1.8

Rates of reaction

Name _____ Class _____ Mark _____ / 15

What you are practising

I can find a rate from a gas-volume graph and use collision theory to explain why it changes.

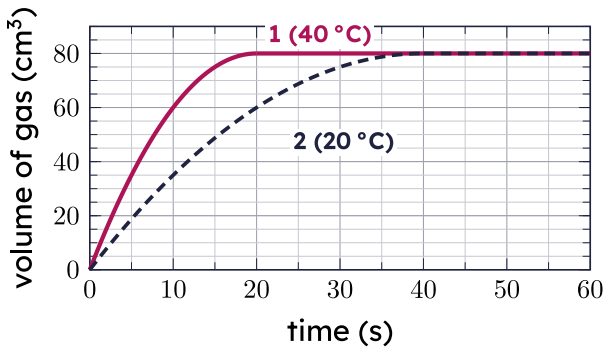
Worked example: 30 cm^3 of gas in 20 s.
mean rate $= 30 \div 20 = 1.5$ cm^3/s
Change in volume divided by the time taken.

Rate: change in amount of reactant or product over time.
Graph: steeper line = faster; flat line = no more gas.
Collision theory: particles must collide to react.

Read the graph

hydrochloric acid + sodium hydrogen carbonate

Carbon dioxide is collected. Same amounts each time; only the acid temperature changes.



1 Which experiment was faster at the start? How can you tell from the graph? **[2]**

2 Exp. 1, gas at 10 s: ☐ cm^3 **[1]**

3 Mean rate of experiment 1 in the first 10 s. Give the unit. **[2]**

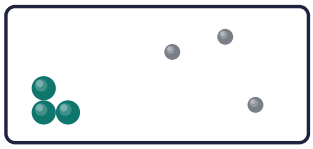
4 Why does the line for experiment 1 go flat after 20 s? **[1]**

5 Name one other way, apart from collecting the gas, to measure the rate of this reaction. **[1]**

Collision theory in pictures

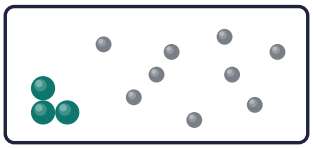
teal = solid reactant grey = acid

Picture 1



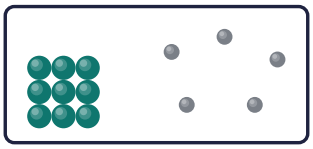
dilute acid

Picture 2



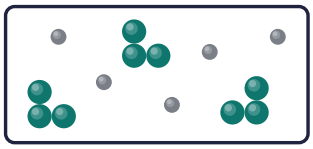
concentrated acid

Picture 3



one lump

Picture 4



small pieces

6 Which reacts faster, 1 or 2? Why? **[2]**

7 Which reacts faster, 3 or 4? Why? **[2]**

Explain

A Experiment 1 used warmer acid. Use collision theory to explain why it was faster. **[2]**

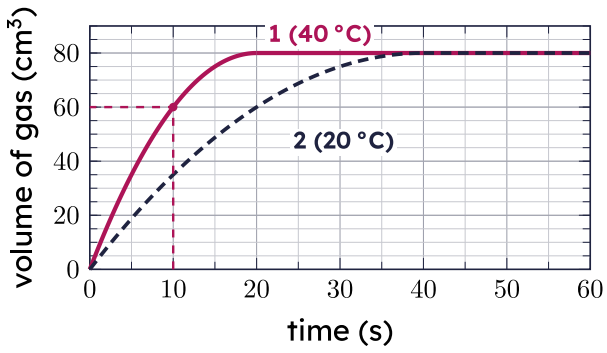
Who is right?

B **Noah:** "Warmer acid made more carbon dioxide." **Priya:** "Same amount, just faster." Who is right? Use the graph. **[2]**

Page done? Tick it off

Answers

Read the graph [7]



1 Experiment 1 **(1)**. Its line is steeper at the start: bigger gradient **(1)**.

2 60 cm^3 **(1)**. Read up from 10 s to the line, then across.

3 $60 \div 10 = 6$ **(1)**, unit cm^3/s **(1)**.

4 One of the reactants has been used up, so no more gas is made **(1)**.

5 Measure the change in mass over time, or measure the pressure as it builds up **(1)**.

Collision theory in pictures [4]

6 Picture 2. There are more acid particles in the same volume **(1)**, so they collide with the solid more often: more collisions each second **(1)**.

7 Picture 4. The small pieces have a larger surface area: more teal particles are on the outside where acid particles can hit them **(1)**, so there are more collisions each second **(1)**.

Explain [2]

Heating gives the particles more energy, so they move faster **(1)**. They collide more often, so there are more collisions each second **(1)**.

Who is right? [2]

Priya **(1)**. Both lines level off at the same volume, 80 cm^3. The same amounts of reactants make the same amount of carbon dioxide; the warmer acid only makes it in less time **(1)**.

How to revise this

Look at the rate rule, the worked example and the three factors: concentration, temperature, surface area. Cover them. Write each factor with a "so the particles…" sentence from memory. Check against page 1. Repeat only the ones you missed.