Exercise-1

✍ **Marked questions are recommended for Revision.**

PART - I : SUBJECTIVE QUESTIONS

Section (A) : Ist Group

A-1. Name of one chloride which is soluble in hot water as well as in excess of HCl.

A-2. Why do lead salts turn black on keeping for a long time in the laboratory ?

A-3.✍ A metal salt forms a yellow precipitate (P) with potassium iodide solution and black precipitate (Q) with acidified H_2S. Yellow precipitate (P) dissolve in excess of concentrated solution of KI and ppt.reappears on dilution. Then metal salt could be and also write the chemical equation.

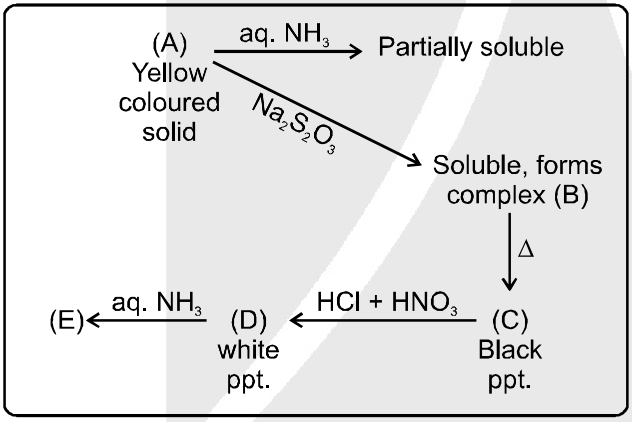
A-4.✍ When calomel reacts with ammonia solution, a black precipitate is formed. Write the chemical equation and also name the reaction nature.

A-5. What products are formed when precipitate formed by the reaction of Hg_2^{2+} ions and excess of sodium hydroxide solution is boiled ?

A-6.✍ A metal salt forms a green precipitate with KI solutiion and white ppt with KCl. This green precipitate under goes disproportionation reaction in excess of reagent which results in a soluble compound and black precipitate then write the chemical equations and identify the cation in the original sample.

A-7. Why bright yellow precipitate of AgI is soluble in KCN and $Na_2S_2O_3$ solution.

A-8.✍ Solid (A) is used in photographic film, Identify (A) to (E) ?



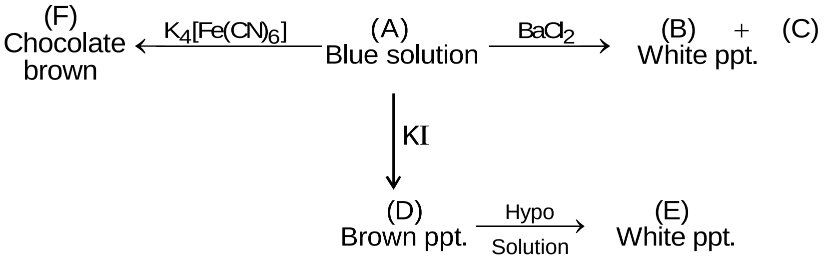
Section (B) : II A Group

B-1. Why Na_2S cannot be used in place of H_2S (in presence of HCl) as a reagent for IInd group cations ?

B-2. Does sodium hydroxide solution can be used to differentiate Hg(I) from Hg(II) ?

B-3. What happens when white precipitate of $Bi(OH)_3$ is boiled ?

B-4. Identify A to F.



Section (C) : IIB Group

C-1.✍ An original solution is prepared in conc. HCl when diluted a white ppt. is formed. What does it indicate ?

C-2.✍ Why HNO_3 can not be used in place of HCl as a reagent (H_2S in presence of HCl) for IInd group cations?

C-3. A chloride of an element (X) forms yellow precipitate with H_2S in acidic medium. This yellow precipitate is soluble in Conc. HNO_3 due to formation of compound (Y). Compound (Y) gives ammonium molybdate test then find the metal salt (X).

C-4.✍ Identify (A) based on the following facts :
(i) (A) reduces $HgCl_2$ solution to white ppt. changing to grey.
(ii) (A) turns $FeCl_3$ yellow coloured solution to green.
(iii) (A) gives white ppt. with NaOH soluble in excess of NaOH.
(iv) (A) gives brown ppt. on passing H_2S gas, soluble in yellow ammonium sulphide (YAS).
(v) (A) gives colourless gas with conc. H_2SO_4 but not with dil. H_2SO_4.

Section (D) : IIIrd Group

D-1.✍ Why is the original solution boiled with conc. HNO_3 in group III ?

D-2.✍ Do Fe(III) salts and Fe(II) salts both give red colouration with dimethylglyoxime in ammonical solution. If not then which iron salt gives red colouration with dimethylglyoxime ?

D-3.✍ Which colour precipitate is formed by Fe(II) salt with potassium ferrocyanide, (i) in complete absence of air and (ii) under ordinary atmospheric conditions ?

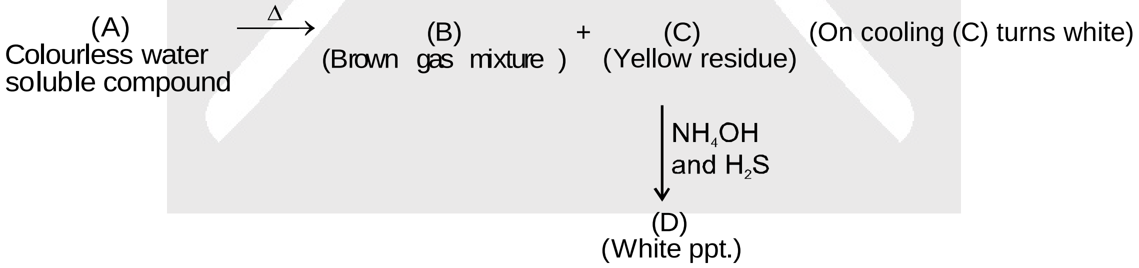
Section (E) : IVth Group

E-1. Partial precipitation of Mn^{2+} as $Mn(OH)_2$ occurs with ammonia solution but the precipitate is soluble in ammonium salts. Explain ?

E-2.✍ Why Zn(II) salt is not precipitated as $Zn(OH)_2$ by ammonia solution in the presence of excess of ammonium chloride ?

E-3.✍ In the absence of copper ion, zinc ion form a white precipitate with the ammonium tetrathiocyanatomercurate(II) How the presence of Cu^{2+} ion affect this test ?

E-4.✍ Identify (A) to (D).



Section (F) : Vth, VIth and Zero Group

F-1.✍ What is the formula of iodide of Millon's base ?

F-2. What happens when ammonia gas is passed into a solution of sodium cobaltinitrite ?

F-3. What will happen if the precipitation of Vth group cation by ammonium carbonate is replaced by Na_2CO_3?

F-4.✍ What happens when ammonium sulphate solution is added to a solution containing both Sr^{2+} and Ca^{2+} ions?

F-5.✍ Which colour precipitate is obtained when a solution of Ca^{2+} ions reacts with potassium ferrocyanide.

PART - II : ONLY ONE OPTION CORRECT TYPE

Section (A) : Ist Group

A-1.✍ A metal nitrate reacts with KI solution to give yellow precipitate which on addition of excess of more concentrated solution (6 M) of KI dissolves forming a solution. The cation of metal nitrate is :
(A) Hg_2^{2+} (B) Ag^+ (C) Pb^{2+} (D) Cu^{2+}

A-2. Three separate samples of a solution of a single salt gave these results. One formed a white precipitate with excess ammonia solution, one formed a white precipitate with dilute NaCl solution and one formed a black precipitate with H_2S. The salt could be :
(A) $AgNO_3$ (B) $Pb(NO_3)_2$ (C) $Hg(NO_3)_2$ (D) $Mn(NO_3)_2$

A-3.✍ Consider the following observation :
M^{n+} + HCl (dilute) $\xrightarrow{\quad}$ white precipitate $\xrightarrow{\Delta}$ water soluble $\xrightarrow{CrO_4^{2-}}$ yellow precipitate.
The metal ion M^{n+} will be :
(A) Hg^{2+} (B) Ag^+ (C) Pb^{2+} (D) Sn^{2+}

A-4. When calomel reacts with NH_4OH solution the compound formed is :
(A) Hg_2Cl_2 (B) $Hg(NH_2)Cl$ (C) $Hg(NH_3)_2Cl$ (D) $HgCl_2.NH_3$

A-5.✍ Consider the following equilibrium :
$AgCl\downarrow + 2NH_3 \rightleftharpoons [Ag(NH_3)_2]^+ + Cl^-$
White ppt of AgCl appears on adding
(A) NH_3 (B) aq. NaBr (C) aq. HNO_3 (D) aq. NH_4I

A-6. AgCl with NH_3 forms a complex :
(A) $[Ag(NH_3)_2]Cl$ (B) $AgNO_3$ (C) $[Ag(NH_2)_2]Cl$ (D) Ag mirror

Section (B) : IIA Group

B-1.✍ Sometimes yellow turbidity appears while passing H_2S gas even in slightly acidic medium in the absence of II group radicals. This is because :
(A) sulphur is present in the mixture as impurity.
(B) IV group radicals are precipitated as sulphides.
(C) of the oxidation of H_2S gas by some acid radicals.
(D) III group radicals are precipitated as hydroxides.

B-2. H_2S in the presence of HCl precipitates II group but not IV group because :
(A) HCl activates H_2S
(B) HCl increases concentration of Cl^-
(C) HCl decreases concentration of S^{2-}
(D) HCl lowers the solubility of H_2S in solution

B-3. When small amount of $SnCl_2$ is added to a solution of Hg^{2+} ions, a silky white precipitate is obtained. The silky white precipitate is due to the formation of :
(A) Hg_2Cl_2 (B) $SnCl_4$ (C) Sn (D) Hg

B-4. When excess of dilute NH_4OH is added to an aqueous solution of copper sulphate an intense blue colour is developed. This is due to the formation of :
(A) $[Cu(NH_3)_6]^{2+}$ (B) $Cu(OH)_2$ (C) $[Cu(NH_3)_4]^{2+}$ (D) $(NH_4)_2SO_4$

B-5.✍ A black sulphide is formed by the action of H_2S on :
(A) cupric chloride (B) cadmium chloride (C) zinc chloride (D) ferric chloride.

B-6. Which one of the following salts will produce clear and transparent original solution in 2M HCl ?
(A) Ag_2CO_3 (B) $Pb(CO_3)$ (C) Hg_2CO_3 (D) $CuCO_3$

B-7. When bismuth chloride is poured into a large volume of water the white precipitate produced is of :
(A) BiO.OH (B) Bi_2O_3 (C) BiOCl (D) $Bi(OH)_3$

B-8.✍ In which of the following pairs the precipitates are red and black coloured respectively and both precipitates are soluble in excess KI solution ?
(A) HgI_2, Hg_2I_2 (B) HgI_2, BiI_3 (C) Cu_2I_2, AgI (D) CdI_2, PbI_2

B-9.✍ A metal chloride original solution (i.e. O.S) on mixing with K_2CrO_4 solution gives a yellow precipitate soluble in aqueous sodium hydroxide. The metal may be :
(A) mercury (B) iron (C) silver (D) lead

Section (C) : IIB Group

C-1. Which of the following metal sulphide is soluble in YAS (yellow ammonium sulphide) :
(A) HgS (B) PbS (C) Bi_2S_3 (D) Sb_2S_3

C-2. When white crystalline precipitate of magnesium ammonium arsenate is treated with acidified silver nitrate solution, precipitate of silver arsenate is formed. The colour of precipitate is :
(A) Yellow (B) Brownish red (C) White (D) Brownish black

Section (D) : IIIrd Group

D-1.✍ When NH_4Cl is added to a solution of NH_4OH :
(A) the dissociation of NH_4OH increases.
(B) the concentration of OH^- increases.
(C) the concentrations of both OH^- an NH_4^+ increase.
(D) the concentration of OH^- ion decreases.

D-2.✍ To avoid the precipitation of Hydroxides of Zn^{2+}, Mn^{2+} and Ni^{2+} along with those of Fe^{3+}, Al^{3+} and Cr^{3+} the third group solution should be :
(A) Concentrated HNO_3 is added (B) Treated with excess of NH_4Cl
(C) Concentrated H_2SO_4 is added (D) Treated with excess of NH_4OH

D-3. An inorganic lewis acid (X) fumes in moist air, and intensity of fumes increases when a rod dipped in NH_4OH is brought near to it. An acidic solution of (X) on addition of NH_4Cl and NH_4OH gives a precipitate which dissolves in NaOH solution. A solution of (X) does not give precipitate with H_2S Hence, compound (X) is
(A) $FeCl_3$ (B) $AlCl_3$ (C) $ZnCl_2$ (D) None of these

D-4.✍ An original solution of an inorganic salt in dilute HCl gives a brown colouration with potassium hexacyanidoferrate (III) and reddish brown colouration with sodium acetate solution. The cation of the salt is :
(A) Ni^{2+} (B) Fe^{3+} (C) Cu^{2+} (D) none

D-5. $Fe(OH)_3$ and $Cr(OH)_3$ precipitates can be completely separated by :
(A) Aq. NH_3 (B) HCl (C) $NaOH/H_2O_2$ (D) H_2SO_4

Section (E) : IVth Group

E-1. A coloured solution of a salt gives following reactions.
(i) It gives white precipitate with sodium hydroxide which becomes brown on exposure to air.
(ii) It gives white precipitate with ammonia solution which is soluble in ammonium salts.
(A) Mn^{2+} (B) Zn^{2+} (C) Al^{3+} (D) Ni^{2+}

E-2. A metal salt form precipitate with H_2S in presence of (NH_4OH + NH_4Cl) and this precipitate is soluble in acetic acid then metal sulphide could be :
(A) ZnS (B) CoS (C) MnS (D) NiS

E-3.✍ To increase significantly the concentration of free Zn^{2+} ion in a solution of the complex ion $[Zn(NH_3)_4]^{2+}$

$$Zn^{2+}\,(aq) + 4NH_3\,(aq) \rightleftharpoons [Zn(NH_3)_4]^{2+}\,(aq)$$

add to the solution some :
(A) H_2O (B) HCl (aq) (C) NH_3(aq) (D) NH_4Cl (aq)

E-4.✍ An aqueous solution of colourless metal sulphate M, gives a white precipitate with NH_4OH. This was soluble in excess of NH_4OH. On passing H_2S gas through this solution a white precipitate is formed. The metal M in the salt is :
(A) Ca (B) Ba (C) Al (D) Zn

E-5.✍ A metal salt solution when treated with dimethyl glyoxime and NH_4OH gives a rose red complex. The metal is :
(A) Ni (B) Zn (C) Co (D) Mn.

E-6. The ion that can not be precipited by H_2S in presence of dil. HCl.
(A) Pb^{2+} (B) Bi^{3+} (C) Cu^{2+} (D) Ni^{2+}

Section (F) : Vth, VIth and Zero Group

F-1.✍ Aqueous Solution of $BaBr_2$ gives yellow precipitate with :
(A) K_2CrO_4 (B) $AgNO_3$ (C) $(CH_3COO)_2Pb$ (D) (A) and (B) both

F-2. The addition of K_2CO_3 (aq) to the following solution is expected to produce a precipitate in every case but that one which does not produce precipitate is :
(A) $BaCl_2$(aq) (B) $CaBr_2$(aq) (C) Na_2SO_4(aq) (D) $Pb(NO_3)_2$ (aq)

F-3. An aqueous solution of salt gives white precipitate with $AgNO_3$ solution as well as with dilute H_2SO_4. It may be
(A) $Pb(NO_3)_2$ (B) $Ba(NO_3)_2$ (C) $BaCl_2$ (D) $CuCl_2$

F-4.✍ Mg is not precipitated in V group because :
(A) $MgCO_3$ is soluble in water. (B) K_{sp} of $MgCO_3$ is high.
(C) $MgCO_3$ is soluble in NH_4OH. (D) None.

F-5. A metal salt solution form a yellow ppt with potassium chromate in acetic acid, a white ppt with dilute sulphuric acid but gives no ppt with sodium chloride or iodide it is :
(A) Lead carbonate (B) Basic lead carbonate
(C) Barium nitrate (D) Strontium nitrate

F-6. A white crystalline substance dissolves in water. On passing H_2S in this solution, a black precipitate is obtained. The black precipitate dissolves completely in hot HNO_3. On adding a few drops of concentrated H_2SO_4, a white precipitate is obtained. This precipitate is that of :
(A) $BaSO_4$ (B) $SrSO_4$ (C) $PbSO_4$ (D) $CdSO_4$

F-7.✍ The brown precipitate formed by passing ammonia into Nessler's reagent in due to the formation of
(A) HgI_4^{2-} (B) $NH_2O–Hg–HgI$
(C) $NH_2–Hg–O–Hg–I$ (D) $NH_3–Hg–I$

PART - III : MATCH THE COLUMN

1. Match the precipitates listed in column-I with their suitable solvents listed in column-II.

	Column I		**Column II**
	(precipitate)		**(solvent)**
(A)	AgCl↓ (white)	(p)	Concentrated HCl.
(B)	CuS↓ (black)	(q)	Dilute ammonia solution (excess).
(C)	$Zn(OH)_2$↓ (white)	(r)	Potassium cyanide solution.
(D)	$BaCO_3$↓ (white)	(s)	Hot 50% nitric acid.
		(t)	Sodium hydroxide solution.

2. Match the basic radicals listed in column-I with the properties listed in column-II.

	Column-I		**Column-II**
	(Basic radical)		**(Properties)**
(A)	Mn^{2+}	(p)	Forms coloured metaborate in oxidising flame in borax bead test.
(B)	Cr^{3+}	(q)	Forms white precipitate with sodium hydroxide but on exposure to air turns rapidly brown.
(C)	Al^{3+}	(r)	With both potassium cyanide (not in excess) and ammonia solution separately forms reddish brown precipitate.
(D)	Fe^{3+}	(s)	With excess of sodium hydroxide forms soluble complex but on adding acid to soluble complex, a precipitate is obtained which redissolves on adding excess of acid.

Exercise-2

✍ **Marked questions are recommended for Revision.**

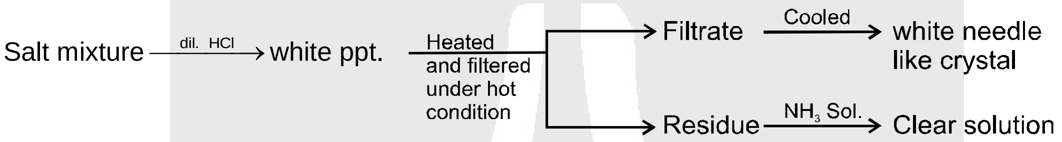
PART - I : ONLY ONE OPTION CORRECT TYPE

1.✍ Which of the following compound does not gives ppt with dil. HCl ?
(A) $AgNO_3$ (B) $Pb(NO_3)_2$ (C) $Hg_2(NO_3)_2$ (D) $Hg(NO_3)_2$

2. KI gives precipitate with all the cations given :
(A) Ag^+, Hg_2^{2+}, Pb^{2+} (B) $Cu^{2+}, Zn^{2+}, Ni^{2+}$ (C) Na^+, Ca^{2+}, Mg^{2+} (D) Ag^+, Ca^{2+}, Sr^{2+}

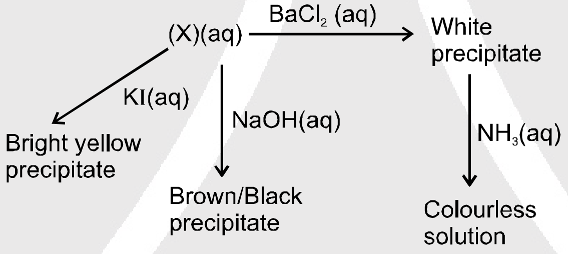
3. Three test tubes A, B, C cation Pb^{2+}, Hg_2^{2+} and Ag^+ (but unknown to each, aqueous solution NaOH is added in excess). Following changes occur.
A : Black ppt, B : Brown ppt, which disolve in NH_3, C : White ppt but dissolves in excess of NaOH
A, B and C contain respectively :
(A) Pb^{2+}, Hg_2^{2+}, Ag^+ (B) Hg_2^{2+}, Ag^+, Pb^{2+}
(C) Ag^+, Pb^{2+}, Hg_2^{2+} (D) Ag^+, Hg_2^{2+}, Pb^{2+}

4.✍



salt mixture contains cations of :
(A) Pb^{2+} and Hg^{2+} (B) Pb^{2+} and Hg_2^{2+} (C) Pb^{2+} and Ag^+ (D) None of these

5. A compound (X) reacts in the following ways.



The compound (X) is likely to be
(A) $Pb(NO_3)_2$ (B) $CaCrO_4$ (C) $Hg(NO_3)_2$ (D) $AgNO_3$

6.✍ When excess of $SnCl_2$ is added to a solution of $HgCl_2$, a white ppt turning grey is obtained. The grey colour is due to the formation of :
(A) Hg_2Cl_2 (B) $SnCl_2$ (C) Sn (D) Hg

7. An aqueous solution of a substance gives a white ppt. on treatment with dil HCl, which dissolves on heating. When hydrogen sulphide is passed through the hot acidic solution, a black ppt is obtained.The subtance is a:
(A) Hg^{2+} salt (B) Cu^{2+} salt (C) Ag^+ salt (D) Pb^{2+} salt

8.✍ Three seperate sample of a solution of a single salt gave these results one formed a white precipitate with excess of ammonia solution, one formed a white precipitate with dil. NaCl solution and one formed a black precipitate with H_2S. The salt could be :
(A) $AgNO_3$ (B) $Pb(NO_3)_2$ (C) $Hg(NO_3)_2$ (D) $MnSO_4$

9. A pale green crystalline metal salt of M dissolves freely in water. On standing it gives a brown ppt on addition of aqueous NaOH. The metal salt solution also gives a black ppt on bubbling H_2S in basic medium. An aqueous solution of the metal salt decolourizes the pink colour of the permanganate solution. The metal in the metal salt solution is :
(A) copper (B) aluminum (C) lead (D) iron

10.✍ $K_4[Fe(CN)_6]$ can be used to precipitate one or more out of Fe^{2+}, Fe^{3+}, Zn^{2+}, Cu^{2+}, Ca^{2+} :
(A) only Fe^{2+}, Fe^{3+} (B) only Fe^{3+},Zn^{2+},Cu^{2+} (C) all but not Ca^{2+} (D) all of these.

11.✍ Ferric alum gives deep red colour with NH_4SCN due to the formation of :
(A) $Al(SCN)_3$ (B) $[Fe(SCN)_3]^-$ (C) $Fe(SCN)_3$ (D) None of these.

12. Nessler's reagent is used to detect.
(A) CrO_4^{2-} (B) PO_4^{3-} (C) MnO_4^- (D) NH_4^+

13. On the addition of a solution containing CrO_4^{2-} & CH_3COOH acid to the solution of Ba^{2+}, Sr^{2+} and Ca^{2+} ions, the ppt obtained first will be of :
(A) $CaCrO_4$ (B) $SrCrO_4$ (C) $BaCrO_4$ (D) a mixture of all the three

14. A salt on treatment with dil. HCl gives a pungent smelling gas and a yellow precipitate. The salt gives green flame when tested. The solution gives a yellow precipitate with potassium chromate. The salt is :
(A) $NiSO_4$ (B) BaS_2O_3 (C) PbS_2O_3 (D) $CuSO_4$

15.✍ A chloride dissolves appreciably in cold water. When placed on a platinum wire in Bunsen flame, no distinctive colour is noticed. The cation of chloride is :
(A) Mg^{2+} (B) Ba^{2+} (C) Pb^{2+} (D) Ca^{2+}

16. In fifth group, $(NH_4)_2CO_3$ is added to precipitate out the carbonates. We do not add Na_2CO_3 because :
(A) $CaCO_3$ is soluble in Na_2CO_3
(B) Na_2CO_3 increases the solubility of fifth group carbonates
(C) $MgCO_3$ will be precipitated out in fifth group
(D) none

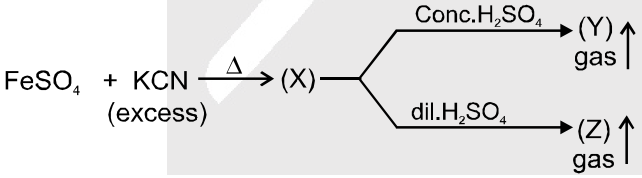
17. A metal salt solution forms a yellow precipitate with potassium chromate in acetic acid, a white precipitate with dilute sulphuric acid, but gives no precipitate with sodium chloride or iodide, it is :
(A) lead salt (B) silver salt (C) barium salt (D) strontium salt

PART - II : SINGLE AND DOUBLE VALUE INTEGER TYPE

1.✍ An aqueous solution contains Hg^{2+}, Hg_2^{2+}, Pb^{2+}, Ag^+, Bi^{3+} and Cd^{2+}. Out of these, how many ions will produce white precipitate with dilute HCl ?

2.✍ A solution of Hg^{2+} ion on treatment with a solution of cobalt(II) thiocyanate gives rise to a deep blue crystalline precipitate. Then the coordination number of mercury in the deep blue coloured compound is:

3.



The sum of number of pπ-pπ bonds present in gas (Y) & (Z) ?

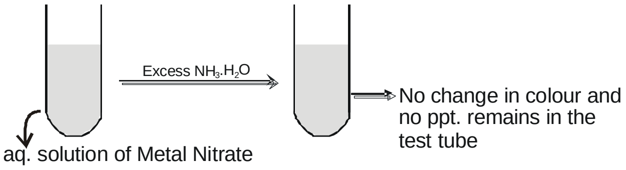
4.✍ An alcoholic solution of dimethylglyoxime is added to an aqueous solution of nickel(II) chloride. Slow addition of ammonium hydroxide led to the precipitation of a bright-red coloured metal complex.
Find out the number of hydrogen bonds present in the structure of the complex.

5. In how many of the following reactions, one of the product is obtained as a yellow precipitate :
(a) $Ba^{2+} + CrO_4^{2-} \longrightarrow$ product
(b) $NH_4^+ + [PtCl_6]^{2-} \longrightarrow$ product
(c) $NH_4^+ + [Co(NO_2)_6]^{3-} \longrightarrow$ product
(d) $Ca^{2+} + [Fe(CN)_6]^{4-} + K^+ \longrightarrow$ product
(e) $Sr^{2+} + CO_3^{2-} \longrightarrow$ product

6. Total number of metal nitrates given below, which give the following reaction,

(i) $AgNO_3$ (ii) $Pb(NO_3)_2$ (iii) $Cu(NO_3)_2$ (iv) $Cd(NO_3)_2$

(v) $Zn(NO_3)_2$ (v) $Ni(NO_3)_2$ (vi) $Al(NO_3)_3$



7. Aqueous $CuSO_4$ decolorizes on addition of excess KCN due to formation of complex (A). In complex "A". If

(i) Number of d orbitals participating in hybridisation is / are 'a'

(ii) Coordination number of Cu is "c".

then find 8a + 5c.

8.✍ $Co^{2+} + CN^- \longrightarrow$ "A" (reddish brown) ppt.

"A" + CN^- (excess) $\longrightarrow$ "B" (brown solution)

"B" + $O_2 + 2H_2O \longrightarrow$ "C" (yellow solution)

then find (a + b) for complex "C" if a = coordination number of Co

b = charge on complex (consider the magnitude)

9.✍ How many of the following reactions give yellow ppt.

(i) $NaBr + AgNO_3 \longrightarrow$

(ii) $NaI + AgNO_3 \longrightarrow$

(iii) $NaBr + Pb(NO_3)_2 \longrightarrow$

(iv) $NaI + Pb(NO_3)_2 \longrightarrow$

(v) $Na_2S + Cd(CH_3COO)_2 \longrightarrow$

(vi) $K_2CrO_4 + Pb(CH_3COO)_2 \longrightarrow$

(vii) $K_2CrO_4 + AgNO_3 \longrightarrow$

(viii) NaBr + Chlorine water (excess) $\longrightarrow$

PART - III : ONE OR MORE THAN ONE OPTIONS CORRECT TYPE

1. Which of the following is/are correctly matched ?

(A) $BiI_3\downarrow \longrightarrow$ Black precipitate (B) $CuI\downarrow \longrightarrow$ White precipitate

(C) $PbI_2\downarrow \longrightarrow$ Yellow precipitate (D) $HgI_2\downarrow \longrightarrow$ Red precipitate

2.✍ Which of the following are completely soluble in concentrated ammonia solution?

(A) AgCl (B) AgBr (C) Ag_2CrO_4 (D) AgI

3.✍ $Hg_2I_2\downarrow$ (green) $\xrightarrow[\text{with } H_2O]{\text{boiled}}$ products

Which of the following statement is / are correct with respect to the products ?

(A) Black precipitate of mercury(I) oxide is formed.

(B) Violet colour gas is evolved.

(C) Red precipitate of HgI_2 is formed.

(D) Mercury is obtained

4. Which of the following cations form coloured (not white) precipitates with aqueous solution of KI and this precipitate does not dissolve in excess of reagent ?

(A) Hg^{2+} (B) Hg_2^{2+} (C) Ag^+ (D) Cu^{2+}

5. Which of the following statements is/are true ?

(A) Ag^+ ions do not give white precipitate with excess of concentrated HCl.

(B) Cu^{2+} ions produce a white precipitate when KCN solution is added in a small quantity, and allowed to stand.

(C) Hg^{2+} ions give deep blue precipitate with cobalt acetate and ammonium thiocyanate.

(D) Black precipitate of BiI_3 turns orange when heated with water.

6.✍ KI solution is the reagent for the analysis of :
(A) Hg^{2+} (B) Pb^{2+} (C) Ag^{+} (D) Cu^{2+}

7. Which of the following metal sulphide are in brown/balck in colour ?
(A) HgS (B) PbS (C) Bi_2S_3 (D) Sb_2S_3

8. Which of the following cations form(s) black precipitate(s) with H_2S (g) ?
(A) Cu^{2+} (B) Sb^{3+} (C) Pb^{2+} (D) Bi^{3+}

9. Which of the following mixture of cations can be separated by adding excess NH_3 solution ?
(A) Zn^{2+}, Mn^{2+} (B) Zn^{2+}, Cd^{2+} (C) Zn^{2+}, Pb^{2+} (D) Zn^{2+}, Cu^{2+}

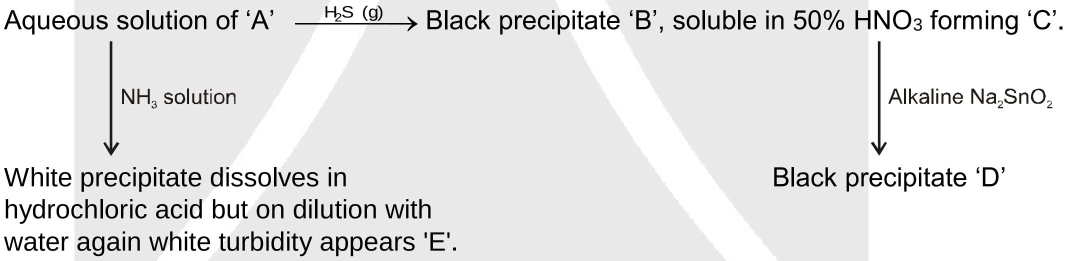
10.✍ $CoCl_2 + KNO_2 + CH_3COOH \longrightarrow [X] + H_2O + KCl + CH_3COOK + NO$
(Unbalanced equation)
Which is / are correct for 'X'?
(A) X is a yellow crystalline solid which is insoluble in water.
(B) X is a green coloured compounds known as Rinman's green.
(C) IUPAC name of X is potassium hexanitrito –N– cobaltate (II)
(D) The compound X is an inner orbital complex.

11.✍ Which of the following is/are correct for potassium ferrocyanide ?
(A) It gives a brown precipitate with Cu^{2+} ions.
(B) It gives a white precipitate of mixed salt with Ca^{2+} ions.
(C) It in excess gives a bluish white/white precipitate with Zn^{2+}.
(D) It develops a deep red colouration with Fe^{3+}.

PART - IV : COMPREHENSION

Read the following passage carefully and answer the questions.

Comprehension # 1



Aqueous solution of 'A' → Black precipitate 'B', soluble in 50% HNO_3 forming 'C'.

White precipitate dissolves in hydrochloric acid but on dilution with water again white turbidity appears 'E'.

Black precipitate 'D'

Moreover, the salt 'A' on heating with solid $K_2Cr_2O_7$ and concentrated H_2SO_4 produces deep red vapours which dissolve in sodium hydroxide solution forming a yellow solution. This yellow solution gives yellow precipitate with $Ba(NO_3)_2$ solution.
On the basis of the aforesaid characteristic informations answer the following questions :

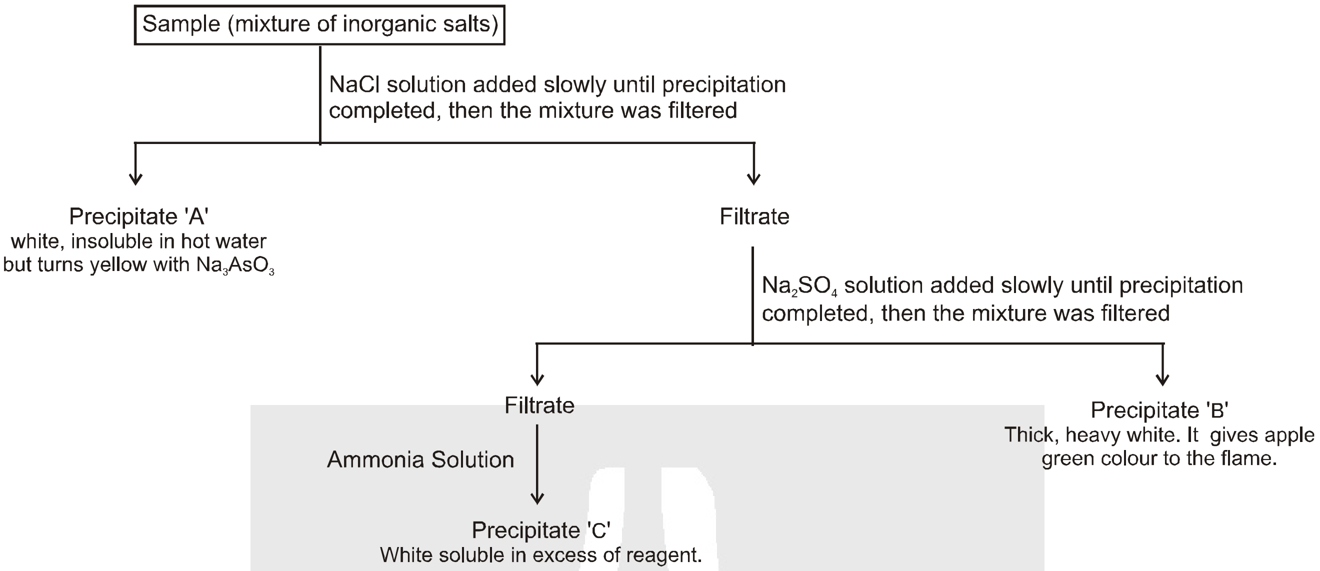
1.✍ Acidified solution of 'A', on treatment with KI gives black precipitate 'F' which dissolves in excess of reagent forming the coloured compound 'G'. The chemical composition of 'F' and 'G' are respectively :
(A) HgI_2 and $[HgI_4]^{2-}$ (B) PbI_2 and $[PbI_4]^{2-}$ (C) BiI_3 and $[BiI_4]^{-}$ (D) CuI and CuI_2.

2. The black precipitate 'F' on heating with water produces :
(A) $Hg(OH)_2$ (B) BiOI (C) BiO.OH (D) CuO.OH

3.✍ Select the correct statement.
(A) Aqueous solution of 'A' reacts with $AgNO_3$ solution to give white precipitate which turns into yellow on treatment with sodium arsenite.
(B) Aqueous solution of 'A' produces white precipitate with sodium hydroxide which turns into yellowish-white on boiling.
(C) White turbidity 'E' is soluble in dilute mineral acids.
(D) All of these.

Comprehension # 2

A student was given a sample of colourless solution containing three cations and was asked to identify the cations. Student carried out a series of reactions as given below.



4. Precipitates 'A', 'B' and 'C' are respectively :

(A) $Al(OH)_3$, $BaSO_4$ and AgCl (B) AgCl, $BaSO_4$ and $Zn(OH)_2$

(C) AgCl, $Ca(OH)_2$ and $ZnSO_4$ (D) $ZnCl_2$, $BaSO_4$ and $Al(OH)_3$

5. White precipitate 'A' is not soluble in :

(A) NH_3 (B) dilute HCl (C) KCN (D) $Na_2S_2O_3$

6.✍ Which of the following statement is correct ?

(A) Precipitate 'C' forms Rinmann's green in $Co(NO_3)_2$ test.

(B) Precipitate 'B' is appreciably soluble in boiling concentrated H_2SO_4.

(C) Precipitate (A) on exposure to sunlight or ultraviolet radiations turns black.

(D) All of these.

Comprehension # 3

Answer Q.7, Q.8 and Q.9 by appropriately matching the information given in the three columns of the following table.

In Column-1 cation are given while in Column-2 reagent are given which is used for test and in Column-3 observation are given. [Consider each solution to be aqueous unless stated.]					
Column-1		**Column-2**		**Column-3**	
(I)	Bi^{3+}	(i)	NH_3	(P)	Black / white precipitate is obtained.
(II)	Cu^{2+}	(ii)	KI	(Q)	Blue / Brown precipitate is obtained.
(III)	Fe^{3+}	(iii)	KCN	(R)	Form soluble complex in excess reagent.
(IV)	Zn^{2+}	(iv)	$K_4[Fe(CN)_6]$	(S)	Redox reaction take place.

7. The only incorrect combination is:

(A) (I) (ii) (P) (B) (II) (ii) (S) (C) (II) (ii) (R) (D) (III) (iii) (R)

8. The only correct combination is:

(A) (II) (ii) (R) (B) (III) (ii) (Q) (C) (III) (i) (R) (D) (II) (iii) (S)

9. The only incorrect combination is:

(A) (III) (iv) (Q) (B) (IV) (ii) (P) (C) (I) (i) (P) (D) (IV) (i) (R)

Exercise-3

*** Marked Questions may have more than one correct option.**

PART - I : JEE (ADVANCED) / IIT-JEE PROBLEMS (PREVIOUS YEARS)

1. A metal nitrate reacts with KI to give a black precipitate which on addition of excess of KI is converted into orange colour solution. The cation of the metal nitrate is : **[JEE - 2005, 3/84]**
(A) Hg^{2+} (B) Bi^{3+} (C) Pb^{2+} (D) Cu^{+}

2. In the given reaction sequence, Identify (A) and (B).

$$Fe^{3+} \xrightarrow[\text{(Excess)}]{SCN^-} \underset{\text{Blood red}}{A} \xrightarrow{F^-\ \text{(excess)}} \text{colourless(B)}$$

(a) Write the IUPAC name of (A) and (B).
(b) Find out the spin only magnetic moment of B. **[JEE 2005, 4/144]**

3. A white precipitate is obtained when a solution is diluted with H_2O and boiled. On addition of excess NH_4Cl/NH_4OH, the volume of precipitate decreases leaving behind a white gelatinous precipitate. Identify the precipitate which dissolves in ammonia solution or NH_4Cl. **[JEE 2006, 3/184]**
(A) $Al(OH)_3$ (B) $Zn(OH)_2$ (C) $Mg(OH)_2$ (D) $Ca(OH)_2$

4. In blue solution of copper sulphate excess of KCN is added then solution becomes colourless due to the formation of : **[JEE 2006, 3/184]**
(A) $[Cu(CN)_4]^{2-}$ (B) Cu^{2+} get reduced to form $[Cu(CN)_4]^{3-}$
(C) $Cu(CN)_2$ (D) CuCN

5. $MgSO_4 + NH_4OH + Na_2HPO_4 \longrightarrow$ white crystalline precipitate. The formula of crystalline precipitate is: **[JEE 2006, 3/184]**
(A) $MgCl_2 . MgSO_4$ (B) $MgSO_4$ (C) $Mg(NH_4)PO_4$ (D) $Mg(PO_4)_2$

6. A solution of a metal ion when treated with KI gives a red precipitate which dissolves in excess KI to give a colourless solution. Moreover, the solution of metal ion on treatment with a solution of cobalt(II) thiocyanate gives rise to a deep blue crystalline precipitate. The metal ion is : **[JEE - 2007, 3/162]**
(A) Pb^{2+} (B) Hg^{2+} (C) Cu^{2+} (D) Co^{2+}

7.* A solution of colourless salt **H** on boiling with excess NaOH produces a non-flammable gas. The gas evolution ceases after some time. On addition of Zn dust to the same solution, the gas evolution restarts. The colourless salt(s) **H** is (are) : **[JEE 2008, 4/163]**
(A) NH_4NO_3 (B) NH_4NO_2 (C) NH_4Cl (D) $(NH_4)_2SO_4$

Paragraph for Question Nos. 8 to 10

p-Amino-N, N-dimethylaniline is added to a strongly acidic solution of **X**. The resulting solution is treated with a few drops of aqueous solution of **Y** to yield blue coloration due to the formation of methylene blue. Treatment of the aqueous solution of **Y** with the reagent potassium hexacyanoferrate(II) leads to the formation of an intense blue precipitate. The precipitate dissolves on excess addition of the reagent. Similarly, treatment of the solution of **Y** with the solution of potassium hexacyanoferrate(III) leads to a brown coloration due to the formation of **Z**.

8. The compound **X** is : **[JEE 2009, 4/160]**
(A) $NaNO_3$ (B) NaCl (C) Na_2SO_4 (D) Na_2S

9. The compound **Y** is : **[JEE 2009, 4/160]**
(A) $MgCl_2$ (B) $FeCl_2$ (C) $FeCl_3$ (D) $ZnCl_2$

10. The compound **Z** is : **[JEE 2009, 4/160]**
(A) $Mg_2[Fe(CN)_6]$ (B) $Fe[Fe(CN)_6]$ (C) $Fe_4[Fe(CN)_6]_3$ (D) $K_2Zn_3[Fe(CN)_6]_2$

Paragraph for Question Nos. 11 to 13

When a metal rod M is dipped into an aqueous colourless concentrated solution of compound N the solution turns light blue. Addition of aqueous NaCl to the blue solution gives a white precipitate O. Addition of aqueous NH_3 dissolves O and gives an intense blue solution.

11. The metal rod **M** is : **[JEE 2011, 3/180]**
(A) Fe (B) Cu (C) Ni (D) Co

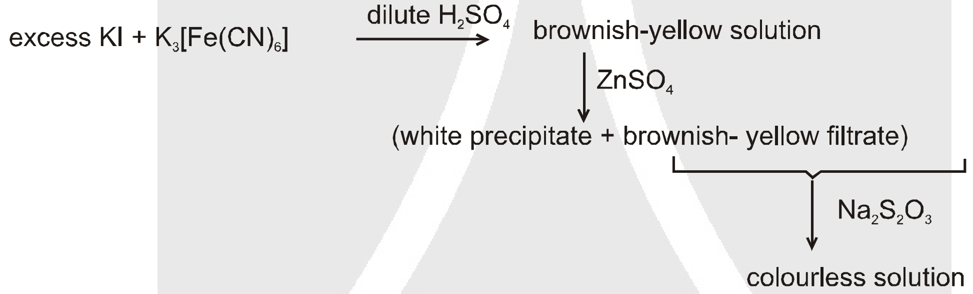
12. The compound **N** is : **[JEE 2011, 3/180]**
(A) $AgNO_3$ (B) $Zn(NO_3)_2$ (C) $Al(NO_3)_3$ (D) $Pb(NO_3)_2$

13. The final solution contains **[JEE 2011, 3/180]**
(A) $[Pb(NH_3)_4]^{2+}$ and $[CoCl_4]^{2-}$ (B) $[Al(NH_3)_4]^{3+}$ and $[Cu(NH_3)_4]^{2+}$
(C) $[Ag(NH_3)_2]^{+}$ and $[Cu(NH_3)_4]^{2+}$ (D) $[Ag(NH_3)_2]^{+}$ and $[Ni(NH_3)_6]^{2+}$

14. Passing H_2S gas into a mixture of Mn^{2+}, Ni^{2+}, Cu^{2+} and Hg^{2+} ions in an acidified aqueous solution precipitates: **[JEE 2011, 3/180]**
(A) CuS and HgS (B) MnS and CuS (C) MnS and NiS (D) NiS and HgS

15.* The equilibrium, $2Cu^{I} \rightleftharpoons Cu^{0} + Cu^{II}$
in aqueous medium at 25° C shifts towards the left in the presence of : **[JEE 2011, 4/180]**
(A) NO_3^- (B) Cl^- (C) SCN^- (D) CN^-

16.* For the given aqueous reaction which of the statement(s) is (are) true ? **[JEE 2012, 4/136]**



(A) The first reaction is a redox reaction
(B) White precipitate is $Zn_3[Fe(CN)_6]_2$
(C) Addition of filtrate to starch solution gives blue colour.
(D) White precipitate is soluble in NaOH solution

17. Upon treatment with ammoniacal H_2S, the metal ion that precipitates as a sulphide is : **[JEE(Advanced) 2013, 2/120]**
(A) Fe(III) (B) Al (III) (C) Mg(II) (D) Zn(II)

Paragraph for Question 18 and 19

An aqueous solution of a mixture of two inorganic salts, when treated with dilute HCl, gave a precipitate **(P)** and a filtrate **(Q)**. The precipitate **P** was found to dissolve in hot water. The filtrate **(Q)** remained unchanged, when treated with H_2S in a dilute mineral acid medium. However, it gave a precipitate **(R)** with H_2S in an ammoniacal medium. The precipitate **R** gave a coloured solution **(S)**, when treated with H_2O_2 in an aqueous NaOH medium.

18. The precipitate **P** contains **[JEE(Advanced) 2013, 3/120]**
(A) Pb^{2+} (B) Hg_2^{2+} (C) Ag^+ (D) Hg^{2+}

19. The coloured solution **S** contains **[JEE(Advanced) 2013, 3/120]**
(A) $Fe_2(SO_4)_3$ (B) $CuSO_4$ (C) $ZnSO_4$ (D) Na_2CrO_4

20. Among PbS, CuS, HgS, MnS, Ag_2S, NiS, CoS, Bi_2S_3 and SnS_2, the total number of **BLACK** coloured sulphides is : **[JEE(Advanced) 2014, 3/120]**

Paragraph For question 21 to 22

An aqueous solution of metal ion M1 reacts separately with reagents Q and R in excess to give tetrahedral and square planar complexes, respectively. An aqueous solution of another metal ion M2 always forms tetrahedral complexes with these reagents. Aqueous solution of M2 on reaction with reagent S gives white precipitate which dissolves in excess of S. The reactions are summarized in the scheme given below :

SCHEME:

$$\begin{tikzcd}
\text{Tetrahedral} & \text{M1} \arrow[l, "Q", "\text{excess}"'] \arrow[r, "R", "\text{excess}"'] & \text{Square planar} \\
\text{Tetrahedral} & \text{M2} \arrow[l, "Q", "\text{excess}"'] \arrow[r, "R", "\text{excess}"'] \arrow[d, "\text{S, stoichiometric amount}"] & \text{Tetrahedral} \\
& \text{White precipitate} \arrow[r, "S", "\text{excess}"'] & \text{precipitate dissolves}
\end{tikzcd}$$

21. M1, Q and R, respectively are **[JEE(Advanced) 2014, 3/120]**

(A) Zn^{2+}, KCN and HCl (B) Ni^{2+}, HCl and KCN
(C) Cd^{2+}, KCN and HCl (D) Co^{2+}, HCl and KCN

22. Reagent S is **[JEE(Advanced) 2014, 3/120]**

(A) $K_4[Fe(CN)_6]$ (B) Na_2HPO_4 (C) K_2CrO_4 (D) KOH

23.* The pair(s) of ions where BOTH the ions are precipitated upon passing H_2S gas in presence of dilute HCl, is(are) **[JEE(Advnaced) 2015, 4/168]**

(A) Ba^{2+}, Zn^{2+} (B) Bi^{3+}, Fe^{3+} (C) Cu^{2+}, Pb^{2+} (D) Hg^{2+}, Bi^{3+}

24. In the following reaction sequence in aqueous solution, the species **X**, **Y** and **Z**, respectively, are **[JEE(Advanced) 2016, 4/120]**

$$S_2O_3^{2-} \xrightarrow{Ag^+} \underset{\substack{\text{Clear}\\ \text{solution}}}{X} \xrightarrow{Ag^+} \underset{\substack{\text{white}\\ \text{precipitate}}}{Y} \xrightarrow{\text{with time}} \underset{\substack{\text{black}\\ \text{precipitate}}}{Y}$$

(A) $[Ag(S_2O_3)_2]^{3-}$, $Ag_2S_2O_3$, Ag_2S (B) $[Ag(S_2O_3)_3]^{5-}$, Ag_2SO_3,Ag_2S
(C) $[Ag(SO_3)_2]^{3-}$, $Ag_2S_2O_3$, Ag (D) $[Ag(SO_3)_3]^{3-}$, Ag_2SO_4,Ags

24.* The correct option(s) to distinguish nitrate salts of Mn^{2+} and Cu^{2+} taken separately is (are) **[JEE(Advanced) 2018, 4/120]**

(A) Mn^{2+} show the characteristic green colour in the flame test
(B) Only Cu^{2+} show the formation of precipitate by passing H_2S in acidic medium
(C) Only Mn^{2+} show the formation of precipitate by passing H_2S in faintly basic medium
(D) Cu^{2+}/Cu has higher reduction potential than Mn^{2+}/Mn (measured under similar conditions)

PART - II : JEE (MAIN) / AIEEE PROBLEMS (PREVIOUS YEARS)

JEE(MAIN) OFFLINE PROBLEMS

1. Which one of the following statement is correct ? **[AIEEE 2003, 3/225]**

(1) From a mixed precipitate of AgCl and AgI, ammonia solution dissolves only AgCl.
(2) Ferric ions gave a deep green precipitate on adding potassium ferrocyanide solution.
(3) On boiling a solution having K^+, Ca^{2+} and HCO_3^- ions we get a precipitate of $K_2Ca(CO_3)_2$.
(4) Manganese salts give a violet borax bead test in the reducing flame .

2. A red solid is insoluble in water. However it becomes soluble if some KI is added to water. Heating the red solid in a test tube results in liberation of some violet coloured fumes and droplets of a metal appear on the cooler parts of the test tube. The red solid is : **[AIEEE 2003, 3/225]**

(1) $(NH_4)_2 Cr_2O_7$ (2) HgI_2 (3) HgO (4) Pb_3O_4.

3. Which of the following compounds is **not** colored yellow ? **[JEE(Main) 2015, 4/120]**

(1) $Zn_2[Fe(CN)_6]$ (2) $K_3[Co(NO_2)_6]$
(3) $(NH_4)_3[As(Mo_3O_{10})_4]$ (4) $BaCrO_4$

4. Sodium salt of an organic acid 'X' produces effervescence with conc. H_2SO_4. 'X' reacts with the acidified aqueous $CaCl_2$ solution to give a white precipitate which decolourises acidic solution of $KMnO_4$. 'X' is: **[JEE(Main) 2017, 4/120]**

(1) HCOONa (2) CH_3COONa (3) $Na_2C_2O_4$ (4) C_6H_5COONa

JEE(MAIN) ONLINE PROBLEMS

1. The cation that will not be precipitated by H_2S in the presence of dil HCl is: **[JEE(Main) 2015 Online (10-04-15), 4/120]**

(1) Pb^{2+} (2) As^{3+} (3) Co^{2+} (4) Cu^{2+}

2. An aqueous solution of a salt X turns blood red on treatment with SCN^- and blue on treatment with $K_4[Fe(CN)_6]$. X also gives a positive chromyl chloride test. The salt X is : **[JEE(Main) 2015 Online (10-04-15), 4/120]**

(1) $CuCl_2$ (2) $Cu(NO_3)_2$ (3) $FeCl_3$ (4) $Fe(NO_3)_3$

3. When concentrated HCl is added to an aqueous solution of $CoCl_2$, its colour changes from reddish pink to deep blue. Which complex ion gives blue colour in this reaction? **[JEE(Main) 2015 Online (11-04-15), 4/120]**

(1) $[CoCl_4]^{2-}$ (2) $[CoCl_6]^{3-}$ (3) $[CoCl_6]^{4-}$ (4) $[Co(H_2O)_6]^{2+}$

4. A pink coloured salt turns blue on heating. The presence of which cation is most likely ? **[JEE(Main) 2015 Online (11-04-15), 4/120]**

(1) Co^{2+} (2) Cu^{2+} (3) Zn^{2+} (4) Fe^{2+}

5. A solution containing a group-IV cation gives a precipitate on passing H_2S. A solution of this precipitate in dil. HCl produces a white precipitate with NaOH solution and bluish-white precipitate with basic potassium ferrocyanide. The cation is : **[JEE(Main) 2017 Online (08-04-17), 4/120]**

(1) Mn^{2+} (2) Zn^{2+} (3) Co^{2+} (4) Ni^{2+}

6. The **incorrect** statement is : **[JEE(Main) 2018 Online (16-04-18), 4/120]**

(1) Cu^{2+} ion gives chocolate coloured precipitate with potassium ferrocyanide solution.
(2) Cu^{2+} and Ni^{2+} ions give black precipitate with H_2S in presence of HCl solution.
(3) Ferric ion gives blood red colour with potassium thiocyanate.
(4) Cu^{2+} salts give red coloured borax bead test in reducing flame.

Answers

EXERCISE - 1

PART - I

A-1. $PbCl_2$ is soluble in hot water and it also dissolves in concentrated HCl and KCl solutions forming soluble complex. ; $PbCl_2 + 2HCl \longrightarrow H_2PbCl_4$ (soluble complex).

A-2. $Pb^{2+} + H_2S$ (atmospheric) $\longrightarrow PbS \downarrow$ (black) $+ 2H^+$.

A-3. $PbCl_2 + 2KI \longrightarrow PbI_2\downarrow$ (yellow) $+ 2KCl$; $PbCl_2 + H_2S \longrightarrow PbS\downarrow$ (Black)
$PbI_2 + KI$(Conc.) $\rightleftharpoons K_2(PbI_4)$ (aq)
yellow precipitate of PbI_2 dissolves in excess KI(conc.) and give PbI_4^{2-} , ppt reappears on dilution.

A-4. $Hg_2Cl_2 + 2\,NH_4OH \longrightarrow \underbrace{HgNH_2Cl \downarrow \text{(white)} + Hg \downarrow \text{(black)}}_{\text{black}} + NH_4Cl + 2\,H_2O$
Disproportionation reaction.

A-5. $Hg_2^{2+} + 2OH^- \longrightarrow Hg_2O \downarrow$ (black) $+ H_2O$
$Hg_2O \downarrow \longrightarrow HgO \downarrow + Hg \downarrow$ (grey) ; Disproportionation reaction.

A-6. $Hg_2^{2+} + 2I^- \longrightarrow \underset{\text{green}}{Hg_2I_2 \downarrow}$

$\underset{\text{(excess)}}{Hg_2I_2 + I^\ominus} \longrightarrow \underset{\text{(Soluble ion)}}{[HgI_4]^{2-}} + \underset{\text{black}}{Hg \downarrow}$

A-7. $AgI\downarrow + 2CN^- \longrightarrow [Ag(CN)_2]^- + I^-$, $AgI\downarrow + 2S_2O_3^{2-} \longrightarrow [Ag(S_2O_3)_2]^{3-} + I^-$
for formation of soluble complex

A-8. (A) is AgBr (present in photographic plate)

$$AgBr + 2Na_2S_2O_3 \longrightarrow \underset{\underset{(B)}{\text{soluble}}}{Na_3[Ag(S_2O_3)_2]} + NaBr$$

$$\begin{tikzcd} & & (B) \arrow[d, "\Delta"] \\ \underset{(E)}{[Ag(NH_3)_2Cl]} & \underset{(D)}{AgCl} \arrow[l, "NH_3"'] & \underset{(C)}{Ag_2S} \arrow[l, "HCl+HNO_3"'] \end{tikzcd}$$

B-1. With Na_2S, along with 2nd group cations, some cations of higher groups i.e., IIIrd and IVth groups may be precipitated because the higher concentration of S^{2-} ions is obtained according to following reaction.
$Na_2S \rightleftharpoons 2\,Na^+ + S^{2-}$
To precipitate IInd group cations lower concentration of S^{2-} ions is required (because of low K_{sp} of IInd group sulphides) and this can be obtained easily by H_2S in presence of dilute HCl.
$H_2S \rightleftharpoons 2\,H^+ + S^{2-}$; $HCl\ \ H^+ + Cl^-$
Due to common ion effect the ionisation of H_2S is suppressed and the concentration of S^{2-} ions obtained is just sufficient to precipitate the cations of IInd group.

B-2. Yes, $Hg^{2+} + 2OH^- \longrightarrow \underset{\text{yellow}}{HgO\downarrow} + H_2O$
$Hg_2^{2+} + 2OH^- \longrightarrow \underset{\text{black}}{Hg_2O\downarrow} + H_2O$

B-3. It turns yellowish–white owing to the formation of BiO.OH $\downarrow$.
$Bi(OH)_3 \longrightarrow BiO.OH \downarrow + H_2O$

B-4. (A) : $CuSO_4$ (B) : $BaSO_4$ (C) : $CuCl_2$ (D) : $(CuI + I_3^-)$
(E) $(CuI + I^- + S_4O_6^{2-})$ (F) $Cu_2[Fe(CN)_6]$

C-1. Presence of Sb^{3+} or Bi^{3+}, their chloride hydrolyse to oxychlorides in presence of excess of water.

$BiCl_3 + H_2O \longrightarrow BiOCl + 2HCl$

$SbCl_3 + H_2O \longrightarrow SbOCl + 2HCl$

C-2. HNO_3 is a powerful oxidising solution. Causing confusion with CdS, AS_2S_3 (both yellow ppt). Colloidal solution can not be filtered causing unnecessary trouble.

C-3. $AsCl_3$ (x) + $3H_2S \xrightarrow{H^+} As_2S_3\downarrow$ (yellow) + 6HCl

$3As_2S_3 + 28HNO_3 + 4H_2O \longrightarrow 6H_3AsO_4(y) + 18H + 9SO_4^{2-} + 28\ NO\uparrow$

$H_3\,AsO_4(y) + 12\ NH_4MoO_4 + 21\ HNO_3 \longrightarrow (NH_4)\ AsO_4.12MoO_3\downarrow$(yellow) $+21\ NH_4NO_3 + 12H_2O$

C-4. (A) is $SnCl_2$

D-1. Fe^{2+} salt are oxidised to Fe^{3+} salt by boiling with conc. HNO_3, before adding NH_4Cl and NH_4OH, otherwise Fe^{2+} would not be precipitated in group III.

D-2. Only Fe(II) salts give soluble red iron(II) dimethylglyoxime in ammonical solution.

D-3. (i) White precipitate, $K_2Fe[Fe(CN)_6]$ and (ii) Pale blue precipitate.

E-1. $Mn^{2+} + 2\ NH_3 + 2\ H_2O \rightleftharpoons Mn(OH)_2\downarrow$ (white) + NH_4^+ .

In presence of ammonium salts, the reaction proceeds in backward direction.

E-2. $Zn^{2+} + 2\ NH_3 + 2\ H_2O \rightleftharpoons Zn(OH)_2\downarrow + 2\ NH_4^+$

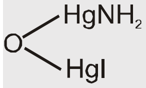
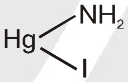
It is due to the lowering of OH^- ion concentration because of common ion effect of NH_4^+ to such a value that the K_{sp} of $Zn(OH)_2$ is not attained.

E-3. → $Zn^{2+} + [Hg(SCN)_4]^{2-} \longrightarrow \underset{\text{(white)}}{Zn[Hg(SCN)_4]}\downarrow$

→ $Cu^{2+} + [Hg(SCN)_4]^{2-} \longrightarrow Cu[Hg(SCN)_4]$

* In the presence of the copper ions, the copper complex Co-precipitated with that of zinc complex and colour become violet

E-4. (A) : $Zn\ (NO_3)_2$ (B) : $NO_2 + O_2$ (C) : ZnO (D) : ZnS

F-1. Hg_2ONH_2I or  or  . HgO

F-2. A yellow precipitate of ammonium cobaltinitrite is formed.

$3\ NH_4^+ + Na_3[Co(NO_2)_6] \longrightarrow (NH_4)_3\ [Co(NO_2)_6]\downarrow$ (yellow) + $3\ Na^+$

F-3. Mg^{2+} ions will also be precipitated.

F-4. $Sr^{2+} + NH_4^+ + SO_4^{2-} \longrightarrow SrSO_4\downarrow$ (white) + NH_4^+

$Ca^{2+} + 2\ NH_4^+ + 2\ SO_4^{2-} \longrightarrow (NH_4)_2[Ca(SO_4)_2]$ (soluble complex).

F-5. White precipitate is obtained.

$Ca^{2+} + 2K^+ + [Fe(CN)_6]^{4-} \longrightarrow K_2Ca[Fe(CN)_6]\downarrow$

PART - II

A-1.	(C)	**A-2.**	(B)	**A-3.**	(C)	**A-4.**	(B)	**A-5.**	(C)
A-6.	(A)	**B-1.**	(C)	**B-2.**	(C)	**B-3.**	(A)	**B-4.**	(C)
B-5.	(A)	**B-6.**	(D)	**B-7.**	(C)	**B-8.**	(B)	**B-9.**	(D)
C-1.	(D)	**C-2.**	(B)	**D-1.**	(D)	**D-2.**	(B)	**D-3.**	(B)
D-4.	(B)	**D-5.**	(C)	**E-1.**	(A)	**E-2.**	(C)	**E-3.**	(B)
E-4.	(D)	**E-5.**	(A)	**E-6.**	(D)	**F-1.**	(D)	**F-2.**	(C)
F-3.	(C)	**F-4.**	(B)	**F-5.**	(C)	**F-6.**	(C)	**F-7.**	(C)

PART - III

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

EXERCISE - 2

PART - I

1.	(D)	**2.**	(A)	**3.**	(B)	**4.**	(C)	**5.**	(D)
6.	(D)	**7.**	(D)	**8.**	(B)	**9.**	(D)	**10.**	(D)
11.	(C)	**12.**	(D)	**13.**	(C)	**14.**	(B)	**15.**	(A)
16.	(C)	**17.**	(C)						

PART - II

1.	3 (Hg_2^{2+}, Pb^{2+}, Ag^+)			**2.**	4	**3.**	4	**4.**	2
5.	3 (a,b,c)	**6.**	3 (I, IV, V)	**7.**	20	**8.**	a = 6 ; b = 3 (a + b = 9)		
9.	5 (i), (ii), (iv), (v), (vi)								

PART - III

1.	(ABCD)	**2.**	(ABC)	**3.**	(CD)	**4.**	(BC)	**5.**	(ABCD)
6.	(ABCD)	**7.**	(ABC)	**8.**	(ACD)	**9.**	(AC)	**10.**	(AD)
11.	(ABC)								

PART - IV

1.	(C)	**2.**	(B)	**3.**	(D)	**4.**	(B)	**5.**	(B)
6.	(D)	**7.**	(C)	**8.**	(D)	**9.**	(B)		

EXERCISE - 3

PART - I

1.	(B)								
2.	(a) (A) = Pentaaquathiocyanato-S-iron(III) ; (B) = Hexafluoridoferrate(III) (b) 5.93 B.M.								
3.	(B)	**4.**	(B)	**5.**	(C)	**6.**	(B)	**7.***	(AB)
8.	(D)	**9.**	(C)	**10.**	(B)	**11.**	(B)	**12.**	(A)
13.	(C)	**14.**	(A)	**15.***	(BCD)	**16.***	(ACD)	**17.**	(D)
18.	(A)	**19.**	(D)	**20.**	7	**21.**	(B)	**22.**	(D)
23.*	(CD)	**24.**	(A)	**25.***	(BD)				

PART - II

JEE(MAIN) OFFLINE PROBLEMS

1.	(1)	**2.**	(2)	**3.**	(1)	**4.**	(3)

JEE(MAIN) ONLINE PROBLEMS

1.	(3)	**2.**	(3)	**3.**	(1)	**4.**	(1)	**5.**	(2)
6.	(2)								