

Chemical Reactions

Any chemical reaction can be classified as one of several basic reaction types. We will experiment with two of these basic reaction types: single and double displacement reactions.

Apparatus

Test tubes, funnel, filter paper

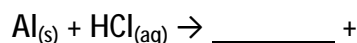
Chemicals: Aluminum foil, 1 M hydrochloric acid, 0.1M CuSO₄ solution, 1 M sulfuric acid, iron nail, 0.1M fresh Fe(SO₄) solution, 1 M NaOH solution, and copper wire

Procedure

1. Displacement of Hydrogen from an acid

Place a one inch square of aluminum foil in a small test tube. Add about 2 mL of water and the same amount of dilute HCl. Warm slightly over a flame. What evidence is there that a reaction is occurring?(1)

The chemical change which took place may be stated in the form of an equation.



Write the balanced equation. (2) Why is this reaction called a displacement reaction? (3)

Continue gentle heating until the aluminum is dissolved or until there is no further evidence of reaction. You may have to add additional acid as it boils away. Pour the resulting solution into a small beaker and add a solution of ammonia (sometimes called ammonium hydroxide) until you get a finely divided solid in the solution. The suspension of the finely divided solid which forms in the solution is known as a precipitate. Filter and place a little of the solution that goes through the filter (known as the filtrate) on a watch glass. Evaporate the filtrate over a water bath. What is the dry solid that forms as a result of the evaporation of the filtrate? (4) Complete the equation for the second chemical change.



Write the balanced equation. (5)

2. Displacement of a Metal

Place two or three mL of copper (II) sulfate solution in a test tube, add a few drops of sulfuric acid and carefully drop in an iron nail. Let it stand a minute or two and pour off the copper (II) sulfate solution. Rinse the nail and examine it. The deposit on it is not rust but another metal. What metal does it appear to be? (6) Where does it come from? (7) What substance must have been formed in the solution? (8) Write an equation for the reaction that you think has taken place. (9) (The sulfuric acid speeds up the reaction but does not take part in it. Such a substance is called a *catalyst*. Do not put it in the balanced equation.)

Repeat this experiment using iron (II) sulfate solution and a small piece of copper wire instead of the copper (II) sulfate and nail. What are the results and what does this mean about the reactivity of iron and copper? (10)

3. Double Displacement

Take about 5 mL solution of copper (II) sulfate solution in a test tube and add three drops of sodium hydroxide solution. What are the results? (11)

That the precipitate formed is copper compound is suggested by its color. What copper compound do you think it is? (12) What other substance must have been formed? (13) Write an equation for the reaction you think has taken place. (14) Why is this reaction called a double displacement reaction? (15)

Filter the solution containing the precipitate. What evidence is there that not all of the copper sulfate in the solution has been reacted? (16)

Add an additional drop of sodium hydroxide solution to the filtrate. What are the results? (17)

What does this prove about the completeness of the reaction resulting from the first addition of sodium hydroxide? (18)

Describe in general terms a method by which one might test the completeness of any reaction which involves a precipitation. (19-20)

Write-up

Answer the numbered questions above on another sheet of paper. Be thorough in your answers and include the color, appearance, etc. of the products. The question's number is after the question.