

Experiment 2

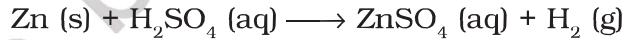
AIM

To study the following chemical reactions: (a) zinc with sulphuric acid; (b) precipitation reaction between aqueous solution of barium chloride and aqueous solution of sodium sulphate; and (c) thermal decomposition of ammonium chloride in an open container.

(a) Chemical reaction of zinc with sulphuric acid.

THEORY

Zinc metal reacts with dil. sulphuric acid and produces hydrogen gas.



This is an example of a single displacement reaction of a non-metal by a metal.

MATERIALS REQUIRED

Zinc metal granules, dil. sulphuric acid, red and blue litmus papers, test tube, and candle.

PROCEDURE

1. Take few zinc granules in a test tube.
2. Add about 10 mL of dil. sulphuric acid to zinc granule. Effervescence

Materials

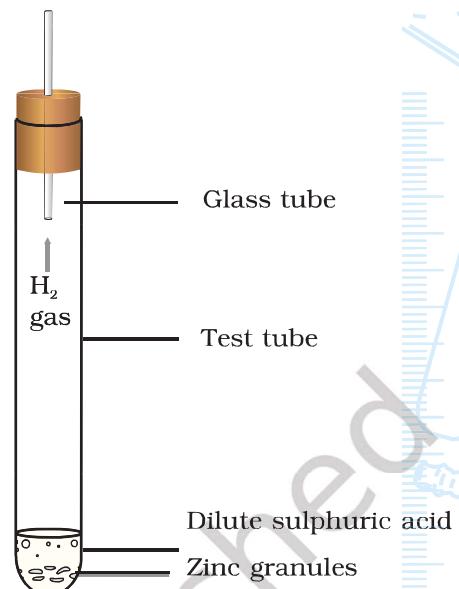


Fig. 2.1 : Reaction of zinc granules with dil. sulphuric acid

OBSERVATIONS



Sl. No.	Test	Activity	Observations
1.	Colour	Look at the colour of the gas liberated	
2.	Smell	Fan the gas gently towards your nose with your hand	
3.	Litmus test	Bring moist blue and red litmus papers near to the mouth of the test tube	
4.	Combustion test	Bring a lighted candle near to the mouth of the test tube	

RESULTS AND DISCUSSION



Infer from the observations about the nature of the gas liberated. Is it acidic or basic or neutral? Does it burn in air (or ignites exothermically) to produce water?

PRECAUTIONS



- Clean zinc granules should be used.
- Care should be taken while pouring the dil. sulphuric acid in the test tube and performing combustion test.

NOTE FOR THE TEACHER

- The combustion test must be performed very carefully. It is advised that this test may first be demonstrated in the laboratory.

QUESTIONS

- Write the chemical reaction of zinc with dil. sulphuric acid.
- How does the combustion of hydrogen gas produce water?
- How will you show that the hydrogen gas is neutral in behaviour?
- What are the others metals among the species Mg, Al, Fe, Sn, Pb, Cu, Ag metals which react with dil. sulphuric acid to produce hydrogen gas?
- Which of the above metal(s) would not evolve hydrogen gas from dilute hydrochloric acid?

- (b) Precipitation reation between aqueous solution of barium chloride with aqueous solution of sodium sulphate.

THEORY

When a solution of sodium sulphate is mixed with a solution of barium chloride, the following double displacement reaction takes place:



In this reaction, sulphate ions (SO_4^{2-}) from sodium sulphate are displaced by chloride ions (Cl^-) and chloride ions in barium chloride are displaced by sulphate ions. As a result, a white precipitate of barium sulphate is formed and sodium chloride remains in the solution.

MATERIALS REQUIRED



Two test tubes, a small measuring cylinder (50 mL), aqueous solution of sodium sulphate, aqueous solution of barium chloride.

PROCEDURE



- Take 3 mL of sodium sulphate solution in a test tube and label it as A.
- In another test tube, take 3 mL of barium chloride and label it as B.

3. Transfer the solution from test tube A to the test tube B.
4. Mix the two solutions with gentle shaking.
5. Observe the changes in colours of the solutions as per the steps given in observation table below.

OBSERVATIONS



Sl.No.	Experiment	Observations
1.	Observe the colour of the two solutions in test tubes A and B before mixing them,	
2.	Mix the two solutions and leave the mixture undisturbed for some time. Does anything precipitates in the test tube? If so, what is the colour of it?	

RESULTS AND DISCUSSION



Confirm whether you have obtained a white precipitate of barium sulphate in the test tube. Does it suggests that the substances which produce ions in water result into precipitation reaction under favourable condition?

NOTE FOR THE TEACHER

- The aqueous solutions of barium chloride and sodium sulphate can be prepared by dissolving 6.1 g $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$ and 3.2 g of $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$ in water and then diluting them to 100 mL separately.

QUESTIONS

- Fill in the blanks:
 - (a) Sodium sulphate and barium chloride are _____ (ionic/ covalent) compounds.

- (b) As the white precipitate of barium sulphate is formed _____ (immediately/sometime after mixing the two solutions), the reaction between _____ (ionic/ covalent) compounds is _____ (instantaneous/ slow).
- What may happen on mixing $\text{Pb}(\text{NO}_3)_2$ and KCl solutions? Predict (you may try to experimentally verify).
 - What are the industrial applications of the type of the reaction being studied?
 - Why do the persons suffering from the ailment of stone formation advised not to take too much milk and tomato juice?

- (c) Thermal decomposition of ammonium chloride in an open container.

THEORY



Ammonium chloride on heating in an open container is decomposed into hydrogen chloride and produces ammonia gas. This is an example of decomposition reaction.



MATERIALS REQUIRED



Ammonium chloride, Nessler's reagent $\text{K}_2[\text{HgI}_4]$, blue litmus paper, laboratory stand with clamp, tripod stand, burner, china dish, wire gauge, and a funnel.

PROCEDURE



1. Take about 5 g of ammonium chloride in a clean and dry china dish.
2. Place the china dish on a wire gauge and keep it on a tripod stand.
3. Place an inverted clean and dry funnel over the china dish containing the sample.
4. Heat the china dish containing the sample of ammonium chloride (Fig. 2.2).
5. Vapours are formed that come out from the stem of the funnel. Check whether any liquid is produced in the china dish?

Materials

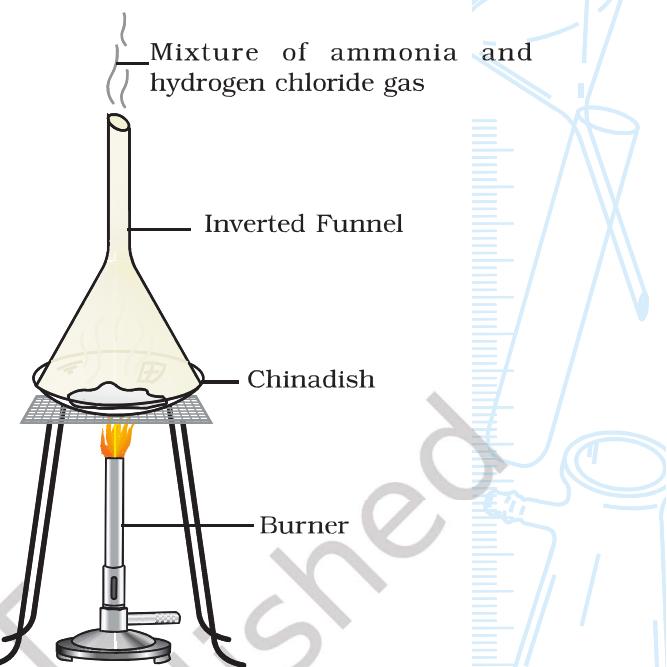


Fig. 2.2 : Heating of ammonium chloride in an open container

OBSERVATIONS



Sl. No.	Experiment	Observations	Inference
1.	Nessler's reagent test		
2.	Litmus paper test		

RESULTS AND DISCUSSION



Infer from the observations from the Nessler's reagent test and litmus paper test on the vapours evolving from the funnel for the presence of ammonia and hydrogen chloride gases respectively. Now conclude that ammonium chloride when heated in open system, decomposes to give ammonia and hydrogen chloride gases.

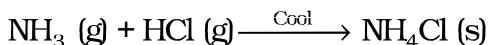
PRECAUTIONS



- The heating must be stopped when most of the ammonium chloride is decomposed.

NOTE FOR THE TEACHER

- If this reaction takes place in a closed container, the hydrogen chloride and ammonia gases cannot escape. (This reaction can be performed by tightly plugging the top of the stem of the funnel by cotton.) These gases then recombine to form ammonium chloride (NH_4Cl).



Thus, an equilibrium exists between ammonium chloride, ammonia and hydrogen chloride in a closed container.

In this reaction, solid ammonium chloride is converted directly into gaseous state without changing into liquid. It is thus sublimation reaction.

- Preparation of Nessler's Reagent :* Dissolve 10 g of potassium iodide in 10 mL water (solution A). Dissolve 6 g mercury(II) chloride in 100 mL water (solution B). Dissolve 45 g potassium hydroxide in water and dilute to 80 mL (solution C). Add solution B to solution A dropwise, until a slight permanent precipitate is formed. Add solution C to it, mix and dilute with water to 200 mL. Allow it to stand overnight and decant the clear solution.

QUESTIONS

- What gases are liberated on heating ammonium chloride?
- How will you distinguish between hydrogen chloride and ammonia gases in a laboratory?
- Can you think of decomposing water into its elemental components H_2 and O_2 , using this method?
- How does the decomposition reaction

$$2\text{Pb}(\text{NO}_3)_2 \xrightarrow{\text{Heat}} 2\text{PbO (s)} + 4 \text{NO}_2 \text{ (g)} + \text{O}_2 \text{ (g)}$$
differ from the one being discussed in this experiment?
- Limestone decomposes thermally into quick lime. What is the industrial importance of this chemical reaction?
- On thermal decomposition, ammonium chloride produces a mixture of ammonia gas (basic) and hydrogen chloride gas (acidic). This gas mixture does not show neutral behaviour in litmus test. Why?