(xxiv) Write balanced equations for the reaction of alkaline per bromate with zinc giving tetrahydroxyzincate anion. (IIT JEE 1997C – 1 Marks)

(xxv) Write balanced equations for the reaction of zinc with dilute nitric acid. (IIT JEE 1997 – 1 Marks)

Q 8.

Give balanced equations for extraction of silver from its sulphide ore (IIT JEE 1982 – 2 Marks)

Q 9.

Give reasons for the following :

(i) Silver bromide is used in photography. (IIT JEE 1983 – 1 Marks)

(ii) Most transition metal compounds are coloured. (IIT JEE 1986 – 1 Marks)

(iii) Zinc and not copper is used for the recovery of metallic silver from complex $[Ag(CN)_2]^-$.

Explain. (IIT JEE 1987 – 1 Marks)

(iv) The colour of mercurous chloride, Hg_2Cl_2 , changes from white to black when treated with ammonia. (IIT JEE 1988 – 1 Marks)

(v) The species $[CuCl_4]^{2-}$ exists while $[CuI_4]^{2-}$ does not (IIT JEE 1992 – 1 Marks)

(vi) CrO_3 is an acid anhydride. (IIT JEE 1999 – 2 Marks)

Q 10.

State the conditions under which the following preparation is carried out.

Potassium permanganate from manganese hydroxide.

Give the necessary equations which need not be balanced. (IIT JEE 1983 – 1 Marks)

Q 11.

What happen when :

(i) aqueous ammonia is added drop wise to a solution of copper sulphate till it is in excess. (IIT JEE 1985 – 1 Marks)

(ii) $CrCl_3$ solution is treated with sodium hydroxide and then with hydrogen peroxide. (IIT JEE 1985 – 1 Marks)

Q 12.

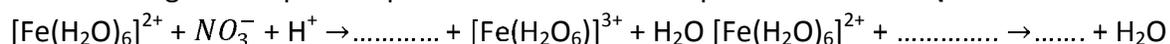
Mention the products formed when zinc oxide is treated with excess of sodium hydroxide solution. (IIT JEE 1986 – 1 Marks)

Q 13.

What is the actual reducing agent of hematite in blast furnace? (IIT JEE 1987 – 1 Marks)

Q 14.

The acidic, aqueous solution of ferrous ion forms a brown complex in the presence of NO_3^- , by the following two steps. Complete and balance the equations : (IIT JEE 1993 – 2 Marks)



Q 15.

Identify the complexes which are expected to be coloured. Explain (IIT JEE 1994 – 2 Marks)

- (i) $[\text{Ti}(\text{NO}_3)_4]$
- (ii) $[\text{Cu}(\text{NCCH}_3)_4]^+ \text{BF}_4^-$
- (iii) $[\text{Cr}(\text{NH}_3)_6]^{3+} 3\text{Cl}^-$
- (iv) $\text{K}_3 [\text{VF}_6]$

Q 16.

Write down the IUPAC names of the following compounds :

- (i) $[\text{Co}(\text{NH}_3)_5 \text{ONO}]\text{Cl}_2$ (IIT JEE 1995 – 1 Marks)
- (ii) $\text{K}_3[\text{Cr}(\text{CN})_6]$ (IIT JEE 1995 – 1 Marks)
- (iii) $[\text{Cr}(\text{NH}_3)_5\text{CO}_3]\text{Cl}$ (IIT JEE 1996 – 1 Marks)

Q 17.

Compare qualitatively the first and second ionization potentials of copper and zinc. Explain the observation. (IIT JEE 1996 – 2 Marks)

Q 18.

Write the IUPAC name of the compound $[\text{Cr}(\text{NH}_3)_5(\text{NCS})] [\text{ZnCl}_4]$. Is this compound coloured? (IIT JEE 1997 – 2 Marks)

Q 19.

Write equations for the reaction of :

- (i) silver bromide with hypo in photographic process. (IIT JEE 1997C – 1 Marks)
- (ii) cobaltous chloride with excess KNO_2 in aqueous acidic solution. (IIT JEE 1997C – 1 Marks)

Q 20.

Write the formulae of the following complexes :

- (i) pentamminechlorocobalt(III) (IIT JEE 1997 – 1 Marks)
- (ii) Lithium tetrahydroaluminate(III) (IIT JEE 1997 – 1 Marks)

Q 21.

When the ore hematite is burnt in air with coke around 2000°C along with lime, the process not only produces steel but also produces a silicate slag that is useful in making building materials such as cement. Discuss the same and show through balanced chemical equations.

(IIT JEE 1998 – 4 Marks)

Q 22.

Work out the following using chemical equations

(IIT JEE 1998 – 2 Marks)

In moist air copper corrodes to produce a green layer on the surface.

Q 23.

A, B, and C are three complexes of chromium (III) with the empirical formula $\text{H}_{12}\text{O}_6\text{Cl}_3\text{Cr}$. All the three complexes have water and chloride ion as ligands. Complex A does not react with concentrated H_2SO_4 , whereas B and C lose 6.75% and 13.5% of their original mass, respectively, on treatment with concentration H_2SO_4 . Identify A, B and C. (IIT JEE 1999 – 6 Marks)

Q 24.

Write the chemical reaction associated with the brown ring test'. (IIT JEE 2000 – 2 Marks)

Q 25.

Draw the structures of $[\text{Co}(\text{NH}_3)_6]^{3+}$, $[\text{Ni}(\text{CN})_4]^{2-}$ and $[\text{Ni}(\text{CO})_4]$. Write the hybridization of atomic orbitals of the transition metal in each case. (IIT JEE 2000 – 4 Marks)

Q 26.

(i) Write the chemical reactions involved in the extraction of metallic silver from argentite.

(ii) Write the balanced chemical equation for developing photographic films.

(IIT JEE 2000 – 4 Marks)

Q 27.

A metal complex having composition $\text{Cr}(\text{NH}_3)_4 \text{Cl}_2\text{Br}$ has been isolated in two forms (A) and (B). The form (A) reacts with AgNO_3 to give a white precipitate readily soluble in dilute aqueous ammonia, whereas (B) gives a pale yellow precipitate soluble in concentrated ammonia. Write the formula of (A) and (B) and state the hybridization of chromium in each. Calculate their magnetic moments (spin only value).

(IIT JEE 2001 – 5 Marks)

Q 28.

Deduce the structure of $[\text{NiCl}_4]^{2-}$ and $[\text{Ni}(\text{CN})_4]^{2-}$ considering the hybridization of the metal ion. Calculate the magnetic moment (spin only) of the species.

(IIT JEE 2002 – 5 Marks)

Q 29.

Write the IUPAC nomenclature of the given complex along with its hybridization and structure.

$\text{K}_2 [\text{Cr}(\text{NO})(\text{NH}_3)(\text{CN})_4]$, $\mu = 1.73 \text{ BM}$

(IIT JEE 2003 – 4 Marks)

Q 30.

Nickel chloride, when treated with dimethylglyoxime in presence of ammonium hydroxide, a bright red precipitate is obtained. Answer the following.

(IIT JEE 2004 – 4 Marks)

(a) Draw the structure of the complex showing H-bonds

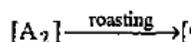
(b) Give oxidation state of nickel and its hybridization

(c) Predict the magnetic behavior of the complex

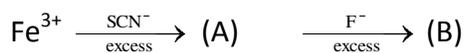
Q 31.

Some reactions of two ores, A_1 and A_2 of the metal M are given below.

(IIT JEE 2004 – 4 Marks)



Identify A_1 , A_2 , M, C, D, and G, and explain using the required chemical reactions.

Q 32.

Blood red
colouration

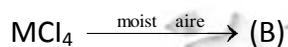
What are (A) and (B)? Give IUPAC name of (A). Find the spin only magnetic momentum of (B)

(IIT JEE 2005 – 4 Marks)

Q 33.

Write the chemical reaction involved in developing of a black and white photographic film. An aqueous $\text{Na}_2\text{S}_2\text{O}_3$ solution is acidified to give a milky white turbidity. Identify the product and write the balanced half chemical reaction for it.

(IIT JEE 2005 – 4 Marks)

Q 34.

White fumes

Identify (A), (B) and MCl_4 . Also explain colour difference between MCl_4 and (A).

(IIT JEE 2005 – 4 Marks)

The d and f block elements & coordination compounds

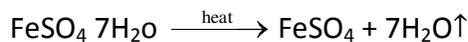
SUBJECTIVE PROBLEMS:

Sol 1.

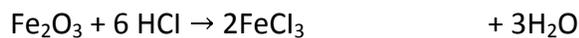
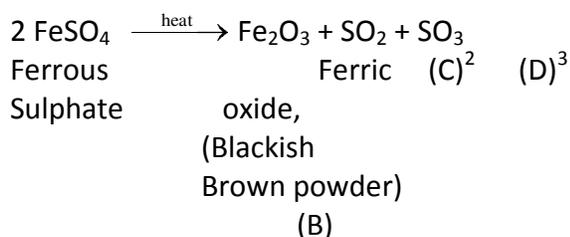
(i) Since the compound (A) on strong heating gives two oxides of sulphur (C and D) which might be SO_2 and SO_3 , it must be a **sulphate**.

(ii) The reaction of compound (E) with thiocyanate to give blood red coloured compound (H) indicates that (E) must have **Fe^{3+} ion**.

Thus the compound (A) must be ferrous sulphate $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$, which explain all given reactions as below (Fe^{2+} ion of FeSO_4 is changed to Fe^{3+} during heating).



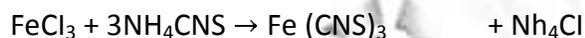
Ferrous sulphate Ferrous
 Sulphate



(B) Ferric chloride
 (Yellow solution). (E)

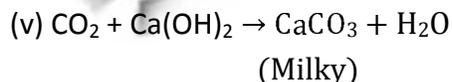
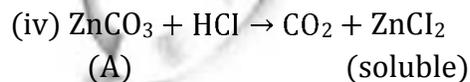
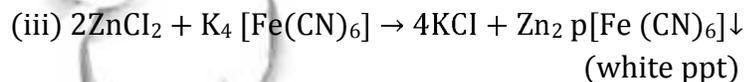
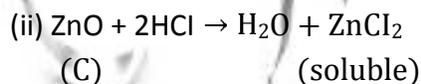
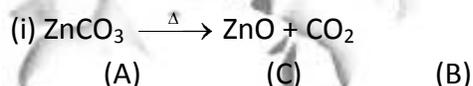


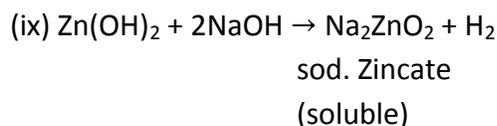
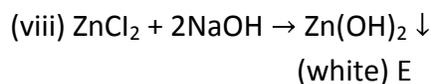
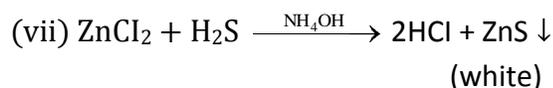
(E) Apple white
 green (G) turbidity (F)



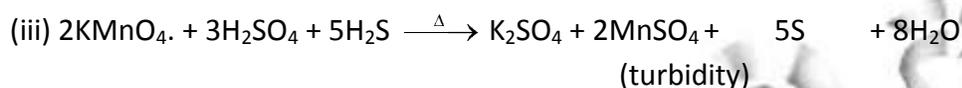
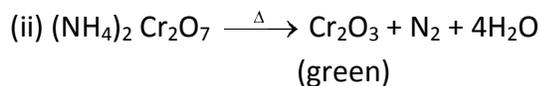
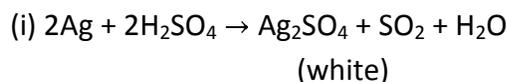
(E) Ferric thiocyanate
 (Blood red colour)

Sol 2.



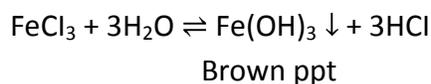


Sol 3.

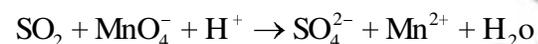


Sol 4.

On standing FeCl_3 is hydrolyses and produces colloidal solution of Fe(OH)_3 which is in form of brown precipitate



Sol 5.



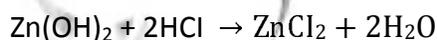
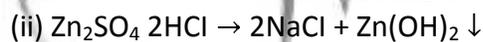
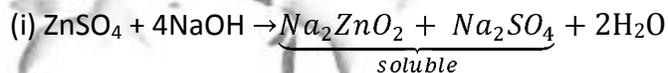
Sol 6.

(i) Since the mixture is soluble in water to give strong alkaline solution, it must contain NaOH as one of the constituents.

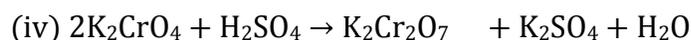
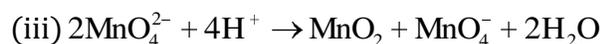
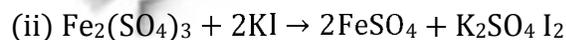
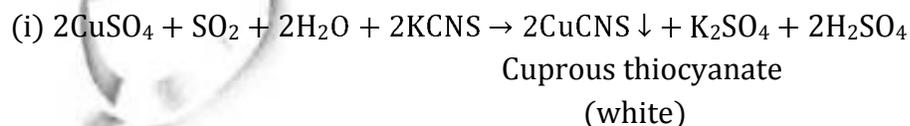
(ii) Since the aqueous solution gives precipitate with dil. HCl, which dissolves in excess of dil. HCl, it must contain zinc salt.

Thus the mixture consists of ZnSO_4 and NaOH which explains all the given reactions.

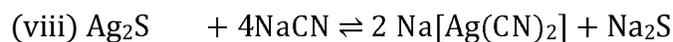
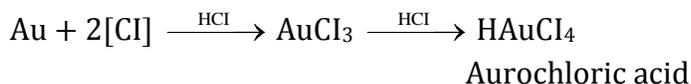
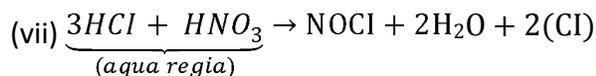
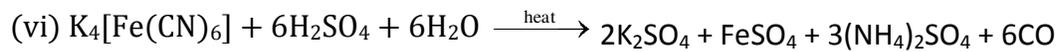
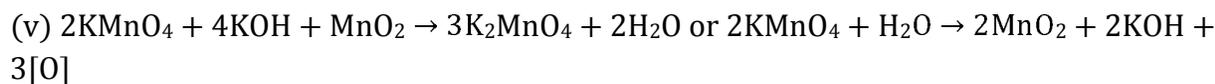
Reactions :



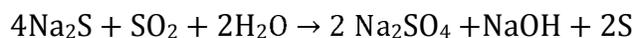
Sol 7.



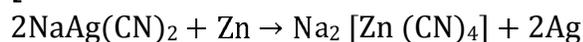
(yellow) (orange red)



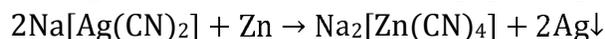
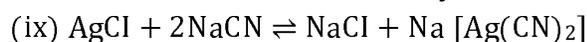
(silver glance)



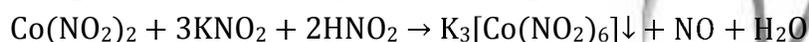
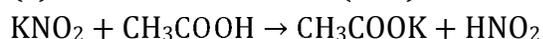
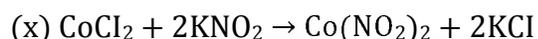
[NOTE : Na_2S is converted into Na_2SO_4 to avoid reversibility of first reaction]



Sod. Zinc cyanide

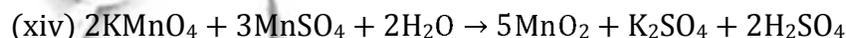
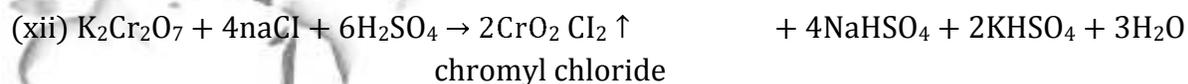
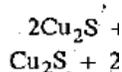


Soluble



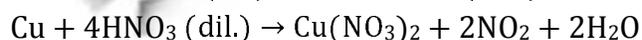
Pot cobaltinitrite

(yellow ppt.)

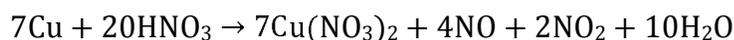


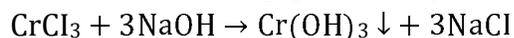
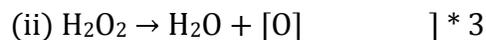
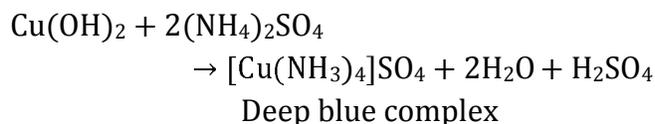
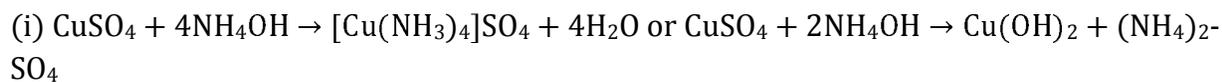
This is known as **Volhard method** for estimation of manganese.

(xv) The individual reactions are

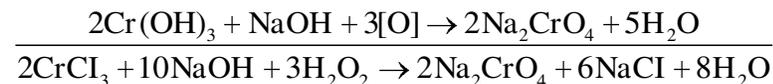


For the molar ratio of 2 : 1 of NO and NO₂, we will have



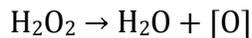
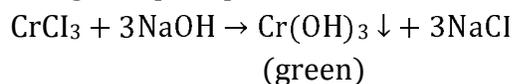
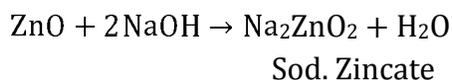
Sol 11.

Green

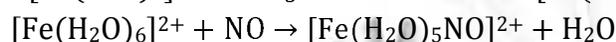
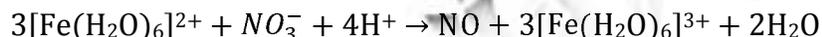


Yellow

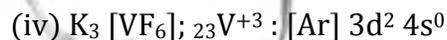
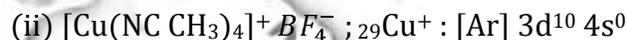
ALTERNATIVE SOLUTION : Precipitates, having green colouration of $\text{Cr}(\text{OH})_3$ are formed. The green precipitate then dissolves to produce a yellow solution of chromate. Reaction are

**Sol 12.****Sol 13.**

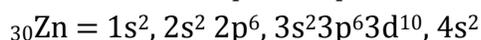
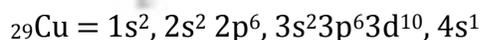
Carbon monoxide is the actual reducing agent of hematite in blast furnace.

Sol 14.**Sol 15.**

For the explanation of colouration of complexes, first of all find out the number of unpaired electrons present in outer available d-orbitals

**Sol 16.**

- (i) Pentamminenitridocobalt (III) chloride
- (ii) Potassium hexacyanochromate (III)
- (iii) Pentamminecarbonatochromium (III) chloride.

Sol 17.

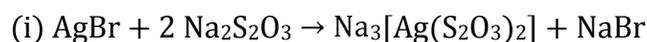
On the basis of configuration of Cu and Zn, first ionization potential of Zn is greater than that of copper because in zinc the electron is removed from $4s^2$ configuration while in copper it is removed from $4s^1$ configuration. So more amount of energy is required for the removal of electron of $4s^2$ (completely filled orbital) than that of $4s^1$ while the second ionization potential of Cu is higher than that of zinc because Cu^+ has $3d^{10}$ (stable configuration) in comparison to Zn^+ ($4s^1$ configuration).

Sol 18.

Pentammine isothiocyanato chromium (III) tetra chlorozincate.

Yes, this compound is coloured because Cr^{3+} . Has $3d^3$ configuration (has unpaired electron in d-orbitals) which show colour, through d-d transition.

Sol 19.



(Hypo) soluble complex



Yellow ppt.

(potassium hex nitro Cobalt ate III)

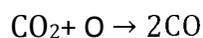
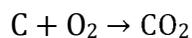
Sol 20.

(i) $[\text{CoCl}(\text{NH}_3)_5]^{2+}$ Formula of pentamminechlorocobalt (III)

(ii) LiAlH_4 Formula of lithium tetrahydroaluminate (III)

Sol 21.

Hematite (Fe_2O_3) on burning with coke and lime at 2000°C result in the following reactions.

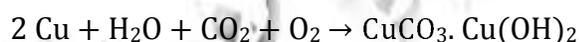


(steel)



(Lime) (Slag)

Sol 22.



Green basic copper carbonate

Sol 23.

The complex A does not react with concentrated H_2SO_4 implying that all water molecules are coordinated with Cr^{3+} ion. Hence, its structure would be $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$.

The compound B loses 6.75% of its original mass when treated with concentrated H_2SO_4 .

This loss is due to the removal of water molecules which is/are not directly coordinate to Cr^{3+} ion.

The mass of water molecules removed per mole of the complex

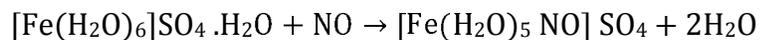
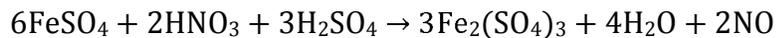
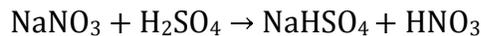
$= 6.75/100 * \text{molar mass of the complex} = 6.75/100 * 266.5 \text{ g} = 17.98 \text{ g}$

This corresponds to one mole of water. Hence, the structure of the compound B will be

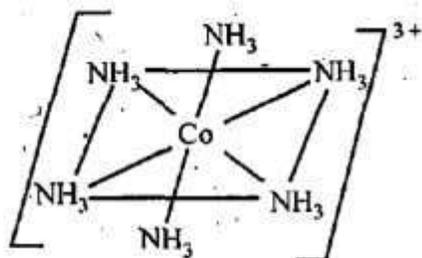
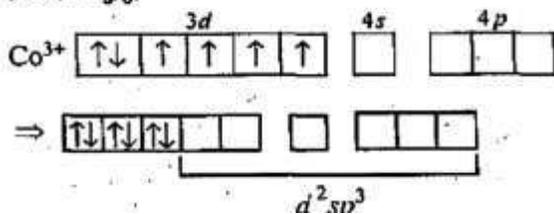
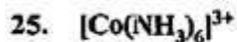


NOTE : The compound C loses 13.5% of its mass when treated with concentrated H_2SO_4 which is twice to the mass lost by the compound B. Hence, the structure of the compound C will be $[\text{Cr}(\text{H}_2\text{O})_4 \text{Cl}_2](\text{H}_2\text{O})_2 \text{Cl}$.

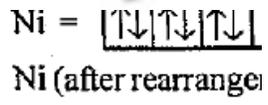
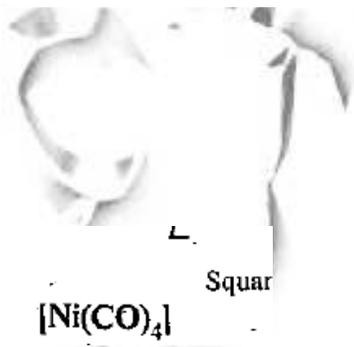
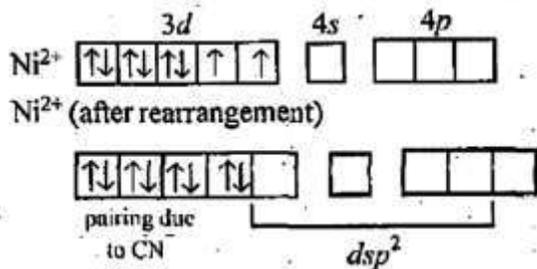
Sol 24.



Sol 25.



Octahedral complex, d^2sp^3 hybridisation



Tetra

Sol 26.

(i) Argentite is Ag_2S . Silver is extracted from its ore argentite (silver glance, Ag_2S) as follows :

(1) Silver glance is concentrated by froth flotation.

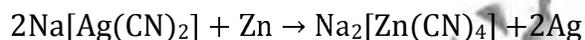
(2) Leaching : The concentrated ore is ground to fine powder and dissolved in dilute solution of sodium cyanide.



Oxygen of air converts Na_2S to Na_2SO_4 thereby preventing reaction to take place in the reversible direction

(3) Recovery of silver.

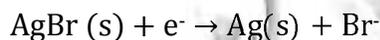
Silver is precipitated out by adding electropositive metal, Zn.



(ii) For development, activated grains are preferentially reduced by mild reducing agents like hydroquinone

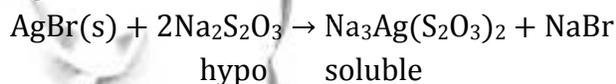


Hydroquinone



(Reducing of activated AgBr to elemental silver.)

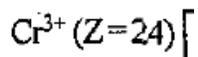
The photographic film is permanently fixed by immediately washing out any non activated AgBr



Sol 27.

Compound (A) on treatment with AgNO_3 gives white precipitate of AgCl , which is readily soluble in dil. aq. NH_3 . Therefore it has at least one Cl^- ion in the ionization sphere furthermore chromium has coordination number equal to 6. So its formula is $[\text{Cr}(\text{NH}_3)_4\text{BrCl}]\text{Cl}$.

Compound (B) on treatment with AgNO_3 gives pale yellow precipitate of AgBr soluble in conc. NH_3 . Therefore it has Br^- in the ionization sphere. So its formula is $[\text{Cr}(\text{NH}_3)_4\text{Cl}_2]\text{Br}$.



State of hybridization of chromium in both (A) and (B) is d^2sp^3 .

Spin magnetic moment of (A) or (B),

$$M_{\text{spin}} = \sqrt{n(n+2)} = \sqrt{3(3+2)} = \sqrt{15}$$

$$= 3.87 \text{ BM}$$

Sol 28.

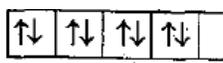
Cl^- is a weak ligand which is unable to pair the electrons of Ni^{2+} . Therefore, here hybridization is sp^3 and shape will be **tetrahedral**.

Electronic configuration of Ni^{2+} (No. of electrons = 26) in presence of Cl^- ion, a weak ligand.



Magnetic moment of $[\text{NiCl}_4]^{2-} = \sqrt{2(2+2)} = 2.82 \text{ BM}$ On the other hand, CN^- is a strong ligand which pairs up the electrons of Ni^{2+} . Therefore, here hybridization is dsp^2 and shape will be square planar.

Electronic configuration of Ni^{2+} in presence of CN^- ion, a strong ligand.



For structure of $[\text{Ni}(\text{CN})_4]^{2-} = \sqrt{0(0+2)} = 0.01 \text{ BM}$

Sol 29.

The spin magnetic moment, μ of the complex is 1.73 BM.

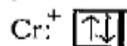
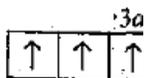
$$M = \sqrt{n(n+2)} = 1.73 \Rightarrow n = 1$$

It means that nucleus of the complex, chromium ion **has one unpaired electron**. So the ligand NO is **unit positively** charged.

IUPAC name :

Potassium amminetetracyanonitrosochromate (I).

(a) Electronic configuration of Cr^+ :



(b) Electronic configuration of Cr^+ under the influence of strong field ligand CN^-

So, Hybridization : d^2sp^3 ; Shape : Octahedral

Sol 30.

Bis(dinr

(b) Charge on Ni in the complex is +2 and it is dsp^2 hybridized

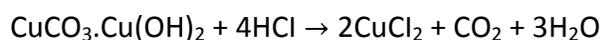
(c) Since number of unpaired electrons in Ni^{2+} is zero, the complex is diamagnetic.

Sol 31.

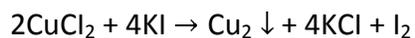
Calcinations of the ore A_1 to form CO_2 indicates that A_1 should be a carbonate. Further, reaction of A_1 with HCl and KI to evolve I_2 indicates that A_1 would also be hydroxide. So the possible formula for the ore, should be $\text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2$ which explains all the given reactions



(A₁) (C) black

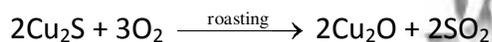


(A₁)

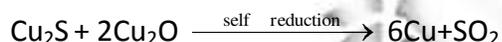


(D)

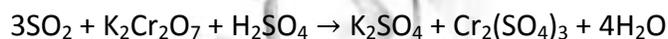
Roasting of A_2 gives gas G whose nature is identified as SO_2 as it gives green colour with acidified $\text{K}_2\text{Cr}_2\text{O}_7$. So A_2 should be sulphide of copper.



(A₂) (G)

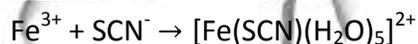


(M)



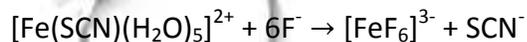
(G) (Green colour)

Sol 32.



(excess) (blood red)

(A)



(B)

IUPAC name of A is pentaquathiocyanatoferrate (III) ion IUPAC name of B is hexafluoroferrate (III)

In $[\text{FeF}_6]^{3-}$ oxidation state of Fe = 6

In $[\text{FeF}_6]^{3-}$ oxidation state of Fe = + 3

