AQA - Rate of reaction – GCSE Combine Science Chemistry

1. May/2020/Paper_8464/2F/No.4

This question is about hydrogen peroxide.

The symbol equation for the decomposition of hydrogen peroxide (H_2O_2) is:

$$2\ H_2O_2 \rightarrow 2\ H_2O + O_2$$

Complete the word equation for the decomposition of hydrogen peroxide.

[2 marks]

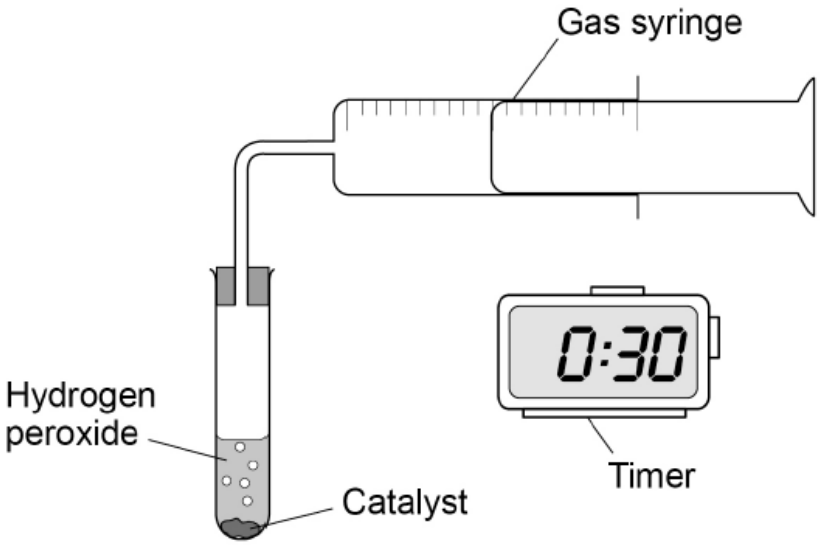
hydrogen peroxide → _____ + _____

A student investigated the effect of different catalysts on the decomposition of hydrogen peroxide.

The student measured the volume of gas collected every 30 seconds for 5 minutes.

Figure 5 shows the apparatus used.

Figure 5



Which **two** variables should the student keep the same to make the investigation a fair test?

[2 marks]

Tick (✓) **two** boxes.

Concentration of hydrogen peroxide ☐

Mass of catalyst ☐

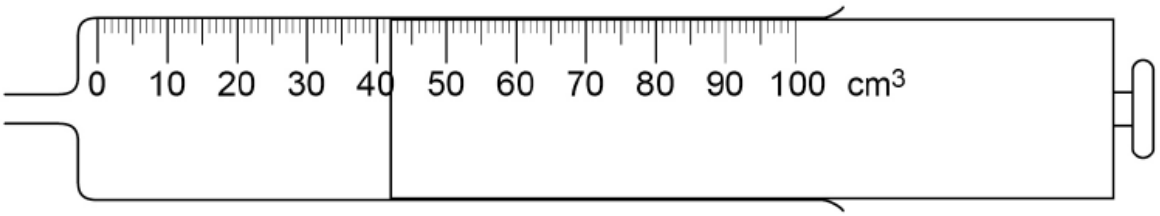
Size of gas syringe ☐

Type of catalyst ☐

Volume of gas collected ☐

Figure 6 shows a gas syringe.

Figure 6



What is the volume of gas in the syringe?

[1 mark]

Volume = _____ cm^3

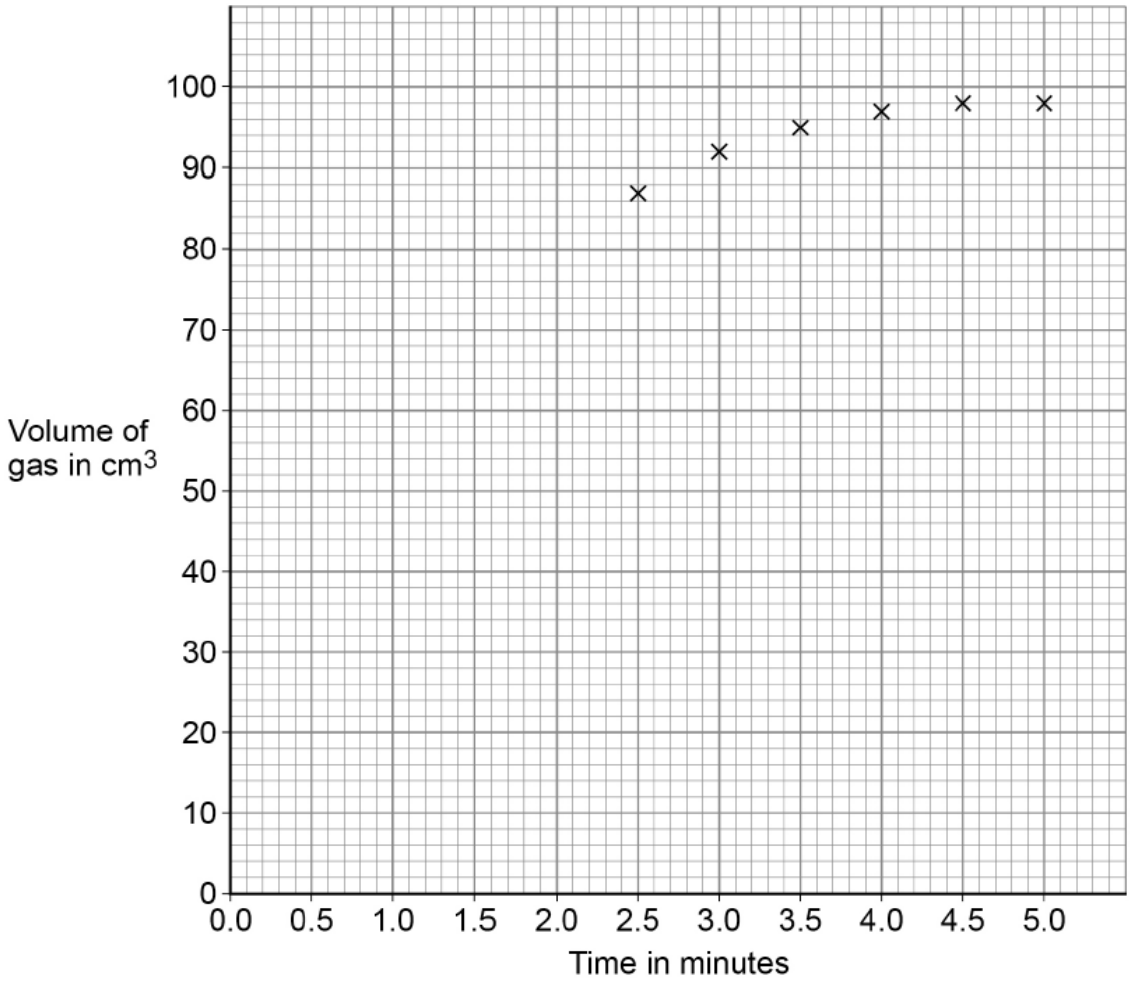
Table 3 shows the student's results for one catalyst.

Table 3

Time in minutes	0.0	0.5	1.0	1.5	2.0
Volume of gas in cm^3	0	34	54	68	78

Six of the other results have been plotted on **Figure 7**.

Figure 7



Complete the graph in **Figure 7**.

You should:

- plot the results from **Table 3**
- draw a line of best fit for all of the results.

[3 marks]

The student repeated the experiment with other catalysts and plotted a graph for each of the catalysts used.

Suggest how the student could use these graphs to identify the best catalyst.

[1 mark]

All the graphs level off at the same volume of gas.

Suggest why.

[1 mark]

In another investigation, a student increased the temperature of the hydrogen peroxide.

Why is the rate of reaction faster when the temperature of the hydrogen peroxide is increased?

[2 marks]

Tick (✓) **two** boxes.

- The concentration of hydrogen peroxide decreases. ☐
- The particles are moving more slowly. ☐
- The particles have more energy. ☐
- There are more particle collisions per second. ☐
- There are more particles per unit volume. ☐

2. May/2020/Paper_8464/2F/No.7

Some students investigated the effect of temperature on the rate of reaction.

The students reacted sodium thiosulfate solution with hydrochloric acid.

This is the method used.

1. Use a beaker to measure 50 cm^3 of heated sodium thiosulfate solution into a conical flask.

2. Measure the temperature of the room.

3. Put the conical flask on a black cross drawn on a piece of paper.

4. Start a timer.

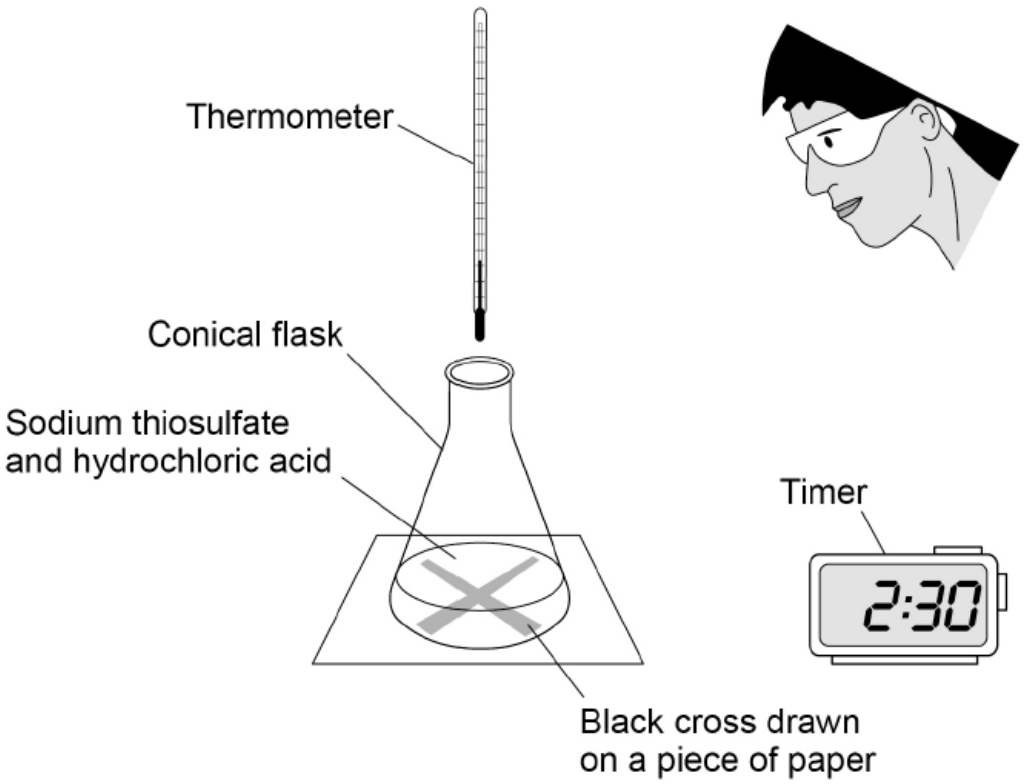
5. Use the same beaker to measure 10 cm^3 of hydrochloric acid into the conical flask.

6. Stop the timer when the cross is no longer visible.

The students repeated the experiment at a different room temperature.

Figure 10 shows the apparatus.

Figure 10



The method contains errors and does **not** produce accurate results.

Describe a method the students should use to produce accurate results.

You do **not** need to write about safety precautions.

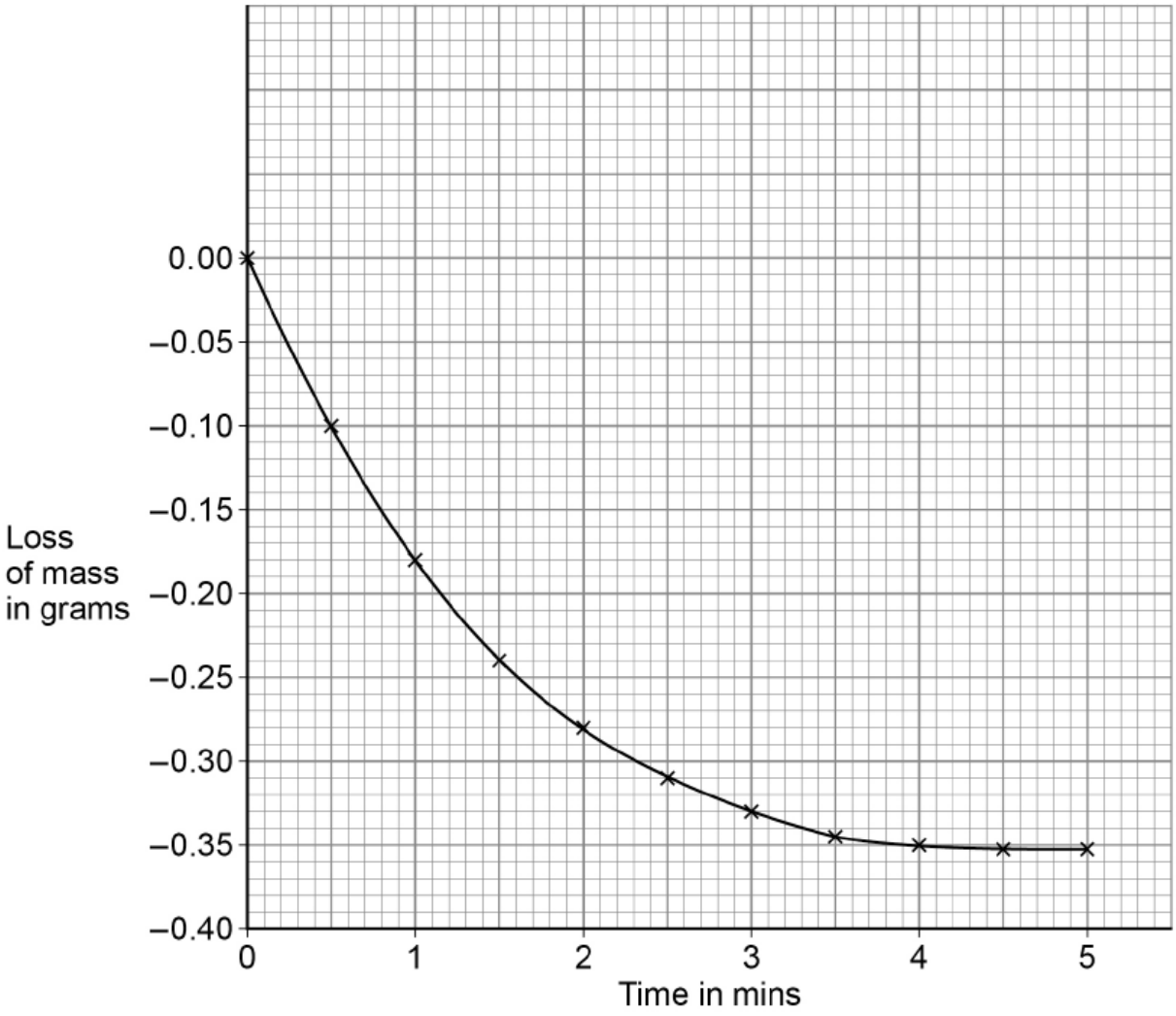
[6 marks]

Some students investigated the effect of temperature on the rate of a different reaction.

They recorded the loss of mass from their apparatus at 40 °C

Figure 11 shows the results.

Figure 11



Calculate the mean rate of reaction between 1 minute and 3 minutes at 40 °C

Use **Figure 11** and the equation:

$$\text{Mean rate of reaction} = \frac{\text{change in mass of gas in g}}{\text{time in mins}}$$

[3 marks]

Mean rate of reaction = _____ g/min

Draw a curve on **Figure 11** for the results you would expect at a temperature of 50 °C instead of 40 °C

[2 marks]

3. May/2020/Paper_8464/2H/No.2

Some students investigated the effect of temperature on the rate of reaction.

The students reacted sodium thiosulfate solution with hydrochloric acid.

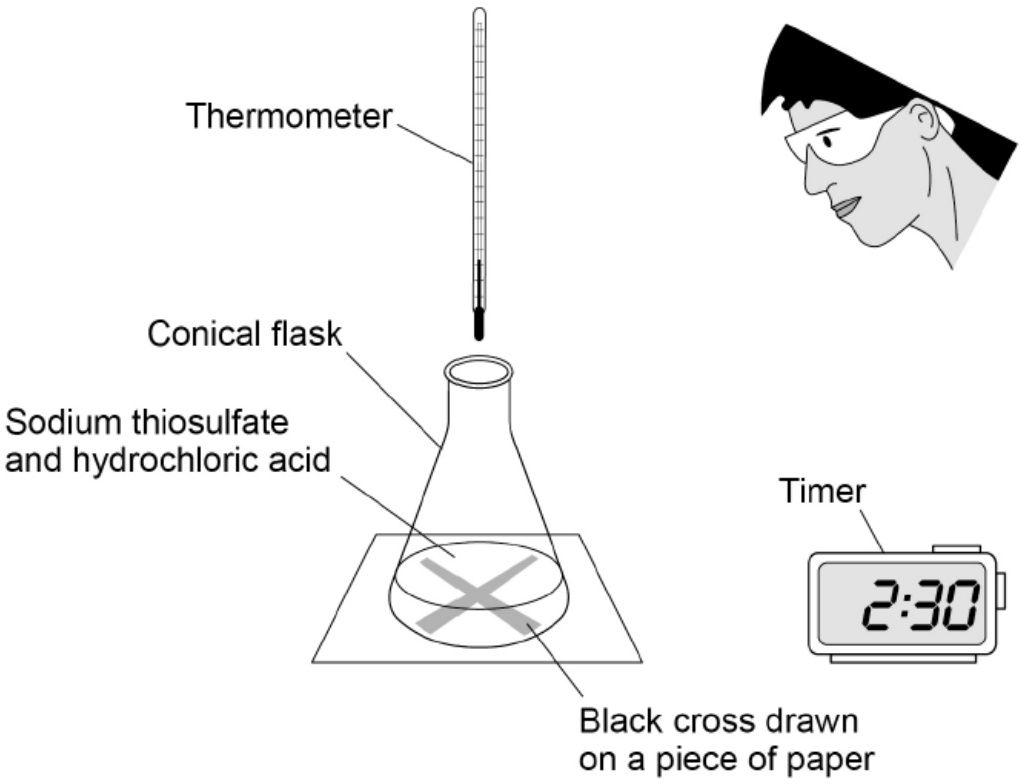
This is the method used.

1. Use a beaker to measure 50 cm^3 of heated sodium thiosulfate solution into a conical flask.
2. Measure the temperature of the room.
3. Put the conical flask on a black cross drawn on a piece of paper.
4. Start a timer.
5. Use the same beaker to measure 10 cm^3 of hydrochloric acid into the conical flask.
6. Stop the timer when the cross is no longer visible.

The students repeated the experiment at a different room temperature.

Figure 1 shows the apparatus.

Figure 1



The method contains errors and does **not** produce accurate results.

Describe a method the students should use to produce accurate results.

You do **not** need to write about safety precautions.

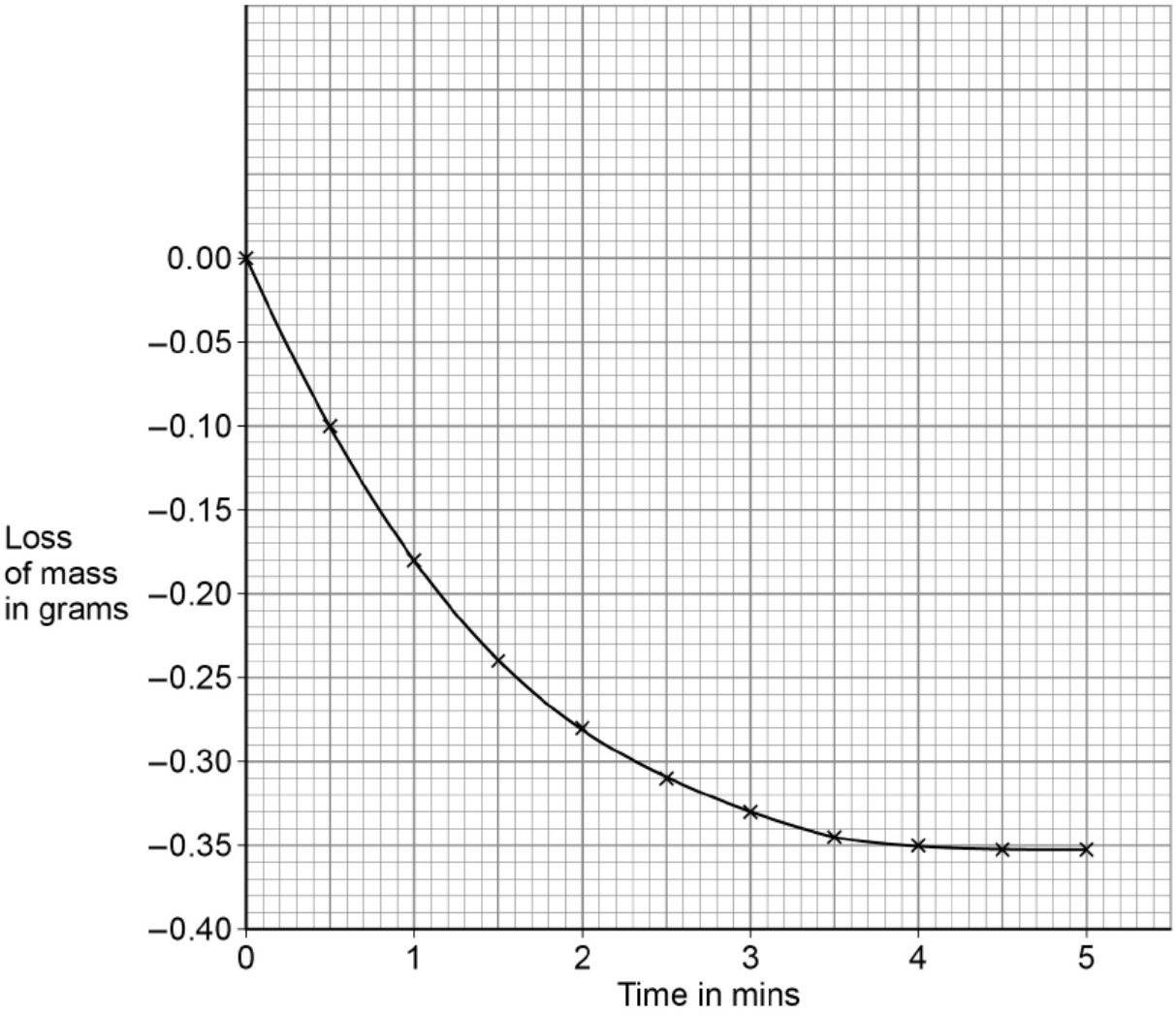
[6 marks]

Some students investigated the effect of temperature on the rate of a different reaction.

They recorded the loss of mass from their apparatus at 40 °C

Figure 2 shows the results.

Figure 2



Calculate the mean rate of reaction between 1 minute and 3 minutes at 40 °C

Use **Figure 2** and the equation:

$$\text{Mean rate of reaction} = \frac{\text{change in mass of gas in g}}{\text{time in mins}}$$

[3 marks]

Mean rate of reaction = _____ g/min

Draw a curve on **Figure 2** for the results you would expect at a temperature of 50 °C instead of 40 °C

[2 marks]

4. Jun/2019/Paper_8464/2F/No.2.4

Table 1 shows Student **A**'s results.

Table 1

Mass of small stones in grams (g)	Weight needed to break concrete beam in newtons (N)
500	70
1000	100
1500	110
2000	100
2250	85
2500	65
2750	35

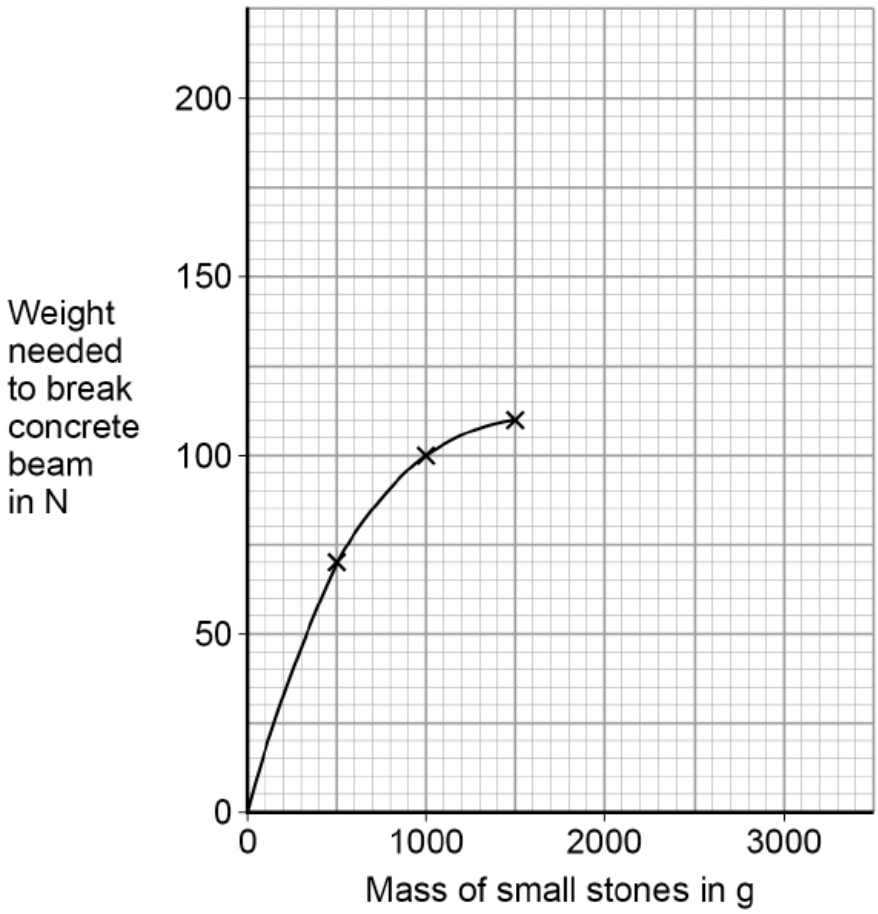
Plot the data from **Table 1** on **Figure 2**.

The first three points are plotted for you.

Draw the line of best fit.

[3 marks]

Figure 2



5. Jun/2019/Paper_8464/2F/No.2.5

What mass of small stones would be needed to make the strongest concrete?

Give a reason for your answer.

Use **Figure 2**.

[2 marks]

Mass = _____ g

Reason _____

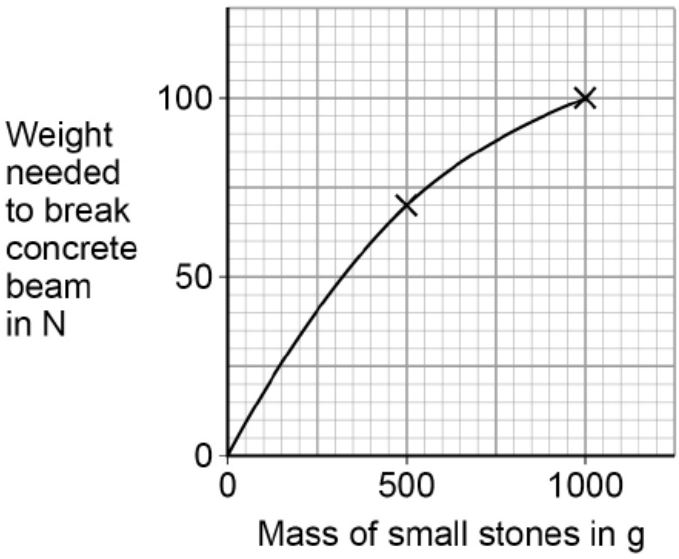
_____

6. Jun/2019/Paper_8464/2F/No.2.6

Student **B** did a similar investigation.

Figure 3 shows Student **B**'s results.

Figure 3



How could Student **B** improve their investigation?

Use **Figure 2** and **Figure 3**.

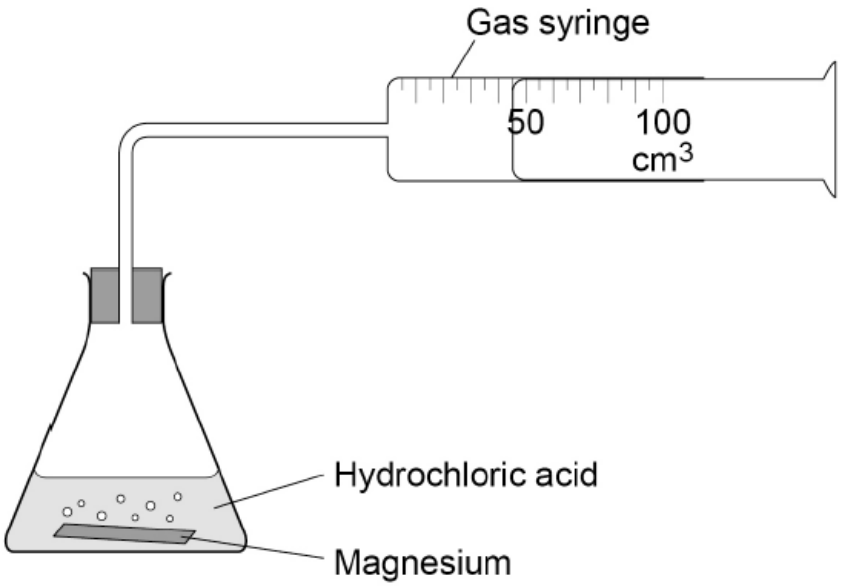
[1 mark]

7. Jun/2019/Paper_8464/2F/No.3

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

Figure 4 shows the apparatus the student used.

Figure 4



Balance the equation for the reaction.

[1 mark]

$$Mg + \_\_\_\_\_ HCl \rightarrow MgCl_2 + H_2$$

The student used 50 cm^3 of hydrochloric acid.

Which apparatus would measure 50 cm^3 of hydrochloric acid with the greatest accuracy?

[1 mark]

Tick (✓) **one** box.

50 cm^3 beaker ☐

50 cm^3 conical flask ☐

50 cm^3 measuring cylinder ☐

The student measured the volume of gas produced every 20 seconds for 2 minutes.

The volume of gas was zero at the start of the experiment.

The measured volumes of gas were:

26 cm^3 38 cm^3 47 cm^3 55 cm^3 59 cm^3 60 cm^3

Complete **Table 2** to show these results.

[4 marks]

Table 2

0	0

The volumes of gas were lower than expected.

Suggest **one** reason.

[1 mark]

_____

_____

The student repeated the experiment using different concentrations of hydrochloric acid.

Give **two** variables the student should keep the same.

[2 marks]

1 _____

2 _____

Complete the sentences.

[3 marks]

As the concentration of the hydrochloric acid increased, the

rate of the reaction _____ .

This is because there were more acid _____ in each

cubic centimetre (cm^3).

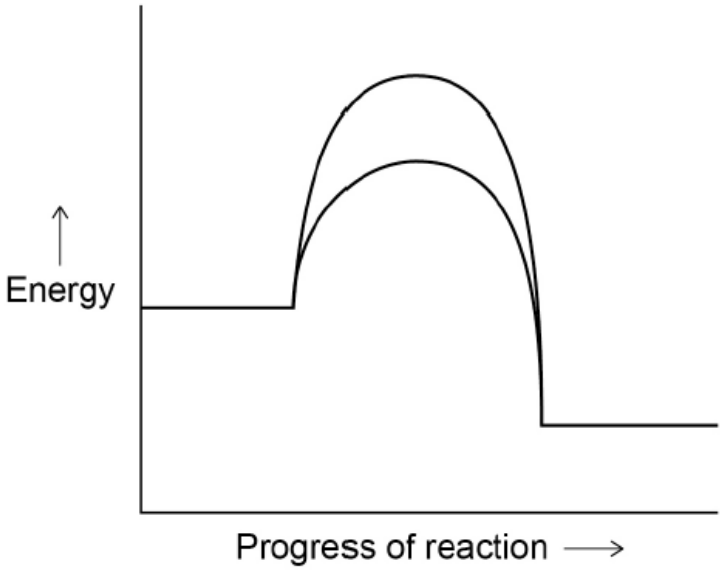
So the collisions happened more _____ .

8. Jun/2019/Paper_8464/2H/No.4.3

Copper is used as a catalyst.

Figure 1 shows reaction profiles for a reaction with and without a catalyst.

Figure 1



How do the reaction profiles show that using a catalyst does **not** affect the overall energy change for the reaction?

[1 mark]

Tick (✓) **one** box.

Both reaction profiles show exothermic reactions. ☐

Both reaction profiles start at the same energy level and end at the same energy level. ☐

Both reaction profiles show the activation energy. ☐

The activation energy for the uncatalysed reaction is much lower than for the catalysed reaction. ☐

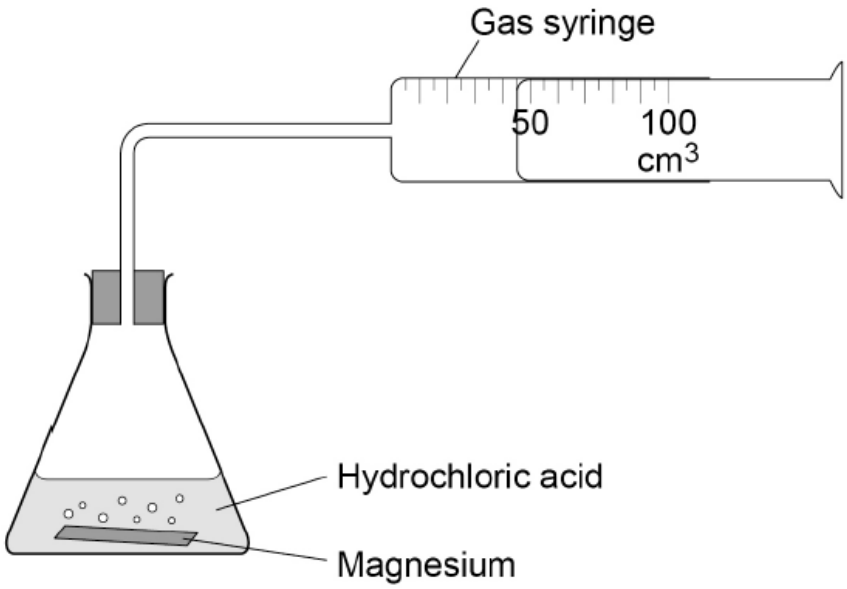
9. Jun/2019/Paper_8464/2H/No.5

This question is about magnesium.

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

Figure 2 shows the apparatus.

Figure 2



Which is the correct ionic equation for the reaction?

[1 mark]

Tick (✓) **one** box.

$Mg + 2H^+ \rightarrow Mg^{2+} + H_2$ ☐

$Mg^{2+} + 2Cl^- \rightarrow MgCl_2$ ☐

$Mg + 2HCl \rightarrow MgCl_2 + H_2$ ☐

$Mg^+ + Cl^- \rightarrow MgCl$ ☐

What happens in the reaction between magnesium and hydrochloric acid?

[1 mark]

Tick (✓) **one** box.

Electron sharing ☐

Electron transfer ☐

Proton transfer ☐

Table 2 shows the student's results.

Table 2

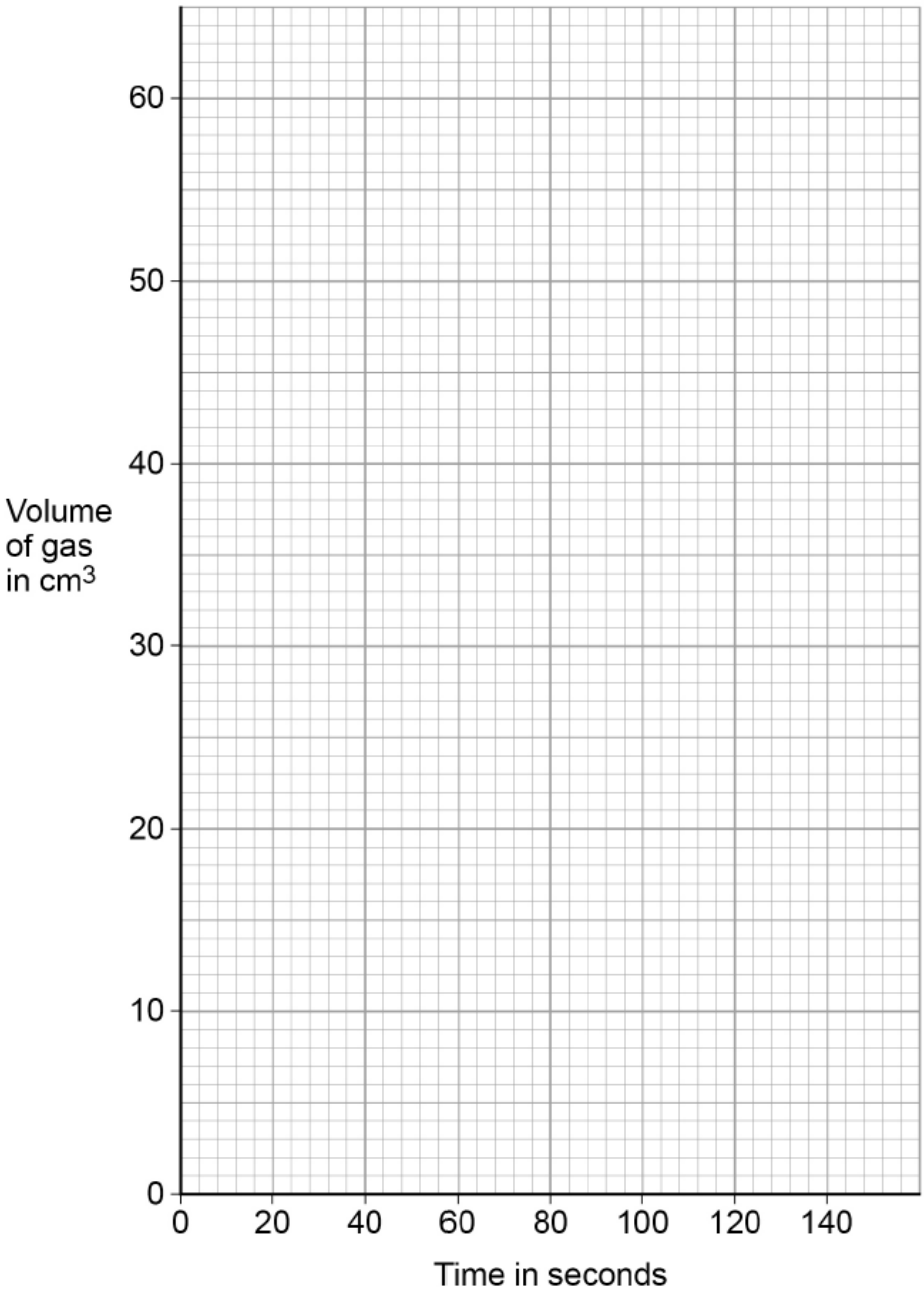
Time in seconds	0	10	35	50	95	120	140
Volume of gas in cm^3	0.0	12.5	36.0	43.5	59.0	60.0	60.0

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

Draw a line of best fit.

[3 marks]

Figure 3



Describe the changes in the rate of this reaction.

[3 marks]

Explain why the rate of this reaction changes.

Give your answer in terms of collision theory.

[3 marks]