WORKSHEET 2

Chapter 9 – Study of Compounds – Ammonia

A. How can you obtain ammonia gas from the following? Also, support your answer by chemical equations.

1. Magnesium
2. Calcium
3. Aluminium

B. On the basis of physical and chemical properties of ammonia, answer the following.

1. a. Of the two gases, ammonia and hydrogen chloride, which is more dense? Name the method of collection of this gas.
   b. Give one example of a reaction between the above two gases which produces a solid compound.
2. Write a balanced equation for a reaction in which ammonia is oxidized by
   a. a metal oxide
   b. a gas which is not oxygen.

C. Answer the following.

1. Name the substance used for drying ammonia.
2. Write an equation to illustrate the reducing nature of ammonia.
3. With reference to Haber's process for the preparation of ammonia, write the equation and the conditions required.
4. State what is observed when excess of ammonia is passed through an aqueous solution of lead nitrate.

D. Based on the chemical study of ammonia state the following.

1. a. Which feature of the ammonia molecule leads to the formation of the ammonium ion when ammonia dissolves in water?
   b. Name the other ion formed when ammonia dissolves in water.
   c. Give one test that can be used to detect the presence of the ion produced in b.
2. Write the equations for the following reactions which result in the formation of ammonia.
   a. A mixture of ammonium chloride and slaked lime is heated.
   b. Aluminium nitride and water.

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E. Answer these questions.

1. State two physical properties of ammonia which enable its separation from a mixture of NH_3, H_2 and N_2.
2. How is density of ammonia compared with air? Name two gases lighter than ammonia.
3. Name an industrial process which uses a catalyst, ammonia and oxygen as reactants.

ANSWERS

WORKSHEET 2

A. How can you obtain ammonia gas from the following? Also, support your answer by chemical equations.

1. Magnesium is burnt in nitrogen, so as to obtain magnesium nitride.

   $3Mg + N_2 \rightarrow Mg_3N_2 + heat$

   The magnesium nitride is treated with warm water, so as to obtain ammonia.

   $Mg_3N_2 + 6H_2O \rightarrow 3Mg(OH)_2 + 2NH_3$

2. Calcium is burnt in nitrogen, so as to obtain calcium nitride.

   $3Ca + N_2 \rightarrow Ca_3N_2 + heat.$

   The calcium nitride is treated with warm water, so as to obtain ammonia.

   $Ca_3N_2 + 6H_2O \rightarrow 3Ca(OH)_2 + 2NH_3$

3. Aluminium is burnt in nitrogen, so as to obtain aluminium nitride.

   $2Al + N_2 \rightarrow + 2AlN + heat$

   Aluminium nitride is treated with warm water, so as to obtain ammonia.

   $AlN + 3H_2O \rightarrow Al(OH)_3 + NH_3$

B. On the basis of physical and chemical properties of ammonia, answer the following.

1. a. Hydrogen chloride is more dense. It is collected by downward displacement of air.

   b. $NH_3 + HCl \rightarrow NH_4Cl$

2. a. $3CuO + 2NH_3 \xrightarrow{heat} 3Cu + 3H_2O + N_2$

   b. $8NH_3 + 3Cl_2 \rightarrow 6NH_4Cl + N_2$

C. Answer the following.

1. Quick lime
2. $3CuO + 2NH_3 \rightarrow 3Cu + 3H_2O + N_2$
3. $N_2 + 3H_2 \rightarrow 2NH_3 + heat$

   Catalyst: Finely divided Fe

   Promoter: Mo

   Temp.: 450–500 °C

   Pressure: 200–900 atm.

   Gases should be pure.

4. White precipitation occurs

D. Based on the chemical study of Ammonia state the following.

1. a. Tendency to donate lone pair of electron to H^+ to form ammonium ion.
   b. Hydroxyl ion, OH^-
   c. It turns red litmus to blue.
2. a. $2NH_4Cl + Ca(OH)_2 \rightarrow 2NH_3 + CaCl_2 + 2H_2O$
   b. $AlN + 3H_2O \rightarrow Al(OH)_3 + NH_3$

E. Answer these questions.

1. i. Ammonia liquefies at a pressure of 8 atmosphere and at –33 °C, but not hydrogen and nitrogen.
   ii. Ammonia is extremely soluble in water, but not hydrogen and nitrogen.
2. The vapour density of ammonia is 8.5 and that of air is 14.4.
   The two gases lighter than ammonia are (i) hydrogen (ii) helium.
3. The industrial process is called Ostwald's process for preparing nitric acid.