AQA - Rate of reaction – GCSE Chemistry

1. May/2020/Paper_8462/2F/No.3.1

The student used the 50 cm^3 line on the conical flask to measure the volume of hydrochloric acid.

Suggest a piece of equipment the student could use to make the measurement of volume more accurate.

[1 mark]

_____

2. May/2020/Paper_8462/2F/No.3.8

The large cube of calcium carbonate was divided into eight smaller cubes.

The eight smaller cubes have a greater total surface area than the one large cube.

Compare the rate of reaction when using the eight smaller cubes with the rate of reaction when using the large cube.

Complete the sentence.

Choose the answer from the box.

[1 mark]

faster	**slower**	**the same**

The rate of reaction of the eight smaller cubes is _____.

3. May/2020/Paper_8462/2F/No.5

This question is about alloys.

Bronze and brass are both alloys which contain copper.

Bronze is an alloy of copper and one other metal.

What is the other metal in bronze?

[1 mark]

Tick (✓) **one** box.

Aluminium ☐

Tin ☐

Zinc ☐

Give **one** use of brass.

[1 mark]

_____

_____

Alloys of gold are used to make jewellery.

The proportion of gold in an alloy is measured in carats:

- pure gold is 24 carat
- 50% gold is 12 carat.

Table 3 shows information about two gold rings, **A** and **B**.

A and **B** contain only gold and silver.

Complete **Table 3**.

[2 marks]

Table 3

Gold ring	Carat	Mass of metal in grams	
		gold	silver
A		7	7
B	18	9	

Suggest **two** reasons why alloys of gold are used instead of pure gold to make jewellery.

[2 marks]

1 _____

_____

2 _____

_____

Steels are alloys of iron.

Spoons are made of stainless steel.

Spoons:

- are washed after use
- must not wear away quickly.

Suggest **one** reason why stainless steel is suitable for making spoons.

[1 mark]

_____

_____

Steel horseshoes are shaped to fit the feet of horses.

Which type of steel is most easily shaped into horseshoes?

[1 mark]

Tick (✓) **one** box.

High carbon steel ☐

Low carbon steel ☐

Stainless steel ☐

4. May/2020/Paper_8462/2H/No.8

This question is about the rate of the reaction between hydrochloric acid and calcium carbonate.

A student investigated the effect of changing the size of calcium carbonate lumps on the rate of this reaction.

This is the method used.

1. Pour 40 cm^3 of hydrochloric acid into a conical flask.

2. Add 10.0 g of small calcium carbonate lumps to the conical flask.

3. Attach a gas syringe to the conical flask.

4. Measure the volume of gas produced every 30 seconds for 180 seconds.

5. Repeat steps 1 to 4 using 10.0 g of large calcium carbonate lumps.

The student calculated the number of moles of gas from each volume of gas measured.

Table 4 shows the student's results for large calcium carbonate lumps.

Table 4

Time in seconds	Number of moles of gas
0	0.0000
30	0.0011
60	0.0020
90	0.0028
120	0.0034
150	0.0038
180	0.0040

The student plotted the results for small calcium carbonate lumps on **Figure 4**.

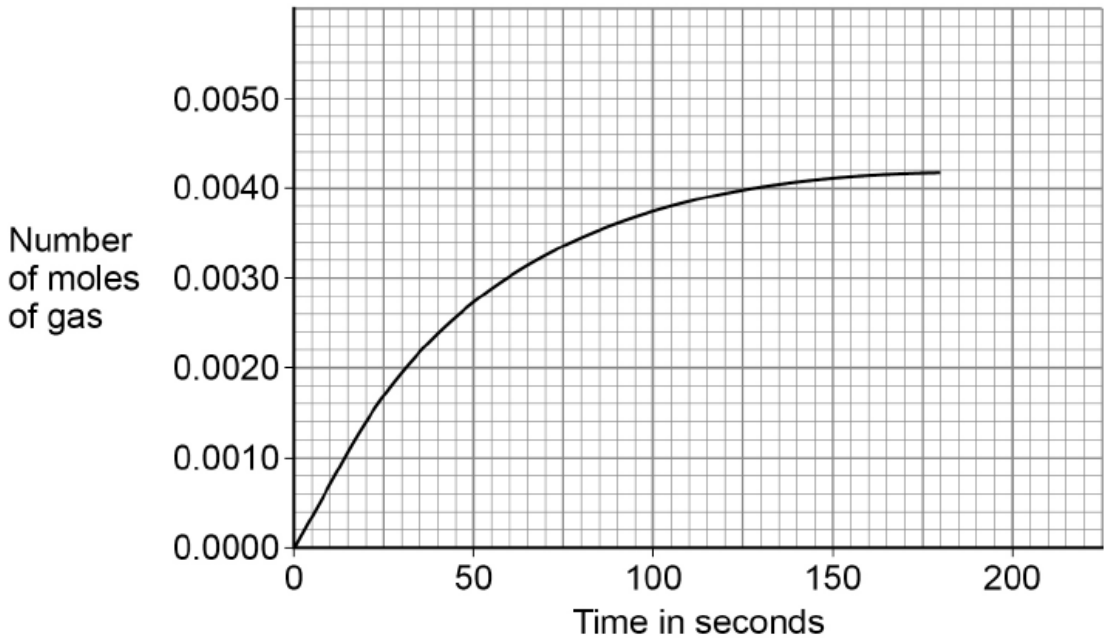
Complete **Figure 4**.

You should:

- plot the data for large calcium carbonate lumps from **Table 4**
- draw a line of best fit.

[3 marks]

Figure 4



Determine the mean rate of reaction for **small** calcium carbonate lumps between 20 seconds and 105 seconds.

Give the unit.

Use **Figure 4**.

[4 marks]

Mean rate of reaction = _____ Unit _____

The student concluded that the large calcium carbonate lumps reacted more slowly than the small calcium carbonate lumps.

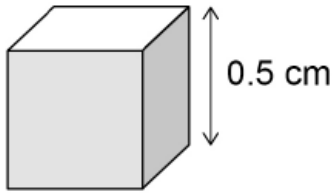
How do the student's results show that this conclusion is correct?

[1 mark]

The difference in the rates of reaction of large lumps and of small lumps of calcium carbonate depends on the surface area to volume ratios of the lumps.

Figure 5 shows a cube of calcium carbonate.

Figure 5



Calculate the surface area to volume ratio of the cube in **Figure 5**.

Give your answer as the simplest whole number ratio.

[3 marks]

Surface area : volume = _____ : _____

A larger cube of calcium carbonate has sides of 5 cm

Describe how the surface area to volume ratio of this larger cube differs from that of the cube shown in **Figure 5**.

[1 mark]

5. May/2019/Paper_8462/2F/No.6

This question is about the corrosion of metals.

The corrosion of iron is called rusting.

Plan an investigation to show that both water and air are needed for iron to rust.

You should include the results you expect to obtain.

Use apparatus and materials from the list:

- test tubes
- stoppers
- iron nails
- tap water
- boiled water
- drying agent
- oil.

[6 marks]

A student investigated how the mass of three iron nails, **A**, **B** and **C**, increased after rusting.

Table 4 shows the student's results.

Table 4

Nail	Mass of nail before rusting in g	Mass of nail after rusting in g	Increase in mass of nail in g
A	1.22	1.30	0.08
B	1.25	1.36	**X**
C	1.24	1.33	0.09

Calculate **X** in **Table 4**.

[1 mark]

X = _____ g

Calculate the mean increase in mass of the three iron nails, **A**, **B** and **C**.

Use **Table 4** and your answer to Question **06.2**

[1 mark]

Mean increase in mass = _____ g

6. May/2019/Paper_8462/2F/No.7

Some students investigated the rate of decomposition of hydrogen peroxide.

The equation for the reaction is:

$$\text{hydrogen peroxide} \rightarrow \text{water} + \text{oxygen}$$

Complete the sentence.

Choose an answer from the box.

[1 mark]

a burning splint	**a glowing splint**
damp litmus paper	**limewater**

The students tested the gas produced to show that it was oxygen.

The students used _____ .

Student **A** investigated the effect of the particle size of a manganese dioxide catalyst on the rate of the reaction.

This is the method used.

1. Measure 25 cm^3 hydrogen peroxide solution into a conical flask.

2. Add some fine manganese dioxide powder to the conical flask.

3. Measure the volume of oxygen produced every 30 seconds for 10 minutes.

4. Repeat steps 1 to 3 two more times.

5. Repeat steps 1 to 4 with coarse manganese dioxide lumps.

The method student **A** used did **not** give repeatable results.

How could student **A** make the results repeatable?

[1 mark]

Tick (✓) **one** box.

Student **A** should make measurements every 2 minutes. ☐

Student **A** should measure the mass of manganese dioxide. ☐

Student **A** should use 50 cm^3 hydrogen peroxide. ☐

Student **A** should use a beaker instead of a conical flask. ☐

Student **B** used a method which gave repeatable results.

How could student **B** improve the accuracy of these results?

[1 mark]

Tick (✓) **one** box.

Calculate a mean but do not include any anomalous results. ☐

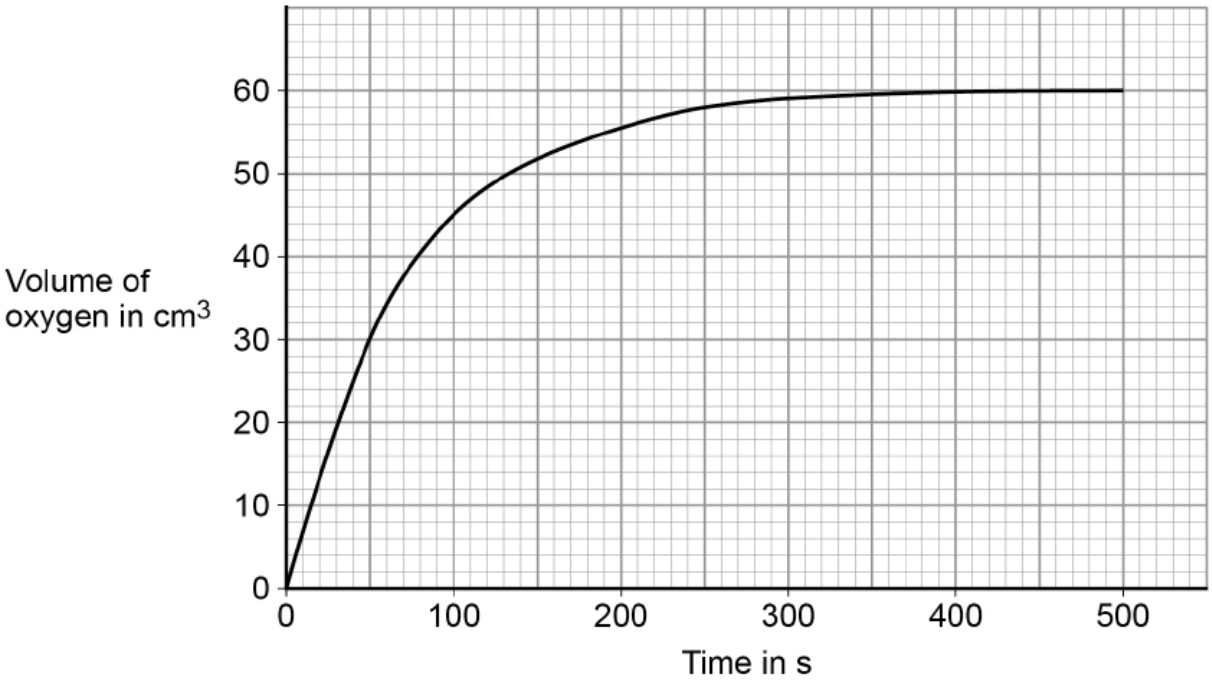
Calculate a mean but do not include the first set of results. ☐

Record the results in a table and plot the results on a bar chart. ☐

Record the results in a table and plot the results on a line graph. ☐

Figure 5 shows student **B**'s results for coarse manganese dioxide lumps.

Figure 5



Calculate the mean rate of reaction between 30 and 250 seconds for coarse manganese dioxide lumps.

Use **Figure 5** and the equation:

$$\text{Mean rate of reaction} = \frac{\text{Volume of oxygen formed}}{\text{Time taken}}$$

Give your answer to 3 significant figures.

[4 marks]

Volume of oxygen formed _____

Time taken _____

_____

_____

_____

_____

Mean rate of reaction = _____ cm^3/s

Fine manganese dioxide powder produces a higher rate of reaction than coarse manganese dioxide lumps.

Sketch on **Figure 5** the results you would expect for student **B**'s experiment with fine manganese dioxide powder.

[2 marks]

Hydrogen peroxide molecules collide with manganese dioxide particles during the reaction.

Why does fine manganese dioxide powder produce a higher rate of reaction than coarse manganese dioxide lumps?

[1 mark]

Tick (✓) **one** box.

Fine manganese dioxide powder has a larger surface area. ☐

Fine manganese dioxide powder has larger particles. ☐

Fine manganese dioxide powder produces less frequent collisions. ☐

7. May/2019/Paper_8462/2F/No.10

This question is about rate of reaction.

A student investigated the rate of the reaction between magnesium and dilute hydrochloric acid.

The equation for the reaction is:

$$Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$$

Which state symbol in the equation for the reaction does **not** represent one of the three states of matter?

[1 mark]

_____

The student determined the rate of production of hydrogen gas.

What **two** pieces of measuring apparatus could the student use to find the rate of production of hydrogen gas?

[2 marks]

1 _____

2 _____

Table 6 shows the results of the investigation.

Table 6

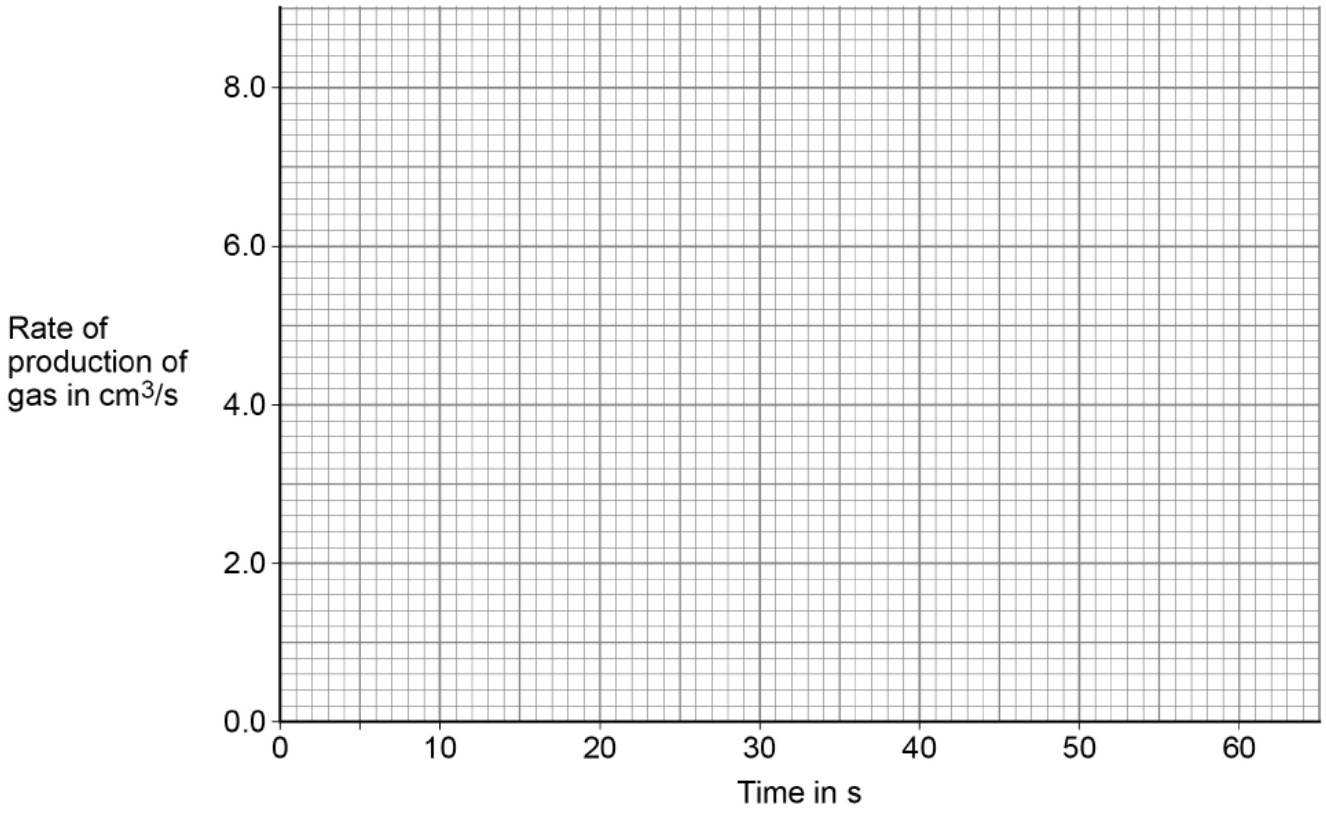
Time in s	Rate of production of gas in cm^3/s
10	6.9
20	3.9
30	2.0
40	0.9
50	0.3
60	0.0

Plot the data from **Table 6** on **Figure 8**.

You should draw a line of best fit.

[3 marks]

Figure 8


Rate of production of gas in cm3/s
8.0
6.0
4.0
2.0
0.0
0
10
20
30
40
50
60
Time in s

Give **three** conclusions that can be drawn about the rate of reaction between magnesium and dilute hydrochloric acid in this investigation.

Use data from **Figure 8** and **Table 6**.

[3 marks]

1 _____

_____

2 _____

_____

3 _____

_____

The student repeated the investigation using dilute hydrochloric acid at a higher temperature.

All the other variables were kept the same.

Which **two** statements are correct?

[2 marks]

Tick (✓) **two** boxes.

More bubbles were produced in the first 10 seconds. ☐

The activation energy for the reaction was higher. ☐

The magnesium was used up more quickly. ☐

The reaction finished at the same time. ☐

The total volume of gas collected was greater. ☐

8. May/2019/Paper_8462/2H/No.3

This question is about rate of reaction.

A student investigated the rate of the reaction between magnesium and dilute hydrochloric acid.

The equation for the reaction is:

$$Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$$

Which state symbol in the equation for the reaction does **not** represent one of the three states of matter?

[1 mark]

_____

The student determined the rate of production of hydrogen gas.

What **two** pieces of measuring apparatus could the student use to find the rate of production of hydrogen gas?

[2 marks]

1 _____

2 _____

Table 2 shows the results of the investigation.

Table 2

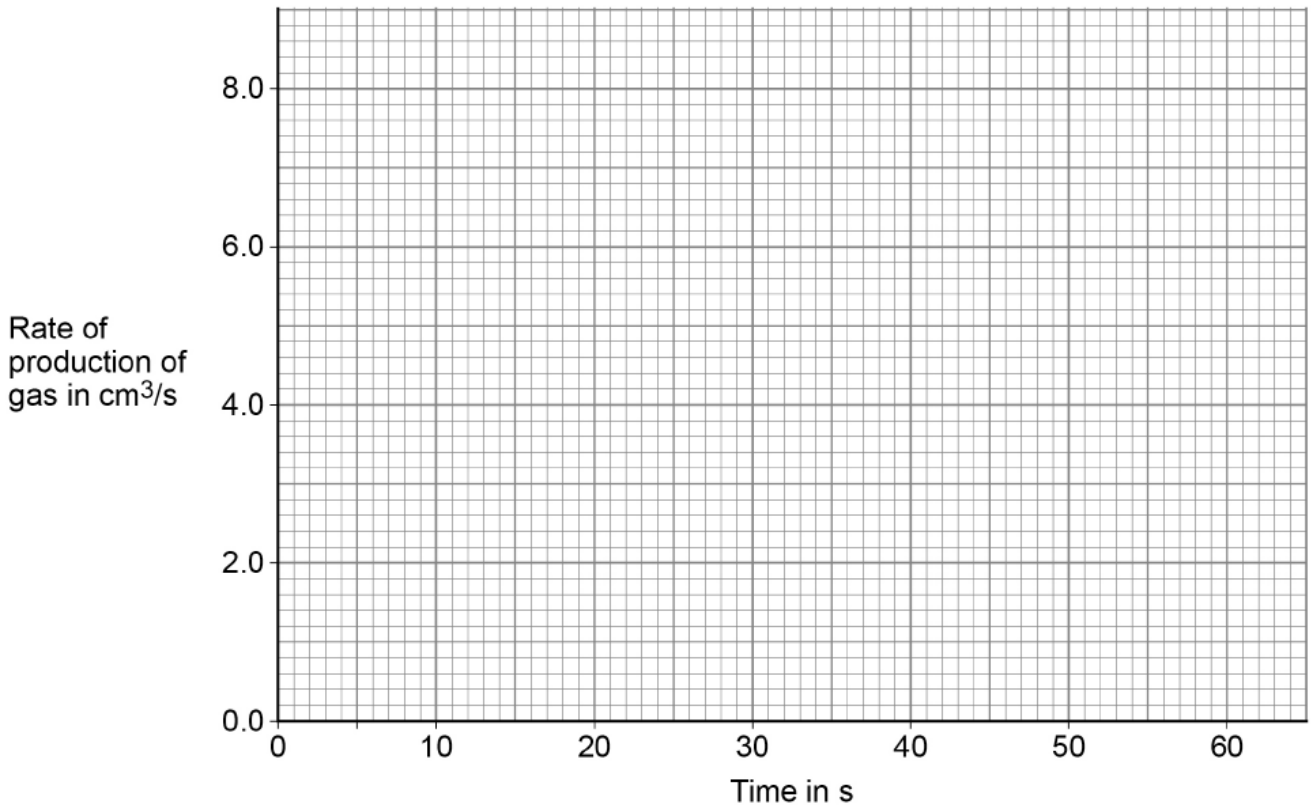
Time in s	Rate of production of gas in cm^3/s
10	6.9
20	3.9
30	2.0
40	0.9
50	0.3
60	0.0

Plot the data from **Table 2** on **Figure 3**.

You should draw a line of best fit.

[3 marks]

Figure 3


Rate of production of gas in cm3/s
8.0
6.0
4.0
2.0
0.0
0
10
20
30
40
50
60
Time in s

Give **three** conclusions that can be drawn about the rate of reaction between magnesium and dilute hydrochloric acid in this investigation.

Use data from **Figure 3** and **Table 2**.

[3 marks]

1 _____

_____

2 _____

_____

3 _____

_____

The student repeated the investigation using dilute hydrochloric acid at a higher temperature.

All the other variables were kept the same.

Which **two** statements are correct?

[2 marks]

Tick (✓) **two** boxes.

More bubbles were produced in the first 10 seconds. ☐

The activation energy for the reaction was higher. ☐

The magnesium was used up more quickly. ☐

The reaction finished at the same time. ☐

The total volume of gas collected was greater. ☐

9. May/2019/Paper_8462/2H/No.9

Some students investigated the rate of decomposition of hydrogen peroxide, H_2O_2

The equation for the reaction is:

$$2\,H_2O_2(aq) \rightarrow 2\,H_2O(l) + O_2(g)$$

The catalyst for the reaction is manganese dioxide.

Describe a test to identify the gas produced in the reaction.

Give the result of the test.

[2 marks]

Test _____

_____

Result _____

_____

Student **A** investigated the effect of the particle size of manganese dioxide on the rate of the reaction.

This is the method used.

1. Measure 25 cm^3 of 0.3 mol/dm^3 hydrogen peroxide solution into a conical flask.

2. Add a spatula of fine manganese dioxide powder to the conical flask.

3. Measure the volume of gas produced every minute for 10 minutes.

4. Repeat steps 1 to 3 with some coarse manganese dioxide lumps.

The method student **A** used did **not** give valid results.

What **two** improvements could student **A** make to the method to give valid results?

[2 marks]

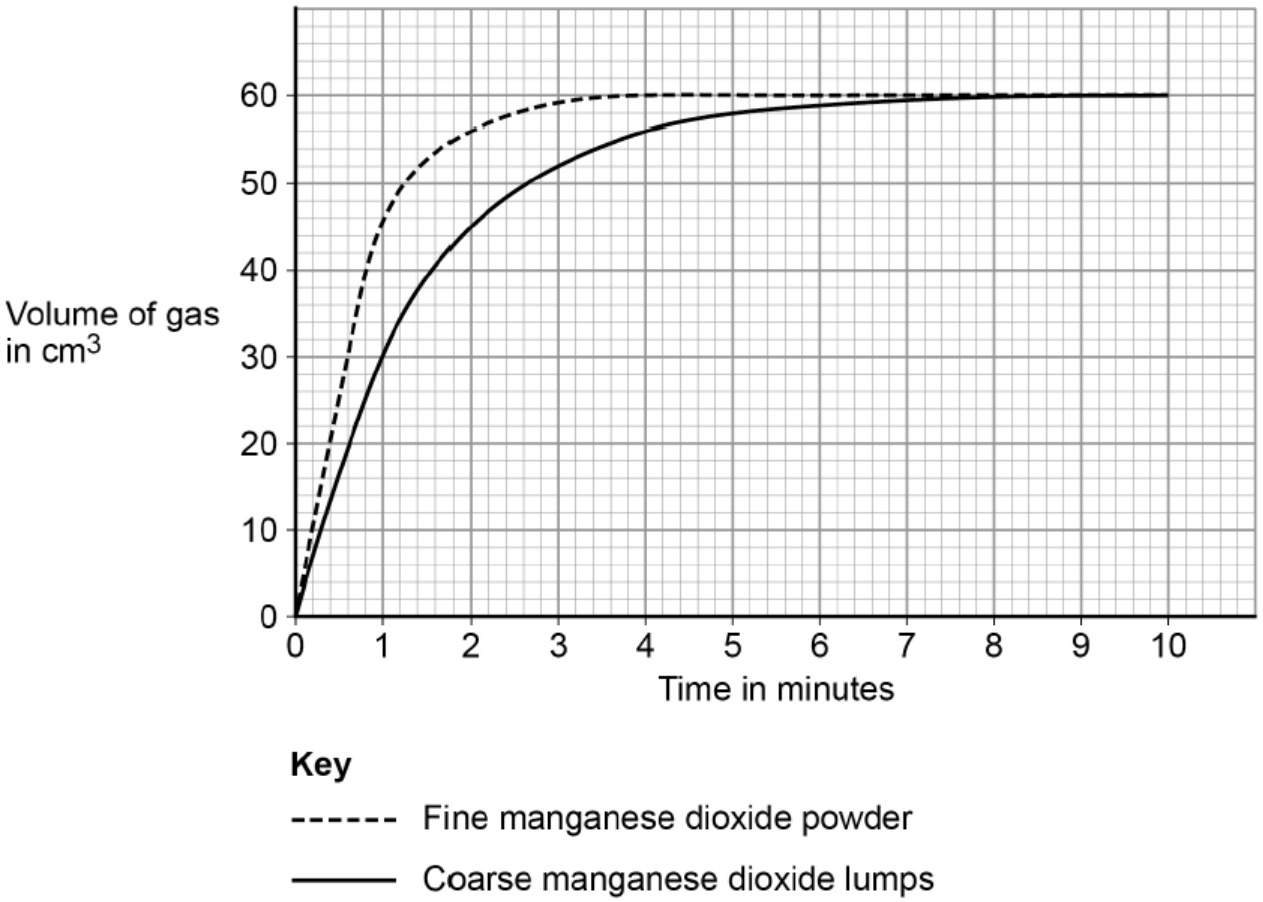
Tick (✓) **two** boxes.

- [ ] Measure the increase in mass of the conical flask and contents.
- [ ] Measure the volume of gas produced every 2 minutes.
- [ ] Place the conical flask in a water bath at constant temperature.
- [ ] Use 0.05 mol/dm^3 hydrogen peroxide solution.
- [ ] Use a mass of 1 g manganese dioxide each time.

Student **B** used a method which gave valid results.

Figure 9 shows student **B**'s results.

Figure 9



Determine the mean rate of reaction in cm^3/s between 2 and 4 minutes for coarse manganese dioxide lumps.

Give your answer to 2 significant figures.

Use data from **Figure 9**.

[3 marks]

Mean rate of reaction = _____ cm^3/s

Hydrogen peroxide molecules must collide with manganese dioxide particles for catalysis to take place.

Student **B** repeated the experiment with coarse lumps of manganese dioxide.

Student **B** used the same volume of 0.2 mol/dm^3 hydrogen peroxide instead of 0.3 mol/dm^3 hydrogen peroxide.

Sketch on **Figure 9** the curve you would expect to see.

Assume that the reaction is complete after 9 minutes.

[2 marks]

The rate of reaction is different when manganese dioxide is used as a fine powder rather than coarse lumps.

Explain why.

You should answer in terms of collision theory.

[2 marks]