

How fast do reactions go?

Chemistry grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · Worksheet

Name: _____ Date: _____ Class: _____

These twenty problems train you to calculate mean rates, read gas volume graphs, use tangents and explain every change in rate with collision theory. They begin with recall and measurement methods and finish with multi-step data analysis and experiment design. They match GCSE and IGCSE chemistry, O Level, CBSE Class 9-10 science and NGSS high school chemistry. In every explanation, mention particles, collisions and energy.

Level: Chemistry grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · **Curriculum:** HS-PS1-5

Problem 1 Defining rate (easy)

Rate of reaction is a key idea in chemistry.

1. Define the rate of a reaction.
2. State two ways of measuring the rate when a gas is made.

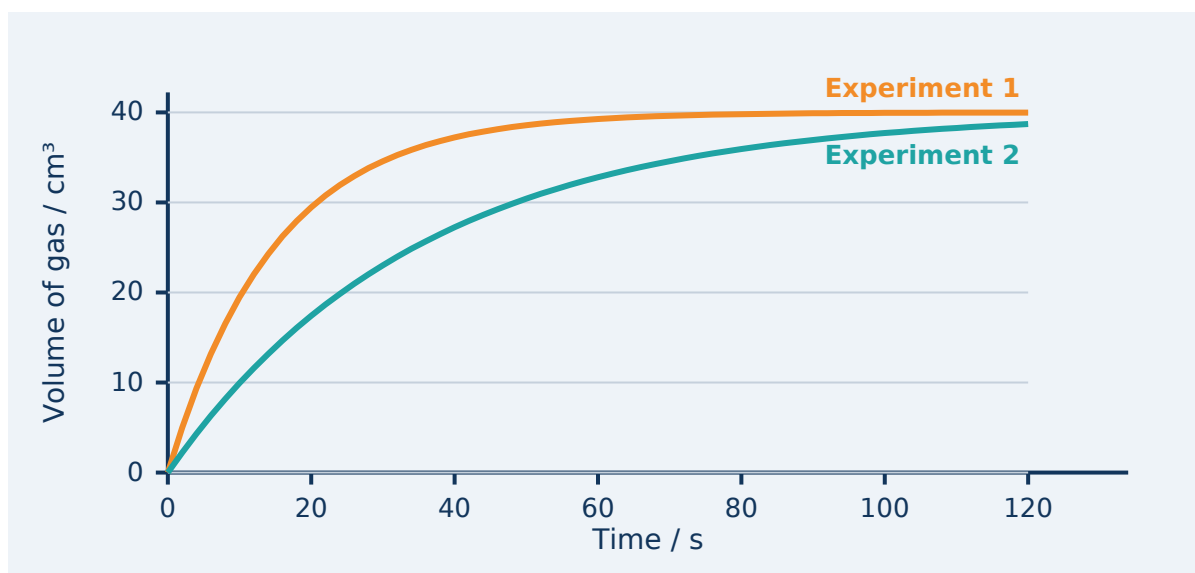
Problem 2 Four ways to speed up (easy)

Name four changes that can make a reaction faster.

Problem 3 Reading a gas graph (easy)

Chiamaka in Lagos reacts magnesium with acid twice, using powder in experiment 1 and a strip in experiment 2.

1. State which curve shows the faster reaction.
2. State the time at which each reaction finishes.
3. Explain why both curves reach the same volume.



Two experiments with the same amount of magnesium.

Problem 4 Collision words (easy)

Complete the sentences.

1. Particles must ____ to react.
2. They must collide with at least the ____ energy.
3. A faster rate means ____ successful collisions each second.

Problem 5 Everyday rates (easy)

Explain each observation using a factor that changes the rate.

1. Milk stays fresh longer in a fridge.
2. Fine flour dust can explode, but a bag of flour burns slowly.
3. A pressure cooker cooks lentils faster.

Problem 6 Choose a method (easy)

Match each reaction with a suitable way to follow its rate.

1. Zinc and acid making hydrogen gas
2. Sodium thiosulfate and acid making a cloudy precipitate
3. Marble chips and acid in an open flask

Problem 7 Mean rate of gas (medium)

Emma in Leeds collects 36 cm³ of gas in 90 s.

1. Calculate the mean rate in cm³/s.
2. Calculate the mean rate in cm³/min.
3. Predict the volume after 60 s if the rate stays constant.

Problem 8 Losing mass (medium)

A flask loses 0.88 g in 4.0 minutes when carbon dioxide escapes (M of $\text{CO}_2 = 44 \text{ g/mol}$).

1. Calculate the mean rate in g/min.
2. Calculate the rate in g/s.
3. Calculate the moles of carbon dioxide lost.

Problem 9 Concentration data (medium)

Mei times how long magnesium ribbon takes to disappear in acid of different concentrations.

Concentration / mol/dm^3	Time / s
0.5	120
1.0	60
1.5	40
2.0	30

1. Calculate $1 \div \text{time}$ for each concentration.
2. State the relationship between rate and concentration.
3. Explain this using collisions.

Problem 10 Cutting a cube (medium)

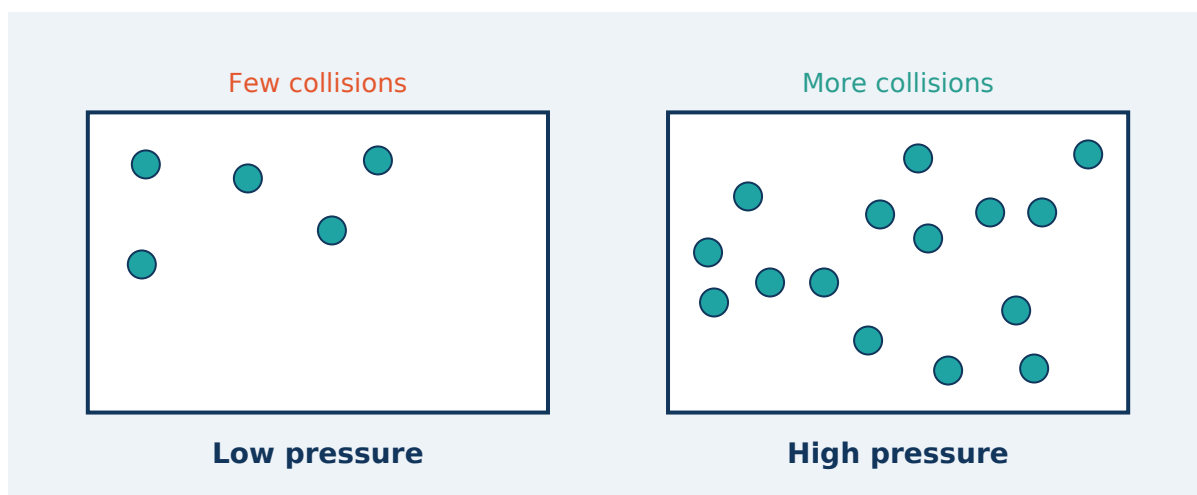
A cube of limestone has sides of 3 cm. It is cut into 27 cubes of side 1 cm.

1. Calculate the surface area before cutting.
2. Calculate the total surface area after cutting.
3. State how the rate with acid changes.

Problem 11 Picture the concentration (medium)

The figure shows a gas at two pressures in the same volume.

1. State which box has more collisions.
2. Explain why.
3. State the effect on the rate.



Gas at two pressures.

Problem 12 Two effects of heat (medium)

Bilal in Lahore warms a reaction mixture from 20 °C to 50 °C.

1. Give two reasons why the rate increases.
2. State which reason matters more.

Problem 13 Catalyst in peroxide (medium)

Hydrogen peroxide decomposes slowly: $2\text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2$. Manganese(IV) oxide makes it fast. Diego finds 0.50 g of the oxide before and 0.50 g after the reaction.

1. Identify the catalyst.
2. Explain why the mass is unchanged.
3. Explain how a catalyst speeds up the reaction.

Problem 14 Doubling every ten degrees (medium)

A reaction takes 160 s at 20 °C. Assume the rate doubles for every 10 °C rise.

1. Calculate the rate factor at 50 °C.
2. Calculate the time at 50 °C.
3. Calculate the time at 10 °C.

Problem 15 Design for speed (medium)

A bakery in Kano wants dough to rise faster. Yeast enzymes act as a biological catalyst.

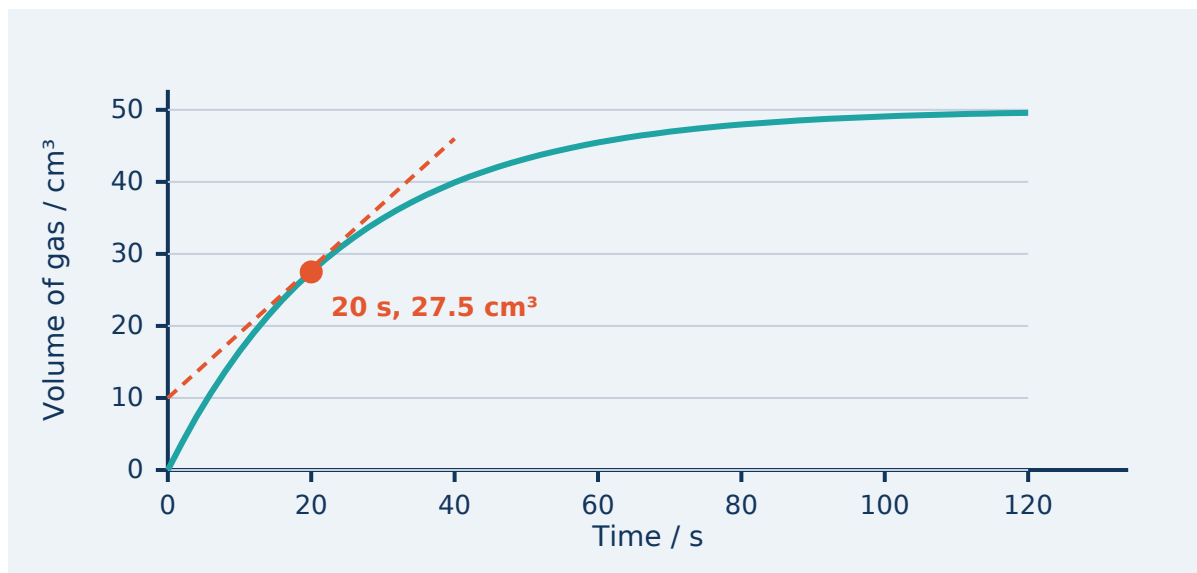
1. Suggest two safe changes to speed up the rising.
2. Explain one change using particle ideas.
3. Explain why too much heat spoils the process.

Problem 16 Gradient at 20 seconds (hard)

Wanjiru follows the gas made when marble reacts with acid. The dashed line is the tangent

at 20 s.

1. Read the volume at 20 s from the marked point.
2. Calculate the mean rate over the first 20 s.
3. Calculate the gradient of the tangent in cm^3/s .
4. Explain why the rate at 20 s is lower than the mean rate.



Gas volume with a tangent drawn at 20 s.

Problem 17 Magnesium powder versus ribbon (hard)

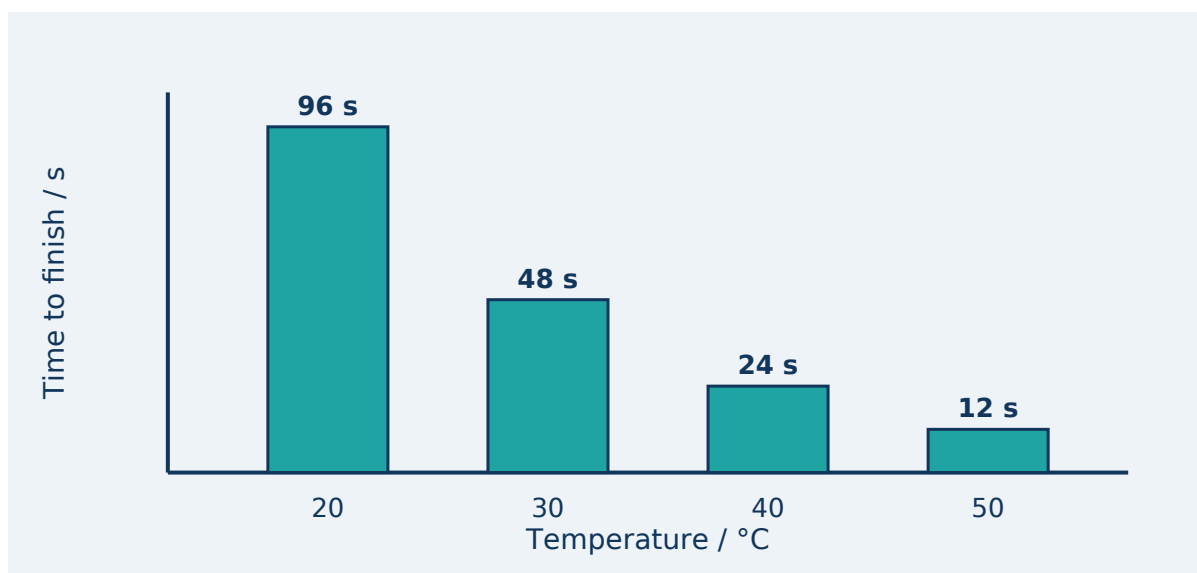
A strip of magnesium of mass 0.24 g ($A_r = 24$) reacts with excess acid: $\text{Mg} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$. At room conditions 1 mol of gas occupies $24\,000\text{ cm}^3$.

1. Calculate the volume of hydrogen formed.
2. The strip takes 60 s. Calculate the mean rate in cm^3/s .
3. The same mass as powder takes 15 s. Calculate the mean rate and the factor of increase.
4. Calculate the mean rate for the strip in mol/s .

Problem 18 Cross disappearing (hard)

Aarav times how long a cross under a flask takes to disappear when sodium thiosulfate reacts with acid at different temperatures. The bar chart shows his results.

1. Calculate the rate ($1 \div \text{time}$) at $20\text{ }^\circ\text{C}$ and at $50\text{ }^\circ\text{C}$.
2. Calculate by what factor the rate changes for each $10\text{ }^\circ\text{C}$ rise.
3. Predict the time at $60\text{ }^\circ\text{C}$.
4. Explain why the cross disappears.



Time for the cross to vanish at four temperatures.

Problem 19 Which catalyst is best? (hard)

Kofi tests catalysts for breaking down 50 cm³ of hydrogen peroxide solution. He collects oxygen for 30 s: no catalyst 2 cm³, copper(II) oxide 14 cm³, manganese(IV) oxide 45 cm³.

1. Calculate the mean rate for each.
2. Identify the best catalyst.
3. List three variables to keep constant.
4. Explain why this does not prove the other catalysts are useless.

Problem 20 Spot the errors (hard)

A student wrote: 'Heating works only because particles collide more often. A catalyst gets used up, so the product mass is less. A steeper gradient shows a slower reaction. Doubling the pressure of a gas halves the number of collisions.' Correct all four statements.