UNIT I
Materials

Experiment 1

Aim 

To study the chemical reaction of an iron nail with aqueous copper sulphate solution; and to study the burning of magnesium ribbon in air.

(a) Chemical reaction of iron nail with copper sulphate solution in water.

Theory 

Iron displaces copper ions from an aqueous solution of copper sulphate. It is a single displacement reaction of one metal by another metal. Iron is placed above copper in the activity series. Elements placed above in this series are more reactive than those placed below them. Thus iron is more reactive than copper. In this reaction, metallic iron is converted into ferrous ion (Fe^{2+}) and cupric ion (Cu^{2+}) is converted into metallic copper.

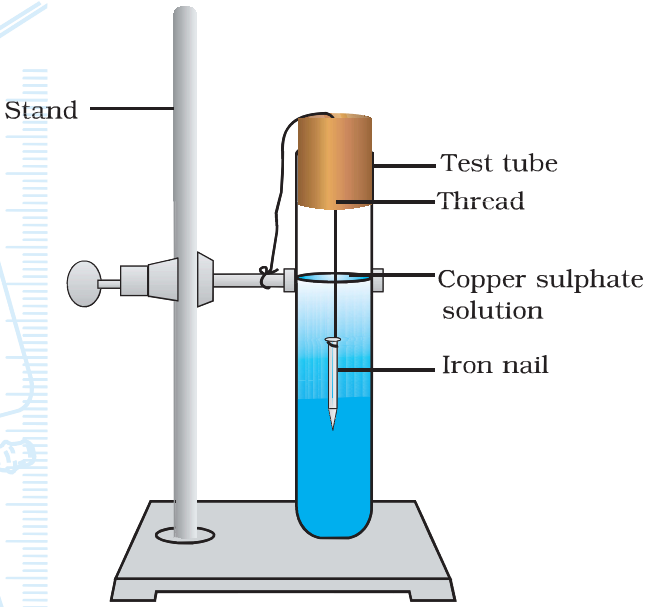
$$Fe\ (s) + Cu^{2+}\ (aq) \longrightarrow Fe^{2+}\ (aq) + Cu\ (s).$$

Materials Required 

Two test tubes, two iron nails, measuring cylinder (50 mL), laboratory stand with clamp, test tube stand, thread, a piece of sand paper, single bored cork, copper sulphate, distilled water, and dil. sulphuric acid,

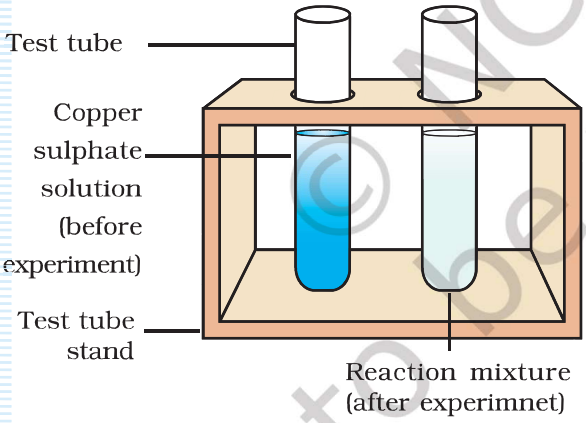
Procedure 

1. Take two iron nails and clean them with a sand paper.

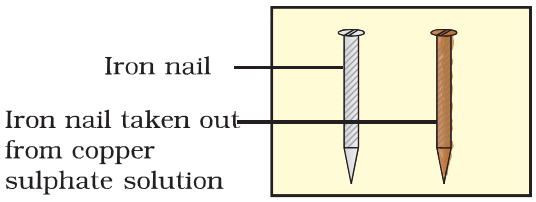


(a)

2. Take 20 mL of distilled water in a clean test tube and dissolve 1.0 g of copper sulphate in it. Add 2 or 3 drops of dil. sulphuric acid to it to check hydrolysis of $CuSO_4$ in water. Label this test tube as A.
3. Transfer about 10 mL of copper sulphate solution from tube A to another clean test tube. Label this test tube as B.
4. Tie one iron nail with a thread and immerse it carefully in copper sulphate solution in test tube B through a bored cork [as shown in the Fig 1.1(a)] for about 15 minutes [Fig. 1.1(a)]. Keep the another iron nail separately for comparison afterwards.
5. After 15 minutes take out the iron nail from the copper sulphate solution.



(b)



(c)

Fig. 1.1 : *(a) Iron nail dipped in copper sulphate solution; and (b) Iron nails and copper sulphate solutions are compared*

6. Compare the intensity of blue colour of copper sulphate solution before and after the experiment in tubes A and B, and also compare the colour of iron nail dipped in copper sulphate solution with the one kept separately [Fig. 1.1(b) and (c)]. Record your observations.

OBSERVATIONS

Sl.No.	Property	Before experiment	After experiment
1.	Colour of copper sulphate solution		
2.	Colour of iron nail		

RESULTS AND DISCUSSION

Infer from your observations about the changes in colours of copper sulphate solution and iron nail. Discuss the reason(s).

PRECAUTIONS

- The iron nails must be cleaned properly by using sand paper before dipping them in copper sulphate solution.

QUESTIONS

- Why does the colour of copper sulphate solution change, when an iron nail is dipped in it?
- How would you devise the procedure to show that Mg > Fe > Cu in reactivity series?
- What is the basic principle involved in this experiment?
- Why does the following reaction takes place?

$$2I^-\ (aq) + Cl_2\ (aq) \xrightarrow{CCl_4} 2Cl^-\ (aq) + I_2\ (solvated)\ .$$

(b) Chemical reaction of burning of magnesium ribbon in air.

THEORY

Magnesium forms magnesium oxide on burning in presence of air. It is a combination reaction between two elements. Magnesium oxide is basic in nature and thus its aqueous solution turns red litmus blue.

$$2Mg\ (s) + O_2\ (g) \longrightarrow 2MgO\ (s)$$

Materials Required

Magnesium ribbon (2 to 3 cm long), a pair of tongs, burner, a pair of dark coloured goggles, watch glass, red and blue litmus papers, distilled water, beaker, and a piece of sand paper.

Procedure

1. Take a magnesium ribbon (2 to 3 cm long) and clean it with a sand paper. This will remove the oxide layer deposited over the magnesium ribbon, which makes it passive.
2. Hold the magnesium ribbon with a pair of tongs over a watch glass and burn it in air with a burner (Fig. 1.2). Watch the burning of magnesium ribbon using a pair of dark coloured goggles.

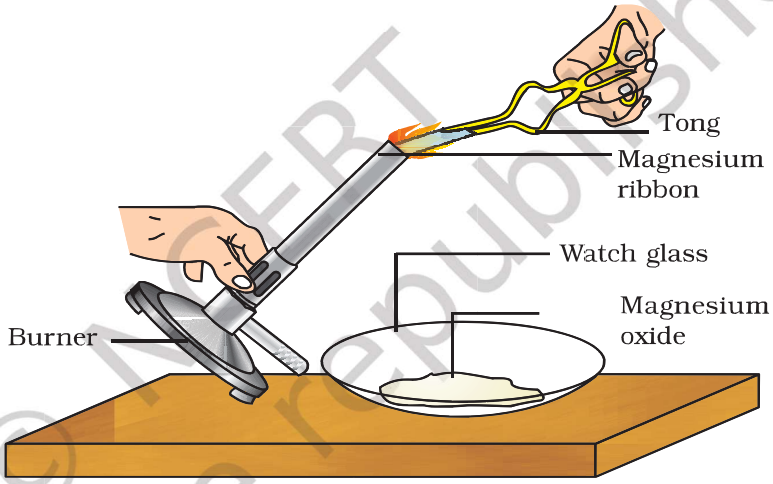


Fig. 1.2 : *Burning of magnesium ribbon and collection of magnesium oxide on a watch glass*

3. Collect the white powder obtained on a watch glass.
4. Transfer and mix the white powder in a beaker containing a little amount of distilled water.
5. Put drops of this mixture over the red and blue litmus papers and record your observations.

Observations

On putting a drop of mixture over the red litmus paper, colour of red litmus paper changes into _____ .

On putting a drop of mixture over the blue litmus paper, colour of blue litmus paper changes into _____ .

Results and Discussion 

The change in the colour of ____ litmus paper into _____ suggests that the aqueous solution of magnesium oxide is _____ in nature.

Precautions 

- Clean the magnesium ribbon carefully to remove the deposited oxide layer on it.
- Burn the magnesium ribbon keeping it away from your eyes as far as possible and use dark coloured goggles to see dazzling light emitted during burning of magnesium. (Why?)
- Collect magnesium oxide powder carefully so that it does not touch your skin.

Note for the Teacher

- Oxides on account of their interacting capability with water are classified as acidic, basic and neutral oxides.
- Magnesium oxide (MgO) dissolves in water to form magnesium hydroxide $Mg(OH)_2$ (aq) which is a strong base.

  $MgO\ (s) + H_2O\ (l) \longrightarrow Mg\ (OH)_2\ (aq)$

  Here the reaction is:

  $O^{2-}\ (s) + H_2O\ (l) \longrightarrow 2OH^-\ (aq)$.
- It is advised to tilt the burner in order to collect the magnesium oxide (product).

Questions

- Why should magnesium ribbon be cleaned before burning it in air?
- Which reaction that takes place when magnesium burns in air? Why is it called a combination reaction?
- Why does the red litmus paper turn blue when touched with aqueous solution of magnesium oxide?
- What is the total electron content of the species Mg^{2+} and O^{2-}? Name 5 more such species?
- Is there a possibility of a compound other than MgO formed in the above reaction?
- Is there any similarity between compounds LiH, MgO, and K_2S?
- Why is it suggested to wear dark coloured goggles while watching the burning of magnesium ribbon in air?