Additional Problems for Self Practice (APSP)

This Section is not meant for classroom discussion. It is being given to promote self-study and self testing amongst the Resonance students.

PART - I : PRACTICE TEST-1 (IIT-JEE (MAIN Pattern))

Max. Time : 1 Hr. **Max. Marks : 120**

Important Instructions

1. The test is of **1 hour** duration.
2. The Test Booklet consists of **30** questions. The maximum marks are **120.**
3. Each question is allotted **4 (four)** marks for correct response.
4. Candidates will be awarded marks as stated above in Instructions No. 3 for correct response of each question. **¼ (one fourth)** marks will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.
5. There is only one correct response for each question. Filling up more than one response in any question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instructions 4 above.

1. Identify the compound which turns black with ammonia solution.
(1) Lead chloride (2) Mercurous chloride
(3) Mercuric chloride (4) Silver chloride

2. 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 which is soluble in ammonium acetate. The white precipitate is that of:
(1) $BaSO_4$ (2) $SrSO_4$ (3) $PbSO_4$ (4) Ag_2SO_4

3. The composition of golden spangles is :
(1) $PbCrO_4$ (2) PbI_2 (3) As_2S_3 (4) $BaCrO_4$

4. In which of the following solvents, AgBr will have the highest solubility ?
(1) 10^{-3} M NaBr (2) 10^{-3} M NH_4OH (3) Pure water (4) 10^{-3} M HBr

5. Which one among the following pairs of ions can not be separated by passing H_2S gas in presence of dilute hydrochloric acid?
(1) Cd^{2+}, Sn^{2+} (2) Al^{3+}, Hg^{2+} (3) Zn^{2+}, Cu^{2+} (4) Ni^{2+}, Bi^{3+}

6. Which of the following is not precipitated as sulphide by passing H_2S in the presence of dilute HCl ?
(1) Copper (2) Arsenic (3) Cadmium (4) none of these

7. Which of the following metal cation is reduced from its higher oxidation state (+2) to (+1) by both KI solution and excess of KCN solution ?
(1) Zn^{2+} (2) Hg^{2+} (3) Cu^{2+} (4) None

8. Which of the following reagents give an orange coloured soluble complex when dissolved in excess with Bi^{+3} ions ?
(1) Ammonia solution (excess).
(2) Dilution in water
(3) Potassium iodide solution.
(4) Freshly prepared 0.125 M alkaline sodium tetrahydroxidostannate (II) solution.

9. Which of the following ions on reaction with NaOH and subsequent heating produce black ppt.
(1) Cu^{+2} (2) Zn^{+2} (3) Al^{+3} (4) Pb^{+2}

10. $FeCl_3 + K_3[Fe(CN)_6] + H_2O_2 \longrightarrow$ Precipitate. The colour of the precipitate is :
(1) sky blue (2) brown (3) prussian blue (4) white

11. $CrO_4^{2-} + H^+ + H_2O_2 \xrightarrow{\text{ether}} X + H_2O$
Identify the correct statement with respect to X.
(1) It is an acid anhydride of chromic acid.
(2) It is a red colour compound which can be extracted easily into the ethereal phase.
(3) It is chromium peroxide which produces blue colouration in ethereal layer on gentle shaking.
(4) It is Cr_2O_3 which is used as a green pigment.

12. White precipitate of $Mn(OH)_2$ on heating with PbO_2 and concentrated HNO_3 gives red-violet (purple) colour due to the formation of :
(1) $HMnO_4$ (2) Mn_2O_7 (3) $MnO(OH)_2$ (4) $PbMnO_4$

13. $Zn(OH)_2$ precipitate is soluble in :
(1) excess of sodium hydroxide (2) excess of ammonia solution
(3) solutions of ammonium salts (4) all of these

14. Select the correct statement with respect to Ca^{2+} ions.
(1) K_2CrO_4 gives white precipitate in the presence of acetic acid.
(2) Potassium hexacyanidoferrate (II) solution gives white precipitate.
(3) It gives lilac colour in Bunsen flame.
(4) Prolonged passage of carbon dioxide gas through its aqueous solution produces white precipitate.

15. A mixture of two salts is not water soluble but dissolves completely in dilute HCl to form a colourless solution. The mixture could be :
(1) $AgNO_3$ and KBr (2) $BaCO_3$ and ZnS
(3) $FeSO_4$ and Na_2CO_3 (4) $Mn(NO_3)_2$ and $MgSO_4$

16. The reagents, NH_4Cl and aqueous NH_3 will precipitate :
(1) Ca^{2+} (2) Al^{3+} (3) Mg^{2+} (4) Zn^{2+} .

17. In the precipitation of the iron group in qualitative analysis, ammonium chloride is added before adding ammonium hydroxide to :
(1) decrease concentration of OH^- ions (2) prevent interference by phosphate ions
(3) increase concentration of Cl^- ions (4) increase concentration of NH_4^+ ions

18. Fe^{2+} does not give prussian blue colour with $K_4[Fe(CN)_6]$ but on its reaction with (X), prussian blue colour appears (X) can be :
(1) MnO_4^-/ H^+ (2) Zn/NaOH (3) NH_3 (aq) (4) all true

19. Select the correct statement with respect to Fe^{3+} ions.
(1) Iron (III) ions react with H_2S in acidic solution to give a black precipitate of Fe_2S_3.
(2) Iron (III) ions react with ammonium sulphide to give the black precipitate of Fe_2S_3.
(3) Iron (III) ions react with ammonium thiocyanate solution to produce deep red colouration.
(4) All of these

20. Which of the following cation does not give red colour precipitate/solution with dimethylglyoxime (DMG) in alkaline solution ?
(1) Zn^{+2} (2) Ni^{+2} (3) Fe^{2+} (4) both (1) and (3)

21. A suspension containing insoluble substances ZnS, MnS, HgS, Ag_2S and FeS, is treated with 2N HCl. On filtering, the filtrate contains appreciable amounts of which one of the following?
(1) Zinc and mercury (2) Silver and iron
(3) Manganese and mercury (4) Zinc, manganese and iron

22. Potassium chromate K_2CrO_4 is NOT used to identify.
(1) Pb^{+2} (2) Ba^{+2} (3) Ag^+ (4) Ca^{+2}

23. When H_2S gas is passed through HCl containing aqueous solution of $CuCl_2$, $HgCl_2$, $BiCl_3$, and $CaCl_2$ it does not precipitate out :
(1) CuS (2) HgS (3) Bi_2S_3 (4) CaS

24. AgI is soluble in NaCN due to formation of :
(1) $Na[Ag(CN)_2]$ (2) $Ag(CN)_2$ (3) $Na_2[Ag(CN)_3]$ (4) $Na_2[Ag(CN)_2]$

25. Cu^{2+} and Ag^{+} are both present in the same solution. To precipitate one of the ions and leave the other in soluton, which reagent should be added :
(1) H_2S (aq) (2) HCl (aq) (3) HNO_3 (aq) (4) NH_4NO_3 (aq)

26. Aqueous (A) + $K_2CrO_4 \longrightarrow$ (B) $\xrightarrow{\text{aq. } NH_3}$ (C)
(Red ppt.) (soluble)
A is :
(1) $AgNO_3$ (2) $Pb(NO_3)_2$ (3) $Hg_2(NO_3)_2$ (4) $Ca(NO_3)_2$

27. The ion most difficult to remove as a precipitate is :
(1) Ag^{+} (2) NH_4^{+} (3) Fe^{3+} (4) Cu^{2+}

28. $CuSO_4$ reacts with NH_4OH to give deep blue complex of :
(1) $[Cu(NH_3)_4]SO_4$ (2) $[Cu(NH_3)_4](OH)_2$
(3) Both (1) and (2) (4) none of these

29. Thenard blue is :
(1) $Cu(NH_3)_4SO_4$ (2) $CoAl_2O_4$
(3) $K_2Fe[Fe(CN)_6]$ (4) $Fe_4[Fe(CN)_6]_3$

30. Among the species A ($CrCl_3$), B (CuS), C ($AlCl_3$), D ($ZnCl_2$), which will be soluble in excess of NaOH ?
(1) A, C and D (2) C and D only (3) B and C only (4) A and D only

Practice Test-1 (IIT-JEE (Main Pattern))

OBJECTIVE RESPONSE SHEET (ORS)

Que.	1	2	3	4	5	6	7	8	9	10
Ans.										
Que.	11	12	13	14	15	16	17	18	19	20
Ans.										
Que.	21	22	23	24	25	26	27	28	29	30
Ans.										

PART - II : NATIONAL STANDARD EXAMINATION IN CHEMISTRY (NSEC) STAGE-I

1. A 0.1 M solution of certain cation will precipitate with 0.1 M solutions of all these anions OH^{-}, CO_3^{-2} & SO_4^{-2}. This description is true for the cation. **[NSEC-2000]**
(A) Fe^{2+} (B) Mg^{2+} (C) Ba^{2+} (D) Pb^{2+}

2. A solution containing Co^{2+}, Zn^{2+} and Al^{3+} is mixed with an excess of KSCN solution. The resulting solution besides the unreacted ions, should contain **[NSEC-2003]**
(A) $[Co(SCN)_6]^{4-}$ (B) $[Zn(NCS)_6]^{2-}$ (C) $Al(SCN)_3$ (D) $Zn(SCN)_2$.

3. The blue pigment prussian blue is an iron complex with formula **[NSEC-2003]**
(A) $K_4[Fe(CN)_6]$ (B) $K_2[Fe(CN)_4(NH_3)_2]$
(C) $Fe_4[Fe(CN)_6]_3$ (D) $Na_2[Fe(CN)_5NO]$.

4. When H_2S is passed through a solution containing Cu^{2+}, Cd^{2+} and an excess of cyanide ions, cadmium sulphide precipitates while copper ions remain in solution. This is because **[NSEC-2003]**
(A) Cu^{2+} forms a stable complex with cyanide while Cd^{2+} does not
(B) Cu^{2+} forms a more stable complex with cyanide than Cd^{2+}
(C) Cu^{2+} does not form a sulphide
(D) both CdS and CuS are formed, but CuS is soluble.

5. Generation of a blue colour which is not due to metal ammonia complex formation is seen when **[NSEC-2003]**

(A) sodium is dissolved in liquid ammonia
(B) copper (II) sulphate is reacted with ammonium hydroxide
(C) cobalt (II) chloride is reacted with ammonium hydroxide
(D) formaldehyde is reacted with ammonuim hydroxide.

6. There is a mixture of Cu(II) chloride and Fe (II) sulphate. The best way to separate the metal ions from this mixture in qualitative analysis is by treating it with **[NSEC-2003]**
(A) hydrogen sulphide in mild acidic medium, where only Cu(II) sulphide will be precipitated
(B) ammonium hydroxide buffer, where only Fe(II) hydroxide will be precipitated
(C) hydrogen sulphide in mild acidic medium, where only Fe(II) sulphide will be precipitated
(D) ammonium hydroxide buffer, where only Cu(II) hydroxide will be precipitated.

7. The precipitate of AgCI dissolves in **[NSEC-2004]**
(A) conc. HNO_3 (B) excess of HCI (C) dilute H_2SO_4 (D) aq. ammonia.

8. Colour of the bead in borax bead test is mainly due to the formation of **[NSEC-2005]**
(A) metal oxides (B) boron oxide (C) metal metaborates (D) elemental boron.

9. The metal that dissolves in liquid ammonia giving dark blue coloured solution is **[NSEC-2005]**
(A) Sn (B) Pb (C) Na (D) Ag.

10. Aqueous solutions having equimolar quantities of $Pb(NO_3)_2$, $AgNO_3$, $AgSO_4$, $BaCl_2$ and K_2CrO_4 are allowed to react and the reaction mixture is then filtered. Which ions in the filtrate in appreciable quantity ? **[NSEC-2007]**
(A) Pb^{2+}, Ag^+, Ba^{2+}, K^+, NO_3^-, SO_4^{2-}, CrO_4^{2-}, Cl^- (B) Ba^{2+}, K^+, NO_3^-, CrO_4^{2-}
(C) Pb^{2+}, Ba^{2+}, K^+, NO_3^-,CrO_4^{2-} (D) K^+, NO_3^-

11. 1 mL of concentrated aqueous ammonia is added dropwise to 1 mL of a dilute aqueous solution of Cu(II). What observations can be made during this process ? **[NSEC-2008]**
(A) The colorless Cu(II) nitrate solution turns blue and yields a dark blue precipitate
(B) The colorless copper (II) nitrate solution yields a white precipitate which turns dark blue upon standing.
(C) The light blue copper(II) nitrate solution yields a blue precipitate which redissolves to form a dark blue solution.
(D) The light blue copper (II) nitrate solution turns dark

12. Two white solids, lead (II) chloride and silver chloride can be distinguished from each other by - **[NSEC-2008]**

(A) adding cold water to each : the silver chloride will dissolve.
(B) adding hot water to each : the lead (II) chloride will dissolve.
(C) adding sodium chloride solution to each : the lead (II) chloride will become warm and release chlorine gas.
(D) adding zinc chloride solution to each : the silver chloride will change to metallic silver.

13. $CuSO_4$ reacts with KCN to form water insoluble CuCN. This insoluble precipitate dissolves in excess of KCN, due to formation of the following complex **[NSEC-2008]**
(A) $K_2[Cu(CN)_4]$ (B) $K_3[Cu(CN)_4]$ (C) $Cu(CN)_2$ (D) $Cu[KCu(CN)_4]$

14. $MgSO_4$ on reaction with NH_4OH and Na_2HPO_4 forms a white crystalline precipitate. The formula of the precipitate is – **[NSEC-2009]**
(A) $Mg(NH_4)PO_4$ (B) $Mg_3(PO_4)_2$ (C) $MgCl_2.MgSO_4$ (D) $MgSO_4$

15. The pair of cations which **cannot** be separated by H_2S in a 0.3N acid solution is - **[NSEC-2011]**
(A) Al^{+++}, Hg^{++} (B) Bi^{+++}, Pb^{++} (C) Zn^{++}, Cu^{++} (D) Ni^{++}, Cd^{++}

16. An aqueous of a salt 'X' gives white precipitate with dilute H_2SO_4. The same solution with a few drops of aq. KI gives golden yellow precipitate which dissolves on heating. The salt 'X' is : **[NSEC-2012]**
(A) $Ba(NO_3)_2$ (B) $Sr(NO_3)_2$ (C) $Pb(NO_3)_2$ (D) $Zn(NO_3)_2$

17. A cold aqueous solution of $PbCl_2$ gives golden yellow precipitate on addition of **[NSEC-2013]**
(A) KCl solution (B) KI solution (C) NaCl solution (D) K_2SO_4 solution

18. The ions which give black precipitates on passing H_2S gas in acidic medium are **[NSEC-2013]**
(A) Al^{3+} and Ni^{2+} (B) Ni^{2+} and Co^{2+} (C) Cu^{2+} and Bi^{3+} (D) Zn^{2+} and Mn^{2+}

19. The colorless salt that gives white precipitate with $BaCl_2$ in aqueous HCl is **[NSEC-2014]**
(A) K_2SO_4 (B) K_2SO_3 (C) KNO_3 (D) KBr

20. Certain combinations of cations and anions lead to the formation of colored salts in solid state even though each of these ions with other counter ions may produce colorless salts. This phenomenon is due to temporary charge transfer between the two ions. Out of the following the salt that can exhibit this behavior is **[NSEC-2015]**
(A) $SnCl_2$ (B) $SnCl_4$ (C) $SnBr_2$ (D) SnI_4

21. Metallic copper dissolves in **[NSEC-2015]**
(A) dilute HCl (B) Concentrated HCl (C) aqueous KCN (D) pure ammonia

22. Cyanide ion is a very good complexing agent and also functions as a reducing agent. Hence may cyanide complexes of metals are known. Addition of an aqueous solution of KCN to a solution of copper sulphate yields a white precipitate which is soluble in excess of aqueous KCN to form the complex : **[NSEC-2016]**
(A) $[Cu(CN)_4]^{1-}$ (B) $[Cu(CN)_4]^{2-}$ (C) $[Cu(CN)_4]^{3-}$ (D) $[Cu(CN)_4]^{4-}$

23. Passing H_2S gas into a mixture of Mn^{2+}, Ni^{2+}, Cu^{2+} and Hg^{2+} in an acidified aqueous solution precipitates. **[NSEC-2016]**
(A) CuS and HgS (B) MnS and CuS (C) MnS and NiS (D) NiS and HgS

PART - III : HIGH LEVEL PROBLEMS (HLP)

THEORY

IIB Group (As^{3+}, Sb^{3+}, Sn^{2+}, Sn^{4+}) (Not in JEE advance syllabus)

1. ARSENIC ION (As^{3+}) :

- **Precipitation with H_2S in acidic medium :** Yellow precipitate is formed which is soluble in warm concentrated nitric acid, sodiumhydroxide solution and yellow ammonium sulphide.

$$2As^{3+} + 3H_2S \xrightarrow{H^+} As_2S_3\downarrow + 6H^+$$
$$3\,As_2S_3\downarrow + 28\,HNO_3 + 4\,H_2O \longrightarrow 6\,AsO_4^{3-} + 9\,SO_4^{2-} + 36\,H^+ + 28\,NO\uparrow$$
$$As_2S_3\downarrow + 6OH^- \longrightarrow AsO_3^{3-} + AsS_3^{3-} + 3\,H_2O$$
$$As_2S_3\downarrow + 4\,S_2^{2-} \longrightarrow 2\,AsS_4^{3-} + S_3^{2-}$$

- **Silver nitrate :** Yellow precipitate of silver arsenite in neutral solution is formed with AsO_3^{3-} ions.

$$AsO_3^{3-} + 3\,Ag^+ \longrightarrow Ag_3AsO_3\downarrow \text{ (yellow)}$$
$$AsO_4^{3-} + 3\,Ag \longrightarrow Ag_3AsO_4\downarrow \text{ (brownish red)}$$

The precipitate is soluble in both nitric acid and ammonia.

- **Marsh's test :** This test is based on the fact that all soluble compounds of arsenic are reduced by 'nascent' hydrogen in acid solution to arsine (AsH_3), a colourless, extremely poisonous gas with a garlic-like odour. If the gas, mixed with hydrogen, is passed through a heated glass tube, it is decomposed into hydrogen and metallic arsenic, which is deposited as a brownish-black 'mirror' just beyond the heated part of the tube.

$$Zn + H_2SO_4 \longrightarrow ZnSO_4 + 2\,[H]\ ;\ AsCl_3 + 3\,[H] \longrightarrow AsH_3\uparrow + 3\,[Cl]$$
$$AsO_4^{3-} + 4\,Zn + 11\,H^+ \longrightarrow AsH_3\uparrow + 4\,Zn^{2+} + 4H_2O\ ;\ AsH_3\uparrow \xrightarrow{Heat} As\downarrow + 3/2\,H_2\uparrow$$

2. ANTIMONY ION (Sb^{3+}) :

- **Precipitation with H_2S in acidic medium :** A orange red precipitate is formed from mildly acidic solutions.

$$Sb^{3+} + 3H_2S \xrightarrow{H^+} Sb_2S_3\downarrow \text{ (orange)} + 6H^+$$

Precipitate is soluble in warm concentrated HCl, in ammonium polysulphide and in alkali hydroxides.

$Sb_2S_3 \downarrow + 6\ HCl \longrightarrow 2\ Sb^{3+} + 6\ Cl^- + 3\ H_2S \uparrow$

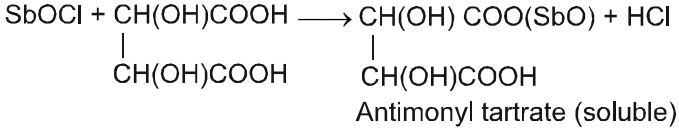
$Sb_2S_3 \downarrow + 4\ S_2^{2-} \longrightarrow 2\ SbS_4^{3-} + S_3^{2-}$

$2Sb_2S_3 \downarrow + 4\ OH^- \longrightarrow SbO_2^- + 3\ SbS_2^- + 2\ H_2O$

- **Dilution with water :** When water is poured in a solution of soluble $SbCl_3$, a white precipitate of antimonyl chloride (SbOCl) is formed, soluble in HCl. With a large excess of water, the hydrated oxide $Sb_2O_3.xH_2O$ is produced.

$SbCl_3 + H_2O \longrightarrow SbOCl + 2\ HCl$

☞ SbO^+Cl^- is soluble in tartaric acid but BiO^+Cl^- is insoluble in tartaric acid.



Antimonyl tartrate (soluble)

- **Sodium hydroxide or Ammonia solution :** White precipitate of hydrate of antimony (III) oxide $Sb_2O_3.xH_2O$ is soluble in concentrated (5M) solution of caustic alkalies forming antimonites.

$2\ Sb^{3+} + 6\ OH^- \longrightarrow Sb_2O_3 \downarrow + 3\ H_2O$; $Sb_2O_3 + 2\ OH^- \longrightarrow 2\ SbO_2^- + H_2O$

- **Potassium iodide solution :** Yellow colouration is obtained owing to the formation of a complex salt.

$Sb^{3+} + 6\ I^- \longrightarrow [SbI_6]^{3-}$

- **Reduction with zinc or tin :** Sb^{3+} ions give black precipitate of metal.

$2\ Sb^{3+} + 3\ Zn \longrightarrow 2\ Sb \downarrow + 3\ Zn^{2+}$; $2\ Sb^{3+} + 3\ Sn \longrightarrow 2\ Sb \downarrow + 3\ Sn^{2+}$

3. TIN (II) ION (Sn^{2+}) AND TIN (IV) ION (Sn^{4+}) :

- **Precipitation with H_2S in acidic medium :**

Brown precipitate is obtained with Sn^{2+} which is soluble in concentrated HCl and yellow ammonium sulphide forming thiostannate but not in colourless ammonium sulphide.

$Sn^{2+} + H_2S \longrightarrow SnS \downarrow$ (brown) ; $SnS \downarrow + S_2^{2-} \longrightarrow SnS_3^{2-}$ (thiostannate)

$Sn^{4+} + 2H_2S \longrightarrow SnS_2 \downarrow$ (yellow) $+ 4\ H^+$

Precipitate is soluble in concentrated HCl (difference from As^{3+} and Hg^{2+}) and in alkali hydroxide, and also in ammonium sulphide and yellow ammonium sulphide.

- **Sodium hydroxide solution:** White precipitate of $Sn(OH)_2$ is formed which is soluble in excess of reagent.

$Sn^{2+} + 2OH^- \rightleftharpoons Sn(OH)_2 \downarrow$; $Sn(OH)_2 \downarrow + 2OH^- \rightleftharpoons [Sn(OH)_4]^{2-}$

☞ With ammonia solution, white tin (II) hydroxide is precipitated, which cannot be dissolved in excess ammonia.

- **Reduction of stannic chloride to stannous chloride by iron filling or granulated zinc :**

$SnCl_4 + Zn \longrightarrow SnCl_2 + ZnCl_2$

- **Mercuric chloride solution :**

$SnCl_2 + 2HgCl_2 \longrightarrow Hg_2Cl_2 \downarrow$ (silky white) $+ SnCl_4$

$SnCl_2 + Hg_2Cl_2 \longrightarrow 2Hg \downarrow$ (black or grey) $+ SnCl_4$

☞ HNO_3 is not used because it acts as an oxidising agent and in solution it oxidises H_2S to S according to the following reaction.

$H_2S + [O] \longrightarrow H_2O + S \downarrow$ (Yellow)

SUBJECTIVE QUESTIONS

1. What happens when diammine silver (I) reacts with hydrazine sulphate ?

2. Does mercuric sulphide dissolve in sodium sulphide solution (of 2M) ?

3. What happens when black precipitate of HgS is dissolved in aquaregia ?

4. Is there any reaction other then cyanide reaction which can be used for the differentiation of Cu^{2+} and Cd^{2+} ions?

5. Which basic radical is tested with the help of alkaline sodium stannite solution ?

6. Does tartaric acid can be used to distinguish SbOCl and BiOCl ?

7. Why use of excess cobalt nitrate solution should be avoided in the dry test of aluminium compounds ?

8. Which basic radical(s) decolourise acidic $KMnO_4$ solution ?

9. What happens when Mn(II) ions free from chloride ions react with acidified solution of $(NH_4)_2S_2O_8$ or $K_2S_2O_8$ in presence of a few drops of $AgNO_3$ solution ?

10. How bromine water test (Alkaline medium) can be used to distinguish between Co^{2+} and Ni^{2+} ions ?

11. A mixture consists (A) (red solid) and (B) (colourless solid) which gives lilac colour in flame.
(a) Mixture gives black precipitate (C) on passing H_2S (g).
(b) (C) is soluble in aquaregia and on evaporation of aquaregia and adding $SnCl_2$ gives greyish black precipitate (D).
The salt solution with NH_4OH gives a brown precipitate.
(i) The sodium extract of the salt with $CCl_4/FeCl_3$ gives a violet layer.
(ii) The sodium extract gives yellow precipitate with $AgNO_3$ solution which is insoluble in dilute ammonia solution.
Identify (A) and (B), and the precipitates (C) and (D). **[JEE 2003, 4/60]**

12. When a crystaline compound (X) is heated with $K_2Cr_2O_7$ and concentrated H_2SO_4, a deep red gas (A) is evolved. On passing (A) into caustic soda solution, a yellow coloured solution of (B) is obtained. Neutralizing the solution of (B) with acetic acid and on subsequent addition of lead acetate a yellow precipitate (C) is obtained. When (X) is heated with NaOH solution, a colourless gas is evolved and on passing this gas into K_2HgI_4 solution, a reddish brown precipitate (D) is formed. Identify (A), (B), (C), (D) and (X). Write the equations of reactions involved. **[JEE 2002, 5/150]**

13. $CaSO_4$ is insoluble in water but when excess of $(NH_4)_2SO_4$ is added in $CaCl_2$ solution, $CaSO_4$ is not precipitated, why ?

14. (A) (colourless solid) $\xrightarrow{\Delta}$ (B) (residue) + (C) (gas) + (D) gas

$\downarrow H_2O$

Solution of (B) $\xrightarrow{(D)}$ milky

(A) gives brick red colour in flame and decolouries MnO_4^-/H^+. Gas (C) burns with blue flame. Identify (A), (B) (C) and (D).

ONLY ONE OPTION CORRECT TYPE

15. Dissolution of white precipitate of Hg_2Cl_2 in aquaregia evolved the gas
(A) Cl_2 (B) NO (C) NO_2 (D) HCl

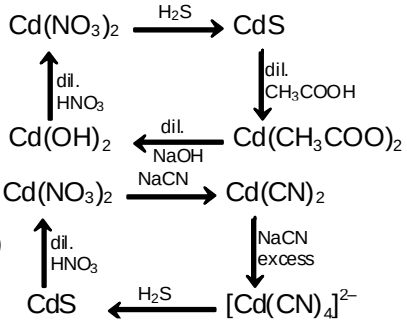
16. White ppt of silver gives brown ppt on boiling but when it is heated (>300°C), then a metallic black ppt. is obtained. Identify the compound of silver having white ppt.
(A) Ag_2SO_3 (B) $Ag_2S_2O_3$ (C) Ag_2CO_3 (D) AgCl

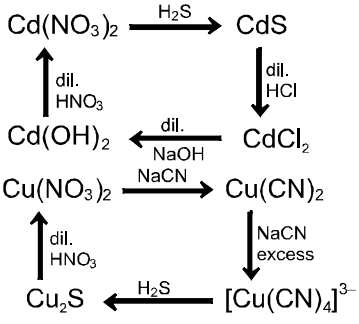
17. Which of the following reagents gives white precipitate with $Hg(NO_3)_2$ solution ?
(A) Cobalt (II) thiocyanate (B) Tin (II) chloride (excess)
(C) Ammonia solution (D) Potassium cyanide solution

18. Which of the following is insoluble in dil. HNO_3 but dissolves in aquaregia ?
(A) HgS (B) PbS (C) Bi_2S_3 (D) CuS.

19. In the separation of Cu^{2+} and Cd^{2+} in 2nd group qualitative analysis of cations tetraammine copper(II) sulphate and tetrammine cadmium(II) sulphate react with KCN to form the corresponding cyano complexes. Which one of the following pairs of the complexes and their relative stability enables the separation of Cu^{2+} and Cd^{2+}?
(A) $K_3[Cu(CN)_4]$ more stable and $K_2[Cd(CN)_4]$ less stable
(B) $K_2[Cu(CN)_4]$ less stable and $K_2[Cd(CN)_4]$ more stable
(C) $K_2[Cu(CN)_4]$ more stable and $K_2[Cd(CN)_4]$ less stable
(D) $K_3[Cu(CN)_4]$ less stable and $K_2[Cd(CN)_4]$ more stable

20. Which diagram correctly represents change for given nitrate solution.

(A)


(B)


(C)

(D)

21. In regards to Sn^{2+} and Sn^{+4} which statement is incorrect -
(A) Sn^{2+} sulphides is black while Sn^{+4} sulphide is golden yellow.
(B) Sn^{2+} sulphides is Brown while Sn^{+4} sulphide is golden yellow.
(C) Both sulphides dissolve in HCl.
(D) Both chloride does not react with $HgCl_2$.

22. $SnCl_2$ solution, when treated with excess of KOH on heating produces
(A) K_2SnO_2 (B) K_2SnO_3 (C) K_4SnO_4 (D) K_3SnO_3

23. Intense blue precipitate of $Fe_4[Fe(CN)_6]_3$ and potassium hydroxide solution when mixed gives :
(A) $K_2Fe[Fe(CN)_6]$ - white precipitate (B) $Fe(OH)_3$ - reddish–brown precipitate
(C) $Fe(CN)_3$ – reddish–brown precipitate (D) $KFe[Fe(CN)_6]$ - Turnbull's blue

24. Turnbull's blue is a ..... .
(A) ferricyanide (B) ferrous ferricyanide
(C) ferrous cyanide (D) ferri ferrocyanide

25. A metal salt cobalt form brown solution with excess of KCN solution. This brown solution turns yellow when boiled for a longer time in air due to formation of :
(A) $Co(CN)_2$ (B) $K_4[Co(CN)_6]$ (C) $K_3[Co(CN)_6]$ (D) $K_2[Co(CN)_6]$

26. CoS (black) obtained in group IV of salt analysis is dissolved in aqua regia and is treated with an excess of $NaHCO_3$ and then Br_2 water. An apple green coloured stable complex is formed. It is :
(A) sodium cobaltocarbonate (B) sodium cobaltibromide
(C) sodium cobalticarbonate (D) sodium cobaltobromide

27. Orange coloured sodium cobaltinitrite $Na_3[Co(NO_2)_6]$ is used for the detection of K^+ ions which gives ..... ppt. due to the formation of Pot. Sod. Cobaltinitrite $K_2Na[Co(NO_2)_6]$
(A) White (B) Orange (C) Yellow (D) Brown

28. $NiCl_2 + KCN$ (excess) $\longrightarrow$ Yellow colour solution $\xrightarrow{NaOH+Br_2 \text{ water}}$ " X " ppt
Colour of precipitate of "X" is :
(A) green (B) black (C) yellow (D) Reddish Brown

29. The presence of magnesium is confirmed in the qualitative analysis by :
(A) titan yellow solution + 2M NaOH solution (B) disodium hydrogen phosphate $+NH_4Cl + NH_3$ (aq.)
(C) magneson(I) reagent (D) all of these

30. To a solution of a substance, gradual addition of ammonium hydroxide results in a brownish black precipitate which does not dissolve in excess of NH_4OH. However, when KI (not in excess) is added to the original solution, a green precipitate is formed. The solution contained :
(A) Lead salt (B) Silver salt (C) Mercurous salt (D) Copper salt.

31. Which of following is soluble in yellow ammonium sulphide ?
(A) CdS (B) CuS (C) SnS (D) PbS

32. A mixture of chlorides of cadmium, chromium, iron and aluminium was dissolved in water acidified with HCl and hydrogen sulphide gas was passed for sufficient time. It was filtered, boiled and a few drops of nitric acid were added while boiling. To this solution ammonium chloride and sodium hydroxide were added in excess of filtered. The filtrate shall give test for :
(A) sodium and iron ion (B) sodium, chromium and aluminium ion
(C) aluminium and iron ion (D) sodium, iron, cadmium and aluminium ion.

33. Which one of the following cations will give a green coloured ash when a piece of filter paper dipped in a solution containing its salt and $Co(NO_3)_2$ is burned ?
(A) Cu^{2+} (B) Mg^{2+} (C) Al^{3+} (D) Zn^{2+}

34. To avoid the precipitation of hydroxides of Ni^{2+}, Co^{2+}, Mn^{2+} along with those of the third group cations, the solutions should be :
(A) heated with few drops of concentrated HNO_3.
(B) boiled with excess of ammonium chloride.
(C) concentrated to small volume.
(D) none of these.

35. A metal M and its compound can give the following observable changes in a sequence of reactions,

$$M \xrightarrow[HNO_3]{\text{very dilute}} \left[\begin{matrix}\text{Colourless solution}\\ \text{and no gas is evolved}\end{matrix}\right] \xrightarrow[NaOH]{\text{aqueous}} \left[\begin{matrix}\text{White}\\ \text{precipitate}\end{matrix}\right] \xrightarrow[NaOH(aq.)]{\text{excess}} \left[\begin{matrix}\text{Colourless}\\ \text{solution}\end{matrix}\right] \xrightarrow{H_2S\ /OH^-} \left[\begin{matrix}\text{White}\\ \text{precipitate}\end{matrix}\right]$$

The metal M can be :
(A) Mg (B) Pb (C) Zn (D) Sn

36. Identify the correct order of solubility of Na_2S, CuS and ZnS in aqueous medium. **[JEE 2002, 3/150]**
(A) CuS > ZnS > Na_2S (B) ZnS > Na_2S < CuS (C) Na_2S > CuS > ZnS (D) Na_2S > ZnS > CuS

SINGLE AND DOUBLE VALUE INTEGER TYPE

37. When a metal rod M is dipped into a aqueous, colourless conc. solution of compound N, which is a nitrate of metal 'P', the solution turns light blue. Addition of aqueous. NaCl to the blue solution given a white ppt 'O'. Addition of aqueous NH_3, dissolve 'O' and give an deep blue solution. The final solution contains $[M(NH_3)_x]^{n+}$ and $[P(NH_3)_y]^{m+}$. (M) & (N) both belongs to same groups in periodic table. Calculate the value of x + y + n + m ?

38. $Sn^{n+} + H_2S \xrightarrow{\text{dil. HCl}}$ (A) Yellow ppt.
If yellow ppt of (A) has "p" number of atom (per molecule). Then what is the value of (p + n).

39. $Na_2CrO_4 + \text{dil.}H_2SO_4 \longrightarrow Na_2SO_4 + H_2CrO_4$
$H_2CrO_4 + 2H_2O_2 \xrightarrow{\text{amyl alcohol}}$ 'A' (blue colouration) + H_2O
then find a + b, if a = number of O – O bonds in "A"
b = number of Cr – O σ(sigma) bonds in "A"

40. $NaBiO_3 + Mn(NO_3)_2 + HNO_3 \longrightarrow$ Product
Sum of oxidation number of Bi, N and Mn in products

41. Solution of AsO_4^{3-} ion containing considerable excess of HNO_3 on boiling with Ammonium molybdate test gives a yellow crystalline precipitate (X). Number of oxygen atom present in per molecule of precipitated (X) are :

42. $As^{3+} + H_2S \xrightarrow{\text{dil. HCl}}$ "yellow ppt of A"
A + yellow ammonium sulphide $\longrightarrow$ C + D
How many different type of oxidation states of sulphur are possible in "C" and "D".

ONE OR MORE THAN ONE OPTIONS CORRECT TYPE

43. Which of the following statement(s) is/are correct ?
(A) Yellow precipitated of silver arsenite is soluble in both nitric acid and ammonia.
(B) Potassium cyanide when added in very small quantity to copper sulphate solution, produces first yellow precipitate which quickly converts in to white precipitate.
(C) Black precipitate of BiI_3 turns orange on heating with water.
(D) White precipitate of $Bi(OH)_3$ turns yellowish brown, when boiled.

44. Cu^{2+} ions give white precipitate with :
(A) potassium iodide solution.
(B) potassium thiocyanate and saturated solution of SO_2.
(C) excess of potassium cyanide solution.
(D) potassium hydroxide solution.

45. Ammonium molybdate is used to detect the radical :
(A) PO_4^{3-} (B) AsO_4^{3-} (C) Cu^{2+} (D) Ag^+

46. Which of the following process result in a prussain blue ppt ?
(A) $Fe^{2+} + [Fe(CN)_6]^{3-} \rightarrow$ (B) $Fe^{3+} + [Fe(CN)_6]^{4-} \rightarrow$
(C) $Fe^{3+} + [Fe(CN)_6]^{3-} \rightarrow$ (D) $Fe^{3+} + [Fe(CN)_6]^{3} \rightarrow P \xrightarrow{SnCl_2}$

47. Which of the following statement(s) is /are false ?
(A) Fe^{3+} gives red precipitate with dimethyl glyoxime in alkaline solution.
(B) Cu^{2+} ion with potassium iodide solution gives a dirty brownish white precipitate which turns white on adding hypo solution.
(C) A filter paper soaked in mercurous nitrate turns black in contact with ammonia gas.
(D) Ag_2O does not dissolve in nitric acid as well as ammonia solution.

48. Which of the following statements is/are correct ?
(A) An aqueous solution of Co(II) thiocyanate (10% freshly prepared) and mercuric nitrate solution taken in equal volumes on stirring the wall of the vessel with a glass rod produce deep-blue precipitate.
(B) White precipitate of $Al(OH)_3$ is soluble in sodium hydroxide as well as in ammonia solution.
(C) Green precipitate of $Cr(OH)_3$ readily dissolves in excess of sodium hydroxide forming a green solution.
(D) Chromium (III) salts give green coloured borax bead in both oxidising and reducing flame.

49. Co^{2+} + KCN (not in excess) $\longrightarrow$ precipitate.
Select the correct statement(s) with respect to the precipitate.
(A) It is yellow in colour.
(B) It is reddish-brown in colour.
(C) It dissolves in excess of the reagent forming a brown solution.
(D) It is obtained when brown solution (option (C)) is acidified with dilute HCl in the cold.

50. Which of the following sulphides do not dissolve in 50% HNO_3 but dissolve in aquaregia ?
(A) CoS (B) NiS (C) CuS (D) HgS

51. Ni + H_2SO_4 (hot and concentrated) $\longrightarrow$ X(g).
The liberated gas (select the correct statement(s)) :
(A) develops blue colour spots on the filter paper moistened with potassium iodate and starch solution.
(B) turns acidified $K_2Cr_2O_7$ solution green.
(C) produces black precipitate with lead acetate solution.
(D) reacts with Cl_2 water to produce an acid which gives white fumes with ammonia.

52. Select the incorrect statement(s).
(A) Ammonium ions produce yellow colour solution with sodium hexanitrito-N-cobaltate (III).
(B) Ammonia gas develops a brown colour on filter paper moistened with a solution of $MnCl_2$ and H_2O_2.
(C) Ammonium ions produce white precipitate with saturated sodium hydrogen tartrate solution.
(D) Ammonium salts in presence of sodium hydroxide solution produces red precipitate with 4-nitrobenzene diazonium chloride reagent.

PART - IV : PRACTICE TEST-2 (IIT-JEE (ADVANCED Pattern))

Max. Time : 1 Hr. **Max. Marks : 66**

Important Instructions

A. General :

1. The test is of 1 hour duration.
2. The Test Booklet consists of 22 questions. The maximum marks are 66.

B. Question Paper Format :

3. Each part consists of five sections.
4. Section-1 contains 7 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONE is correct.
5. Section-2 contains 5 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONE OR MORE THAN ONE are correct.
6. Section-3 contains 6 questions. The answer to each of the questions is a single-digit integer, ranging from 0 to 9 (both inclusive).
7. Section-4 contains 1 paragraphs each describing theory, experiment and data etc. 3 questions relate to paragraph. Each question pertaining to a partcular passage should have only one correct answer among the four given choices (A), (B), (C) and (D).
8. Section-5 contains 1 multiple choice questions. Question has two lists (list-1 : P, Q, R and S; List-2 : 1, 2, 3 and 4). The options for the correct match are provided as (A), (B), (C) and (D) out of which ONLY ONE is correct.

C. Marking Scheme :

9. For each question in Section-1, 4 and 5 you will be awarded 3 marks if you darken the bubble corresponding to the correct answer and zero mark if no bubble is darkened. In all other cases, minus one (– 1) mark will be awarded.
10. For each question in Section-2, you will be awarded 3 marks. If you darken all the bubble(s) corresponding to the correct answer(s) and zero mark. If no bubbles are darkened. No negative marks will be answered for incorrect answer in this section.
11. For each question in Section-3, you will be awarded 3 marks if you darken only the bubble corresponding to the correct answer and zero mark if no bubble is darkened. No negative marks will be awarded for incorrect answer in this section.

SECTION-1 : (Only One option correct Type)

This section contains 7 multiple choice questions. Each questions has four choices (A), (B), (C) and (D) out of which Only ONE option is correct.

---

1. A solution containing SCN^- ions can be used to test one or more out of : Fe^{3+}, Co^{2+}, Cu^{2+}, Ag^+ and Hg^{2+}.
(A) Fe^{3+} and Co^{2+} only (B) Co^{2+}, Cu^{2+}, Ag^+ and Hg^{2+}
(C) Fe^{3+}, Cu^{2+}, Co^{2+} and Hg^{2+} (D) all

2. A blue colouration (in solution or precipitate) is not obtained when :
(A) ammonium hydroxide dissolves in copper sulphate.
(B) cobalt chloride reacts with NH_4SCN in presence of amyl alcohol.
(C) ferric chloride reacts with sodium ferrocyanide.
(D) aqueous ammonia reacts with white precipitate of silver (I) chloride.

3. A metal nitrate solution reacts with dilute hydrochloric acid to give a white precipitate which is soluble in concentrated potassium chloride. White precipitate on passing of hydrogen sulphide gas is converted into black precipitate. The black precipitate on boiling with hydrogen peroxide (3%) is converted again to a white precipitate which is soluble in ammonium acetate. The cation of the metal nitrate is :
(A) Pb^{2+} (B) Ag^+ (C) Hg^{2+} (D) Bi^{3+}

4. A metal nitrate solution does not give white precipitate with concentrated hydrochloric acid but on dilution with water produces a white precipitate. The metal nitrate solution with K_2CrO_4 and Na_2HPO_4 reagents gives red and yellow precipitates respectively which are soluble in ammonia solution. The cation of the metal nitrate is :
(A) Pb^{2+} (B) Ag^+ (C) Cu^{2+} (D) Bi^{3+}

5. Which of the following pairs comprise the red precipitates ?
(A) Ag_2CrO_4 and Hg_2CrO_4 (B) HgI_2 and $Ni(dmg)_2$
(C) BiOI and $Cu_2[Fe(CN)_6]$ (D) (A) and (B) both

6. A coloured solution of an inorganic salt reacts with potassium thiocyanate to give first a black precipitate, which slowly turns white. The salt solution also gives black precipitate with H_2S gas in slightly acidic medium. The black precipitate dissolves in potassium cyanide forming a colourless solution. The basic radical present in the inorganic salt is :
(A) Bi^{3+} (B) Cu^{2+} (C) Hg^{2+} (D) None

7. Select the incorrect statement.
(A) Marsh's test involves the reduction of soluble arsenic compound to arsine by nascent hydrogen in acidic solution and its subsequent decomposition into hydrogen and metallic arsenic as a brownish-black mirror on heating in a glass tube mixed with hydrogen.
(B) Ammonical silver nitrate gives metallic silver mirror with saturated solution of hydrazine sulphate.
(C) Red precipitate of silver (I) chromate is soluble in dilute nitric acid and ammonia solution.
(D) None of these

Section-2 : (One or More than one options correct Type)

This section contains 5 multipole choice questions. Each questions has four choices (A), (B), (C) and (D) out of which ONE or MORE THAN ONE are correct.

8. The following can be used to regulate the concentration of OH^- ions for the scheme of basic radical analysis (III group).
(A) NH_4NO_3 (B) NH_4Cl (C) $(NH_4)_2SO_4$ (D) $(NH_4)_2CO_3$

9. White precipitate of $PbSO_4$ gets dissolved in :
(A) concentrated H_2SO_4 on heating (B) concentrated NaOH
(C) $(NH_4)_2CO_3$ (D) dilute HNO_3

10. Select the correct statement(s).
(A) In group III, Fe^{3+} and Cr^{3+} can be differentiated by increasing NH_4^+ ion concentration
(B) In V^{th} group, Na_2CO_3 is added to precipitate out only the carbonates of Ba^{2+}, Sr^{2+} and Ca^{2+}.
(C) Like brown ring test, diphenylamine test is given only by salts containing NO_3^-.
(D) Sodium chloride on heating with aqueous solution of $K_2Cr_2O_7$ and concentrated H_2SO_4 produces deep red vapours.

11. Which of the following statement(s) is/are not correct ?
(A) Nickel salts give rosy red precipitate with dimethyl glyoxime in excess of NH_4OH.
(B) Fe (III) salts give red colour with potassium sulphocyanide.
(C) In nitroprusside, the iron and NO exist as Fe(III) and NO.
(D) Mn (II) salts give white precipitate with NaOH which turns brown on adding Br_2 water.

12. Potassium ferrocyanide is used for testing
(A) Cu^{2+} and Zn^{2+} (B) Fe^{3+} and Ca^{2+} (C) Ag^+ and Zn^{2+} (D) Cd^{2+} and Cu^{2+}

Section-3 : (One Integer Value Correct Type.)

This section contains 6 questions. Each question, when worked out will result in one integer from 0 to 9 (both inclusive)

13. How many of the following pairs of ions can be separated by H_2S in dilute HCl ?
Bi^{3+} and Sn^{4+}, Al^{3+} and Hg^{2+}, Cd^{2+} and Zn^{2+}, Fe^{3+} and Cu^{2+}, As^{3+} and Sb^{3+}

14. In how many of the following reactions, one of the product is obtained as a yellow precipitate ?
$Ba^{2+}(aq) + CrO_4^{2-}(aq) \longrightarrow$ product
$Ag^+(aq) + Br^-(aq) \longrightarrow$ product
$Pb^{2+}(aq) + I^-(aq) \longrightarrow$ product
$NH_4^+(aq) + [PtCl_6]^{2-}(aq) \longrightarrow$ product

15. In how many of the following cases solubility of salt is greater in acidic solution than in pure water?

AgCl,	AgCN,	MnS,
$Zn(OH)_2$,	Ag_3PO_4,	$AgNO_2$,
$Al(OH)_3$,	CH_3COOAg,	$BaSO_3$

16. How many statements are correct ?

(i) Like CO_3^{2-}, SO_3^{2-} also gives test with lime water.

(ii) In the test of NO_3^-, brown ring is formed due to the formation of $[Fe(H_2O)_5 NO]^{2+}$.

(iii) Aqueous solution of Ag^+ ions gives brick red/red precipitate with K_2CrO_4.

(iv) Lead salts turn black on prolonged exposure in a chemical laboratory.

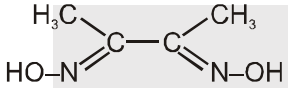
(v) In analysis of group IInd cations, H_2S gas is passed in presence of hydrochloric acid to enhance the concentration of S^{2-} ions.

(vi) Aqueous solution of Cu^{2+} ions forms a green complex with $K_4[Fe(CN)_6]$.

17. How many of the following reaction result in the formation of colored precipitate (not white).

(a) $HgCl_2 + SnCl_2$ (excess) $\longrightarrow$ (b) $HgCl_2 + KI \longrightarrow$

(c) $Pb(NO_3)_2 + KCl \longrightarrow$ (d) $NH_4Cl + NO_2^- + Co^{3+} \longrightarrow$

(e) Ni^{2+} +  + $NH_4OH \longrightarrow$ (f) $K_2CrO_4 + Hg_2^{2+} \longrightarrow$

(g) $Hg^{2+} + Co^{2+} + SCN^- \longrightarrow$ (h) $Cu^{2+} + I^- \longrightarrow$

(i) $Cd^{2+} + CN^- \longrightarrow$

(j) $K_2Cr_2O_7 + conc.H_2SO_4 + Cl_2 \longrightarrow A \xrightarrow[NaOH]{aq.} B \xrightarrow{Pb^{2+}} ?$

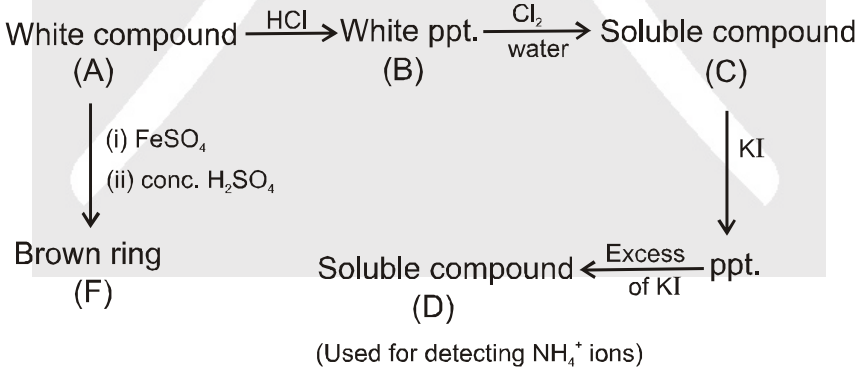
18. Which of the following sulphides are not black in colour.

PbS, CdS, As_2S_3, Sb_2S_3, SnS, CoS, HgS, ZnS, MnS.

SECTION-4 : Comprehension Type (Only One options correct)

This section contains 1 paragraphs, each describing theory, experiments, data etc. 3 questions relate to the paragraph. Each question has only one correct answer among the four given options (A), (B), (C) and (D)

Paragraph for Questions 19 to 21



19. Compound (A) is :

(A) HgI_2 (B) K_2HgI_4 (C) $Hg(NO_3)_2$ (D) $Hg_2(NO_3)_2$

20. (D) + $(NH_4)_2SO_4$ $\longrightarrow$ brown ppt. (G). Hence, compound (G) is :
in basic medium

(A) HgI_2 (B) NH_4I (C) $HgO.Hg(NH_2)I$ (D) $Hg(NH_2)I$

21. White ppt. (B) + NH_3 $\longrightarrow$ Black ppt. (H). Hence, (H) is due to the formation of :
in basic medium

(A) $Hg(NH_2)Cl$ (B) Hg (C) $Hg(NH_2)Cl + Hg$ (D) $Hg(NH_2)_2$

SECTION-5 : Matching List Type (Only One options correct)

This section contains 1 questions, each having two matching lists. Choices for the correct combination of elements from List-I and List-II are given as options (A), (B), (C) and (D) out of which one is correct.

22. Match the reactions/reaction conditions listed in column-I with the characteristics/ precipitate colour of the reaction products listed in column-II.

	Column I		**Column II**
(P)	$2NiS + 2HNO_3 + 6HCl \xrightarrow[\text{extract with water}]{\Delta}$	(1)	Black precipitate & its chloride imparts greenish blue flame.
(Q)	$CoCl_2 + 4NH_4CNS \xrightarrow{\text{amyl alcohol}}$	(2)	Blue colour in organic layer.
(R)	$CuCl_2 + NaOH \xrightarrow{\Delta}$	(3)	White precipitate soluble in ammonium acetate.
(S)	$Sr(CH_3COO)_2 + (NH_4)_2C_2O_4 \longrightarrow$	(4)	Green colour solution.
(T)	$H_2SO_4 + PbCl_2 \longrightarrow$	(5)	Yellow precipitate soluble in NaOH.
(U)	$Na_2CrO_4 + (CH_3OO)_2Pb \longrightarrow$	(6)	Scarlet / red precipitate.
(V)	$HgCl_2 + KI$ (Not in excess) $\longrightarrow$	(7)	White precipitate & its chloride imparts crimson flame.

Code :

	P	Q	R	S	T	U	V
(A)	1	3	2	4	7	6	5
(B)	3	2	7	6	5	4	1
(C)	4	2	1	7	3	5	6
(D)	7	3	5	6	4	2	1

Practice Test-2 ((IIT-JEE (ADVANCED Pattern))

OBJECTIVE RESPONSE SHEET (ORS)

Que.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Ans.										
Que.	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Ans.										
Que.	**21**	**22**								
Ans.										

APSP Answers

PART - I

1.	(2)	**2.**	(3)	**3.**	(2)	**4.**	(2)	**5.**	(1)
6.	(4)	**7.**	(3)	**8.**	(3)	**9.**	(1)	**10.**	(3)
11.	(3)	**12.**	(1)	**13.**	(4)	**14.**	(2)	**15.**	(2)
16.	(2)	**17.**	(1)	**18.**	(1)	**19.**	(3)	**20.**	(1)
21.	(4)	**22.**	(4)	**23.**	(4)	**24.**	(1)	**25.**	(2)
26.	(1)	**27.**	(2)	**28.**	(1)	**29.**	(2)	**30.**	(1)

PART - II

1.	(D)	**2.**	(C)	**3.**	(C)	**4.**	(B)	**5.**	(A)
6.	(A)	**7.**	(D)	**8.**	(C)	**9.**	(C)	**10.**	(D)
11.	(C)	**12.**	(B)	**13.**	(B)	**14.**	(A)	**15.**	(B)
16.	(C)	**17.**	(B)	**18.**	(C)	**19.**	(A)	**20.**	(D)
21.	(C)	**22.**	(C)	**23.**	(A)				

PART - III

1. $4[Ag(NH_3)_2]^+ + H_2N–NH_2.H_2SO_4 \rightarrow 4Ag\downarrow + N_2\uparrow + 6NH_4^+ + 2NH_3 + SO_4^{2-}$

2. Yes, forming a soluble complex.

$HgS + S^{2-} \longrightarrow [HgS_2]^{2-}$

3. $3HgS + 6HCl + 2HNO_3 \longrightarrow 3HgCl_2 + 3S\downarrow + 2NO\uparrow + 4H_2O$

4. Yes. By the reaction of ammonia according to the following reactions.

$Cu^{2+} + 4NH_3 \longrightarrow [Cu(NH_3)_4]^{2+}$ (deep blue solution).

$Cd^{2+} + 4NH_3 \longrightarrow [Cd(NH_3)_4]^{2+}$ (colourless solution).

5. Bi^{3+} ; $Bi^{3+} + 3OH^- \longrightarrow Bi(OH)_3\downarrow$; $2Bi(OH)_3\downarrow + 3[Sn(OH)_4]^{2-} \longrightarrow 2Bi\downarrow$ (black) + $3[Sn(OH)_6]^{2-}$.

6. Yes : SbOCl is soluble in tartaric acid but BiOCl is insoluble in tartaric acid.

7. $2Al_2O_3 + 2Co^{2+} + 4NO_3^- \longrightarrow 2CoAl_2O_4$ (thenard blue) $+ 4NO_2\uparrow + O_2\uparrow$

In case of excess of $Co(NO_3)_2$, $CoAl_2O_3$ will produce black cobalt oxide (CO_3O_4), which will mask the blue colour.

8. Ferrous and stannous (Fe^{2+} and Sn^{2+}) both act as reducing agents and decolourize acidic $KMnO_4$.

$MnO_4^- + 5Fe^{2+} + 8H^+ \longrightarrow 5Fe^{3+} + Mn^{2+} + 4H_2O$.

9. Reddish–violet colouration is obtained owing to the formation of MnO_4^-.

$2\,Mn^{2+} + 5\,S_2O_8^{2-} + 8\,H_2O \longrightarrow MnO_4^- + 10\,SO_4^{2-} + 16\,H^+$

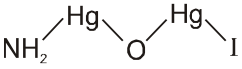
$AgNO_3$ acts as catalyst.

10. Ni^{2+} gives black ppt (Ni_2O_3) with $NaHCO_3$ and bromine water on heating. Where as Co^{2+} gives green coloured solution.

$NiCl_2 + 2NaHCO_3 \longrightarrow NiCO_3 + 2NaCl + H_2O$

$2\,NiCO_3 + [O] \longrightarrow Ni_2O_3\downarrow$ (Black) $+ 2CO_2$

11. (A), (B), (C) and (D) are HgI_2, KI, HgS and Hg respectively.

12. (X) = NH_4Cl, (A) = CrO_2Cl_2, (B) = Na_2CrO_4, (C) = $PbCrO_4$, (D) = 

13. Because $CaSO_4$ precipitate form a complex with $(NH_4)_2SO_4$ which is water soluble

$$CaSO_4 + (NH_4)_2SO_4 \longrightarrow (NH_4)_2Ca(SO_4)_2 \text{ (soluble)}$$

14. (A) : CaC_2O_4 (B) : CaO (C) : CO (D) : CO_2

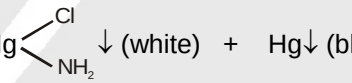
15.	(B)	**16.**	(C)	**17.**	(C)	**18.**	(A)	**19.**	(A)
20.	(C)	**21.**	(A)	**22.**	(A)	**23.**	(B)	**24.**	(B)
25.	(C)	**26.**	(C)	**27.**	(C)	**28.**	(B)	**29.**	(D)
30.	(C)	**31.**	(C)	**32.**	(B)	**33.**	(D)	**34.**	(B)
35.	(C)	**36.**	(D)	**37.**	9	**38.**	7		
39.	a + b = 2 + 5 = 7			**40.**	7 + 3 + 5 = 15	**41.**	40	**42.**	3
43.	(ABC)	**44.**	(AB)	**45.**	(AB)	**46.**	(ABD)	**47.**	(AD)
48.	(ACD)	**49.**	(BCD)	**50.**	(ABD)	**51.**	(ABD)	**52.**	(AD)

PART - IV

1.	(D)	**2.**	(D)	**3.**	(A)	**4.**	(B)	**5.**	(D)
6.	(B)	**7.**	(D)	**8.**	(AB)	**9.**	(AB)	**10.**	(A)
11.	(C)	**12.**	(ABCD)	**13.**	3	**14.**	4	**15.**	8
16.	4	**17.**	07	**18.**	6	**19.**	(D)	**20.**	(C)
21.	(C)	**22.**	(C)						

APSP Solutions

PART - I

1. $Hg_2Cl_2 + 2NH_3 \longrightarrow$  (white) + Hg↓ (black) + NH_4Cl

Black

2. The white precipitate obtained with H_2SO_4 is that of $PbSO_4$. The white crystalline substance may be that of $Pb(NO_3)_2$.

$Pb^{2+} + S^{2-} \longrightarrow PbS \downarrow$ (black) ; $3PbS \downarrow + 8HNO_3 \longrightarrow 3Pb^{2+} + 6NO_3^- + 3S \downarrow + 2NO + 4H_2O$

$Pb^{2+} + SO_4^{2-} \longrightarrow PbSO_4 \downarrow$ (white)

$PbSO_4 + 2CH_3COONH_4 \longrightarrow (NH_4)_2[Pb(CH_3COO)_4] + (NH_4)_2SO_4$

BaS and SrS are not precipitated. Ag_2SO_4 is white precipitate but does not dissolve in ammonium acetate.

3. PbI_2 is yellow (known as golden spangles).

4. AgBr has the highest solubility in 10^{-3} M NH_4OH
AgBr dissolves in all other solvents poorly.

5. Both Cd^{2+} and Sn^{2+} are precipitated as yellow sulphides in the presence of dilute HCl.

6. $Cd^{2+} + H_2S \longrightarrow CdS\downarrow + 2H^+$, reaction is reversible; if the concentration of strong acid in the solution is above 0.5 M, precipitation is incomplete. Concentrated acid dissolves the precipitate for the same reason.

7. $2Cu^{2+} + 4I^- \longrightarrow Cu_2I_2\downarrow + I_2$
$Cu^{2+} + 3CN^- \longrightarrow CuCN\downarrow + (CN)_2$

8. (1) $Bi^{3+} + 3NH_4OH \longrightarrow Bi(OH)_3\downarrow$ (white) $+ 3NH_4^+$
(2) $Bi^{3+} + NO_3^- + H_2O \longrightarrow BiO(NO_3)\downarrow$ (white) $+ 2H^+$
$Bi^{3+} + Cl^- + H_2O \longrightarrow BiOCl\downarrow$ (white) $+ 2H^+$
(3) $Bi^{3+} + 3I^- \longrightarrow BiI_3\downarrow$ (black) ; $BiI_3 + I^- \longrightarrow [BiI_4]^-$ (orange solution)
(4) $Bi^{3+} + 3OH^- \longrightarrow Bi(OH)_3\downarrow$ (white) ; $2Bi(OH)_3\downarrow + 3[Sn(OH)_4]^{2-} \longrightarrow 2Bi\downarrow$ (black) $+ 3[Sn(OH)_6]^{2-}$

9. (i) $Cu^{+2} + 2OH^- \rightarrow Cu(OH)_2 \xrightarrow{\Delta} CuO\downarrow + H_2O$
black ppt.
(ii) $Zn^{+2} + 2OH^- \rightarrow Zn(OH)_2$
white ppt.
(iii) $Al^{+3} + 3OH^- \rightarrow Al(OH)_3$
white ppt.
(iv) $Pb^{+2} + 2OH^- \rightarrow Pb(OH)_2 \xrightarrow{\Delta} PbO\downarrow + H_2O$
white ppt. red yellow ppt.

10. On adding H_2O_2 in alkaline medium or $SnCl_2$ solution in acidic medium, the $[Fe(CN)_6]^{3-}$ part of the compound is reduced and prussian blue is precipitated.

11. $CrO_4^{2-} + 2H^+ + 2H_2O_2 \longrightarrow CrO_5$ (chromium peroxide) $+ 3H_2O$
It in etheral layer develops blue colouration.

12. $Mn(OH)_2 + 2HNO_3 \longrightarrow Mn(NO_3)_2 + 2H_2O$.
$2Mn(NO_3)_2 + 5PbO_2 + 6HNO_3 \longrightarrow 2HMnO_4$ (red – violet or purple colour) $+ 5Pb(NO_3)_2 + 2H_2O$.

13. (1) $Zn(OH)_2\downarrow + 2OH^- \rightleftharpoons [Zn(OH)_4]^{2-}$
(2) and (3) $Zn(OH)_2\downarrow + 4NH_3 \rightleftharpoons [Zn(NH_3)_4]^{2+} + 2OH^-$
or NH_4^+

14. (1) No precipitate with K_2CrO_4 in acetic acid as its K_{sp} is high.
(2) $Ca^{2+} + 2K^+ + [Fe(CN)_6]^{4-} \longrightarrow K_2Ca[Fe(CN)_6]\downarrow$ (white)
(3) It imparts brick red colour to Bunsen flame.
(4) $Ca(HCO_3)_2$ is formed which is water soluble.

15. (2) $BaCO_3 + ZnS$ mixture dissolves in HCl but is insoluble in water. Further the solution in HCl will be colourless due to the formation of soluble $BaCl_2$ and $ZnCl_2$.

16. The K_{SP} of $Al(OH)_3$ is low as compared to that of the hydroxides of other metals. The OH^- concentration provided by ammonium hydroxide in presence of NH_4Cl is just sufficient to precipitate Al^{3+} as $Al(OH)_3$.
$Al^{3+} + NH_3 + H_2O \xrightarrow{NH_4Cl} Al(OH)_3\downarrow$ (gelatinous white) $+ NH_4^+$.

17. Group 3rd radicals are precipitated as hydroxides and the addition of NH_4Cl suppresses the ionisation of NH_4OH so that only the group 3 cations are precipitated as hydroxides because of their low solubility products.

18. MnO_4^- in acidic medium oxidises Fe^{2+} to Fe^{3+}.

19. (1) $2Fe^{3+} + H_2S \longrightarrow 2Fe^{2+} + 2H^+ + S\downarrow$ (white)
(2) $2Fe^{3+} + 3S^{2-} \longrightarrow 2FeS\downarrow$ (black) $+ S\downarrow$
(3) $Fe^{3+} + 3SCN^- \longrightarrow Fe(SCN)_3$ deep red colouration

20. Ni^{2+} and Fe^{2+} both on reaction with alkaline solution of dimethyl glyoxime give red precipitate and red solution respectively but not zinc.

21. $Ag_2S + 2HCl \longrightarrow AgCl\downarrow + 2H_2S$; HgS is also insoluble in 2N HCl so silver and mercury do not pass into filtrate while ZnS, MnS and FeS dissolve in 2N HCl forming their soluble chlorides and thus pass into filtrate.

22. (1) $Pb^{+2} + CrO_4^{-2} \longrightarrow PbCrO_4$ (yellow ppt)

(2) $Ba^{+2} + CrO_4^{-2} \longrightarrow BaCrO_4$ (Yellow ppt)

(3) $Ag^{\oplus} + CrO_4^{-2} \longrightarrow Ag_2CrO_4$ (Brick like red ppt)

(4) $Ca^{+2} + CrO_4^{-2} \longrightarrow CaCrO_4$ (soluble)

23. CaS belongs to V^{th} group and precipitate by H_2S in presence of NH_4OH and NH_4Cl

24. $AgI + NaCN \longrightarrow Na[Ag(CN)_2]$ (soluble)

25. (1) $Cu^{2+} + H_2S \longrightarrow CuS$ (ppt.)

$Ag^{2+} + H_2S \longrightarrow Ag_2S$ (ppt.)

(2) $Cu^{2+} + HCl \longrightarrow CuCl_2$ (soluble)

$Ag^{2+} + HCl \longrightarrow AgCl$ (ppt.)

with HNO_3 and NH_4NO_3 both Ag^+ and Cu^{2+} form soluble compound.

26. $2Ag^+ + CrO_4^{2-} \rightarrow \underset{\text{(red ppt.)}}{Ag_2CrO_4}\downarrow \xrightarrow{NH_3} \underset{\text{(Soluble)}}{[Ag(NH_3)_2]^+} + CrO_4^{2-}$

27. Because NH_4^+ form soluble compounds.

28. $CuSO_4 + NH_4OH \longrightarrow [Cu(NH_3)_4]SO_4 + H_2O$

29. $2Al_2O_3 + 2Co^{+2} + 4NO_3^- \longrightarrow 2CoAl_2O_4$ (thenard blue) $+ 4NO_2 + O_2$

30. $CrCl_3 + NaOH \longrightarrow Cr(OH)_3\downarrow \underset{}{\overset{OH^-}{\rightleftharpoons}} [Cr(OH_4)]^-$ (soluble)

$AlCl_3 + NaOH \longrightarrow Al(OH)_3\downarrow \underset{}{\overset{OH^-}{\rightleftharpoons}} [Al(OH)_4]^-$ (soluble)

$ZnCl_2 + NaOH \longrightarrow Zn(OH)_2\downarrow \underset{}{\overset{OH^-}{\rightleftharpoons}} [Zn(OH)_4]^{2-}$ (soluble)

$CuCl_2 + NaOH \longrightarrow Cu(OH)_2\downarrow \underset{}{\overset{OH^-}{\rightleftharpoons}}$ (not soluble in excess NaOH)

PART - III

11. (A) + (B) $\rightarrow$ lilac colour in flame. So one of the cation may be K^+ .

(a) (A) + (B) $\xrightarrow{H_2S\ (g)}$ (C) black precipitate.

(b) (C) $\xrightarrow[\text{in aqua regia}]{\text{soluble}}$ soluble $\xrightarrow{\text{Evaporation}}$ Residue $\xrightarrow{SnCl_2}$ Greyish black precipitate (D).

(A) + (B) $\xrightarrow{NH_4OH}$ brown precipitate. So second cation may be Hg^{2+}.

(i) Sodium carbonate extract of salt $\xrightarrow{CCl_4/FeCl_3}$ violet colour.

(ii) Sodium extract of salt $\xrightarrow{AgNO_3}$ yellow precipitate $\xrightarrow{NH_3}$ soluble.

So the anion may be I^- .

(a) $HgI_2 + H_2S \longrightarrow HgS$ (C) $\downarrow$ (black) $+ 2HI$.

(b) $3HgS + 6HCl + 2HNO_3 \longrightarrow 3HgCl_2 + 2NO + 4H_2O + S$.

$HgCl_2 + SnCl_2 \longrightarrow Hg\downarrow$ (D) (greyish black) $+ SnCl_4$.

$2KI$ (B) $+ HgI_2$ (A) $\longrightarrow K_2[HgI_4]$ (colourless).

$2K_2[HgI_4] + NH_3 + 3KOH \longrightarrow [HgOHg(NH_2)I]\downarrow$ (brown).

Sodium carbonate extract of salt contains NaI.

$2NaI + 2Fe^{3+} \xrightarrow{CCl_4} I_2$ (violet)$+ 2Na^+ + 2Fe^{2+}$.

I_2 dissolves in CCl_4 giving violet colour solution.

$AgNO_3 + NaI \longrightarrow AgI\downarrow$ (yellow) $+ NaNO_3$.

AgI is insoluble in ammonia solution.

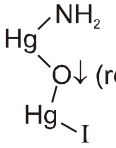
So, (A), (B), (C) and (D) are HgI_2, KI, HgS and Hg respectively.

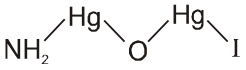
12. $4Cl^- + Cr_2O_7^{2-} + 6H^+ \longrightarrow 2CrO_2Cl_2$ (A)(deep red) $+ 3H_2O$

$CrO_2Cl_2 + 4OH^- \longrightarrow CrO_4^{2-}$ (B)(yellow solution) $+ 2Cl^- + 2H_2O$

$CrO_4^{2-} + Pb^{2+} \longrightarrow PbCrO_4 \downarrow$ (C)(yellow)

$NH_4Cl + NaOH \longrightarrow NaCl + NH_3 + H_2O$

$NH_3 + K_2HgI_4 + H_2O \longrightarrow$  (reddish brown) (D) $+ 4KI + 3HI$

So, (X) = NH_4Cl, (A) = CrO_2Cl_2, (B) = Na_2CrO_4, (C) = $PbCrO_4$, (D) = 

15. aquaregia is $HNO_3 + HCl$

1 : 3

$3Hg_2Cl_2 + 2HNO_3 + 6HCl \longrightarrow 6HgCl_2 + 2NO + 4H_2O$

16. $Ag_2CO_3 \xrightarrow{\Delta} Ag_2O\downarrow + CO_2$

unstable

brown ppt

$\downarrow$ >300°C

$Ag\downarrow$ black ppt

17. (A) $Hg^{2+} + Co^{2+} + 4SCN^- \longrightarrow Co[Hg(SCN)_4]\downarrow$ (deep blue) ;

(B) $2Hg^{2+} + Sn^{2+} + 2Cl^- \longrightarrow Hg_2Cl_2\downarrow$ (white) $+ Sn^{4+}$; $Hg_2Cl_2 + Sn^{2+} \longrightarrow Hg\downarrow$ (black) $+ Sn^{4+} + 2Cl^-$

(C) $2Hg^{2+} + NO_3^- + 4NH_3 + H_2O \longrightarrow HgO.Hg(NH_2)NO_3\downarrow$ (white)

(D) KCN no effect i.e. no reaction.

18. PbS, Bi_2S_3 and CuS dissolve in dilute HNO_3 forming nitrates but HgS dissolves in aquaregia forming $HgCl_2$.

19. $Cu^{2+} + CN^-$ (excess) $\rightarrow [Cu(CN)_4]^{3-}$ (stable) $\xrightarrow{H_2S}$ No ppt

$Cd^{2+} + CN^-$ (excess) $\rightarrow [Cd(CN)_4]^{2-}$ (un-stable) $\xrightarrow{H_2S}$ CdS yellow ppt

21. Sn^{2+} chloride react with $HgCl_2$ and formed black or grey ppt of Hg

$SnCl_2 + HgCl_2 \longrightarrow SnCl_4 + Hg_2Cl_2$

$SnCl_2 + HgCl_2 \longrightarrow SnCl_4 + 2Hg\downarrow$ (black grey ppt)

Sn^{+4} does not react with $HgCl_2$. It is first treated with Aluminium foil which reduces Sn^{+4} to Sn^{+2} (Stannous ion); then it with $HgCl_2$

$3SnCl_4 + 2Al \longrightarrow 2AlCl_3 + 3SnCl_2$ (Stannous chloride)

22. $SnCl_2 + KOH \longrightarrow SnO$

$SnO + KOH$ (excess) $\longrightarrow K_2SnO_2 + 2H_2O$

23. $Fe_4[Fe(CN)_6]_3 + 12OH^- \longrightarrow 4Fe(OH)_3$(reddish brown) $+ 3[Fe(CN)_6]^{4-}$

25. $Co^{2+} + CN^-$(excess) $\longrightarrow [Co(CN)_6]^{4-}$ (Brown solution)

$[Co(CN)_6]^{4-} + O_2 + 2H_2O \longrightarrow [Co(CN)_6]^{3-}$ (Yellow solution)

26. $2CoS + 6HCl + 2HNO_3 \longrightarrow 3CoCl_2 + 2NO + 3S + 4H_2O$

$CoCl_2 + 6NaHCO_3 \longrightarrow Na_4[Co(CO_3)_3] + 2NaCl + 3H_2O + 3CO_2$

$2Na_4[Co(CO_3)_3] + Br_2 \longrightarrow 2Na_3[Co(CO_3)_3] + 2NaBr$

(Green)

28. $NiCl_2 + KCN$ (excess) $K_2[Ni(CN)_4]$

$K_2[Ni(CN)_4] \xrightarrow{NaOH+Br_2 \text{ water}} \underset{\text{black}}{Ni_2O_3\downarrow} + 4NaCNO + NaBr + KCNO + H_2O$

29. (A) titan yellow is absorbed by magnesium hydroxide producing a deep-red colour or precipitate.

(B) $Mg^{2+} + NH_3 + HPO_4^{2-} \longrightarrow Mg(NH_4)PO_4 \downarrow$ (white).

(C) Blue lake is formed by the adsorption of reagent on $Mg(OH)_2$.

30. $Hg_2Cl_2 + 2NH_3 \longrightarrow Hg\begin{matrix}Cl\\NH_2\end{matrix}\downarrow$ (white) + $\underbrace{Hg\downarrow \text{ (black)}}_{\text{black}}$ + NH_4Cl

$Hg_2^{2+} + 2I^- \longrightarrow Hg_2I_2\downarrow$ (green)

31. Sn^{2+} belongs to second B group.

32. $(Cd^{2+}, Cr^{3+}, Fe^{2+}, Al^{3+}) + H_2S \xrightarrow{\text{dil. HCl}} CdS\downarrow$ (yellow ppt.) + Filtrate $(Cr^{3+}, Fe^{2+}, Al^{3+}) \xrightarrow[HNO_3]{\text{boiled}}$

$(Cr^{3+}, Fe^{3+}, Al^{3+}) \xrightarrow[NH_4OH \ \& \ NaOH]{\text{excess}} Fe(OH)_3\downarrow$ (ppt.) + Filtrate, $(Na^+, Cr(OH)_4^-, Al(OH)_4^-,)$

33. The filter paper ash test is substitute for cobalt nitrate charcoal cavity test. Double oxide ZnO.CoO formed is green in colour. It is called Rinmann's green.

34. Function of strong electrolyte NH_4Cl is to suppress the ionisation of NH_4OH so that the concentration of OH^- ions in the solution is decreased but it is sufficient to precipitate the third group basic radicals because the solubility product of group III hydroxides is lower than IV, V and VI group hydroxides. The $Cr(OH)_3\downarrow$ is slightly soluble in excess of precipitant, upon boiling the solution, $Cr(OH)_3$ is precipitated.

35. $4Zn + 10H^+ + NO_3^- \longrightarrow 4Zn^{2+} + NH_4^+ + 3H_2O$.

$Zn^{2+} + 2OH^- \longrightarrow Zn(OH)_2\downarrow$ (white) ; $Zn(OH)_2 + 2OH^- \longrightarrow [Zn(OH)_4]^{2-}$.

$[Zn(OH)_4]^{2-} + H_2S \longrightarrow ZnS\downarrow$ (white) $+ 2OH^- + 2H_2O$.

36. Sodium sulphide is water soluble and K_{sp} of ZnS is higher than that of CuS. So correct order is $Na_2S > ZnS > CuS$

37. Metal P is Ag & metal M is Cu.

$Cu + 2AgNO_3 \longrightarrow \underbrace{Cu(NO_3)_2 + 2Ag + AgNO_3}_{\text{Blue solution}} \xrightarrow{NaCl} \underbrace{Cu(NO_3)_2 + AgCl\downarrow}_{\text{White ppt}}$

(M) (P)

$\xrightarrow{NH_3 \text{ (excess)}} [Cu(NH_3)_4]^{2+} + [Ag(NH_3)_2]^+$

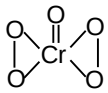
$\therefore$ x = 4, y = 2, m = 1, n = 2

$\therefore$ x + y + m + n = 4 + 2 + 2 + 1 = 9

38. $Sn^{4+} + H_2S \xrightarrow{\text{dil. HCl}} SnS_2$ (yellow ppt)

n = 4, p = 3, n + p = 7

39. A is CrO_5



40. $H\underline{Mn}O_4 + \underline{Bi}(NO_3)_2 + Na\underline{N}O_3$

41. $AsO_4^{3-} + NO_3^- + (NH_4)_2MoO_4 \longrightarrow (NH_4)_3AsMo_{12}O_{40}$

42. $As^{3+} + 3H_2S \longrightarrow \underset{\text{yellow}}{As_3S_3\downarrow}$

$As_2S_3 + S_2^{2-} \longrightarrow AsS_4^{3-} + S_3^{2-}$

Oxidation state of sulphur –2, –1, 0.

43. (A) Correct.

(B) $Cu^{2+} + 2CN^- \longrightarrow Cu(CN)_2\downarrow$ (yellow)

$2Cu(CN)_2\downarrow \longrightarrow 2Cu(CN)_2\downarrow$ (white) $+ (CN)_2$

(C) $BiI_3\downarrow + H_2O \xrightarrow{\text{boiled}} BiOI\downarrow$ (orange) $+ 2HI$

(D) $Bi(OH)_3\downarrow \xrightarrow{\Delta} BiO.OH\downarrow$ (yellowish white) $+ H_2O$

44. (A) $2Cu^{2+} + 4I^- \longrightarrow CuI$ (white) $\downarrow + I_2$

(B) $2Cu^{2+} + 4SCN^- + SO_2 + 2H_2O \longrightarrow 2CuSCN \downarrow$ (white) $+ 2SCN^- + SO_4^{2-} + 4H^+$.

(C) $Cu^{2+} + 6CN^- \longrightarrow [Cu(CN)_4]^{3-}$ (soluble complex) $+ (CN)_2$.

(D) $Cu^{2+} + 2OH^- \longrightarrow Cu(OH)_2 \downarrow$ (blue).

45. $\because$ PO_4^{3-} and AsO_4^{3-} both radical give ammonium molybdate test.

47. (A) Fe^{2+} responds to this test but not Fe^{3+}; Fe(II) gives soluble red iron(II) dimethylglyoxime in alkaline solution.

(D) $Ag_2O \downarrow + 4NH_3 + H_2O \longrightarrow 2[Ag(NH_3)_2]^+ + 2OH^-$

$Ag_2O \downarrow + 2H^+ \longrightarrow 2Ag^+ + H_2O$

(B) and (C) are correct statements.

48. (A) $Hg^{2+} + Co^{2+} + 4SCN^- \longrightarrow Co[Hg(SCN)_4] \downarrow$ (deep blue)

(B) Soluble in NaOH forming $[Al(OH)_4]^-$, not in NH_3 (aq)

(C) $Cr(OH)_3 \downarrow$ (green) $+ OH^- \rightleftharpoons [Cr(OH)_4]^-$ (green solution)

(D) Correct statement.

49. $Co^{2+} + 2CN^- \longrightarrow Co(CN)_2 \downarrow$ (reddish - brown) or buff colour

$Co(CN)_2 \downarrow + 4CN^-$ (excess) $\longrightarrow [Co(CN)_6]^{4-}$ (brown solution)

$[Co(CN)_6]^{4-} + 4H^+ \longrightarrow Co(CN)_2 \downarrow + 4HCN$.

50. CuS dissolves in 50% HNO_3; $3CuS + 8HNO_3 \longrightarrow 3Cu^{2+} + 6NO_3^- + 3S \downarrow + 2NO + 4H_2O$

But NiS, CoS and HgS do not dissolve in 50% HNO_3 and dissolve in aquaregia forming their chlorides.

51. (A) $5SO_2 + 2IO_3^- + 4H_2O \longrightarrow I_2 + 5SO_4^{2-} + 8H^+$; I_2 + starch $\longrightarrow$ blue colour.

(B) $2H^+ + 3SO_2 + Cr_2O_7^{2-} \longrightarrow 2Cr^{3+}$ (green) $+ 3SO_4^{2-} + H_2O$

(C) $Pb^{2+} + SO_3^{2-} \longrightarrow PbSO_3 \downarrow$ (white)

(D) $SO_2 + 2H_2O + Cl_2 \longrightarrow H_2SO_4 + HCl$

$HCl + NH_3 \longrightarrow NH_4Cl$

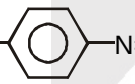
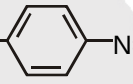
$Ni + H_2SO_4 + 2H^+ \longrightarrow Ni^{2+} + SO_2$ [X] $+ 2H_2O$

With dilute H_2SO_4, hydrogen gas is liberated.

52. (A) $3NH_4^+ + [Co(NO_2)_6]^{3-} \longrightarrow (NH_4)_3[Co(NO_2)_6] \downarrow$ (yellow)

(B) $2NH_3 + Mn^{2+} + H_2O_2 + H_2O \longrightarrow MnO(OH)_2 \downarrow$ (brown) $+ 2NH_4^+$

(C) $NH_4^+ + HC_4H_4O_6^- \longrightarrow NH_4HC_4H_4O_6 \downarrow$ (white)

(D) O_2N–  –$N{=}N{-}Cl + NH_4^+ + 2OH^- \longrightarrow O_2N$–  –$N{=}NONH_4$(red colouration) $+ Cl^- + H_2O$

PART - IV

1. $CoCl_2 + 4NH_4SCN \xrightarrow{\text{ether}} (NH_4)_2[Co(SCN)_4]$ (blue colour in ethereal layer) $+ 2NH_4Cl$.

$Cu^{2+} + 3SCN^- \longrightarrow CuSCN \downarrow$ (white) $+ (SCN)_2$.

$FeCl_3 + 3NH_4SCN \xrightarrow{\text{ether}} Fe(SCN)_3$ (blood red colour) $+ 3NH_4Cl$.

$Ag^+ + SCN^- \longrightarrow AgSCN \downarrow$ (white).

$Co^{2+} + 4SCN^- + Hg^{2+} \longrightarrow Co[Hg(SCN)_4] \downarrow$ (deep blue) or $Hg[Co(NCS)_4]$.

2. (A), (B) and (C) all gives blue colouration in solution or blue precipitate.

(D) $AgCl \downarrow + 2NH_3 \longrightarrow [Ag(NH_3)_2]^+ Cl^-$ (colourless solution)

3. $Pb^{2+} + 2Cl^- \longrightarrow PbCl_2 \downarrow$ (white) ; $PbCl_2 + 2Cl^- \longrightarrow [PbCl_4]^{2-}$ (colourless soluble complex)

$PbCl_2 \downarrow + H_2S \longrightarrow PbS \downarrow$ (black) $+ 2HCl$

$PbS + 4H_2O_2 \longrightarrow PbSO_4 \downarrow$ (white) $+ 4H_2O$

$PbSO_4 \downarrow + 2CH_3COONH_4 \longrightarrow (NH_4)_2SO_4 + (NH_4)_2[Pb(CH_3COO)_4]$

4. $Ag^+ + 2Cl^- \longrightarrow [AgCl_2]^-$ (soluble complex) ; $Ag^+ + Cl^-$ (dilute HCl) $\longrightarrow AgCl \downarrow$ (white)

$2Ag^+ + CrO_4^{2-} \longrightarrow Ag_2CrO_4 \downarrow$ (red) ; $Ag_2CrO_4 \downarrow + NH_3 \longrightarrow 2[Ag(NH_3)_2]^+ + CrO_4^{2-}$

$3Ag^+ + HPO_4^{2-} \longrightarrow Ag_3PO_4 \downarrow$ (yellow) $+ H^+$; $Ag_3PO_4 \downarrow + 6NH_3 \longrightarrow [Ag(NH_3)_2]^+ + PO_4^{3-}$

5. (A) Both are red precipitates
(B) $Ni^{2+} + 2dmg + NH_4OH \rightarrow Ni(dmg)_2\downarrow$ (red)
(C) BiOI↓ (orange) and $Cu_2[Fe(CN)_6]\downarrow$ (brown)

6. $Cu^{2+} + 2SCN^- \longrightarrow Cu(SCN)_2\downarrow$ (black)
$2Cu(SCN)_2 \longrightarrow 2CuSCN\downarrow$ (white) + $(SCN)_2$
$Cu^{2+} + H_2S \xrightarrow{H^+} CuS\downarrow$ (black) + $2H^+$
$2CuS\downarrow + 8CN^- \longrightarrow 2[Cu(CN)_4]^{3-} + S_2^{2-}$

7. (A) $As^{3+} + 3Zn + 3H^+ \longrightarrow AsH_3 + 3Zn^{2+}$; $4AsH_3 \xrightarrow{\Delta} 4As\downarrow + 6H_2$
(B) $4[Ag(NH_3)_2]^+ + H_2N–NH_2.H_2SO_4 \longrightarrow 4Ag\downarrow + N_2 + 6NH_4^+ + 2NH_3 + SO_4^{2-}$
(C) $2Ag_2CrO_4\downarrow + 2H^+ \rightleftharpoons 4Ag^+ + Cr_2O_7^{2-} + H_2O$
$Ag_2CrO_4\downarrow + 4NH_3 \rightleftharpoons 2[Ag(NH_3)_2]^+ + CrO_4^{2-}$
So, all statements are correct.

8. $(NH_4)_2CO_3$ and $(NH_4)_2SO_4$ can not be used as they would also precipitate the IV and Vth group cations.

9. (A) $PbSO_4\downarrow + H_2SO_4$ (hot and concentrated) $\longrightarrow Pb^{2+} + 2HSO_4^-$ (soluble)
(B) It dissolves forming $Na_2[Pb(OH)_4]$ soluble complex.

10. (A) $Cr^{3+} + 3NH_3 + 3H_2O \rightleftharpoons Cr(OH)_3\downarrow + 3NH_4^+$
The above reaction is reversible. On addition of NH_4^+, shifts to backward direction. Thus if excess of NH_4^+ salt is added, then precipitation of $Cr(OH)_3$ will not take place. However, because of very small K_{sp} of iron (III) hydroxide complete precipitation will take place even in the presence of ammonium salts. ($K_{sp} = 3.8 \times 10^{-38}$)
(B) Concentration of CO_3^{2-} provided by Na_2CO_3 in aqueous solution is just sufficient to precipitate Mg^{2+} ion as $MgCO_3$ along with Ba^{2+}, Ca^{2+} and Sr^{2+} as their carbonates.
(C) The oxidising anions like MnO_4^-, $Cr_2O_7^{2-}$, ClO_4^- etc., also respond to this test.
(D) $K_2Cr_2O_7 + NaCl + H_2SO_4 \longrightarrow CrO_2Cl_2$

11. Iron and NO exist as Fe(II) and NO^+ respectively.

12. (A) $Cu_2[Fe(CN)_6]$; $K_2Zn_3[Fe(CN)_6]_2$; (B) $Fe_4[Fe(CN)_6]_3$; $K_2Ca[Fe(CN)_6]$
(C) $Ag_4[Fe(CN)_6]$; $K_2Zn_3[Fe(CN)_6]$; (D) $Cd_2[Fe(CN)_6]$; $Cu_2[Fe(CN)_6]$

13. (1) Al^{3+} and $Hg^{2+} \xrightarrow[H_2S]{H^+} HgS\downarrow$ (black) + Al^{3+} (in solution)

(2) Cu^{2+} and $Zn^{2+} \xrightarrow[H_2S]{H^+} CuS\downarrow$ (black) + Zn^{2+} (in solution)

(3) Cd^{2+} and $Zn^{2+} \xrightarrow[H_2S]{H^+} CdS\downarrow$ (yellow) + Zn^{2+} (in solution)

14. $Ba^{2+}(aq) + CrO_4^{2-}(aq) \longrightarrow BaCrO_4\downarrow$ (yellow)
$Ag^+(aq) + Br^-(aq) \longrightarrow AgBr\downarrow$ (yellow)
$Pb^{2+}(aq) + 2I^-(aq) \longrightarrow PbI_2\downarrow$ (yellow)
$2NH_4^+(aq) + [PtCl_6]^{2-}(aq) \longrightarrow (NH_4)_2[PtCl_6]\downarrow$ (yellow)

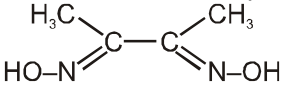
15. AgCN, MnS, Ag_3PO_4, $Zn(OH)_2$, $AgNO_2$, FeS, $BaSO_3$, $Al(OH)_3$, $CH_3COOAg \longrightarrow$ solubility in acidic solution is greater than that in pure water due to protonation of anion.

16. T T T T F F
(i) $SO_3^{2-} + Ca(OH)_2 \longrightarrow CaSO_3\downarrow$ (white) + H_2O
$CO_3^{2-} + Ca(OH)_2 \longrightarrow CaCO_3\downarrow$ (white) + H_2O
(ii) $FeSO_4 + NO + 5H_2O \longrightarrow [Fe(H_2O)_5NO]^{2+}SO_4^{2-}$
(iii) $2AgNO_3 + K_2CrO_4 \longrightarrow Ag_2CrO_4\downarrow$ (red) + $2KNO_3$
(iv) $Pb^{2+} + H_2S \longrightarrow PbS + 2H^+$
(v) S^{2-} concentration in presence of dil HCl is sufficient to ppt the IInd group cations only. Due to common ion effect ionization of H_2S is suppressed.
(iv) $2Cu^{2+} + [Fe(CN)_6]^{4-} \longrightarrow Cu_2[Fe(CN)_6]\downarrow$ (chocolate brown)

17. (a) $HgCl_2 + SnCl_2$ (excess) $\longrightarrow Hg + SnCl_4$
black precipitated

(b) $HgCl_2 + KI \longrightarrow K_2(HgI_4)$ (soluble)

(d) $NH_4Cl + NO_2^- + Co^{3+} \longrightarrow (NH_4)_3[Co(NO_2)_6] \downarrow$ yellow

(e) Ni^{2+} +  + $NH_4OH \longrightarrow Ni(dmg)_2 \downarrow$ (red)

(f) $K_2Cr_2O_7 + \text{conc.}H_2SO_4 + Cl_2 \longrightarrow CrO_2Cl_2 \xrightarrow[NaOH]{aq.} Na_2CrO_4 \xrightarrow{Pb^{2+}} PbCrO_4$

(g) $K_2CrO_4 + Hg_2^{2+} \longrightarrow HgCrO_4$ (red ppt.)

(h) $Hg^{2+} + Co^{2+} + SCN^- \longrightarrow Co[Hg(SCN)_4]$ or $Hg[Co(NCS)_4]$ (deepblue crystalline ppt.)

18. PbS $\longrightarrow$ Black, CdS $\longrightarrow$ yellow, $As_2S_3 \longrightarrow$ yellow, $Sb_2S_3 \longrightarrow$ Orange, SnS $\longrightarrow$ Brown, CoS $\longrightarrow$ Black, HgS $\longrightarrow$ Black, ZnS $\longrightarrow$ White, MnS $\longrightarrow$ Pink.

21. $\underset{(A)}{Hg_2(NO_3)_2} \xrightarrow{HCl} \underset{(B)}{Hg_2Cl_2}$ (White ppt.) $\xrightarrow[water]{Cl_2} \underset{(C)}{HgCl_2}$ (soluble compound)

$\downarrow$ (i) $FeSO_4$, (ii) conc. H_2SO_4 — Brown ring (F)

$\underset{(D)}{K_2[HgI_4]}$ (soluble compound) $\xleftarrow[\text{of KI}]{\text{Excess}} HgI_2$ (Red ppt.) $\downarrow$ KI

(Used for detecting NH_4^+ ions)

$\underset{(D)}{K_2[HgI_4]} + OH^- + (NH_4)_2SO_4 \longrightarrow \underset{(G)}{HgO.Hg(NH_2)I}$ (brown ppt)

$\underset{(B)}{HgCl_2} + NH_3 \longrightarrow Hg(NH_2)Cl + \underset{(H)}{Hg}$ (black ppt)

$NO^-{}_2 / NO_3^- + \text{dil. HCl/con.HCl} \rightarrow NO$

$\Rightarrow \quad Fe^{2+}\,NO + 5H_2O \rightarrow [Fe(H_2O)_5NO]^2$

22. (P) Aqueous solutions of nickel (II) salts are green, owing to the colour of the $[Ni(H_2O)_6]^{2+}$ complex.

(Q) $Co^{2+} + 4SCN^- \longrightarrow [Co(SCN)_4]^{2-}$ (blue colour complex).

In amyl alcohol or diethyl ether dissolves forming $H_2[Co(SCN)_4]$.

(R) $Cu^{2+} + 2OH^- \longrightarrow Cu(OH_2) \downarrow$ (blue) ; $Cu(OH)_2 \downarrow \xrightarrow{\Delta} CuO \downarrow$ (black) + H_2O.

Copper salts imparts greenish blue colour to the Bunsen flame.

(S) $Sr^{2+} + 2C_2O_4^{2-} \longrightarrow SrC_2O_4 \downarrow$ (white) .

Strontium salts imparts crimson colour to the Bunsen burner.

(T) $Pb^{2+} + SO_4^{2-} \longrightarrow PbSO_4 \downarrow$ (white) ; $PbSO_4 \downarrow + 2CH_3COONH_4 \rightarrow (CH_3COO)_2Pb + (NH_4)_2SO_4$.

(U) $CrO_4^2 + Pb^{2+} \longrightarrow PbCrO_4 \downarrow$ (yellow) ; $PbCrO_4 \downarrow + 4OH^- \rightleftharpoons [Pb(OH)_4]^{2-} + CrO_4^{2-}$.

(V) $Hg^{2+} + 2I^- \longrightarrow HgI_2 \downarrow$ (scarlet / red).