# Test for carbon dioxide

4.8.2.3 · Chemical analysis · revision notes

How to show that a gas is carbon dioxide: it turns limewater milky (cloudy). Usually a 2-mark test-and-result question, often linked to acids reacting with carbonates or to burning fuels.

## Key facts

- Limewater = calcium hydroxide solution, $Ca(OH)_2(aq)$
- Result: limewater turns milky (cloudy)
- acid + metal carbonate → salt + water + carbon dioxide
- Test: bubble the gas through (or shake it with) limewater
- Grade 7+ only $Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$ (white precipitate of calcium carbonate)
- A splint going out is NOT a test for carbon dioxide

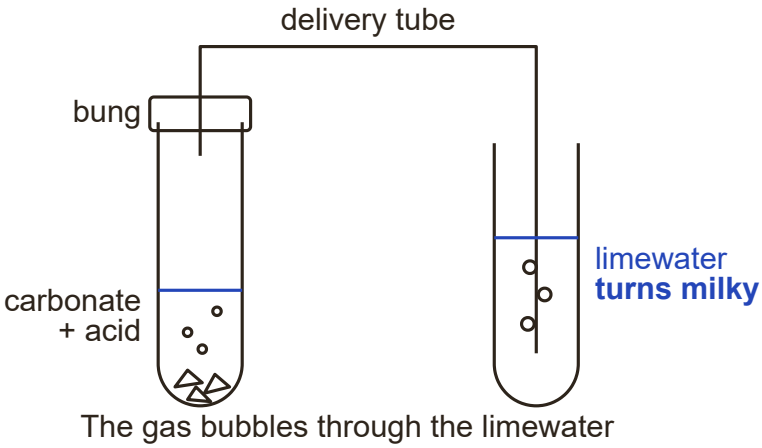
## Notes

### The test

- **Limewater** is an aqueous solution of calcium hydroxide. It is colourless.
- Bubble the gas through limewater (e.g. using a delivery tube), or shake the gas with limewater in a stoppered tube.
- If the gas is carbon dioxide, the limewater turns **milky** (cloudy).
- Why: carbon dioxide reacts with calcium hydroxide to form calcium carbonate, which is insoluble and forms a white precipitate: $Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$. Grade 7+ only

## Where carbon dioxide comes from

- Acids react with metal carbonates to form a salt, water and carbon dioxide, e.g. calcium carbonate + hydrochloric acid → calcium chloride + water + carbon dioxide.
- Complete combustion of hydrocarbon fuels, such as methane, produces carbon dioxide and water.
- To test the gas from a reaction, fit the reaction tube with a bung and delivery tube, and dip the end of the delivery tube into limewater in another tube.




Carbon dioxide turns limewater milky (cloudy).

## Watch out

- Carbon dioxide puts out a burning splint, but so do other gases such as nitrogen. This is **not** a test for carbon dioxide.
- It is the limewater that turns milky, not the gas.
- Fizzing only shows that a gas is given off. You need the limewater test to show that the gas is carbon dioxide.

## How to answer each type of question

**Describe the test for carbon dioxide and give the result** 2 marks Grade 3

1. Test (1 mark): bubble the gas through limewater.
2. Result (1 mark): the limewater turns milky / cloudy.

**Example.** When dilute hydrochloric acid is added to marble chips, a gas is given off.
Describe a test to show that the gas is carbon dioxide. Give the result of the test.

**Model answer.** Bubble the gas through limewater (1). The limewater turns milky / cloudy (1).

**Describe how to collect and test the gas from a reaction** 3 marks **Grade 5**

1. Put the reactants in a tube with a bung and a delivery tube.
2. Put the end of the delivery tube into limewater so the gas bubbles through it.
3. Give the result: the limewater turns milky.

**Example.** Copper carbonate reacts with dilute sulfuric acid.
Describe how a student could show that carbon dioxide is produced in this reaction. Give the result.

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**Model answer.** Put the copper carbonate and acid in a boiling tube fitted with a bung and delivery tube (1). Put the other end of the delivery tube into limewater in a second tube, so the gas bubbles through it (1). The limewater turns milky / cloudy (1).

**Identify the gas and balance the equation** 2 marks **Grade 5**

1. Acid + carbonate always gives carbon dioxide (plus a salt and water).
2. Name the salt from the metal and the acid: hydrochloric → chloride, sulfuric → sulfate, nitric → nitrate.
3. Balance by counting each type of atom on both sides.

**Example.** Sodium carbonate reacts with dilute hydrochloric acid. The gas produced turns limewater milky.
(a) Name the gas.
(b) Balance the equation:
$Na_2CO_3$ + ....HCl → ....NaCl + $H_2O$ + $CO_2$

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**Model answer.**

(a) carbon dioxide (1)

(b) $Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2$ (1)

## Don’t lose marks

- Writing only 'the limewater changes colour'. Say it turns milky (cloudy) because a white precipitate forms.
- Using a burning splint as the test. It goes out in carbon dioxide, but it goes out in other gases too.
- Calling limewater 'calcium carbonate solution'. Limewater is calcium hydroxide solution; calcium carbonate is the precipitate that makes it cloudy.
- Saying 'the gas turns milky'. It is the limewater that changes.

## More tips

### Memory tricks

- Carbon dioxide → Cloudy: both start with a C sound.
- Carbon dioxide makes limewater look like milk.
- Acid + carbonate always fizzes: the fizz is carbon dioxide.

### Exam technique

- Two marks: 'bubble through limewater' (1) and 'turns milky / cloudy' (1).
- If asked what limewater is, write 'calcium hydroxide solution'.
- In practical questions, make sure the delivery tube goes from the reaction into the limewater.

## What each grade needs

What you need to be able to do, from the first marks up to the top grade.

**Grade 3** — **Describe the test for carbon dioxide**
Bubble the gas through limewater, or shake the gas with limewater.

**Grade 3** — **State the positive result for carbon dioxide**
The limewater turns milky (cloudy).

**Grade 4** — **Name the chemical in limewater**
Limewater is an aqueous solution of calcium hydroxide.

**Grade 5** — **Describe how to test gas from a reaction**
Use a delivery tube to bubble the gas from the reaction through limewater.

**Grade 5** — **Name reactions that produce carbon dioxide**
Acids with metal carbonates, and complete combustion of fuels that contain carbon.

**Grade 7** — **Explain why limewater turns milky**
Carbon dioxide reacts with calcium hydroxide to form insoluble calcium carbonate, a white precipitate.

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