Chapter 10

Principles of Qualitative Analysis

Solutions

1. Which among the following sulphates is insoluble in water?

(1) $CuSO_4$ (2) $CdSO_4$ (3) $PbSO_4$ (4) $Bi_2(SO_4)_3$

Sol. Answer (3)

$PbSO_4$ is insoluble in water.

2. Which compound will not give positive chromyl chloride test?

(1) $CuCl_2$ (2) $HgCl_2$ (3) $ZnCl_2$ (4) $C_6H_5NH_3^+Cl^-$

Sol. Answer (2)

$HgCl_2$ does not give chromyl chloride test.

3. Which of the following is not a preliminary test used to detect ions?

(1) Borax bead test (2) Flame test

(3) Brown ring test (4) Microcosmic salt bead test

Sol. Answer (3)

Brown ring test is not a preliminary test.

4. When $K_2Cr_2O_7$ crystals are heated with concentrated HCl, the gas evolved is

(1) O_2 (2) Cl_2 (3) CrO_2Cl_2 (4) HCl

Sol. Answer (2)

When HCl is treated with $K_2Cr_2O_7$, Cl_2 goes is evolved.

5. The brown ring test for NO_3^- is due to the formation of the complex ion with formula as

(1) $[Fe(H_2O)_6^{2+}$ (2) $[Fe(NO(CN)_5]^{2-}$

(3) $[Fe(H_2O)_5NO]^{2+}$ (4) $[Fe(H_2O)(NO)_5]^{2+}$

Sol. Answer (3)

The Brown ring test for NO_3^- is due to the formation of the complex ion $[Fe(H_2O)_5NO]^{2+}$.

6. A salt which gives CO_2 with hot H_2SO_4 and also decolourizes acidified $KMnO_4$ on warming is

(1) HCO_3^- (2) CO_3^{2-} (3) Oxalate ion (4) Acetate ion

Sol. Answer (3)

$$\begin{matrix}COO^- \\ | \\ COO^-\end{matrix} + H_2SO_4 \longrightarrow CO_2$$

It also decolourises $KMnO_4$.

7. An aqueous solution of $FeSO_4.Al_2(SO_4)_3$ and chrome alum is heated with excess of Na_2O_2 and filtered. The materials obtained are

(1) A colourless filtrate and a green residue (2) A yellow filtrate and a green residue

(3) A yellow filtrate and a brown residue (4) A green filtrate and a brown residue

Sol. Answer (3)

8. When concentrated H_2SO_4 is added to dry KNO_3, brown fumes evolve. These brown fumes are of

(1) SO_2 (2) SO_3 (3) NO (4) NO_2

Sol. Answer (4)

The brown fumes are of NO_2.

9. A violet colour is obtained on adding Cl_2 water in solution of potassium halide in presence of chloroform and on adding excess of Cl_2 water, violet colour disappears and colourless solution appears. The test shows the presence of

(1) Iodide ion (2) Bromide ion

(3) Chloride ion (4) Iodide and bromide ion

Sol. Answer (1)

$2KI + Cl_2 \longrightarrow 2KCl + I_2$.

10. A substance on treatment with dil H_2SO_4 liberates a colourless gas which produces

(i) Turbidity with baryta water and (ii) turns acidified dichromate solution green.

The reaction indicates the presence of

(1) $C_2O_3^{2-}$ (2) S^{2-} (3) SO_3^{2-} (4) NO_2^-

Sol. Answer (3)

SO_2 produce turbidity in Baryta water and turns acidified dichromate solution green.

11. A mixture is known to contain NO_3^- and NO_2^- before performing ring test for NO_3^-. The aq. solution should be made free of NO_2^-. This is done by heating with

(1) NH_4Cl (2) Zn dust (3) Conc. HNO_3 (4) Dil. HNO_3

Sol. Answer (1)

Fact.

12. $PbCl_2 + KI \rightarrow \underset{\text{Yellow ppt}}{[A]} + KCl$

$$\underset{\text{Yellow ppt}}{[A]} + \underset{\text{excess}}{KI} \longrightarrow \underset{\text{soluble}}{[B]}$$

Compound [A] and [B] are

(1) PbI_4 and $K_2[PbI_4]$ respectively (2) $K_2[PbI_4]$ and PbI_4 respectively

(3) PbI_2 and $K_2[PbI_4]$ respectively (4) PbI_2 and $K_2[PbI_2]$ respectively

Sol. Answer (3)

$$PbCl_2 + KI \longrightarrow \underset{\text{yellow ppt}}{PbI_2} + KCl$$

$$PbI_2 + KI \longrightarrow K_2[PbI_4]$$

13. The reagent NH_4Cl and aqueous NH_3 precipitate.

(1) Ca^{2+} (2) Al^{3+} (3) Mg^{2+} (4) Zn^{2+}

Sol. Answer (2)

Conc. of OH^- exceeds K_{sp} of $Al(OH)_3$.

14. Mark the correct statement out of the following.

(1) Group I basic radicals precipitate as chlorides

(2) Group IV basic radicals precipitate as sulphides

(3) Group V basic radicals precipitate as carbonates

(4) All of the above statements are correct

Sol. Answer (4)

Group I basic radical (Pb^{2+}, Ag^+, Hg_2^{2+}) precipitate as chloride group IV basic radicals $(Ni^+, Co^{2+}, Mn^{2+}, Zn^{2+})$ precipitate as sulphide group V basic radicals (Ba^{2+}, Sr^{2+}, Co^+) precipitate as carbonate.

15. Which of the following sulphides does not dissolve in hot dilute HNO_3?

(1) HgS (2) CuS (3) PbS (4) CdS

Sol. Answer (1)

HgS does not dissolve in hot dilute HNO_3.

16. The only cations present in slightly acidic solution are Fe^{3+}, Zn^{2+} and Cu^{2+}. The reagent that when added in excess to this solution would identify and separate Fe^{3+} in one step is

(1) 2 M HCl (2) 6 M NH_3 (3) 6 M NaOH (4) H_2S gas

Sol. Answer (2)

Zn and Cu can form soluble complexes with NH_3.

17. In the fifth group $(NH_4)_2CO_3$ is added to precipitate out the carbonates, we do not add Na_2CO_3 because

(1) $MgCO_3$ is soluble in Na_2CO_3

(2) Na_2CO_3 increases the solubility of fifth group carbonates

(3) $MgCO_3$ will also be precipitated out in fifth group

(4) Na_2CO_3 will decrease the solubility product of $MgCO_3$

Sol. Answer (3)

$MgCO_3$ will also be precipitated out in fifth group.

18. White substance dissolves in hot water. A black precipitate appears on passing H_2S gas in its aqueous solution. The black precipitate dissolves in hot HNO_3. A white precipitate is obtained on adding concentrated H_2SO_4 in its solution. This white precipitate is of

(1) $BaSO_4$ (2) $SrSO_4$ (3) $PbSO_4$ (4) $CdSO_4$

Sol. Answer (3)

Black precipitates are of PbS which are soluble in hot HNO_3. Precipitate of $PbSO_4$ is white.

19. A salt on treatment with dilute HCl gives a pungent smelling gas and a yellow precipitate. The salt gives green flame when tested. The solution gives a yellow precipitate with potassium chromate. The salt is

(1) $NiSO_4$ (2) BaS_2O_3 (3) PbS_2O_3 (4) $CuSO_4$

Sol. Answer (2)

The salt is BaS_2O_3, $BaCrO_4$ is yellow coloured.

20. Which of the following statement is correct?

(1) Fe^{2+} gives brown colour with ammonium thiocyanate

(2) Fe^{2+} gives blue precipitate with potassium ferricyanide

(3) Fe^{3+} gives brown colour with potassium ferrocyanide

(4) Fe^{3+} gives red colour with potassium ferrocyanide

Sol. Answer (2)

$$Fe^{2+} + K_3Fe(CN)_6 \longrightarrow \underset{\text{Turnbull's Blue}}{KFe[Fe(CN)_6]}$$

21. When H_2S is passed through an ammonical salt solution (x), a white precipitate is obtained. The (x) can be a

(1) Cobalt salt (2) Nickel salt (3) Manganese salt (4) Zinc salt

Sol. Answer (4)

White precipitate is of ZnS.

22. The ion most difficult to remove as precipitate is

(1) Ag^+ (2) NH_4^+ (3) Fe^{2+} (4) Co^{2+}

Sol. Answer (2)

All most all salt of NH_4^+ are soluble.

23. Which of the following white ppts are insoluble in NH_3?

(1) AgCl (2) Hg_2Cl_2 (3) $PbCl_2$ (4) All of these

Sol. Answer (3)

$PbCl_2$ is insoluble in NH_3.

24. The oxidation state of Fe in its brown ring complex is

(1) +1 (2) +2 (3) +3 (4) +4

Sol. Answer (1)

$[Fe(H_2O)_5NO]^{2+}$

25. Choose the correct pair regarding solubility

(1) CuS < MnS (2) CoS > ZnS (3) CdS > NiS (4) CuS > ZnS

Sol. Answer (1)

Mn^{2+} belong with 4^{th} group.

26. Strontium sulphate is mixed with conc. HCl and flame test is performed. The colour of flame is

(1) Yellow (2) Violet (3) Green (4) Crimson Red

Sol. Answer (4)

Strontium impart characteristics crimson red colour.

27. The white precipitate of which salt turn black with ammonia solution

(1) $PbCl_2$ (2) Hg_2Cl_2 (3) AgCl (4) All of these

Sol. Answer (2)

$Hg_2Cl_2 + 2NH_3 \longrightarrow [H_2N \cdot HgCl + Hg]$

28. $Ag^+ + CN^- \longrightarrow A(ppt) \xrightarrow[Excess]{CN^-} B$

Select the correct statement.

(1) Colour of compound A is yellow (2) Compound B are a black precipitates

(3) Colour of compound A is red (4) B is $[Ag(CN)_2]^-$

Sol. Answer (4)

$$Ag^+ + CN^- \rightarrow \underset{(White)}{AgCN\downarrow} + CN^- \rightarrow [Ag(CN)_2]^-$$

29. I $Sb^{3+} + H_2S \longrightarrow A$

II $A + \underset{(warm\ conc)}{HCl} \longrightarrow$

In which of the following reaction precipitation occurs?

(1) I only (2) II only (3) Both I and II (4) Neither I nor II

Sol. Answer (1)

$$Sb^{3+} + H_2S \rightarrow Sb_2S_3\downarrow + HCl$$

30. $Fe^{+3} \xrightarrow{NH_4OH} A \xrightarrow{HCl} B \xrightarrow{K_4[Fe(CN)_6]} C$

$FeCl_3 \xrightarrow{KCNS} D$

Which of the following is correct?

(1) A are brownish red precipitates (2) C formed has blue colour

(3) Compound D is blood red in colour (4) All of these

Sol. Answer (4)

A = $Fe(OH)_3$, B = $FeCl_3$, C = $Fe_4[Fe(CN)_6]_3$

31. The gas produced in the reaction given below at 25°C is

$$Na_2C_2O_4 + \underset{(conc)}{H_2SO_4} \longrightarrow$$

(1) SO_2 only (2) CO_2 only (3) CO_2 and CO mixture (4) Na_2SO_4

Sol. Answer (3)

CO_2 and CO.

32. The colour of the solution in product of the given reaction is

$$CH_3COONa + FeCl_3 + H_2O \longrightarrow \underset{(Neutral)}{\quad}$$

(1) Reddish Brown (2) Yellow (3) Black (4) Green

Sol. Answer (1)

Colour is reddish brown due to formation of $[Fe_3(OH)_2(CH_3COO)_6]^+$.

33. Which of the following statement is incorrect?

(1) Colour of lead sulphide (PbS) precipitate is yellow.

(2) Colour of lead iodide precipitate is yellow.

(3) Colour of lead sulphide (PbS) precipitate is black.

(4) $Ag^{(+)}$ form black precipitate with H_2S and hot concentrated HNO_3 decomposed the precipitate.

Sol. Answer (1)

PbS is black coloured ppt.

34. Most of salts react with acid to liberate gas characteristic of that radical. Which of following acidic radicals are detected by conc. H_2SO_4?

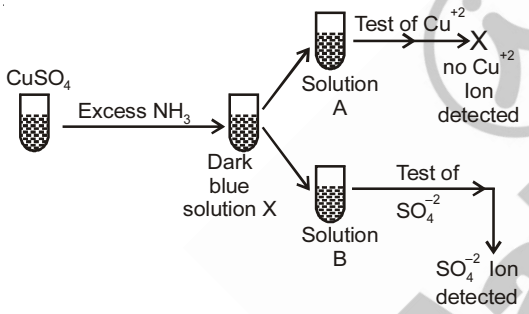
(1) Sulphate and phosphate (2) Sulphide and sulphite ion

(3) Carbonate and acetate ion (4) Nitrate and iodide ion

Sol. Answer (4)

Nitrite and iodide ion treated with conc. H_2SO_4 and produce NO_2 and I_2.

35.



Which of the following is correct regarding the above experiment?

(1) Dark blue solution X contain copper in Cu^{+1} form

(2) Experiment was wrongly conducted so Cu^{+2} was not detected.

(3) The dark blue solution X contained complex salt of Cu^{+2}.

(4) $CuSO_4$ does not react with NH_3 and the reaction does not take place.

Sol. Answer (3)

X is $[Cu(NH_3)_4]^{2+}$ so Cu^{2+} is not detected.

36. Which of the following is correct statement?

(1) Cu^+ can undergo disproportionation in aqueous solution

(2) $Cu^{2+}(aq)$ is more stable than $Cu^+(aq)$

(3) Hydration energy of Cu^{2+} is more negative than Cu^+

(4) All of these

Sol. Answer (4)

In aqueous solution $Cu^+ \rightarrow Cu^{2+} + Cu$

37. Which of the following solution not form precipitate when H_2S is pass through solution?

(1) Antimony(III) chloride solution (2) Barium chloride solution

(3) Antimony(V) chloride solution (4) Cadmium acetate solution

Sol. Answer (2)

(ii) $BaCl_2 + H_2S \rightarrow$ No precipitate

38. The colour of the precipitate in the following reaction is

$2NaOH + Hg_2(NO_3)_2 \longrightarrow Hg_2O + 2NaNO_3 + H_2O$

(1) Blue (2) Black (3) Yellow (4) Red

Sol. Answer (2)

Hg_2O is black.

39. A salt X when treated with dilute acid gives a colourless gas which on coming in contact with air forms reddish brown gas. Identify the salt X.

(1) Na_2CO_3 (2) $NaNO_2$ (3) CH_3COONa (4) NaCl

Sol. Answer (2)

40. Which of the following is insoluble in aqua regia?

(1) HgS (2) NiS (3) CoS (4) Ag_2S

Sol. Answer (4)

Ag_2S insoluble in aqua ragia.

41. Salt + $AgNO_3 \longrightarrow$ Yellow ppt. (A)

A is almost insoluble in concentrated ammonia solution. Identify the anion in the salt.

(1) Cl^- (2) S^{-2} (3) I^- (4) CH_3COO^-

Sol. Answer (3)

AgI is yellow and insoluble in ammonia.

42. Experiment of detection of S^{-2} is given below in alkaline medium

$$S^{2-} + [Fe(CN)_5NO]^{2-} \longrightarrow \text{product}$$

Select the correct statement about the experiment.

(1) Colour of the complex compound formed in product is purple violet

(2) Oxidation number of Fe, in complex compound formed in product is +3

(3) IUPAC name of complex compound formed in product is pentacyanonitro ferrate(I) ion

(4) Colour of complex formed is yellow

Sol. Answer (1)

$$\overset{-2}{S} + [Fe(CN)_5NO]^{2-} \longrightarrow [Fe(CN)_5(NOS)]^{4-}$$

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Violet colour

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