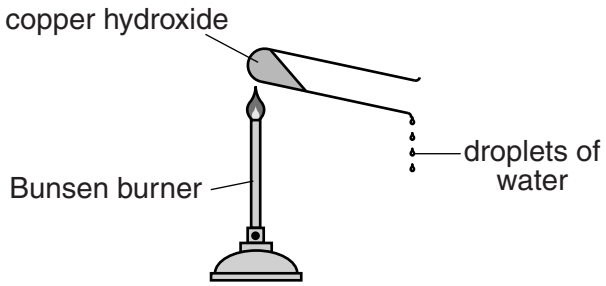
1 Jess investigates the thermal decomposition of copper hydroxide.

$$\text{copper hydroxide} \rightarrow \text{copper oxide} + \text{water}$$

Look at the apparatus she uses.



She measures the mass of copper hydroxide at the start.

She then heats the copper hydroxide for 5 minutes.

Jess lets the apparatus cool down.

She then measures the mass of copper oxide made.

Jess does the experiment four more times.

Look at her results.

Experiment number	Mass of copper hydroxide in g	Mass of copper oxide made in g	Mass of water made in g
1	0.50	0.41	
2	1.00	0.82	
3	1.50	1.22	
4	2.00	1.63	
5	2.50	1.90	

Jess predicts that the mass of water made is directly proportional to the mass of copper hydroxide heated.

Is this prediction supported by her results?

Complete the table and use the data to explain your answer.

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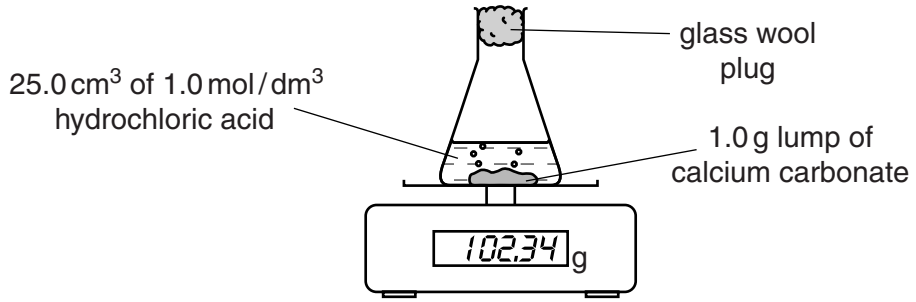
..... **[3]**

[Total: 3]

2 Debbie places a 1.0 g lump of calcium carbonate into a flask.

She adds 25.0 cm^3 of 1.0 mol/dm^3 hydrochloric acid to the flask.

She puts the flask on top of an electronic balance.



This apparatus can be used to find the mass of carbon dioxide made during the reaction.

(a) Debbie repeats the experiment.

This time she uses 25.0 cm^3 of 1.0 mol/dm^3 **ethanoic acid** instead of hydrochloric acid.

The reaction is much slower because ethanoic acid is a weak acid.

Explain why weak acids react **more slowly** than strong acids.

.....

.....

..... **[1]**

(b) Debbie wants to measure the **volume** of carbon dioxide made during the reaction.

Draw a labelled diagram of the apparatus she should use.

[2]

[Total: 3]

3 Faye is a scientist. She works for Didcot Detergents.

Faye is researching some new detergents.

Look at the table. It shows if her new detergents remove different stains at low temperatures.

Detergent	Is stain removed?			
	Food	**Paint**	**Grease**	**Blood**
A	✗	✓		✗
B	✗	✓	partly	✗
C	✓	✗		✓
D	✗	✗	✓	✗

(a) One of the detergents contains an **enzyme**.

Suggest which one.

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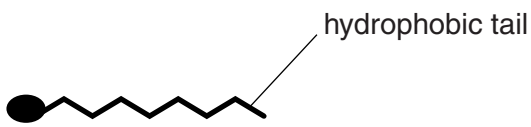
Explain your answer.

.....

.....

..... **[2]**

(b) Look at the diagram of a detergent molecule.



Explain how detergents remove fat and oil stains from clothes.

You may wish to draw a **labelled** diagram.

.....

.....

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.....

..... **[3]**

(c) Some fats are **unsaturated**.

Describe a chemical test to show that a fat is unsaturated.

test .....

result .....

.....

[2]

[Total: 7]

4 Ethanol can be made by the fermentation of glucose.

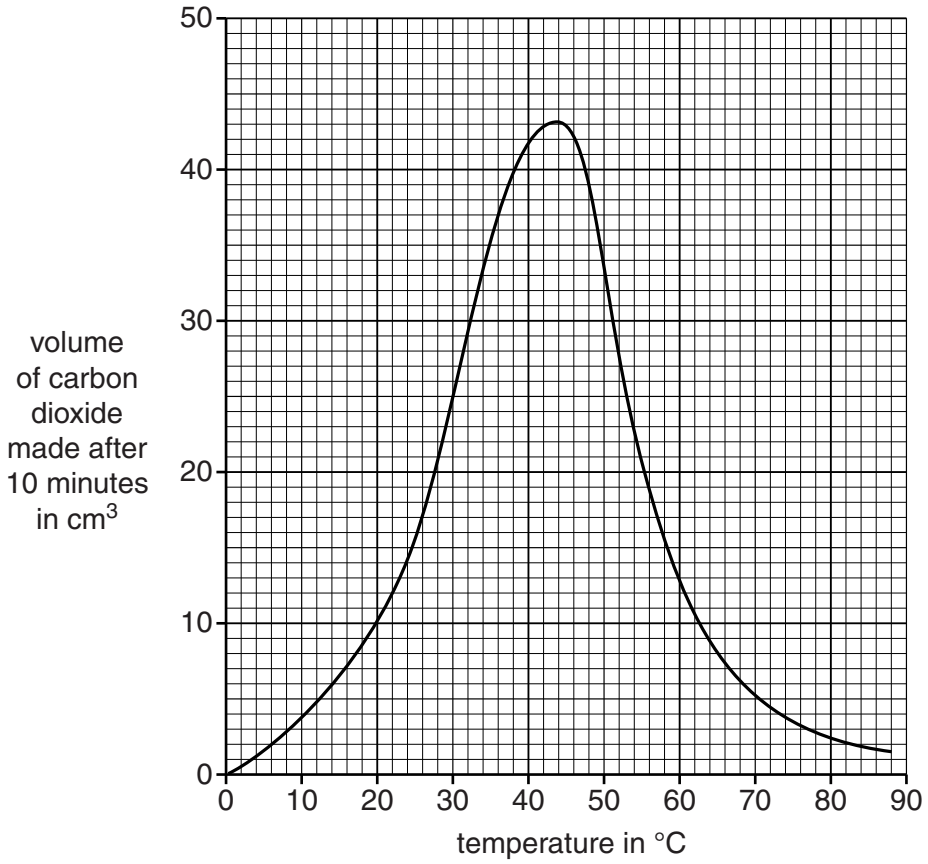
Tina and Tommy investigate the fermentation of glucose.

They use 50 cm^3 of glucose solution and 1 g of yeast.

Tina and Tommy measure the volume of carbon dioxide made after 10 minutes.

They do the experiment at different temperatures.

Look at the graph. It shows their results.



(a) **(i)** What is the volume of carbon dioxide made at **60 °C**?

answer ..... cm^3 **[1]**

(ii) At what temperature is the reaction fastest?

answer ..... °C

Explain your answer.

.....

..... **[2]**

(b) Glucose reacts to make carbon dioxide and ethanol.

Look at the formulas.

Substance	Formula
glucose	$C_6H_{12}O_6$
carbon dioxide	CO_2
ethanol	C_2H_5OH

Write down the **balanced symbol** equation for this reaction.

..... **[2]**

(c) The general formula for an alcohol is

$$C_nH_{2n+1}OH$$

Propanol contains three carbon atoms.

(i) Write the formula for propanol.

..... **[1]**

(ii) Draw the **displayed formula** of propanol.

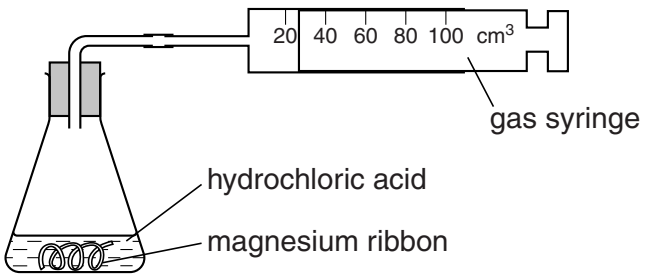
[1]

[Total: 7]

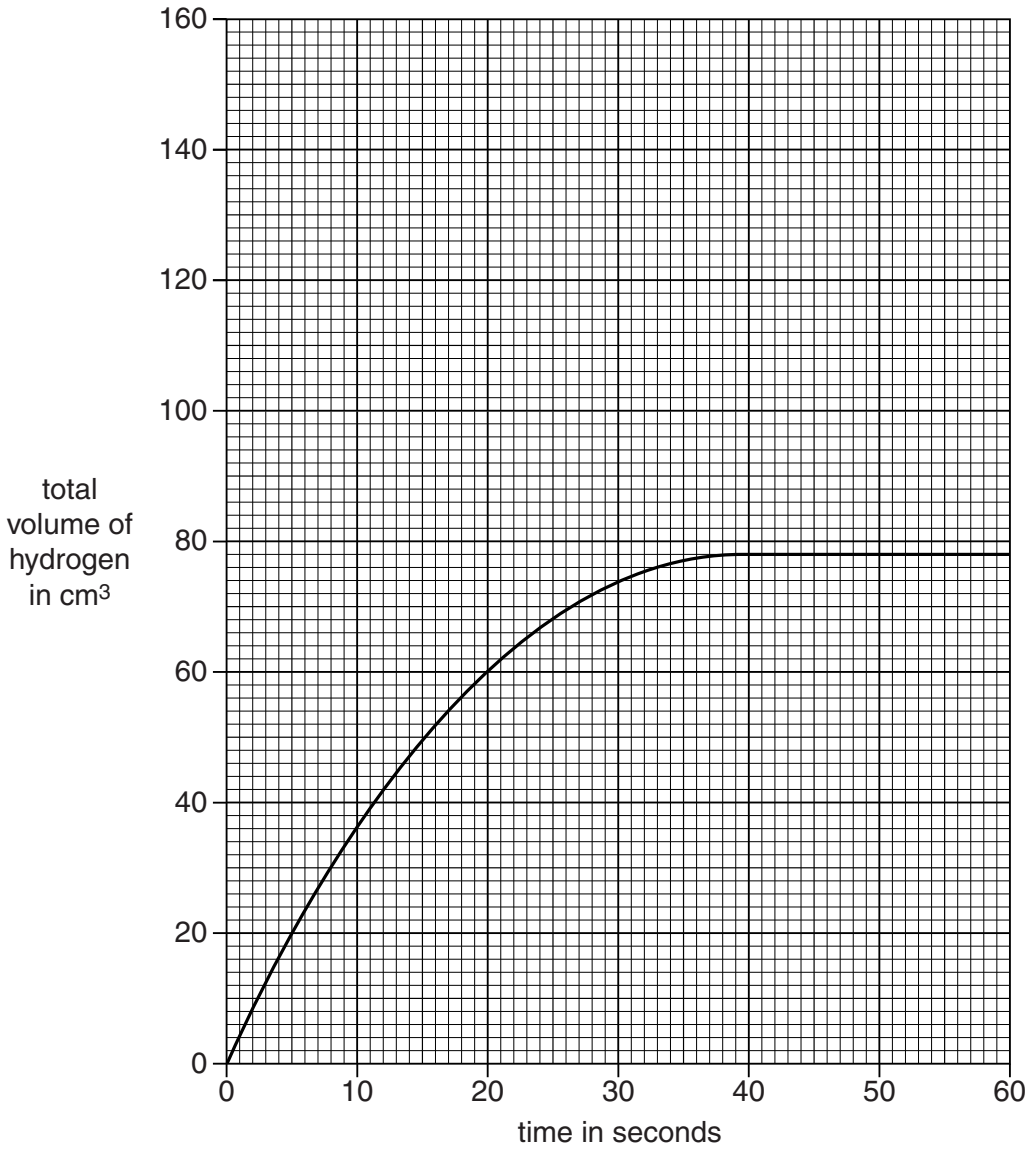
5 Trevor and Julie investigate the reaction between magnesium and hydrochloric acid at 20 °C.

magnesium + hydrochloric acid → magnesium chloride + hydrogen

Look at the diagram. It shows the apparatus they use.



Look at the graph. It shows their results.



(a) **(i)** What is the volume of hydrogen made after 25 seconds?

answer ..... cm^3 **[1]**

(ii) How long does it take for the reaction to stop?

answer ..... seconds **[1]**

(iii) Trevor and Julie repeat the experiment.

They keep everything the same except the temperature.

They increase the temperature from 20 °C to 35 °C.

On the grid, sketch the graph of the results they should get. **[1]**

(b) Magnesium is the **limiting reactant** in this reaction.

What is meant by limiting reactant?

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..... **[1]**

[Total: 4]

6 Antacid tablets are used to stop indigestion.

Antacid tablets contain calcium carbonate, $CaCO_3$.

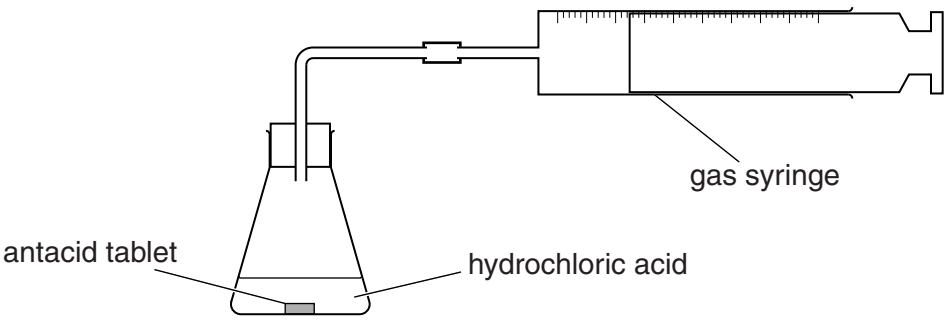
Jennie and Gary investigate the reaction of antacid tablets with hydrochloric acid.

Calcium chloride, $CaCl_2$, water and carbon dioxide are made.

(a) Write a **balanced symbol** equation for this reaction.

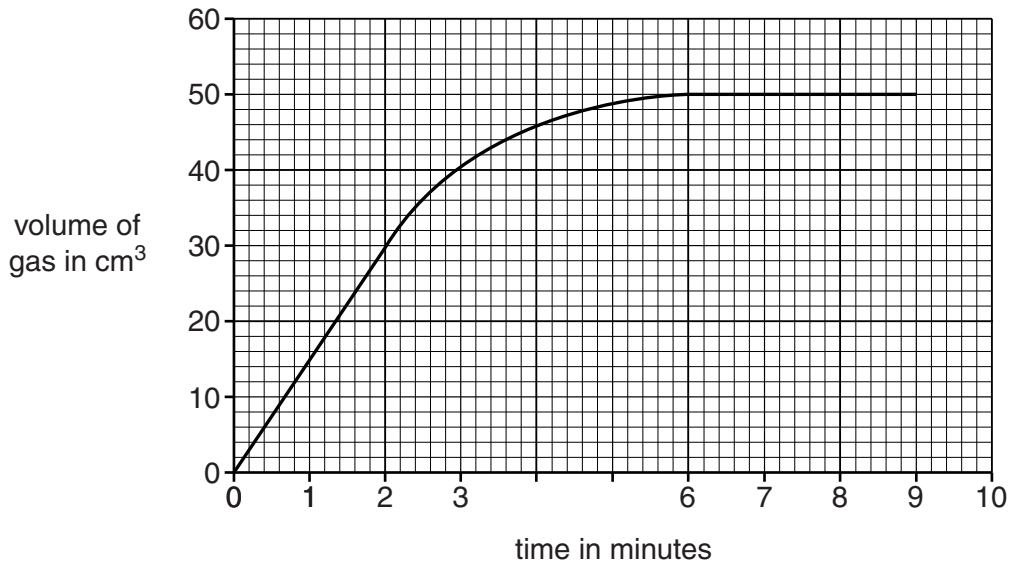
..... **[2]**

(b) Look at the diagram. It shows the apparatus they use.



Jennie and Gary react an antacid tablet with 100 cm^3 of hydrochloric acid.

Look at the graph. It shows their results.



(i) How long does it take for the reaction to stop?

answer ..... minutes **[1]**

(ii) Calculate the average rate of this reaction during the first 2 minutes of the experiment.

.....

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answer ..... unit ..... **[2]**

(iii) The rate of reaction for the first 2 minutes is different to the rate of reaction between 2 and 4 minutes.

Describe how.

.....

..... **[1]**

(c) The rate of reaction between an antacid tablet and hydrochloric acid can be increased by

- increasing the concentration of the hydrochloric acid
- crushing the tablet.

Explain, using ideas about collisions between reacting particles, why these methods increase the rate of this reaction.



The quality of written communication will be assessed in your answer to this question.

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..... **[6]**

[Total: 12]

7 Magnesium reacts with dilute hydrochloric acid, HC*l*.

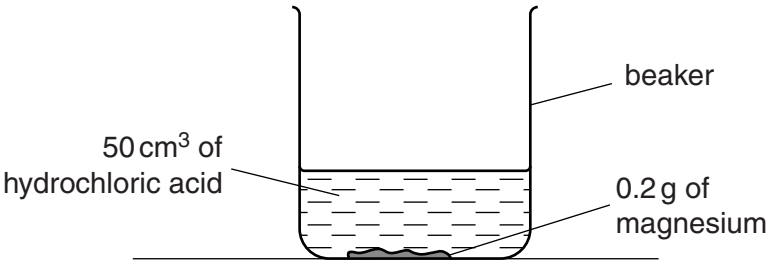
Magnesium chloride and hydrogen, H_2, are made.

(a) Write down the **balanced symbol** equation for this reaction.

..... **[2]**

(b) Peter and Rachel investigate the reaction between magnesium and hydrochloric acid.

Look at the apparatus they use.



They time how long it takes for all of the magnesium to react (the reaction time).

Look at their results.

experiment	temperature of acid	concentration of acid	magnesium ribbon or powder	reaction time in seconds	mean rate of reaction in g/s
A	cold	dilute	ribbon	240	8.33×10^{-4}
B	cold	concentrated	ribbon	120	
C	warm	dilute	ribbon	100	2.00×10^{-3}
D	cold	dilute	powder	50	4.00×10^{-3}

(i) Look at the results for experiment **B**.

Calculate the mean rate of reaction in experiment **B**.

Give your answer to **three** significant figures.

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.....

rate of reaction = ... g/s **[1]**

(ii) Peter and Rachel can use a model called **collision theory** to explain how factors affect the rate of a reaction.

They know the rate of reaction increases when

- the temperature of the acid increases
- magnesium powder is used instead of magnesium ribbon.

Explain why, using collision theory.



The quality of written communication will be assessed in your answer to this question.

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..... **[6]**

[Total: 9]