Qualitative Analysis

1. Fe(OH)₃ can be separated from Al(OH)₃ by addition of:

(a) BaCl₂

(b) Dil. HCl

- (c) NaOH solution
- (d) NH₄Cl & NH₄OH

2. Cations present in slightly acidic solution are Al^{3+} , Zn^{2+} and Cu^{2+} . The reagent which when added in excess to this solution would identity and separate Cu^{2+} in one step is :

- (a) HCl acid
- (b) NH₃ solution
- (c) NaOH solution
- (d) Na₂CO₃ solution

3. When a KI solution is added to a metal nitrate, a black precipitate is produced which dissolves in an excess of KI to give an orange solution. The metal ion is:

- (a) Hg²⁺
- (b) Bi³⁺
- (c) Cu²⁺
- (d) Pb²⁺

4. To avoid the precipitation of hydroxides of Ni²⁺, Co²⁺, Zn²⁺ and Mn²⁺ along with those of Fe³⁺, Al³⁺ and Cr³⁺ the third group solution should be:

- (a) Heated with a few drops of conc. HNO₃
- (b) Treated with excess of NH₄Cl
- (c) H₂S gas is passes into solution
- (d) None of these

5. Brown ppt. (A) dissolve in HNO_3 gives (B) which gives white ppt. (C) with NH_4OH . (C) on reaction with HCl gives solution (D) which gives white turbidity on addition of water. What is D?

(a) BiCl₃

(b) Bi(OH)₃

(c) BiOCl

(d) Bi(NO₃)₃

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:

(a) hydrogen sulphide in 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 acidic medium, where only Fe(II) sulphide will be precipitated

(d) ammonium hydroxide buffer, where only Cu(II) hydroxide will be precipitated

7. A doctor by mistake administers a $Ba(NO_3)_2$ solution to a patient for radiography investigations. Which of the following should be given as the best to prevent the absorption of soluble barium?

(a) NaCl

(b) Na₂SO₄

(c) Na₂CO₃

(d) NH₄Cl

8. A colourless water soluble solid 'X' on heating gives equimolar quantities of Y and Z. Y gives dense white fumes HCl and Z does so with NH_3 . Y gives brown precipitate with Nessler's reagent and Z gives white precipitate with nitrates of Ag^+ , Pb^{2+} and Hg^+ . X is

(a) NH₄Cl

(b) NH₄NO₃

(c) Na₂CO₃

(d) NH₄Cl

9. The colour of the iodine solution is discharged by shaking with:

(a) sodium sulphate

- (b) sodium sulphide
- (c) aqueous sulphur dioxide
- (d) sodium bromide

10. 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 dil. NaCl solution and one formed a black precipitate with H_2S . The salt could be:

(a) AgNO₃

(b) Pb(NO₃)₂

(c) $Hg(NO_3)_2$

(d) MnSO₄

11. A pale yellow precipitate and a gas with pungent odour are formed on warming dilute hydrochloric acid with an aqueous solution containing:

- (a) sulphate ion
- (b) sulphide ion
- (c) thiosulphate ion
- (d) sulphite ion

12.

AgNO₃
$$\xrightarrow{\Delta}$$
 (W) + (X) + O₂
(X) + H₂O \longrightarrow HNO₂ + HNO₃
(W) + HNO₃ \longrightarrow Y + NO + H₂O
(Y) + Na₂S₂O₃ (excess) \longrightarrow (Z) + NaNO₃
Identify (W) to (Z):

(a)

W = Ag, $X = N_2O$, $Y = AgNO_3$, $Z = Na_2[Ag(S_2O_3)_2]$

(b)

 $W = Ag_2O, X = NO, Y = AgNO_3, Z = Na_3[Ag(S_2O_3)_2]$

(c)

$$W = Ag$$
, $X = NO_2$, $Y = AgNO_3$, $Z = Na_3[Ag(S_2O_3)_2]$
(d)
 $W = Ag_2O$, $X = N_2$, $Y = AgNO_3$, $Z = Na[Ag(S_2O_3)_2]$

13. A compound 'X' on heating gives a colourless gas. The residue is dissolved in water to obtain Y. Excess CO_2 is passes through aqueous solution of 'Y' when 'Z' is formed. Z on gentle heating gives back X. The compound X is:

(a) NaHCO₃

(b) Na₂CO₃

(c) Ca(HCO₃)₂

(d) CaCO₃

14. An aqueous solution of a substance gives a white precipitate on treatment with dil. HCl which dissolves on heating, When H_2S is passes through the hot acidic solution, black precipitate is obtained. The substance is:

(a) $Hg_2^{\rm 2+}$ salt

(b) Hg^{2+} salt

(c) Ag⁺ salt

(d) Pb²⁺ salt

15. lodate ions (IO_3^-) can be reduced to iodine ions. The half equations which represent the redox reactions are:

 $IO_{3}^{-}(aq.) + 6H^{+}(aq.) + 5e \longrightarrow \frac{1}{2}I_{2}(s) + 3H_{2}O(l)$ $I^{-}(aq.) \longrightarrow \frac{1}{2}I_{2}(s) + e^{-}$

How many moles of iodine are produced for every mole of iodate ions consumed in the reaction?

(a) 0.5

(b) 1

- (c) 2.5
- (d) 3

16. $Cl_2 + OH^- \rightarrow Cl^- + ClO_3^-$. What is the coefficient for OH⁻ when this equation is balanced with the smallest integer coefficients?

- (a) 2
- (b) 3
- (c) 4
- (d) 6

17. A solution of metal hydroxide (MOH) with copper sulphate and mixed tartarate of metal M with another metal M_1 of the same group, is used in the detection of —CHO group. Metal M and M_1 are respectively:

- (a) K, Na
- (b) K, Rb
- (c) Na, Li
- (d) Rb, Na
- 18.

(i) $A + \text{Na}_2\text{CO}_3 \longrightarrow B + C$, (ii) $A \xrightarrow{\text{CO}_2}$ (Milky) C

The chemical formula of A and B are respectively:

- (a) NaOH and Ca(OH)₂
- (b) Ca(OH)₂ and NaOH
- (c) NaOH and CaO
- (d) CaO and Ca(OH)₂

19. On passing H_2S gas into first group filtrate sometimes yellow turbidity appears even in the absence of H group radicals, this is because of :

- (a) sulphur is present in the mixture as impurity
- (b) (IV) group radicals are precipitated as sulphides
- (c) the oxidation of H_2S gas by some acid radicals
- (d) III group radicals are precipitated as hydroxides

20. Incorrect order of solubility product (K_{sp}) of given precipitated compound is :

- (a) AgCl < PbCl₂
- (b) $AI(OH)_3 < Zn(OH)_2$
- (c) $BaCO_3 < MgCO_3$
- (d) $MnS < Ag_2S$

21. On adding KI to a metal salt solution, no precipitate was observed but the salt solution gives yellow precipitate with K_2CrO_4 in the presence of CH_3COOH . Then the salt is :

- (a) Sr(NO₃)₂
- (b) Pb(CH₃COO)₂
- (c) AgNO₃
- (d) BaCl₂

22. Which of the following precipitate is soluble in excess of NH_3 solution ?

- (a) $Pb(OH)_2$
- (b) Fe(OH)₂
- (c) Ni(OH)₂
- (d) BaCl₂

23. When a black metal sulphide reacts with dil. HCl, a gas liberates, which of the following pair of cation can be separated by the liberated gas ?

(a) Zn²⁺, Cd²⁺

(b) Hg²⁺, Ag²⁺

(c) Cu²⁺, Pb²⁺

- (d) Mn²⁺, Ni²⁺
- 24. Which of the following mixtures can be separated by using excess NH₃ solution?
- (a) $\operatorname{Bi}_{(aq.)}^{3+}$ and $\operatorname{Al}_{(aq.)}^{3+}$
- (b) $Al_{(aq.)}^{3+}$ and $Zn_{(aq.)}^{2+}$
- (c) $Hg_{(aq.)}^{2+}$ and $Pb_{(aq.)}^{2+}$
- (d) $\operatorname{Cu}_{(aq.)}^{2+}$ and $\operatorname{Cd}_{(aq.)}^{2+}$
- 25. Which of the following salt on heating with concentrated H₂SO₄, coloured vapours do not evolve?
- (a) NaBr
- (b) NaNO₃
- (c) CaF₂
- (d) KI

26. When a reagent (X) reacts with Fe^{3+} salt solution turns red due to the formation compound (Y). This reagent causes no change in colour with Fe^{2+} salt solution. Compound (X) and (Y) are respectively:

- (a) NH₄SCN and Fe(SCN)₃
- (b) $K_4[Fe(CN)_6]$ and $FeSO_4$
- (c) Na_2HPO_4 and $FeSO_4$
- (d) $K_3[Fe(CN)_6]$ and $K_2Fe[Fe(CN)_6]$

27. Which of the following mixtures can be separated by using excess NH₃ solution?

- (a) Bi^{3+} (aq.) and Al^{3+} (aq.)
- (b) $AI^{3+}(aq.)$ and $Zn^{2+}(aq.)$
- (c) $Hg^{2+}(aq.)$ and $Pb^{2+}(aq.)$
- (d) $Cu^{2+}(aq.)$ and $Cd^{2+}(aq.)$

28. Which of the following salt will not give positive brown ring test?

(a) Cu(NO₃)₂

(b) Pb(NO₃)₂

(c) Zn(NO₃)₂

(d) Mg(NO₃)₂

29. Consider the following reactions

 $p + Q \longrightarrow R + K_2 SO_4$ $R \longrightarrow 2CuI + I_2$ $Ag^+ + Q \longrightarrow S + K^+$

Then according to given information the incorrect match is:

(a) $P = CuSO_4$

(b) Q = KI

- (c) $R = Cul_2$
- (d) $S = K[AgI_2]$

30. A very dilute acidic solution of Cd^{2+} and Ni^{2+} gives only yellow ppt. of CdS on passing H₂S, this is due to :

(a) Solubility product (K_{sp}) of CdS is more than that of NiS

- (b) Solubility product (K_{sp}) of CdS is less than that of NiS
- (c) Cd^{2+} belong to IIB group while Ni^{2+} belongs to IV th group
- (d) CdS is insoluble in yellow ammonium sulphide (YAS)

31. Choose the correct code by identifying (X), (Y) and (Z) in each case for the changes indicated:

(i)
$$\operatorname{CrO}_{2}\operatorname{Cl}_{2} \xrightarrow{\operatorname{KOH}} (X) \xrightarrow{\operatorname{conc.} H_{2}SO_{4}} (Y) \xrightarrow{\operatorname{AgNO}_{3}} (Z)$$

(ii) $\operatorname{CrCl}_{3}(aq) \xrightarrow{\operatorname{excess}} (X) \xrightarrow{\operatorname{Na}_{2}O_{2}}_{H_{2}O, \text{ boil}} (Y) \xrightarrow{\operatorname{lead}} (Z)$
(iii) $\operatorname{ZnSO}_{4}(aq) \xrightarrow{\operatorname{Na}_{2}CO_{3}} (X) \xrightarrow{\Delta} (Y) \xrightarrow{\operatorname{cobalt}}_{\operatorname{nitrate}, \Delta} (Z)$
(iv) $\operatorname{CuCl}_{2}(aq) \xrightarrow{\operatorname{NH}_{4}OH}_{H_{2}S} (X) \xrightarrow{\Delta} (Y) \xrightarrow{\operatorname{KCN}}_{\operatorname{excess}} (Z)$
(a) $X = K_{2}\operatorname{CrO}_{4} \qquad Y = K_{2}\operatorname{Cr}_{2}\operatorname{O}_{7} \qquad Z = \operatorname{Ag}_{2}\operatorname{CrO}_{4}$

(b) X = [Cr(OH) ₄] ⁻	$Y = Na_2CrO_4$	$Z = PbCrO_4$
(c) X = ZnCO₃	Y = ZnO	$Z = CoZnO_2$
(d) X = CuS	$Y = Cu(NO_3)_2$	$Z = K_3[Cu(CN)_4]$

32. A sulphate of a metal (A) on heating evolves two gases (B) and (C) and an oxide (D). Gas (B) turns $K_2Cr_2O_7$ paper, green while gas (C) forms a thinner in which there is no S–S bond. Compound (D) with conc. HCl forms a Lewis acid (E) which exists in a dimer. Compounds (A), (B), (C), (D) and (E) are respectively:

- (a) FeSO₄, SO₂, SO₃, Fe₂O₃, FeCl₃
- (b) Al₂(SO₄)₃, SO₂, SO₃, Al₂O₃, FeCl₃
- (c) FeS, SO₂, SO₃, FeSO₄, FeCl₃
- (d) FeS, SO₂, SO₃, Fe₂(PO₄)₃, FeCl₂

33. $X + HNO_3 \rightarrow Y + NO_2 + H_2O + S, Y + Ammonium molybdate \rightarrow yellow ppt.$ Identify X:

- (a) As_2S_5
- (b) Sb₂S₅
- (c) SnS₂
- (d) CdS

34.	(X)(Black)	$\xrightarrow{dil.H_2SO_4} (Y)(gas) -$	$\xrightarrow{dil.HNO_3}$ Colloidal sulphur	; Identify X
-----	------------	--	---	--------------

- (a) CuS
- (b) FeS
- (c) PbS
- (d) NiS

35. An organic compound (A) on heating produces two gases (B) and (C) and neutral oxide (D) which turns cobalt chloride paper pink. Gas (B) turns lime water milky and produces an acidic solution with water. Gas (C) produces a poisonous gas (E) with chlorine gas, this gas with ammonia gives an organic compound (F) which on further reaction with (D) gives NH₃ gas. Then, compounds (A) and (F) can be found as:

(a) H₂C₂O₄ and NH₂CONH₂

(b) CH₃COOH and NH₂CONH₂

- (c) CHCl₃ and CH₃CONH₂
- (d) CH₃Cl and NH₂COONH₄

36. Which of the following compounds is/are partially soluble or insoluble in NH₄OH solution:

- (1) Fe(OH)₃
- (2) Ag₂CrO₄
- (3) Al(OH)₃
- (4) Ag₂CO₃
- (5) Ni(OH)₂
- (a) 1, 3, 5
- (b) 2, 3, 4
- (c) 1, 3
- (d) 2, 3, 5

37. Give the correct order of initials **T** or **F** for following statements. Use **T** if statement 1 is true and **F** if it is false.

(i) Cu⁺ undergoes disproportionation to Cu and Cu²⁺ in aqueous solution

(ii) Hg₂Cl₂ does not impart chromyl chloride test

(iii) Sulphide ions react with sodium nitroprusside to form a purple coloured complex. In this reaction, oxidation state of iron changes.

(a) TFF

(b) FTT

(c) TFT

(d) TTF

38. In this sequence *X*, *Y*, *Z* are respectively:



- (a) Acidified H₂O₂; Alkaline H₂O₂; Acidified H₂O₂
- (b) Alkaline H₂O₂ ; Acidified H₂O₂ ; Zn/HCl
- (c) Acidified H₂O₂; Heat; Alkaline H₂O₂
- (d) Alkaline H₂O₂; Acidified H₂O₂; On standing

39. A white powder "A" on heating gave a non-combustible gas and a white residue. The residue on heating turns yellow. The residue dissolves in dil. HCl and the solution gives a white ppt. with $K_4[Fe(CN)_6]$. "A" would be

- (a) CaCO₃
- (b) ZnCO₃
- (c) CaSO₃
- (d) CuCO₃
- 40. Fe²⁺ and Fe³⁺ can be distinguished by
- (a) $K_3[Fe(CN)_6]$
- (b) K₄[Fe(CN)₆]
- (c) KSCN
- (d) All are correct
- 41. Match the following
 - (I) HCO₂ (II) K₂CO₃

- (P) Obtained through Solvay's process
- (Q) Green colouration due to [Cr(H₂O)₆]^{3*} ion
- (III) S₂O₃²⁻ + FeCl₃ solution (R) Reduces [Cu(C4H4O6)2]2- to red ppt. $(IV) SO_3^{2-} + K_2 Cr_2 O_7 / H^+$
 - (S) Green colouration
- (V) Na₂CO₃
- (T) Melts at 850°C

- (a) P-I; Q-III; R-V; S-IV; T-II
- (b) P-I; Q-III; R-II; S-IV; T-V
- (c) P-V; Q-IV; R-I; S-III; T-II
- (d) P-V; Q-IV; R-III; S-I; T-II

 $(X) \xrightarrow{\text{KOH}} (Y) \text{ (gas turns red litmus blue)} + (Z) \xrightarrow{Zn + \text{KOH}} (Y) \text{ (gas)}.$ $(X) \xrightarrow{\Delta} \text{ gas (does not support combustion)}$ 42.

Identify (X) to (Z):

(a) $X = NH_4NO_2$	$Y = NH_3$	$Z = KNO_2$
(b) X = (NH ₄)2Cr ₂ O ₇	$Y = NH_3$	$Z = Cr_2O_3$
(c) X = (NH ₄) ₂ SO ₄	$Y = NH_3$	$Z = K_2 SO_4$
(d) $X = NH_4NO_3$	$Y = NH_3$	Z = KNO3

$$SO_3^{2-} + S^* \xrightarrow{\text{boil}} SS^*O_3^{2-}, SS^*O_3^{2-} + 2H^+ \longrightarrow H_2SO_3 + S^*$$

43.

The above reaction sequence proves:

- (a) Two sulphur atoms of thiosulphate are not equivalent
- (b) Both are equivalent
- (c) Both of the above are correct
- (d) None of these

(Clear solution)
$$D \xleftarrow{\text{dil. HCl}} A \xrightarrow{\text{K}_2\text{CrO}_4} B$$
 (Yellow ppt.)
dil. H₂SO₄
 C (White ppt.)

Compound(s) A and B is/are

(a) lead carbonate

(b) red lead

(c) barium carbonate

(d) calcium carbonate

$$\begin{array}{l} \operatorname{AgNO}_{3} \xrightarrow{\Delta} (W) + (X) + \operatorname{O}_{2} \\ (X) + \operatorname{H}_{2}\operatorname{O} \longrightarrow \operatorname{HNO}_{2} + \operatorname{HNO}_{3} \\ (W) + \operatorname{HNO}_{3} \longrightarrow Y + \operatorname{NO} + \operatorname{H}_{2}\operatorname{O} \\ (Y) + \operatorname{Na}_{2}\operatorname{S}_{2}\operatorname{O}_{3} (\operatorname{excess}) \longrightarrow (Z) + \operatorname{NaNO}_{3} \\ \operatorname{Identify} (W) \text{ to } (Z): \\ (a) W = \operatorname{Ag}, \quad X = \operatorname{N}_{2}\operatorname{O}, \quad Y = \operatorname{AgNO}_{3}, \quad Z = \operatorname{Na}_{2}[\operatorname{Ag}(\operatorname{S}_{2}\operatorname{O}_{3})_{2}] \\ (b) W = \operatorname{Ag}_{2}\operatorname{O}, \quad X = \operatorname{NO}, \quad Y = \operatorname{AgNO}_{3}, \quad Z = \operatorname{Na}_{3}[\operatorname{Ag}(\operatorname{S}_{2}\operatorname{O}_{3})_{2}] \\ (c) W = \operatorname{Ag}, \quad X = \operatorname{NO}_{2}, \quad Y = \operatorname{AgNO}_{3}, \quad Z = \operatorname{Na}_{3}[\operatorname{Ag}(\operatorname{S}_{2}\operatorname{O}_{3})_{2}] \\ (d) W = \operatorname{Ag}_{2}\operatorname{O}, \quad X = \operatorname{N}_{2}, \quad Y = \operatorname{AgNO}_{3}, \quad Z = \operatorname{Na}_{3}[\operatorname{Ag}(\operatorname{S}_{2}\operatorname{O}_{3})_{2}] \end{array}$$

Answer Keys:

1. c	2. c	3. b	4. b	5. a
6. a	7. b	8. a	9. c	10. b
11. c	12. c	13. d	14. d	15. d
16. d	17. a	18. b	19. c	20. d
21. d	22. c	23. a	24. b	25. c
26. a	27. b	28. b	29. d	30. b
31. d	32. a	33. a	34. b	35. a
36. c	37. d	38. d	39. b	40. d
41. c	42. a	43. a	44. c	45. c

Solutions

1.

$\begin{array}{c} \text{Al(OH)}_3 & \underline{\qquad} \text{NaOH} \\ \text{(Amphoteric)} & \underline{\qquad} \text{Excess} \end{array} \\ \text{Na[Al(OH)}_4] + H_2O \\ \end{array}$

2.

(i) $Al_{(aq.)}^{3+} + NaOH \longrightarrow Al(OH)_{3} \downarrow \xrightarrow{NaOH} Na[Al(OH)_{4}]$ $\stackrel{White ppt.}{(Amphoteric)}$ (ii) $Zn_{(aq.)}^{2+} + NaOH \longrightarrow Zn(OH)_{2} \downarrow \xrightarrow{NaOH} Na_{2}[Zn(OH)_{4}]$ $\stackrel{White ppt.}{(Amphoteric)}$ (iii) $Cu_{(aq.)}^{2+} + OH^{-} \longrightarrow CuOH_{2} \downarrow \xrightarrow{NaOH}$ No reaction $\stackrel{Blue ppt.}{(Basic)}$

3.

$$\begin{array}{cccc} Bilue & ppt. \\ (Basic) \\ Bil_{3} & \xrightarrow{\Gamma^{-}} & [Bil_{4}]^{-} \\ (black) & (orange) \\ & soluble \end{array}$$

4.

The value of K_{sp} of hydroxides of Fe³⁺, Cr³⁺, Al³⁺ are lower than that of Co²⁺, Ni²⁺, Mn²⁺ and Zn²⁺. Therefore; in the presence of NH₄Cl, dissociation of NH₄OH is suppressed and conc. of OH⁻, furnished from NH₄OH, is such that only third group basic radicals are precipitate.

$$\begin{array}{ccc} \operatorname{Bi}_{2}S_{3} + 8\operatorname{HNO}_{3} & \xrightarrow{\operatorname{hot}} & 2\operatorname{Bi}(\operatorname{NO}_{3})_{3} + 3\operatorname{S} \downarrow + 2\operatorname{NO} + 4\operatorname{H}_{2}\operatorname{O} \\ & \operatorname{Bi}(\operatorname{NO}_{3})_{3} + 3\operatorname{NH}_{4}\operatorname{OH} & \longrightarrow & \operatorname{Bi}(\operatorname{OH})_{3} \downarrow + 3\operatorname{NH}_{4}\operatorname{NO}_{3} \\ & \operatorname{Bi}(\operatorname{OH})_{3} \downarrow + 3\operatorname{HCl} & \longrightarrow & \operatorname{Bi}(\operatorname{Cl}_{3} + 3\operatorname{H}_{2}\operatorname{O} \\ & & \operatorname{CO} \\ & & \operatorname{Bi}(\operatorname{OH})_{3} \downarrow + 3\operatorname{HCl} & \longrightarrow & \operatorname{Bi}(\operatorname{Cl}_{3} + 3\operatorname{H}_{2}\operatorname{O} \\ & & & \operatorname{CO} \\ & & & \operatorname{Bi}(\operatorname{OH})_{3} \downarrow + 2\operatorname{HCl} \\ & & & & \operatorname{Bi}(\operatorname{OH})_{3} \downarrow + 2\operatorname{HCl} \\ & & & & \operatorname{Bi}(\operatorname{OH})_{3} \downarrow + 2\operatorname{HCl} \\ & & & & & \operatorname{CO} \\ & & & & & \operatorname{CO} \\ & & & & & & \operatorname{CO} \\ & & & & & & & \operatorname{CO} \\ & & & & & & & & \operatorname{CO} \\ & & & & & & & & & \\ \end{array}$$

Cu²⁺ is second group radical, gets precipitated first due to having lower solubility product [K_{sp} (CuS)= 1 × 10⁻⁴⁴]

7. $Ba(NO_3)_2 + Na_2SO_4 \longrightarrow BaSO_4 \downarrow + 2NaNO_3$ white ppt.

8.

 $\begin{array}{ccc} \mathrm{NH_4Cl} & \stackrel{\Delta}{\longrightarrow} & \mathrm{NH_3} + \mathrm{HCl} \\ & & & Y \\ \mathrm{NH_3} + & 2\mathrm{K_2[HgI_4]} & + 3\mathrm{KOH} & \longrightarrow & \mathrm{H_2NHgO} \cdot \mathrm{HgI} & + 7\mathrm{KI} + \mathrm{H_2O} \\ & & & & \mathrm{brown \ ppt.} \\ & & & & \mathrm{iodide \ of \ Millon's \ base} \end{array}$

9.

 I_2 is reduced to HI; thus, decolorization of iodine takes place.

 $SO_2 + I_2 + 2H_2O \longrightarrow H_2SO_4 + 2HI$

$$\begin{array}{ccc} Pb(NO_3)_2 + 2NH_4OH & \longrightarrow & Pb(OH)_2 + 2NH_4NO_3 \\ & & \text{white ppt.} \end{array}$$

$$Pb(NO_3)_3 + 2NaCl & \longrightarrow & PbCl_2 & + 2NaNO_3 \\ & & \text{white ppt.} \end{array}$$

$$Pb(NO_3)_3 + H_2S \longrightarrow PbS + 2HNO_3$$

black ppt.

$$S_2O_3^{2-} + 2H^+ \xrightarrow{\Delta} SO_2 + S + H_2O$$

gas pungent pale yellow
odour ppt.

12.

$$\begin{array}{ccc} \operatorname{AgNO}_{3} & \stackrel{\Delta}{\longrightarrow} & \operatorname{Ag} + \operatorname{NO}_{2} + \frac{1}{2}\operatorname{O}_{2} \\ & & & & & \\ \operatorname{NO}_{2} + \operatorname{H}_{2}\operatorname{O} & \longrightarrow & \operatorname{HNO}_{2} + \operatorname{HNO}_{3} \\ & & & & \\ \operatorname{(X)} & & & & \\ \operatorname{3Ag} + & \operatorname{4HNO}_{3} & \longrightarrow & \operatorname{3AgNO}_{3} + \operatorname{NO} + & \operatorname{2H}_{2}\operatorname{O} \\ & & & & \\ \operatorname{(W)} & & & & \\ \operatorname{AgNO}_{3} + & & \operatorname{2Na}_{2}\operatorname{S}_{2}\operatorname{O}_{3} & \longrightarrow & \operatorname{Na}_{3}[\operatorname{Ag}(\operatorname{S}_{2}\operatorname{O}_{3})_{2}] + & \operatorname{NaNO}_{3} \\ & & & & \\ \operatorname{(Y)} & & & & & \\ \end{array}$$

13.

$$\begin{array}{ccc} CaCO_{3} & \stackrel{heat}{\longrightarrow} CaO + & CO_{2}\uparrow\\ & colourless gas\end{array}$$

$$\begin{array}{ccc} CaO + H_{2}O & \longrightarrow & Ca(OH)_{2}\\ Fresidue & & & \\ Ca(OH)_{2} + 2CO_{2} & \longrightarrow & Ca(HCO_{3})_{2}\\ Fresidue & & & \\ Ca(HCO_{3})_{2} & \stackrel{heat}{\longrightarrow} & CaCO_{3} + CO_{2} + H_{2}O\end{array}$$

14.

 $Pb^{2+}(aq) + 2HCl (dil.) \longrightarrow PbCl_2 (white ppt.)$ White ppt. of $PbCl_2$ is soluble in hot water. Pb^{2+} ions give black ppt. of PbS with H₂S.

$$\Gamma(aq) \longrightarrow \frac{1}{2} I_2(s) + e^- \} \times 5$$

$$IO_3^-(aq) + 6H^+(aq) + 5e \longrightarrow \frac{1}{2} I_2(s) + 3H_2O(l)$$

$$5\Gamma^-(aq) + IO_3^-(aq) + 6H^+(aq) \longrightarrow 3I_2 + 3H_2O(l)$$

16.

$$3\text{Cl}_2 + 6\text{OH}^- \rightarrow 5\text{Cl}^- + \text{ClO}_3^- + 3\text{H}_2\text{O}$$

17.

 $NaOH + CuSO_4 + Sodium(M) + Potassium(M_1)$ tartarate solution is known as Fehling's solution an is used in the detection of -CHO group.

18.

 $\begin{array}{ccc} \operatorname{Ca(OH)}_2 + \operatorname{Na}_2 \operatorname{CO}_3 & \longrightarrow & \operatorname{2NaOH} + \operatorname{CaCO}_3 & \operatorname{Ca(OH)}_2 & \xrightarrow{\operatorname{CO}_2} & \operatorname{CaCO}_3 \\ (A) & (B) & (C) & (A) & (A) & C & (\operatorname{milky}) \end{array}$

19.

On passing H_2S gas into first group filtrate sometimes yellow turbidity appears even in the absence of group radicals, this is because of the oxidation of H_2S gas by some acid radicals and form Collin solution of sulphur.

$$\operatorname{Fe}_{(aq.)}^{3+} \xrightarrow{\operatorname{H}_2S/\operatorname{H}^+} \operatorname{Fe}_{(aq.)}^{2+} + S\downarrow$$

20.

Correct order of K_{sp} is $Ag_2S < MnS$ according to classification of basic radical.

(i) $BaCl_2 + KI \rightarrow No \text{ ppt.}$ (ii) $BaCl_{2(aq.)} + CrO_4^{2-} \rightarrow BaCrO_4 \downarrow$ (insoluble in CH₃COOH acid) Yellow ppt.

22.

The green ppt. of Ni(OH)₂ is soluble in excess of NH₃ solution. $Ni(OH)_2 \downarrow + 6NH_3 \longrightarrow [Ni(NH_3)_6]^{2+} + 2OH^-$ Green ppt. Deep blue

23.

Both Zn²⁺ and Cd²⁺ cations can be separated by passing H₂S gas in acidic as well as in neutral medium

(i) $Zn^{2+} + H_2S \rightarrow No ppt.$	-	(ii) $Cd^{2+} + H_2S \rightarrow$	CdS↓ Yellow ppt.

24.

 Al^{3+} and Zn^{3+} both form white ppt. with NH_3 solution but white ppt. of $Zn(OH)_2$ is soluble in excess of NH_3 .

 $\begin{array}{l} \text{Al}^{3+} + 3\text{NH}_3 + 3\text{H}_2\text{O} \longrightarrow \text{Al}(\text{OH})_3 \downarrow \xrightarrow{\text{Px NH}_2 \text{ molution}} \rightarrow \text{No reaction} \\ \text{Zn}^{2+} + 2\text{NH}_3 + 2\text{H}_2\text{O} \longrightarrow \text{Zn}(\text{OH})_2 \downarrow \xrightarrow{\text{Px NH}_2 \text{ molution}} \left[\text{Zn}(\text{NH}_3)_4\right]^{2+} \end{array}$

25.

(a) NaBr + H₂SO₄
$$\rightarrow$$
 Na₂SO₄ + HBr $\uparrow \underbrace{Conc. H_2SO_4}_{(Remaining part)} \rightarrow Br_2 \uparrow$
(b) NaNO₃ + H₂SO₄ $\rightarrow NO_2 \uparrow$
Raddish brown
(c) CaF₂ + H₂SO₄ $\rightarrow CaSO_4 + HF \uparrow$
Colourless
(d) KI + H₂SO₄ $\rightarrow K_2SO_4 + 2HI \xrightarrow{Conc. H_2SO_4}_{(Remaining part)} 1_2 \uparrow$
(Violet)

26.

$$\begin{array}{c} \operatorname{Fe}^{3+} + 3\operatorname{NH}_{4}\operatorname{SCN} \longrightarrow 3\operatorname{NH}_{4}^{+} & + & \operatorname{Fe}(\operatorname{SCN})_{3} \\ (X) & & (Blood red colour solution) \end{array}$$

NH4SCN has no change in colour with Fe2+.

Bi3+(aq) + Al3+(aq) (b) $Al^{3+}(aq) + Zn^{2+}(aq)$ NH₃ sol. NH3 sol. $Bi(OH)_3 \downarrow + Al(OH)_3 \downarrow$ $Al(OH)_3 \downarrow +Zn(OH)_3 \downarrow$ (Gelatinous white) (white) (Gelatinous white) (Gelatinous white) Excess of Excess NH₃ sol. NH₃ sol. both are not soluble ppt, Al(OH)₃ Filtrate [Zn(NH3)4] colourless sol. (d) $Cu^{2+}(aq) + Cd^{2+}(aq)$ (c) Hg²⁺(aq) + Pb²⁺(aq) NH₃ sol. NH₃ sol. $Cu^{2+}(OH)_2 \downarrow + Cd(OH)_2 \downarrow$ $HgO \cdot Hg(NH_2)(NO_3) \downarrow +Pb(OH)_2 \downarrow$ (W) Excess of (Blue) white white Excess of NH3 sol. NH₃ sol. $[Cu^{2+}(NH_3)_4]^{2+} + [Cd(NH_3)_4]^{2+}$ both are not soluble both are soluble

28.

During Brown ring test, ppt. of PbSO₄ will be formed, which hinder the formation of brown ring.

29.

$$\begin{array}{c} \operatorname{CuSO}_{4} + 2\operatorname{KI} \longrightarrow \operatorname{CuI}_{2} + \operatorname{K}_{2}\operatorname{SO}_{4} \\ (Q) & (R) \\ (unstable) \\ 2\operatorname{CuI}_{2} \longrightarrow 2 \operatorname{CuI} \downarrow + \operatorname{I}_{2}^{\uparrow} \\ \operatorname{Ag}^{+} + \operatorname{KI} \longrightarrow \operatorname{AgI} \downarrow + \operatorname{K}^{+} \\ (S) \end{array}$$

30.

Basic radicals are classified on the basis of increasing order of K_{sp}, Cd²⁺ in II group while Ni²⁺ in IV group.

(i)
$$\operatorname{CrO}_{2}\operatorname{Cl}_{2} \xrightarrow{\operatorname{KOH}} \operatorname{K}_{2}\operatorname{CrO}_{4} \xrightarrow{\operatorname{conc.}} \operatorname{K}_{2}\operatorname{CrO}_{7} \xrightarrow{\operatorname{AgNO}_{3}} \operatorname{Ag}_{2}\operatorname{CrO}_{7}$$

(ii) $\operatorname{CrCl}_{3}(aq) \xrightarrow{\operatorname{excess}}_{\operatorname{NaOH}} \operatorname{Na}[\operatorname{Cr}(\operatorname{OH})_{4}] \xrightarrow{\operatorname{Na}_{2}O_{2}}_{\operatorname{H}_{2}O_{1}} \xrightarrow{\operatorname{Na}_{2}O_{2}} \operatorname{Na}_{(Y)} \xrightarrow{\operatorname{AgNO}_{3}} \operatorname{Ag}_{2}\operatorname{CrO}_{7}$
(iii) $\operatorname{CrCl}_{3}(aq) \xrightarrow{\operatorname{excess}}_{\operatorname{NaOH}} \operatorname{Na}[\operatorname{Cr}(\operatorname{OH})_{4}] \xrightarrow{\operatorname{Na}_{2}O_{2}}_{\operatorname{H}_{2}O_{1}} \xrightarrow{\operatorname{Na}_{2}O_{2}} \operatorname{Na}_{(Y)} \xrightarrow{\operatorname{AgNO}_{3}} \operatorname{Ag}_{2}\operatorname{CrO}_{7} \xrightarrow{\operatorname{conc.}}_{(Y)} \xrightarrow{\operatorname{AgNO}_{3}} \operatorname{Ag}_{2}\operatorname{CrO}_{7}$
(iii) $\operatorname{CrCl}_{3}(aq) \xrightarrow{\operatorname{Na}_{2}O_{3}}_{\operatorname{H}_{2}O} \operatorname{CnO}_{3} \cdot \operatorname{3}Zn(\operatorname{OH})_{2} \xrightarrow{\Delta} \operatorname{CnO}_{(Y)} \xrightarrow{\operatorname{cobalt}}_{\operatorname{nitrate}, \Delta} \operatorname{CoZnO}_{2}$
(iv) $\operatorname{CuCl}_{2}(aq) \xrightarrow{\operatorname{NH}_{4}OH}_{\operatorname{H}_{2}S} \xrightarrow{\operatorname{Cu}}_{(X)} \xrightarrow{\operatorname{AnO}_{3}}_{\Delta} \operatorname{Cu}(\operatorname{NO}_{3})_{2} \xrightarrow{\operatorname{KCN}_{2}}_{\operatorname{excess}} \operatorname{K}_{3}[\operatorname{Cu}(\operatorname{CN})_{4}]$
(Z)

$$\begin{array}{ccc} 2\text{FeSO}_4 & \longrightarrow & \text{Fe}_2\text{O}_3 + \text{SO}_2 + \text{SO}_3 \\ (A) & (D) & (B) & (C) \end{array}$$

$$\begin{array}{ccc} \text{Fe}_2\text{O}_3 + 6\text{HCl} & \longrightarrow & 2\text{FeCl}_3 + 3\text{H}_2\text{O} \end{array}$$

33.

As $_2S_5 + HNO_3 \longrightarrow H_3AsO_4 + NO_2 + H_2O + S$ (ammonium molybdate) $H_3AsO_4 + (NH_4)_2MoO_4 \longrightarrow$ yellow ppt. of $(NH_4)_3AsO_4 \cdot 12MoO_3$

34.

$$\begin{array}{c} \text{FeS} & \xrightarrow{\text{dil. } H_2 \text{SO}_4} & H_2 \text{S} \xrightarrow{\text{dil. } \text{HNO}_3} & \text{S} \\ \text{Black} & \xrightarrow{\text{gas}} & \xrightarrow{\text{gas}} & \xrightarrow{\text{colloidal}} + \text{NO}_2 + 2H_2 \text{O} \end{array}$$

35.

$$\begin{array}{cccc} H_{2}C_{2}O_{4} & \stackrel{\Delta}{\longrightarrow} & CO_{2}(g) + CO(g) + H_{2}O(g) \\ & & (B) & (D) & (D)$$

Ppts. of Ag ₂CrO₄, Ag ₂CO₃ are soluble in NH₄OH due to formation of $[Ag(NH_3)_2]^+$ Green ppt. of Ni(OH)₂ is soluble in NH₄OH due to formation of $[Ni(NH_3)_6]^{2+}$ Ag ₂CrO₄ ↑ + 4NH₄OH $\longrightarrow 2[Ag(NH_3)_2]^+ + CrO_4^{2-} + 4H_2O$ Ag ₂CO₃ ↑ + 4NH₄OH $\longrightarrow 2[Ag(NH_3)_2]^+ + CO_3^{2-} + 4H_2O$ $Ni(OH)_2^{\uparrow} + 8NH_4OH \longrightarrow [Ni(NH_3)_6]^{2+} + 2OH^- + 6H_2O$ green ppt.

Fe(OH)3 is insoluble in NH4OH. Al(OH)₃ is insoluble in NH₄OH.

37.

38.

$$X : 2Cr^{3+} + 10 \text{ OH}^{-} + 3H_2O_2 \longrightarrow 2CrO_4^{2-} + H_2O_{\text{yellow}}$$

$$Y : CrO_4^{2-} + 2H_2O_2 + 2H^+ \rightarrow \bigcup_{O}^{O} Cr_{O} + 3H_2O_{O}$$

In aq. solution CrO_5 is unstable and if further decom

poses 7

$$Z: 2CrO_5 \longrightarrow Cr_2O_3 + \frac{7}{2}O_2$$
(Amphoteric)
$$Cr_2O_3 + 3H_2SO_4 \longrightarrow Cr_2(SO_4)_3 + 3H_2O$$

39.

$$\begin{array}{ccc} \operatorname{ZnCO}_3(s) & \stackrel{\Delta}{\longrightarrow} & \operatorname{ZnO}(s) + \operatorname{CO}_2(g) \\ & & & & \\ &$$

$$\begin{array}{rcl} \operatorname{Fe}^{2+} + \left[\operatorname{Fe}(\operatorname{CN})_{6}\right]^{3-} & \longrightarrow & \operatorname{Fe}^{3+} + \left[\operatorname{Fe}(\operatorname{CN})_{6}\right]^{4-} & \longrightarrow & \operatorname{Fe}_{4}[\operatorname{Fe}(\operatorname{CN})_{6}]_{3} \\ & & \operatorname{Turnbull}''s \ blue \\ & & \left(\operatorname{Prussian \ blue}\right) \end{array} \\ & & \operatorname{Fe}^{3+} + \left[\operatorname{Fe}(\operatorname{CN})_{6}\right]^{3-} & \longrightarrow & \operatorname{Fe}[\operatorname{Fe}(\operatorname{CN})_{6}] \\ & & \operatorname{Brown \ colour} \\ & & \operatorname{solution} \end{array} \\ & & \operatorname{Fe}^{2+} + \operatorname{K}_{4}[\operatorname{Fe}(\operatorname{CN})_{6}] & \longrightarrow & \operatorname{K}_{2}\operatorname{Fe}[\operatorname{Fe}(\operatorname{CN})_{6}] + 2\operatorname{K}^{+} \\ & & \operatorname{white \ ppt.} \end{array} \\ & & 4\operatorname{Fe}^{3+} + 3\operatorname{K}_{4}[\operatorname{Fe}(\operatorname{CN})_{6}] & \longrightarrow & \operatorname{Fe}_{4}[\operatorname{Fe}(\operatorname{CN})_{6}]_{3} + 12\operatorname{K}^{+} \\ & & \operatorname{Fe}^{2+} + \operatorname{KSCN} & \longrightarrow & \operatorname{No \ coloured \ solution} \\ & & \operatorname{Fe}^{3+} + 3\operatorname{KSCN} & \longrightarrow & \operatorname{Fe}(\operatorname{SCN})_{3} + 3\operatorname{K}^{+} \\ & & \operatorname{solution} \end{array} \end{array}$$

-

.

(V) Na2CO3 : Solvay process

42.

$$NH_4NO_2 + KOH \longrightarrow NH_3 \uparrow + KNO_2 + H_2O$$

$$(X) \qquad (Y) \qquad (Z) \qquad (Z) \qquad (Y) \qquad (Z) \qquad (Z) \qquad (X) \qquad (Y) \qquad (Z) \qquad (Z) \qquad (Y) \qquad (Z) \qquad (Y) \qquad (Z) \qquad (Y) \qquad$$





$$\begin{array}{ccc} BaCO_3 + K_2CrO_4 & \xrightarrow{H^+} & BaCrO_4 + 2K^+ + CO_3^{2-} \\ (A) & BaCO_3 + H_2SO_4 & \longrightarrow & BaSO_4 \downarrow + CO_2 \uparrow + H_2O \\ & & (C) \text{ white} \\ BaCO_3 + 2HCl & \longrightarrow & BaCl_2 + CO_2 \uparrow + H_2O \\ & & Clear \text{ sol.} \\ & & (D) \end{array}$$

$$\begin{array}{ccc} \operatorname{AgNO}_{3} & \stackrel{\Delta}{\longrightarrow} & \operatorname{Ag} + \operatorname{NO}_{2} + \frac{1}{2} \operatorname{O}_{2} \\ & \operatorname{NO}_{2} + \operatorname{H}_{2} \operatorname{O} & \longrightarrow & \operatorname{HNO}_{2} + \operatorname{HNO}_{3} \\ & \operatorname{X}_{3} \\ & \operatorname$$