

Reactions of metals with dilute acid

Aims

A salt and hydrogen are produced when a metal reacts with a dilute acid. In general, the more reactive the metal, the faster the reaction and the greater the rate of bubbling.

You are going to investigate the reactions of magnesium, aluminium, zinc, iron and copper with dilute hydrochloric acid. You will then use your results to work out a reactivity series for these five metals.



Apparatus

Eye protection

Heat-resistant mat

Bunsen burner

Test tubes and test-tube rack

Test tube holder

Dropping pipette

Wooden splints

Dilute hydrochloric acid

Pieces of magnesium, aluminium, zinc, iron and copper

Method

1. Put the test tubes in the test-tube rack.
2. Use the dropping pipette to add no more than 2 cm³ of dilute hydrochloric acid to each test tube.
3. Add the piece of zinc to one of the test tubes. Observe and record any signs of a reaction.
4. If the reaction is slow, or there is no visible reaction, **gently warm** the contents of the test tube. Allow to cool for a short time, then record your observations.



Clamp the test tube holder around the neck of the test tube. Hold the test tube at about 45° and point it away from people. Warm with the air hole half open. **Do not boil the acid.**

5. If you see bubbling at step 3 or 4, try to test for the presence of hydrogen using a lighted splint.
6. Repeat steps 3 – 5 for the other metals.

Results

Metal	Observations in cold acid	Observations in warm acid
Zinc		
Magnesium		
Aluminium		
Iron		
Copper		

Analysis

1. List the metals in order of reactivity (from most reactive to least reactive) using your results.
2. Explain why you placed each metal where you did.

Evaluation

Describe how you could improve or extend your investigation. Explain your answer.

Results

Metal	Observations in cold acid	Observations in warm acid
Zinc		
Magnesium		
Aluminium		
Iron		
Copper		

Results

Metal	Observations in cold acid	Observations in warm acid
Zinc		
Magnesium		
Aluminium		
Iron		
Copper		

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Model results

Results ordered in increasing reactivity (aluminium is placed above zinc because of its reaction in warm acid).

Metal	Observations in cold acid	Observations in warm acid
Magnesium	Rapid bubbling, metal gets smaller and disappears	No done – not necessary or safe to do
Aluminium	No visible reaction	Slow bubbling to begin with, then rate of bubbling increases to vigorous bubbling
Zinc	Steady bubbling	Fast bubbling
Iron	Bubbles form on the surface	Slow bubbling
Copper	No visible reaction	No visible reaction – any bubbling seen stops when warming stops

Technician's notes

Per pair of students

Heat-resistant mat

Bunsen burner

5 × test tubes

Test-tube rack

Test tube holder

Dropping pipette

Wooden splints

2 × pieces (about 15 mm × 5 mm) of:

- aluminium
- copper
- iron (or small steel nails instead)
- magnesium
- zinc

Access to:

- 1 mol/dm³ hydrochloric acid 

Allow about 20 cm³ per pair of students.