Physical change and Chemical change

Experiment 4(A)

Aim

To study the reaction between iron nail and copper sulphate solution in water and classify it as physical or chemical change.

Theory

Iron is more reactive than copper. As such, when iron is added to an aqueous solution of copper salt, iron displaces copper. For example, iron displaces copper from copper sulphate solution as follows:

$Fe(s) + CuSO_4(aq) \rightarrow FeSO_4(aq) + Cu(s)$

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

(Grey) (sky blue) (pale green) (Reddish brown)

Due to this displacement, the solution which was originally sky blue in colour, turns pale green and the iron article is covered with a reddish brown layer copper. As new products ($FeSO_4$ and Cu), with new properties are formed during the change, it is a chemical change.

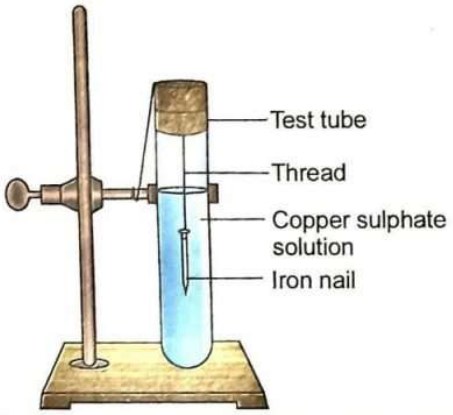

Fig. 4.1. Iron nail dipped in copper sulphate solution

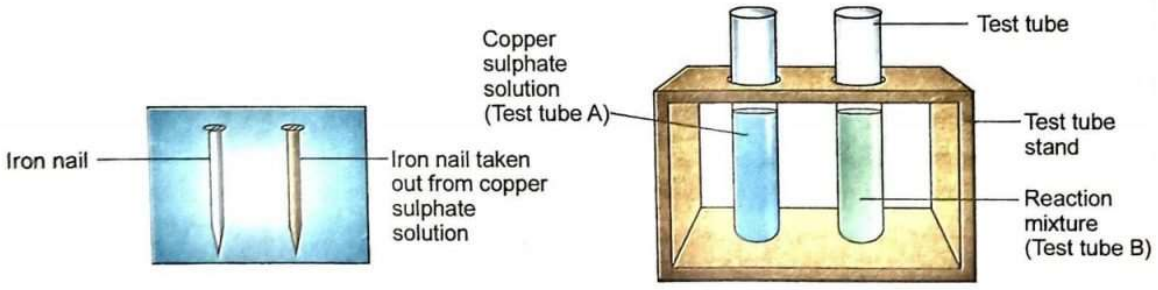

Fig. Iron nails and copper sulphate solution compared before and after the experiment

Materials Required

Two identical iron nails, copper sulphate solution, test tubes, test tube stand, sand paper, thread, cork etc.

Procedure

- Rub two iron nails with a sand paper to get a shining appearance. Tie a thread to one of the iron nail.
- Take nearly 10 ml of copper sulphate solution in a test tube.
- Suspend the iron nail in this solution. Add more copper sulphate solution to the test tube (if necessary) so that the nail dips completely in the solution.
- Wait for about 10 minutes. Remove the nail from the test tube.
- Observe the colour of the nail. Compare it with the colour of the other iron nail.
- Compare the colour of the resulting solution with the original copper sulphate solution.
- Record your observations in a table. Classify the type of chamge involved as physical or chemical change.

Observations

S. No.	Experiment	Observation	Inference
1.	Note the original colour of the solution.	Sky blue	The solution contains Cu^{2+} ions.
2.	Note the original colour of the iron nail.	Steel grey	The nail has the natural colour of iron.
3.	Note the colour of the solution after the experiment.	Pale green	The solution contains Fe^{2+} ions.
4.	Note the colour of the nail after the	Reddish brown experiment	The iron nail is covered by a thin layer of copper.

Result and Discussion

Iron displaces copper sulphate solution. As new products with new properties are formed during the change, it is a chemical change.

Precautions

- Clean the iron nail by rubbing it with a sand paper.
- If the solution of copper sulphate in water is not clear, add a few drops of conc. H_2SO_4 to make it clear.

Experiment 4(B)

Aim

To study the burning of magnesium ribbon in air and classify it as a physical or chemical change.

Theory

Magnesium burns in air on heating to give magnesium oxide.

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

The reaction is highly exothermic and produces a bright dazzling light. The magnesium oxide so formed is a white powder. It is basic in nature. When mixed with water, it turns red litmus blue. As new product (MgO), with new properties alongwith a large amount of heat and light are produced during the change, it is a chemical change.

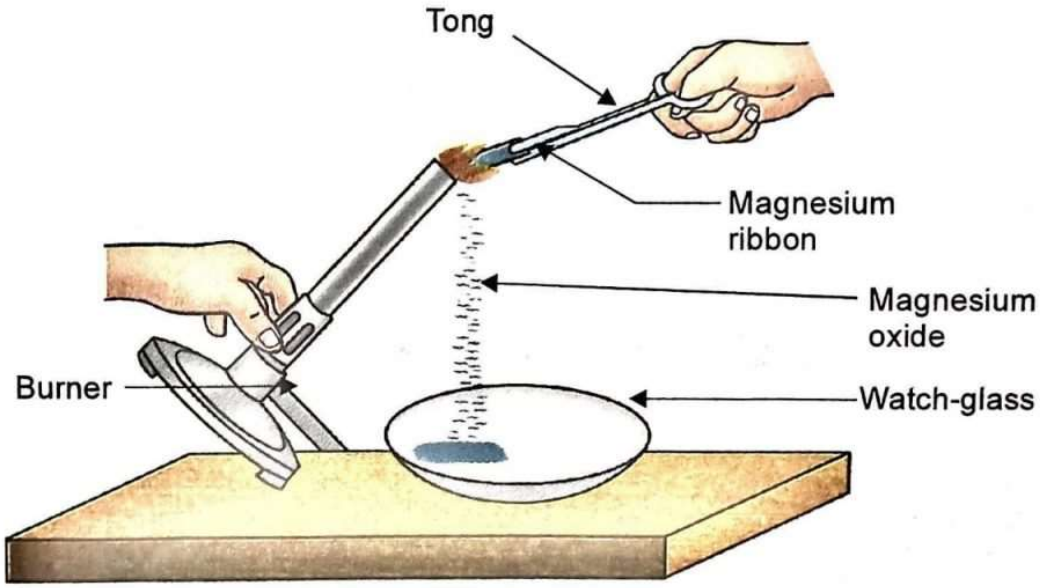

Fig. . Burning of magnesium ribbon in air

Materials Required

Magnesium ribbon, tongs, Bunsen burner, china dish, red litmus solution, sand paper etc.

Procedure

- Take a piece of magnesium ribbon nearly 5 cm long and cleean it thoroughly with a sand paper.
- Hold this magnesium ribbon in tongs. Heat the other end of this ribbon in a flame of a Bunsen burner.
- When the ribbon starts burning, hold it over an empty china dish so that the ash formed falls in the china dish.

- When the process of burning is complete, collect the ash in the china dish. Moisten it with a few drops of water. Test this suspension with red litmus solution or paper.
- Record your observations in a Table. Classify the type of change involved as physical or chemical change.

Observations

S. No.	Experiment	Observation	Inference
1.	Note the colour of magnesium ribbon.	Silvery white.	Magnesium metal is silvery white in colour.
2.	Note the colour of the ash formed.	It is white	Magnesium oxide is white in colour.
3.	Mix the white ash with water.	It forms a suspension.	Magnesium oxide is not fully soluble in water.
4.	Test this suspension with red litmus solution.	Red litmus turns blue.	Magnesium oxide is basic in nature.

Result and Discussion

Magnesium burns in air (or oxygen) to form magnesium oxide. As new product (magnesium oxide) with new properties is formed during the change, it is a chemical change.

Precautions

- Take only a ssmall piece of magnesium ribbon.
- Clean the magnesium ribbon thoroughly with a sand paper.
- Don not hold the burning magnesium ribbon with your hands.
- To collect the ash in a china dish tilt the burner.
- Use sunglasses to protect eyes from dazzling light of burning magnesium.

Experiment 4(C)

Aim

To study the reaction of zinc with dilute sulphuric acid and classify it as physical or chemical change.

Theory

Zinc reacts with dilute sulphuric acid to give hydrogen

$Zn(s) + H_2SO_4(aq) \rightarrow ZnSO_4(aq) + H_2(g)$

Hydrogen is a colourless, odourless gas. It burns with a blue flame to give water.

$2H_2(g) + O_2(g) \rightarrow 2H_2O(g) + Heat$

As new products ($ZnSO_4$ and H_2), with new properties are produced during the change, it is a chemical change.

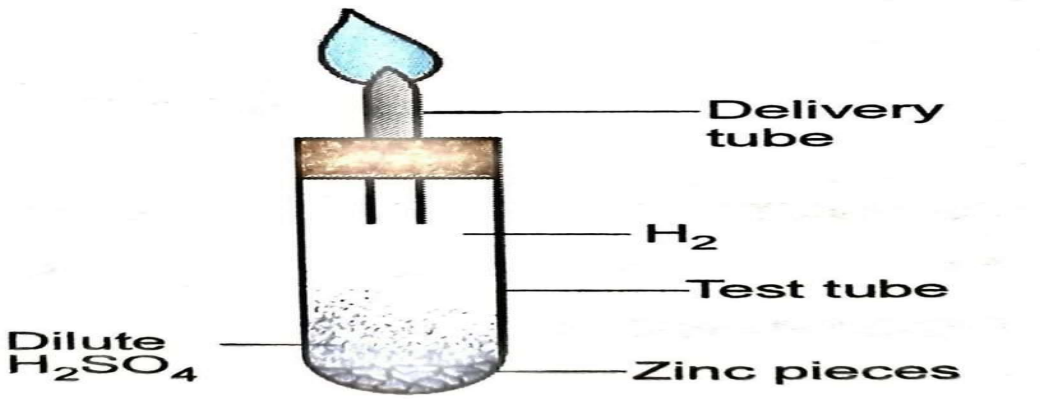

Fig. Correct method to check the combustibility of hydrogen gas

Materials Required

Granulated zinc, dilute sulphuric acid, test tubes, test tube stand, cork with delivery tube, red and blue litmus papers etc.

Procedure

- Take some pieces of granulated zinc in a test tube.
- Pour some dilute sulphuric acid on these zinc pieces.
- Note the colour and odour of the gas evolved.
- Test the gas with litmus paper.
- Ignite the gas by using a cork with delivery tube (see fig) and see the colour of the flame, if it burns.
- Record your observations in the note book.

Observations

S. No.	Experiment	Observation	Inference
1.	Note the colour of the gas.	Colourless	Hydrogen is colourless.
2.	Note the smell of the gas.	No smell	Hydrogen is odourless.
3.	Test the gas with moist red and blue litmus.	No change paoer	Hydrogen is neutral *i.e.,* neither acidic nor basic.
4.	Ignite the gas with a burning match stick.	The gas burns	Hydrogen burns with a blue flame.

Result and Discussion

Zinc reacts with dilute sulphuric acid to give zinc sulphate and hydrogen. As new products with new properties are formed during the change, it is a chemical change.

Precautions

- Use only dilute sulphuric acid for the experiment.
- Carry out the experiment in a well ventilated space.
- Use only 2-3 zinc pieces.
- Ignite the gas very carefully using a test tube with delivery tube as hydrogen forms an explosive mixture with oxygen.

Experiment 4(D)

Aim

To study the effect of heat on the copper sulphate crystals and classify it as physical or chemical change.

Theory

Copper sulphate crystals or blue vitriol is chemically copper sulphate pentahydrate ($CuSO_4.5H_2O$). On heating, it loses its water of crystallisation to form anhydrous copper sulphate, which is a white amorphous (non-crystalline) substance.

$CuSO_4.5H_2O \rightarrow CuSO_4(s) + H_2O(g)$

When 1-2 drops of water are added to anhydrous copper sulphate, it changes back into hydrated copper sulphate, which blue in colour. As no new product is formed during the change and the change can easily be reversed, it is a physical change.

Materials Required

Hard glass test tube, beaker, iron stand, pestle, mortar, delivery tube, watch glass, Bunsen burner, copper sulphate crystals, red and blue litmus papers, ice etc.

Procedure

- Powder nearly 5 g of copper sulphate crystals, using a pestle and mortar.
- Take this powered copper sulphate crystals in a hard glass test tube and set up the apparatus as shown in the figure. The other end of the delivery tube should be well inside a clean and dry test tube placed in an ice bath.
- Start heating the test tube containing powered copper sulphate crystals and note the change in its appearance (if any).
- Stop heating when the residue in the test tube becomes completely white.
- Transfer the white powder to a watch glass and let it cool.
- Note the colour and smell of the liquid collected in the test tube placed in ice bath. Also test the acidic or basic nature of the liquid collected with blue and red litmus papers. Record your observations on the note book.
- Add 1-2 drops of this liquid to the white powder in the watch glass. Record your observations in the note book.

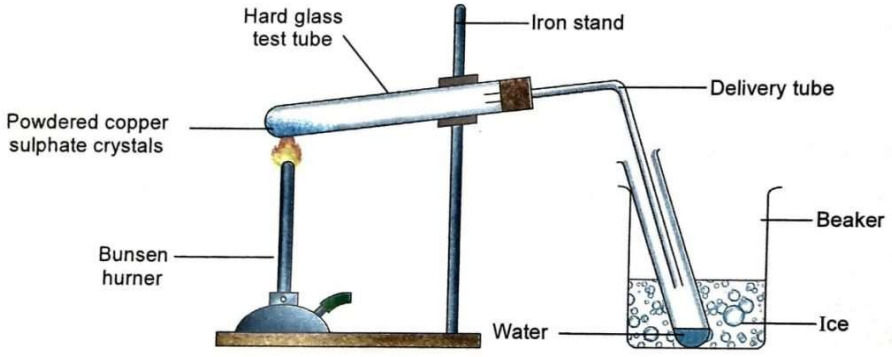

Fig. Thermal decomposition of copper sulphate pentahydrate ($CuSO_4.5H_2O$)

Observations

S. No.	Experiment	Observation	Inference
1.	Note the original colour of copper sulphate crystals	Blue	Copper sulphate crystals are blue in colour.
2.	Note the colour of the residue in the test tube.	White	Anhydrous copper sulphate is white in colour.
3.	Note the colour and smell of the liquid collected in the test tube in ice bath.	It is colourless and odourless.	White is a colourless and odourless liquid.
4.	(a) Test this colourless and odourless liquid with a blue litmus paper. (b) Test this colourless and odourless liquid with a red litmus paper.	No change in the colour of blue litmus paper. No change in the colour of red litmus paper.	The colourless and odourless liquid is neutral in nature.
5.	Add 1-2 drops of colourles and odourless liquid to the white residue in the watch glass.	It turns blue.	Hydrated copper sulphate is blue in colour.

Result and Discussion

Blue coloured copper sulphate crystals ($CuSO_4.5H_2O$) on heating loses its water of crystallisation to form anhydrous copper sulphate which is colourless or white. On adding 1-2 drops of water, the white anhydrous copper sulphate changes into blue coloured hydrated copper sulphate.
As no new product is formed during the change and the change can easily be reversed, it is a physical change.

Precautions

- Powder copper sulphate crystals before heating.
- Use only a clean and dry hard glass test tube to heat hydrated copper sulphate.
- Use only a clean and dry test tube to condense the water vapours produced.

Experiment 4(E)

Aim

To study the reaction between sodium sulphate and barium chloride in aqueous solutions and to classify it as a physical or chemical change.

Theory

When an aqueous solution of barium chloride is added to an aqueous solution of sodium sulphate (or vice versa), a white precipitate of barium sulphate is immediately formed.

$BaCl_2(aq) + Na_2SO_4(aq) \rightarrow BaSO_4(s) + 2NaCl(aq)$
white ppt.

As new products [$BaSO_4$ and NaCl] with new properties are formed during the change, it is a chemical change.

Procedure

- Wash and clean a couple of test tubes.
- Take nearly 5 ml of an aqueous solution of barium chloride in one test tube. Take an equal volume of sodium sulphate solution in another test tube.
- Add barium chloride solution to the sodium sulphate solution (or alternatively add sodium sulphate solution to barium chloride solution).
- Note the colour of the precipitate so formed and record your observation in the note book.

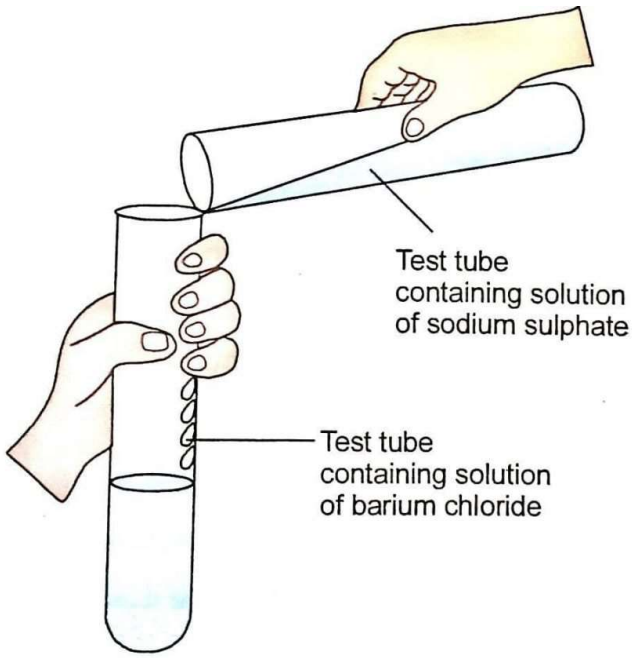

Fig. Formation of barium sulphate and sodium chloride

Observations

S. No.	Experiment	Observation	Inference
1.	Note the colour and appearance of barium chloride solution.	Colourless and transparent.	An aqueous solution of barium chloride is colourless and transparent.
2.	Note the colour and appearance of sodium sulphate solution.	Colourless and transparent.	An aqueous solution of sodium sulphate is colourless and transparent.
3.	Note the colour and appearance of the products obtained on mixing the two solutions.	A white precipitate of barium sulphate with a colourless and transparent supernatant solution of sodium chloride.	White coloured barium sulphate is insoluble in water. A solution of sodium chloride in water is colourless and transparent.

Result and Discussion

Both barium chloride and sodium sulphate are freely soluble in water forming colourless solutions. On mixing the two solutions, the barium sulphate formed is insoluble in water and settles down while sodium chloride remains in solution which is colourless. As new products with new properties are formed during the change, it is a chemical change.

Precautions

- Clean the apparatus very thoroughly before the experiments.
- Use equal volumes of barium chloride and sodium sulphate solutions.