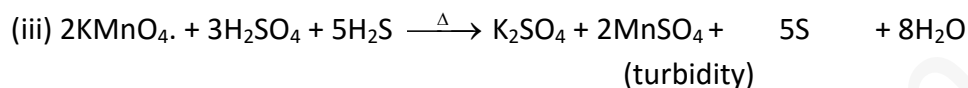
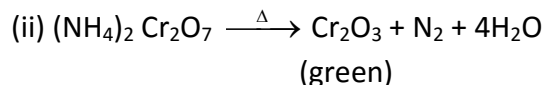
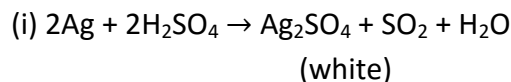
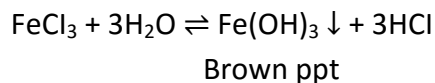


### **Sol 3.**

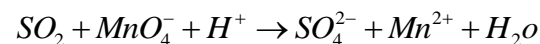


### **Sol 4.**

On standing  $\text{FeCl}_3$  is hydrolyses and produces colloidal solution of  $\text{Fe(OH)}_3$  which is in form of brown precipitate



### **Sol 5.**



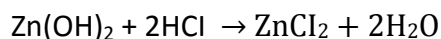
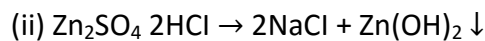
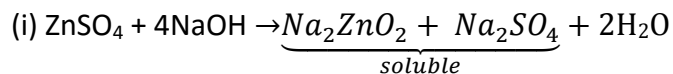
### **Sol 6.**

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

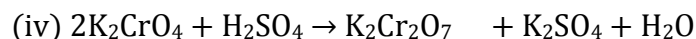
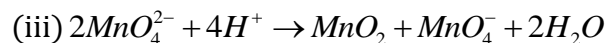
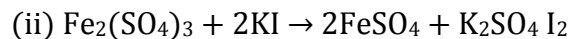
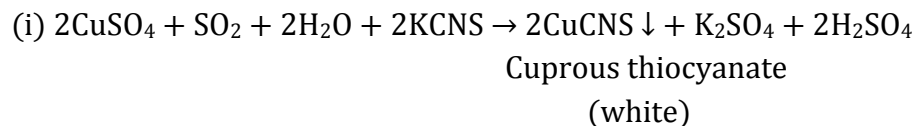
(ii) Since the aqueous solution gives precipitate with dil. HCl, which dissolves in excess of dil. HCl, it must contain zinc salt.

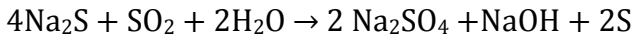
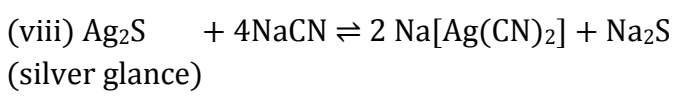
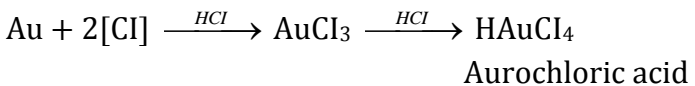
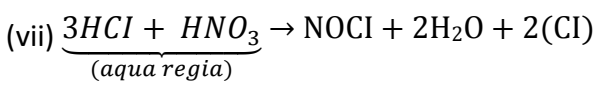
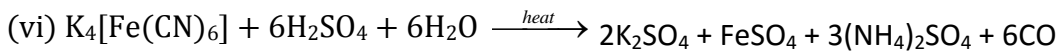
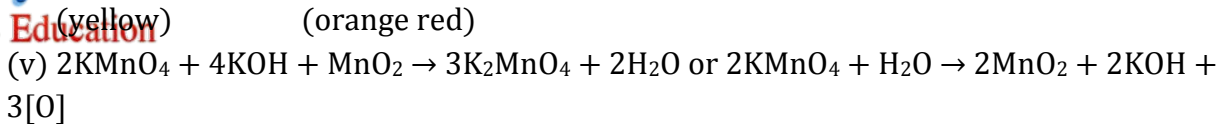
Thus the mixture consists of  $\text{ZnSO}_4$  and NaOH which explains all the given reactions.

#### **Reactions :**

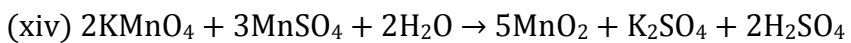
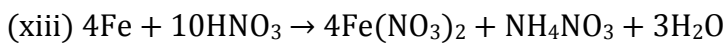
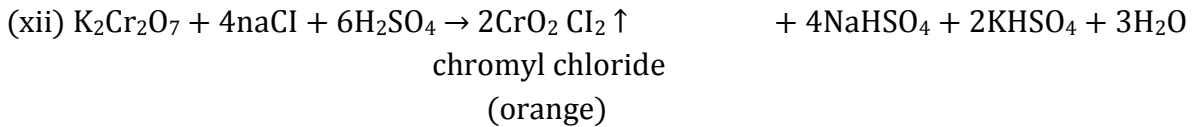
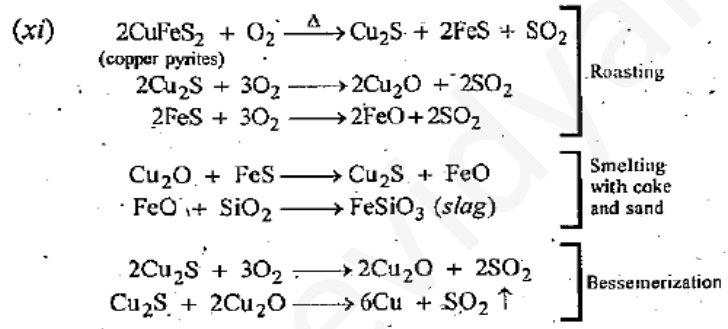
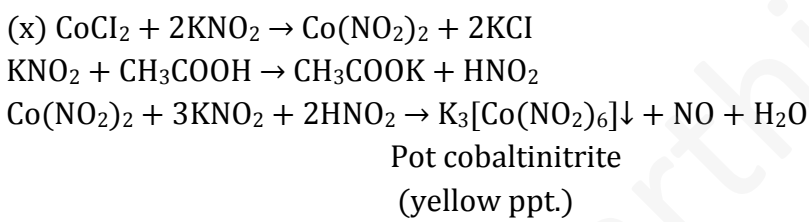
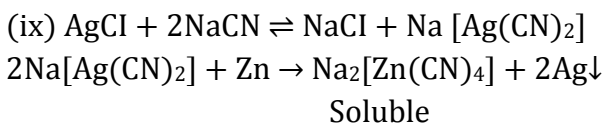
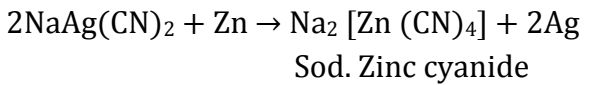


### **Sol 7.**

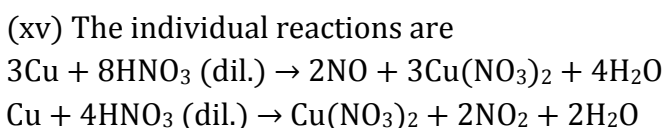




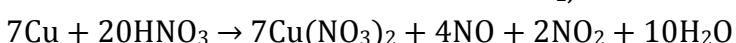
[NOTE :  $\text{Na}_2\text{S}$  is converted into  $\text{Na}_2\text{SO}_4$  to avoid reversibility of first reaction]



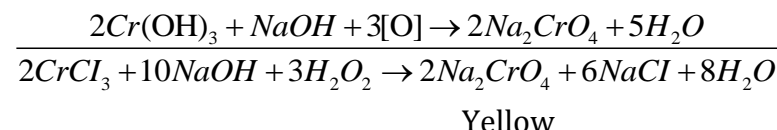
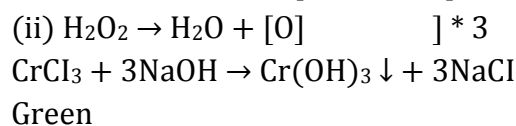
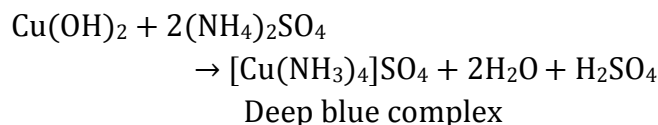
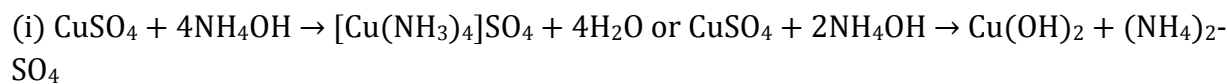
This is known as **Volhard method** for estimation of manganese.



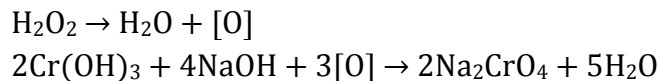
For the molar ratio of 2 : 1 of NO and NO<sub>2</sub>, we will have



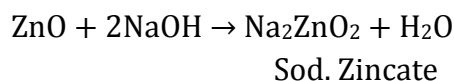




**ALTERNATIVE SOLUTION :** Precipitates, having green colouration of  $\text{Cr}(\text{OH})_3$  are formed. The green precipitate then dissolves to produce a yellow solution of chromate. Reaction are



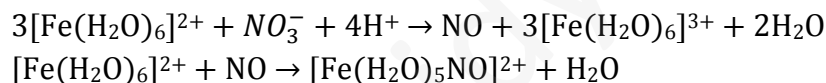
**Sol 12.**



**Sol 13.**

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

**Sol 14.**



**Sol 15.**

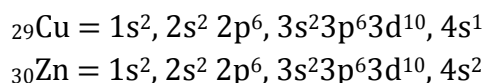
For the explanation of colouration of complexes, first of all find out the number of unpaired electrons present in outer available d-orbitals

- (i)  $[\text{Ti}(\text{NO}_3)_4]$  ;  ${}_{22}\text{Ti}^{4+}$  :  $[\text{Ar}] 3d^0 4s^0$
- (ii)  $[\text{Cu}(\text{NC CH}_3)_4]^+ \text{BF}_4^-$  ;  ${}_{29}\text{Cu}^+$  :  $[\text{Ar}] 3d^{10} 4s^0$
- (iii)  $[\text{Cr}(\text{NH}_3)_6]^{+3} 3\text{Cl}^-$  ;  ${}_{24}\text{Cr}^{3+}$  :  $[\text{Ar}] 3d^3 4s^0$
- (iv)  $\text{K}_3 [\text{VF}_6]$  ;  ${}_{23}\text{V}^{+3}$  :  $[\text{Ar}] 3d^2 4s^0$

**Sol 16.**

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

**Sol 17.**



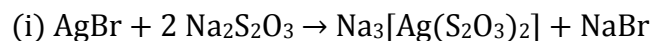
On the basis of configuration of Cu and Zn, first ionization potential of Zn is greater than that of copper because in zinc the electron is removed from  $4s^2$  configuration while in copper it is removed from  $4s^1$  configuration. So more amount of energy is required for the removal of electron of  $4s^2$  (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.**

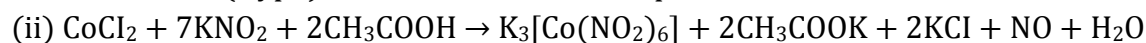
Pentammine isothiocyanato chromium (III) tetra chlorozincate.

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)

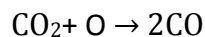
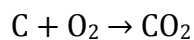
**Sol 20.**

(i)  $[CoCl(NH_3)_5]^{2+}$  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  $2000^\circ C$  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  $[Cr(H_2O)_6]Cl_3$ .

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

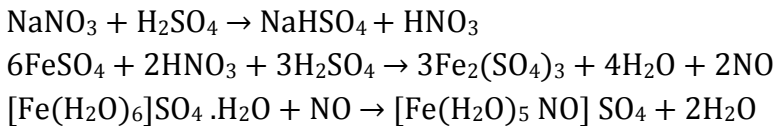
$= 6.75/100 * \text{molar mass of the complex} = 6.75/100 * 266.5 \text{ g} = 17.98 \text{ g}$

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



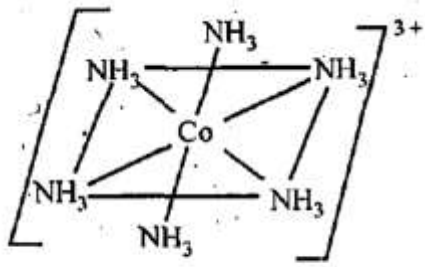
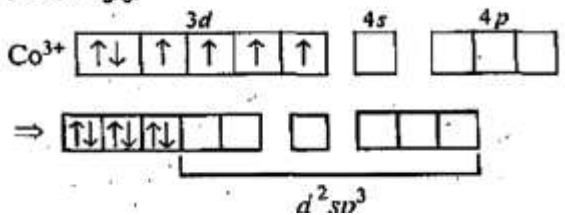
**NOTE:** The compound C loses 13.5% of its mass when treated with concentrated  $H_2SO_4$  which is twice to the mass lost by the compound B. Hence, the structure of the compound C will be  $[Cr(H_2O)_4 Cl_2](H_2O)_2 Cl$ .

**Sol 24.**

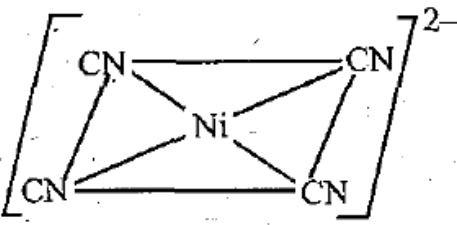
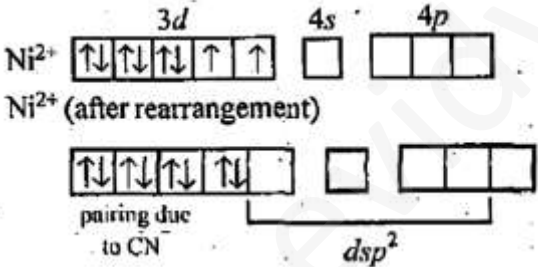


**Sol 25.**

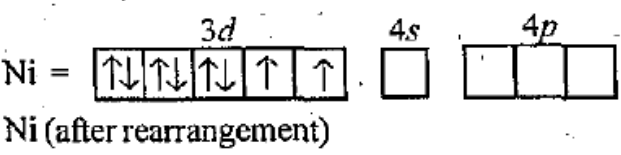
25.  $[Co(NH_3)_6]^{3+}$

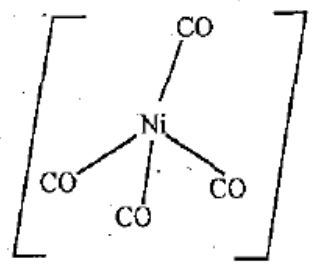
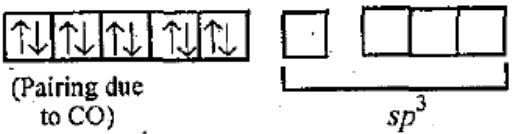


$[Ni(CN)_4]^{2-}$



$[Ni(CO)_4]$





Tetrahedral ( $sp^3$  hybridisation)

**Sol 26.**

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

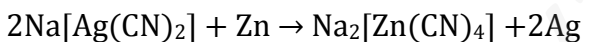
- (1) Silver glance is concentrated by froth flotation.
- (2) Leaching : The concentrated ore is ground to fine powder and dissolved in dilute solution of sodium cyanide.



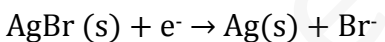
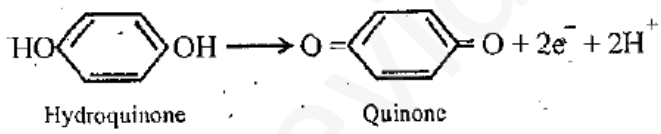
Oxygen of air converts  $Na_2S$  to  $Na_2SO_4$  thereby preventing reaction to take place in the reversible direction

- (3) Recovery of silver.

Silver is precipitated out by adding electropositive metal, Zn.

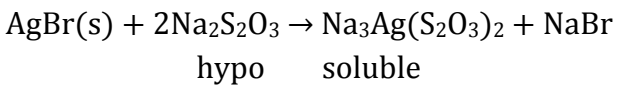


(ii) For development, activated grains are preferentially reduced by mild reducing agents like hydroquinone



(Reducing of activated  $AgBr$  to elemental silver.)

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

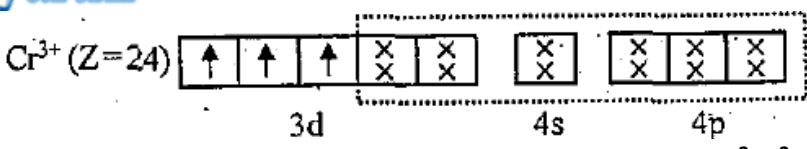


**Sol 27.**

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  $[Cr(NH_3)_4BrCl]Cl$ .

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  $[Cr(NH_3)_4Cl_2]Br$ .





State of hybridization of chromium in both (A) and (B) is **d<sup>2</sup>sp<sup>3</sup>**.

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

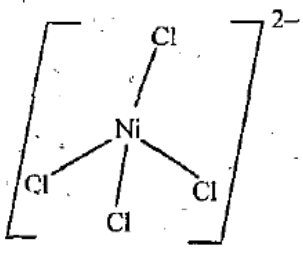
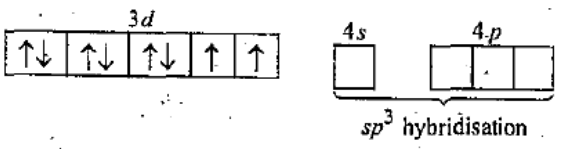
$$M_{spin} = \sqrt{n(n + 2)} = \sqrt{3(3 + 2)} = \sqrt{15}$$

$$= 3.87 \text{ BM}$$

**Sol 28.**

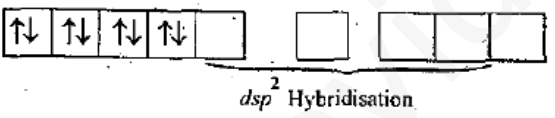
Cl<sup>-</sup> is a weak ligand which is unable to pair the electrons of Ni<sup>2+</sup>. Therefore, here hybridization is sp<sup>3</sup> and shape will be **tetrahedral**.

Electronic configuration of Ni<sup>2+</sup> (No. of electrons = 26) in presence of Cl<sup>-</sup> ion, a weak ligand.



Magnetic moment of [NiCl<sub>4</sub>]<sup>2-</sup> =  $\sqrt{2(2 + 2)} = 2.82 \text{ BM}$  On the other hand, CN<sup>-</sup> is a strong ligand which pairs up the electrons of Ni<sup>2+</sup>. Therefore, here hybridization is d<sup>2</sup>sp<sup>2</sup> and shape will be square planar.

Electronic configuration of Ni<sup>2+</sup> in presence of CN<sup>-</sup> ion, a strong ligand.



For structure of [Ni(CN)<sub>4</sub>]<sup>2-</sup> =  $\sqrt{0(0 + 2)} = 0.01 \text{ BM}$

**Sol 29.**

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

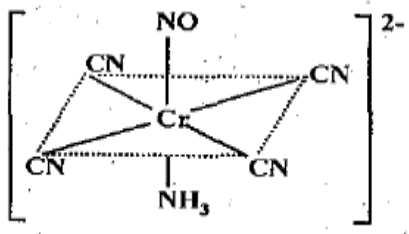
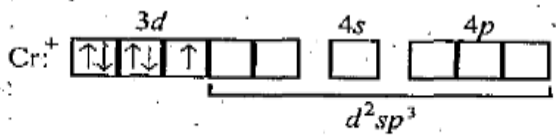
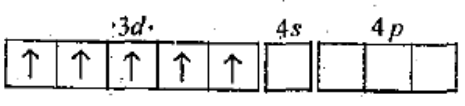
$$M = \sqrt{n(n + 2)} = 1.73 \Rightarrow n = 1$$

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).

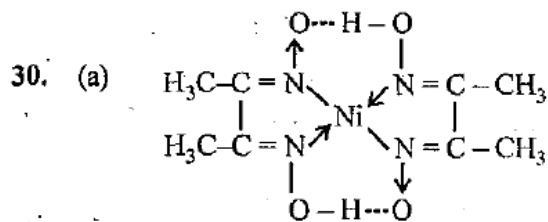
(a) Electronic configuration of Cr<sup>+</sup> :



(b) Electronic configuration of  $\text{Cr}^+$  under the influence of strong field ligand  $\text{CN}^-$

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

**Sol 30.**



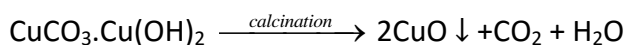
Bis(dimethylglyoximato) nickel (II)

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

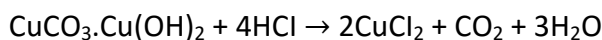
(c) Since number of unpaired electrons in  $\text{Ni}^{2+}$  is zero, the complex is diamagnetic.

**Sol 31.**

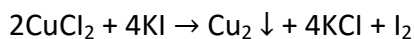
Calcinations of the ore  $A_1$  to form  $\text{CO}_2$  indicates that  $A_1$  should be a carbonate. Further, reaction of  $A_1$  with  $\text{HCl}$  and  $\text{KI}$  to evolve  $\text{I}_2$  indicates that  $A_1$  would also be hydroxide. So the possible formula for the ore, should be  $\text{CuCO}_3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



(A<sub>1</sub>) (C) black

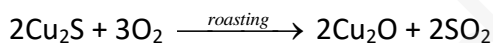


(A<sub>1</sub>)

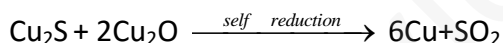


(D)

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



(A<sub>2</sub>) (G)

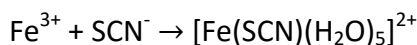


(M)



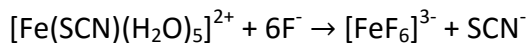
(G) (Green colour)

**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

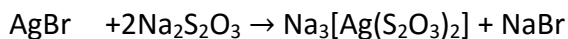
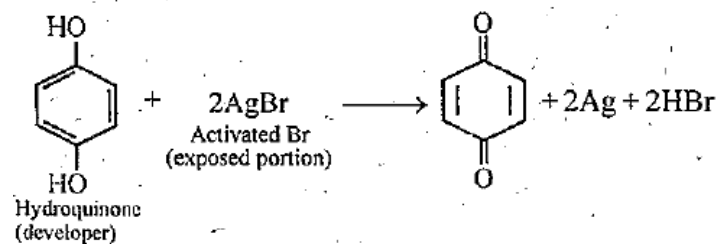
It has 5 unpaired electrons,  $n = 5$ ,  $\text{Fe}^{3+}$  is  $3d^5$

Magnetic moment ( $\mu$ ) =  $\sqrt{n(n+2)}$  (B.M.)

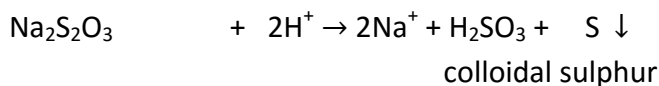
$$\sqrt{5(5+2)} = \sqrt{35} = 5.92 \text{ B.M.}$$

**Sol 33.**

Reaction involved in developing of a black and white photographic film.

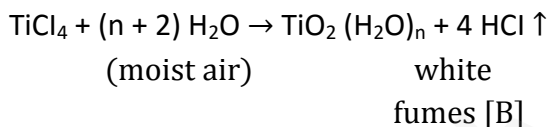
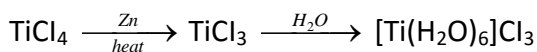


unexposed portion



**Sol 34.**

[A]  $[\text{Ti}(\text{H}_2\text{O})_6]\text{Cl}_3$  [B] HCl



$\text{Ti}^{4+} = [\text{Ar}] 3d^0$ ;  $\text{Ti}^{3+} = [\text{Ar}] 3d^1$

$\text{TiCl}_4$  is colourless since  $\text{Ti}^{4+}$  has no d electrons, hence d-d transition is impossible. On the other hand,  $\text{Ti}^{3+}$  absorbs greenish yellow compound of white light, hence its aqueous solution is purple which is complementary colour of greenish yellow in white light.

(C) : (q) and (s) In  $[\text{Co}(\text{H}_2\text{O})_5\text{Cl}]\text{Cl}$ , is in +2 state with  $3d^7$  configuration making it paramagnetic.

(D) : (q) and (s) In  $[\text{Ni}(\text{H}_2\text{O})_6]\text{Cl}_2$ , Ni is in +2 state with  $3d^8$  configuration. It is attached with weak field ligands, therefore it is paramagnetic.

2. (A) -p, s ; (B) -q, s ; (C) -r, t ; (D) -q, t

