STUDY OF COMPOUNDS & ANALYTICAL CHEMISTRY SOLVED EXAMPLE

SpeedLabs
Assisted Practice | Expert Guidance | Personalized Insights
"An Innovative Practice Methodology by IITians."

1. (i) State one condition under which chlorine and hydrogen react to form hydrogen chloride gas.
(ii) Name the gas which is a covalent compound but becomes electrovalent when dissolved in water?
(iii) For which gas, ammonia fountain experiment can be used?

Ans. (i) Presence of diffused sunlight.
(ii) Hydrogen chloride (HCl) gas.
(iv) Hydrogen chloride gas.

2. Water for drinking purpose and in swimming pools, is treated with chlorine. Give reason.

Ans. Water for drinking purpose and in swimming pools is treated with chlorine because it sterilizes the water. Due to its strong oxidizing action, it destroys bacteria, fungus and other microorganisms.

3. Sodium is not used to prepare hydrogen from hydrochloric acid (or any other acid). Why?

Ans. Sodium is not used to prepare hydrogen from acids because sodium metal is highly reactive. So, the reaction with acids is much exothermic and there are more chances of explosion. It is also very dangerous to handle sodium metal.

4. Dilute hydrochloric acid cannot be concentrated by distilling (boiling) the dilute acid. Why?

Ans. When dilute hydrochloric acid is distilled, a constant boiling mixture containing 20 – 24% of hydrochloric acid distills over unchanged at 760 mm Hg pressure. This constant boiling mixture cannot be separated into its constituents by simply distilling.

5. When the stopper of a bottle full of hydrogen chloride gas is opened there are fumes in the air?

Ans. This is because hydrogen chloride gas has an affinity for water, hence, when the stopper is opened it immediately reacts with water vapour present in the atmosphere which leads to the formation of fumes.

6. Hydrogen chloride gas cannot be dried over quick time. Why?

Ans. Because quick lime is basic in nature and combines with moist hydrogen chloride gas forming calcium chloride.

7. State three uses of hydrochloric acid.

Ans. (i) It is used in the manufacture of silver chloride, which is used widely in photography.
(ii) It is used in the manufacture of dyes, drugs and paints.
(iii) It is used for cleaning metal surface before painting, electroplating, galvanising, soldering etc.

8. (i) When moist chlorine reacts with hydrogen sulphide, two products are formed :
(a) A gas which fumes in moist air; and
(b) A yellow solid.
Name these products.
(ii) What type of reaction is taking place when chlorine acts as a bleaching agent?

Ans. (i) (a) Hydrogen chloride gas (b) Sulphur

(ii) Oxidation reaction.

9. Nitrous oxide supports combustion more vigorously than air does. Give reason.

Ans. The percentage of oxygen present in nitrous oxide is more than air and it readily decomposes to form oxygen, which supports combustion. Nitrous oxide contains 36-37% of available oxygen, while air contains 21% of oxygen.

10. Nitrogen obtained from air is denser as compared to nitrogen obtained from chemicals. Why?

Ans. Nitrogen obtained from air contains traces of inert gases and therefore, it is denser as compared to chemical nitrogen.

11. Aluminium does not react with nitric acid of any concentration. Why?

Ans. Aluminum metal is not attacked by nitric acid of any concentration because of the thin and unreactive protective layer of aluminum oxide formed on the metallic surface due to the reaction of aluminium metal with oxygen of air.

12. The mixture of nitrogen and hydrogen gases entering the catalyst chamber must be pure. Why?

Ans. The mixture of nitrogen and hydrogen gases entering the catalyst chamber must be pure, because the presence of carbon dioxide, carbon monoxide and traces of sulphur compound poison the catalyst. Therefore, the removal of these catalyst poisons from nitrogen and hydrogen is very essential.

13. Nitric acid stains the skin yellow. Give reason.

Ans. Dilute nitric acid reacts with the proteins of the skin and forms a yellow compound called xanthoproteic acid. Hence, the skin becomes yellow. Cone, nitric acid causes blisters on the skin and is highly corrosive.

14. Give examples of the use of sulphuric acid as:
(i) An electrolyte in everyday use (ii) A non-volatile acid (iii) An oxidizing agent

Ans. (i) In lead accumulators or in storage batteries.
(ii) In the manufacture of other acids like nitric acid, HCl and phosphoric acid.
(iii) For cleaning metals before enameling, electroplating and galvanizing, as a pickling agent.

15. Why concentrated sulphuric acid is called the “oil of vitriol”?

Ans. Concentrated sulphuric acid is called “Oil of vitriol” because of its oily appearance and the fact that it is present in vitreous or glassy substances like ferrous sulphate, alum, etc.

16. What are the use of sodium and ammonium hydroxide in analytical chemistry?

Ans. Sodium hydroxide and ammonium hydroxide are used in analytical chemistry to precipitate insoluble metal hydroxide.

17. Three test tubes contain calcium nitrate solution, zinc nitrate solution and lead nitrate solution respectively. Each solution is divided into two portions. Describe the effect of:
(i) Adding sodium hydroxide solution to each portion in turn till it is in excess.
(ii) Adding ammonium hydroxide to each portion till it is in excess.

Ans.

Solution	Effect of adding sodium hydroxide solution		Effect of adding ammonium hydroxide solution	
	Small amount	In excess	Small amount	In excess
Calcium nitrate	A white precipitate.	No change.	No precipitate.	No change.
Zinc nitrate	A white ppt.	White ppt. dissolves, gives a colourless solution.	A white ppt.	A white ppt. dissolves to give a colourless solution.
Lead nitrate	A white ppt.	White ppt. dissolves to give a colourless solution.	A white ppt.	No change.

18. (i) What are amphoteric metals? Describe their reactions with hot caustic alkali.

(ii) What are amphoteric oxides? Why these oxides react with NaOH?

Ans.

(i) Those metals which react with both alkalies as well as acids are called amphoteric metals e.g., Zn, Sn, Al etc. They react with caustic alkalies like NaOH, KOH on heating and liberates H_2 gas. e.g.,

$$\underset{\text{Zinc}}{Zn} + \underset{\text{(Conc.)}}{2NaOH\,(aq.)} \longrightarrow \underset{\text{Sodium zincate}}{Na_2ZnO_2} + H_2\uparrow$$

$$\underset{\text{Zinc}}{Zn} + \underset{\text{(Conc.)}}{2KOH\,(aq.)} \longrightarrow \underset{\text{Potassium zincate}}{K_2ZnO_2} + H_2\uparrow$$

$$\underset{\text{Tin}}{Sn} + \underset{\text{(Conc.)}}{2NaOH\,(aq.)} + H_2O \longrightarrow \underset{\text{Sodium stannate}}{Na_2SnO_3} + 2H_2\uparrow$$

$$\underset{\text{Tin}}{Sn} + \underset{\text{(Conc.)}}{2KOH\,(aq.)} + H_2O \longrightarrow \underset{\text{Potassium stannate}}{K_2SnO_3} + 2H_2\uparrow$$

$$\underset{\text{Aluminium}}{2Al} + 2NaOH + 2H_2O \longrightarrow \underset{\text{Sodium aluminate}}{2NaAlO_2} + 3H_2\uparrow$$

$$\underset{\text{Aluminium}}{2Al} + 2KOH + 2H_2O \longrightarrow \underset{\text{Potassium aluminate}}{2KAlO_2} + 3H_2\uparrow$$

(ii) Those oxides which react with both acids as well as bases are called amphoteric oxides. Oxides of amphoteric metals like Zn, Sn, Al, etc. react With strong alkalies like NaOH to form complex salt and water, e.g.,

$$\underset{\text{Zinc oxide}}{ZnO} + \underset{\text{(Conc.)}}{2NaOH\,(aq.)} \longrightarrow \underset{\text{Sodium zincate}}{Na_2ZnO_2} + H_2O$$

$$\underset{\text{Tin oxide}}{SnO_2} + \underset{\text{(Conc.)}}{2NaOH\,(aq.)} \longrightarrow \underset{\text{Sodium stannate}}{Na_2SnO_3} + H_2O$$

$$\underset{\text{Aluminium oxide}}{Al_2O_3} + \underset{\text{(Conc.)}}{2NaOH\,(aq.)} \longrightarrow \underset{\text{Sodium aluminate}}{2NaAlO_2} + H_2O$$

19. What do you observe when caustic soda solution is added to the following solutions first a little and then in excess :

(i) $FeCl_3$ (ii) $Al_2(SO_4)_3$ (iii) $ZnSO_4$ (iv) $Pb(NO_3)_2$ (v) $CuSO_4$

Also give balanced chemical equations.

Ans.

(i) A reddish brown ppt. of ferric hydroxide is obtained which is insoluble in excess of caustic soda solution.

$$FeCl_3 + 3NaOH \longrightarrow \underset{\text{Ferric hydroxide (Reddish brown ppt.)}}{Fe(OH)_3\uparrow} + 3NaCl$$

(ii) A gelatinous white ppt. of aluminium hydroxide is obtained which is soluble in excess of caustic soda solution.

$$Al_2(SO_4)_3 + 6NaOH \longrightarrow \underset{\text{Aluminium hydroxide (White, gelatinous ppt.)}}{2Al(OH)_3\downarrow} + 3Na_2SO_4$$

$$Al(OH)_3 + \underset{\text{(Excess)}}{NaOH} \longrightarrow \underset{\text{Sodium meta-aluminate (Soluble)}}{NaAlO_2} + 3Na_2SO_4$$

(iii) A gelatinous white ppt. of zinc hydroxide is obtained which is soluble in excess of caustic soda solution.

$$ZnSO_4 + 2NaOH \longrightarrow \underset{\text{Zinc hydroxide (White gelatinous ppt.)}}{Zn(OH)_2\downarrow} + Na_2SO_4$$

$$Zn(OH)_2 + \underset{\text{(Excess)}}{2NaOH} \longrightarrow \underset{\text{Soluble (Colourless)}}{NaZnO_2} + 22H_2O$$

(iv) A white ppt. of lead (II) hydroxide is obtained which is soluble in excess of caustic soda solution.

$$Pb(NO_3)_2 + 2NaOH \longrightarrow \underset{\text{Lead hydroxide (White ppt.)}}{Pb(OH)_2\downarrow} + 2NaNO_3$$

$$Pb(OH)_2 + \underset{\text{(Excess)}}{2NaOH} \longrightarrow \underset{\text{Sodium plumbite (Colourless) (Soluble)}}{Na_2PbO_2} + 2H_2O$$

(v) A pie blue ppt. of copper (II) hydroxide is obtained which is insoluble in excess of caustic soda solution.

$$CuSO_4 + 2NaOH \longrightarrow \underset{\text{Copper (II) (hydroxide) (Pale blue ppt.)}}{Cu(OH)_2\downarrow} + Na_2SO_4$$

20. Sodium hydroxide solution is added to the solutions containing the ions mentioned in list X, Y gives the details of the precipitate. Match the ions with their coloured precipitates.

List X	List Y
(i) Pb^{2+}	A. Reddish brown
(ii) Fe^{2+}	B. White insoluble in excess
(iii) Zn^{2+}	C. Dirty green
(iv) Fe^{3+}	D. White soluble in excess
(v) Cu^{2+}	E. White soluble in excess
(iv) Ca^{2+}	F. Blue

Ans. (i) Pb^{2+} ⟶ White soluble in excess (ii) Fe^{2+} ⟶ Dirty green
(iii) Zn^{2+} ⟶ White soluble in excess (iv) Fe^{2+} ⟶ Reddish brown
(v) Cu^{2+} ⟶ Blue (vi) Ca^{2+} ⟶ White insoluble in excess.