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Exercise-4

1. Write the probable colour of the following salts?(a) Ferrous salts(b) Ammonium salts(c) Cupric salts(d) Calcium salts(e) Aluminium saltsSolution:

- (a) Ferrous salts Light green
- (b) Ammonium salts Colourless
- (c) Cupric salts Blue
- (d) Calcium salts Colourless
- (e) Aluminium salts Colourless
- 2. Name:
- (a) a metallic hydroxide soluble in excess of NH₄OH.
- (b) a metallic oxide soluble in excess of caustic soda solution.
- (c) a strong alkali.
- (d) a weak alkali.
- (e) Two colourless metal ions.
- (f) Two coloured metal ions.
- (g) a metal that evolves a gas which burns with a pop sound when boiled with alkali solutions.
- (h) Two bases which are not alkalis but dissolve in strong alkalis.
- (i) a coloured metallic oxide which dissolves in alkalis to yield colourless solutions.
- (\mathbf{j}) a colourless cation not a representative element.

Solution:

(a) Cu(OH)₂ (b) ZnO (c) NaOH (d) NH₄OH (e) Na⁺, Ca²⁺ (f) Fe²⁺, Mn²⁺ (g) Aluminium (h) Zn(OH)₂ and Al(OH)₃ (i) PbO (j) Ammonium ion

3. Write balanced equations for Q.2 (g) and (i). Solution:

For 2(g): $2Al + 2NaOH + 2H_2O \rightarrow 2NaAlO_2 + 3H_2$ (Hot a conc.) Sodium meta aluminate (Colourless)

For 2(i):



 $\begin{array}{c} PbO + 2NaOH \rightarrow Na_2PbO_2 + H_2O \\ (Yellow) & Sodium \ Plumbate \\ (Colourless, \ soluble) \end{array}$

4. What happens when ammonia solution is added first dropwise and then in excess to the following solutions:

(i) CuSO₄ (ii) ZnSO₄ (iii)FeCl₃ Write balanced equations for these reactions. Solution:

(i) $CuSO_4 + 2NH_4OH$ $Cu(OH)_2 \downarrow$ (NH₄)2SO₄ +Blue Pale blue ppt. colourless in solution With excess of NH4OH, ppt. dissolves $Cu(OH)_2 + (NH_4)_2SO_4 + 2NH_4OH$ $[Cu(NH_3)_4]SO_4 + 4H_2O$ Tetrammine excess Copper(II) sulphate (ii) $ZnSO_4 + 2NH_4OH$ \rightarrow $Zn(OH)_2 \downarrow$ + $(NH_4)_2SO_4$ Colourless white, gelatinous ppt Colourless With excess of NH₄OH, ppt. dissolves $Zn(OH)_2 + (NH_4)_2SO_4 + 2NH_4OH$ $[Zn(NH_3)_4]SO_4 + 4H_2O$ Tetrammine zinc(II) sulphate (excess) (colourless) (iii) FeCl₃ $3NH_4OH \rightarrow Fe(OH)_3 \downarrow$ 3NH₄Cl ++Reddish brown ppt. Colourless in solution Yellow solution 5. What do you observe when caustic soda solution is added to the following solution: first a little

and then in excess. (a) FeCl₃, (b) ZnSO₄, (c) $Pb(NO_3)_2$, (d) CuSO₄? Write balanced equations for these reactions. Solution: Caustic soda is Sodium hydroxide (NaOH) (a) FeCl₃ + $3NaOH \rightarrow$ $Fe(OH)_3 \downarrow$ +3NaCl Yellow solution Reddish brown ppt. Colourless in solution In excess of alkali, the reddish brown ppt. of Fe(OH)₃ remains insoluble. (b) $ZnSO_4 + 2NaOH$ $Zn(OH)_2 \downarrow$ Na₂SO₄ \rightarrow +Colourless white, gelatinous ppt Colourless



With excess of alkali, ppt. dissolves $Zn(OH)_2 + 2NaOH \rightarrow Na_2ZnO_2 + 2H_2O$ (excess) Sodium Zincate (colourless)

(c) $Pb(NO_3)2 + 2NaOH \rightarrow Pb(OH)_2 \downarrow + 2NaNO_3$ White ppt. (colourless) In excess of alkali, white precipitate of $Pb(OH)_2$ becomes soluble. $Pb(OH)_2 + 2NaOH \rightarrow Na_2PbO_2 + 2H_2O$ (excess) Sodium Plumbate (colourless)

6. Name the chloride of a metal which is soluble in excess of ammonium hydroxide. Write equation for the same. Solution:

Zinc chloride (ZnCl₂) is soluble in excess of ammonium hydroxide. ZnCl₂ + 2NH₄OH \rightarrow Zn(OH)₂ \downarrow + 2NH₄Cl Colourless White gelatinous ppt. With excess of NH₄OH ppt. dissolves Zn(OH)₂ + 2NH₄Cl + 2NH₄OH (excess) \rightarrow [Zn(NH₃)₄]Cl₂ + 4H₂O Tetrammine zinc (II) chloride colourless

7. On adding dilute ammonia solution to a colourless solution of a salt, a white gelatinous precipitate appears. This precipitate however dissolves on addition of excess of ammonia solution. Identify (choose from Na, Al, Zn, Pb, Fe)
(a) Which metal salt solution was used?
(b) What is the formula of the white gelatinous precipitate obtained? Solution:

(a) ZnCl₂(b) Zn(OH)₂

8. Name:

(a) A yellow monoxide that dissolves in hot and concentrated caustic alkali.

(b) A white, insoluble oxide that dissolves when fused with caustic soda or caustic potash.

(c) A compound containing zinc in the anion.

Solution:

(a) PbO



- (b) ZnO
- (c) K_2ZnO_2
- 9. Select the correct answers:
- (a) Colour of an aqueous solution of copper sulphate is
- (i) Green (ii) Brown
- (iii) Blue (iv) Yellow

(b) Colour of the precipitate formed on adding NaOH solution to iron (II) sulphate solution is

- (i) White (ii) Brown
- (iii) Green (iv) Pale blue
- (c) A metal which produces hydrogen on reacting with alkali as well as with acid.
- (i) Iron (ii) Magnesium
- (iii) Zinc (iv) Copper
- (d) The salt solution which does not react with ammonium hydroxide is
- (i) Calcium nitrate (ii) Zinc nitrate
- (iii) Lead nitrate (iv) Copper nitrate

Solution:

(a) (iii) Aqueous solution of copper sulphate is blue.

- (b) (iii)
- $FeSO_4 + 2NaOH \rightarrow Fe(OH)_2 \downarrow + Na_2SO_4$ (Dirty green, gelatinous ppt.) (Colourless)

(c) (iii)

- $Zn + 2NaOH \rightarrow Na_2ZnO_2 + H_2$ Sodium zincate (Colourless) $Zn + HCl \rightarrow ZnCl_2 + H_2$
- (d) (i) Calcium nitrate

The salt solution which does not react with ammonium hydroxide is calcium nitrate.

10. What do you observe when freshly precipitated aluminum hydroxide reacts with caustic soda solution? Give balanced equation. Solution:

When freshly precipitated aluminum hydroxide reacts with caustic soda solution, a white salt of sodium meta aluminate is obtained.

 $\begin{array}{rcl} Al(OH)_3 + NaOH & \rightarrow & NaAlO_2 + 2H_2O \\ & & Sodium \ meta \ aluminate \end{array}$

11. You are provided with two reagent bottles marked A and B. One of which contains NH₄OH solution and the other contains NaOH solution. How will you identify them by a chemical test? Solution:

Reagent bottles A and B can identified by using calcium salts such as $Ca(NO_3)_2$. On adding NaOH to $Ca(NO_3)_2$, a white precipitate Ca (OH) 2 is formed which is sparingly soluble in



excess of NaOH. Ca(NO₃)₂ + 2NaOH \rightarrow Ca(OH)₂ + 2NaNO₃

On the other hand, addition of NH_4OH to calcium salts, no precipitation of $Ca(OH)_2$ is seen even with addition of excess of NH_4OH because the concentration of OH^- ions from the ionization of NH_4OH is so low that it cannot precipitate the hydroxide of calcium.

Thus, the reagent bottle which gives white precipitate is NaOH and the other one should contain NH₄OH.

12. Distinguish by adding: sodium hydroxide solution and ammonium hydroxide solution to

- (a) Calcium salt solution and lead salt solution
- (b) Lead nitrate solution and zinc nitrate solution
- (c) Copper salt solution and ferrous salt solution
- (d) Fe(II) salt solution and Fe(III) salt solution
- (e) Ferrous nitrate and lead nitrate

Solution:

(a) Sodium hydroxide and ammonium hydroxide on reaction with calcium salt gives a milky white precipitate Ca(OH)₂, while that of with lead salt solution it gives chalky white precipitate Pb(OH)₂.
(b) Sodium hydroxide and ammonium hydroxide on reaction with lead salt gives brown coloured precipitate, and with zinc it forms white gelatin like precipitate.

(c) Sodium hydroxide and ammonium hydroxide on reaction with Copper salt gives pale blue coloured precipitate, and with ferrous salt solution it forms dirty green coloured precipitate.

(d) Sodium hydroxide and ammonium hydroxide on reaction with Fe(II) salt gives dirty green coloured precipitate, while that of with Fe(III) salt solution it forms reddish brown insoluble precipitate.

(e) Ammonium hydroxide on reaction with lead nitrate gives a chalky white insoluble precipitate, and with ferrous nitrate will not give any precipitation.

13. How will you distinguish lead carbonate and zinc carbonate in solution? Solution:

They can be distinguished by dissolving it dilute nitric acid and then with ammonium hydroxide in excess.

When lead carbonate is dissolved in dilute nitric acid and then ammonium hydroxide is added to it. A white precipitate is formed which is insoluble in excess of ammonium hydroxide.

Whereas, when zinc carbonate is dissolved in dilute nitric acid and then ammonium hydroxide is added to it. A white precipitate is formed which is soluble in excess of ammonium hydroxide.

14. What is observed when hot concentrated caustic soda solution is added to (a) Zinc(b) Aluminium? Write balanced equations.Solution:

The balanced equations are as follows: (a) $Zn + 2NaOH \rightarrow Na_2ZnO_2 + H_2$ (b) $2Al + 2NaOH + 2H_2O \rightarrow 2Na_2AlO_2 + 3H_2$



15. (a) What do you understand by amphoteric oxide?

(b) Give the balanced equations for the reaction with two different amphoteric oxides with a caustic alkali.

(c) Name the products formed.

Solution:

- (a) Amphoteric oxides are compounds which react with both acids and alkalis to form salt and water.
- (b) $ZnO + 2NaOH \rightarrow Na_2ZnO_2 + H_2O$

 $Al_2O_3 + 2NaOH \rightarrow 2NaAlO_2 + H_2O$

(c) Sodium zincate and Aluminium zincate are the products formed.

16. Write balanced equations for the following conversions:

(a)
$$ZnSO_4 \xrightarrow{A} Zn(OH)_2 \xrightarrow{B} Na_2ZnO_2$$

(b) $CuSO_4 \xrightarrow{A} Cu(OH)_2 \xrightarrow{B} [Cu(NH_3)_4]SO_4$

Solution:

- (a) $ZnSO_4$ \xrightarrow{NaOH} $Zn(OH)_2 + Na_2SO_4$ $Zn(OH)_2$ \xrightarrow{NaOH} $Na_2ZnO_2 + 2H_2O$
- (b) $\operatorname{CuSO_4} \xrightarrow{2\mathrm{NH_4OH}} \operatorname{Cu(OH)_2} + (\mathrm{NH_4})_2\mathrm{SO_4}$ $\operatorname{Cu(OH)_2} + (\mathrm{NH4})_2\mathrm{SO_4} + 2\mathrm{NH_4OH} \longrightarrow [\operatorname{Cu(NH_3)_4}]\mathrm{SO_4} + 4\mathrm{H_2O}$