Test for carbon dioxide

5.8.2.3 · Chemistry · 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

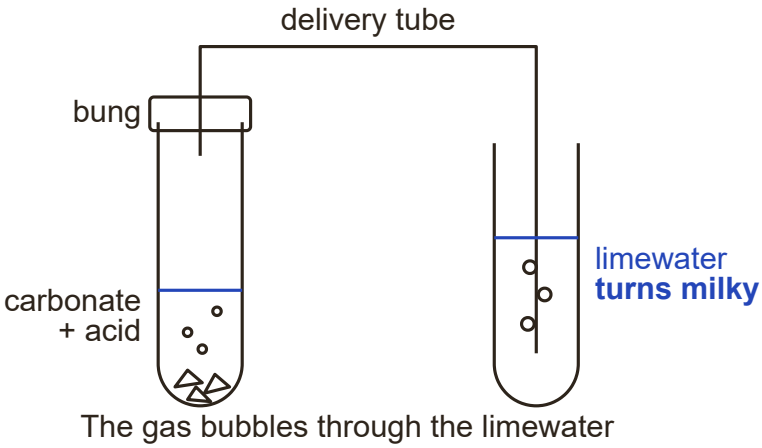
Notes

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.

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

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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