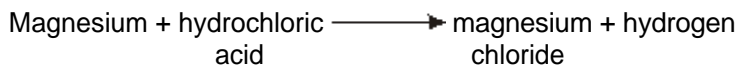
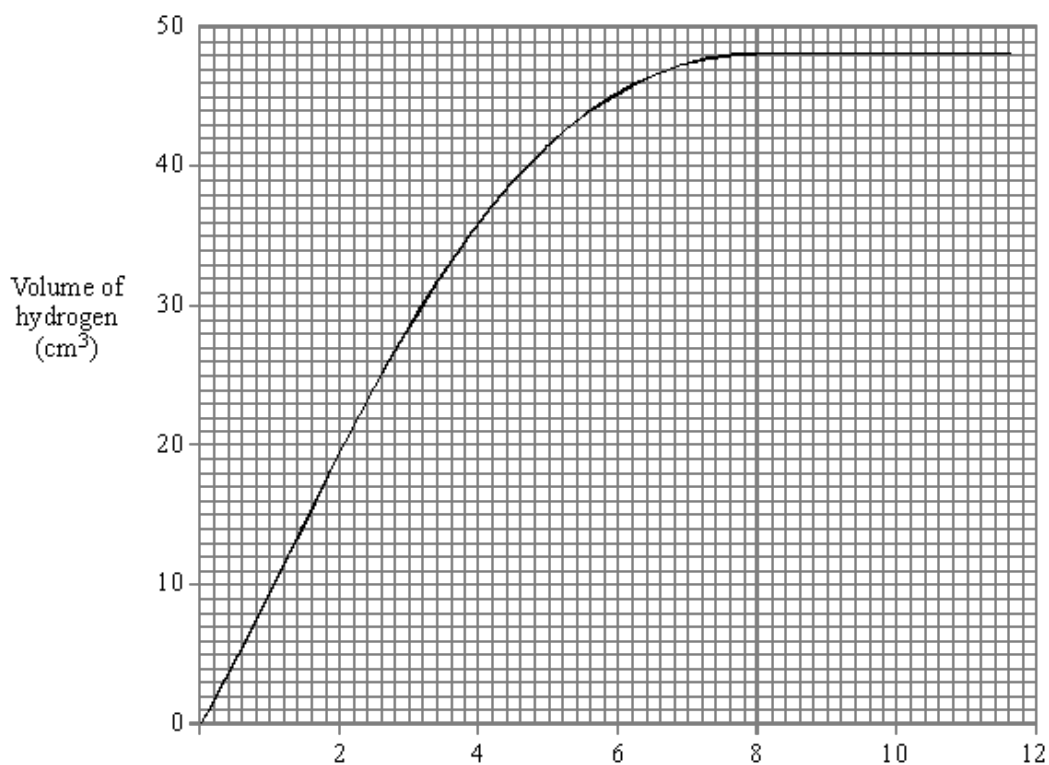


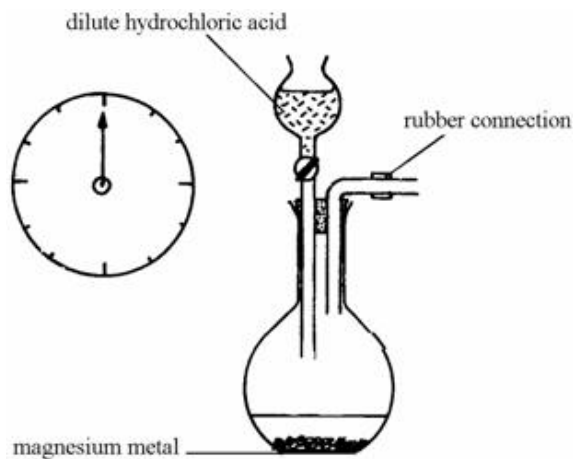
- Q1.** A student does an experiment to examine the rate of reaction between magnesium and dilute hydrochloric acid. She adds 25 cm³ of the acid to a weighed amount of the metal. The reaction produces hydrogen gas.



She collects the gas and measures the volume collected at one minute intervals. All the metal reacted but there was some acid left unreacted. Her results are shown on the graph.



- (a) The diagram shows part of the apparatus she used for the experiment. Complete the diagram to show how the student could collect the hydrogen produced and measure the volume after each minute.



(2)

(b) (i) When is the rate of reaction at its fastest?

.....

(1)

(ii) State **one** way in which she could increase the rate of reaction.

.....

(1)

(c) (i) What is the total volume of hydrogen collected in the experiment?

..... cm³

(1)

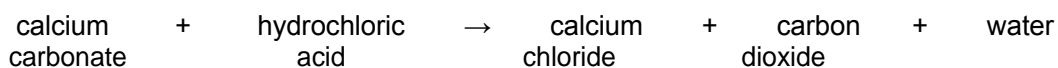
(ii) State **one** way in which she could increase the final volume of hydrogen collected.

.....

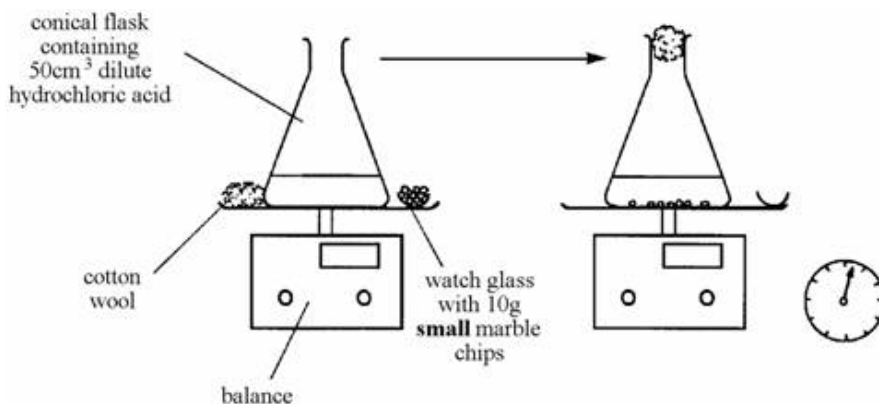
(1)

(Total 6 marks)

Q2. Marble chips (calcium carbonate) react with dilute hydrochloric acid.



A student wanted to find out if the size of the marble chips made a difference to how fast the reaction took place.



(a) What readings should she take?

.....
.....
.....

(2)

- (b) She repeated the experiment but this time used the same mass (10g) of **large** marble chips.

In both experiments there was some marble left in the flask when the reaction stopped.

These are the results of the two experiments.

TIME (minutes)	0	2	4	6	8	10	12
Loss in mass (g), using small chips	0.00	0.40	0.72	0.91	1.04	1.04	1.04
Loss in mass (g), using large chips	0.00	0.28	0.52	0.70	0.84	0.94	1.04

- (i) Explain the loss in mass in the two experiments.

.....

(1)

- (ii) What difference does the size of the chips make?

.....

(1)

- (c) A chemical reaction occurs when reacting particles collide with sufficient energy. The reaction between marble and hydrochloric acid is faster if the acid is at a higher temperature. Explain why.

.....

(3)

(Total 7 marks)

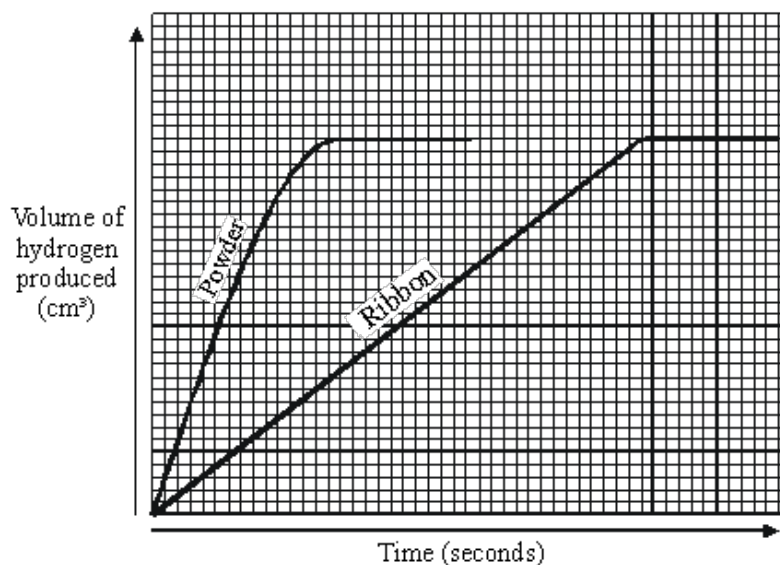
- Q3.** Some students were investigating how fast hydrogen gas is released in the reaction between magnesium and dilute hydrochloric acid.

To begin with they used 0.1 g of magnesium ribbon.

Next, they repeated the experiment using 0.1 g of magnesium powder.

In each case, they used enough acid to react with all the metal.

(a) Their results are shown on the graph below.



Hydrogen is produced in both the reactions.

Use the information on the graph to describe **two other** ways in which the two reactions are similar.

1.

.....

2.

.....

(2)

(b) Describe **one** way in which the reactions are different.

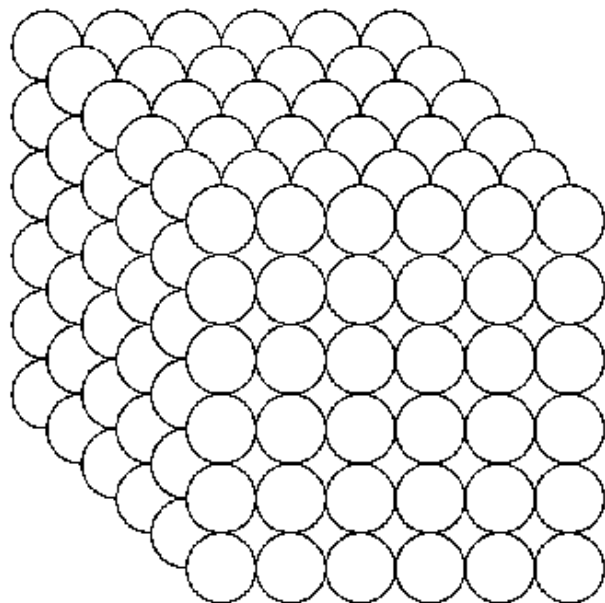
.....

.....

(1)

(Total 3 marks)

Q4. The diagram represents the particles in a piece of reactive metal.



The piece of reactive metal is added to dilute hydrochloric acid.

(a) (i) Which particle will probably react first?

Choose from:

- a particle inside the piece;
- a particle at the centre of a face;
- a particle on one of the corners.

.....

(1)

(ii) Explain the reason for your choice.

.....

.....

(1)

(b) The reaction can be speeded up by making changes to the hydrochloric acid or the solid.

(i) State **two** ways to speed up the reaction by changing the hydrochloric acid. In each case explain in terms of particles why the reaction is faster.

1.

.....

.....

(2)

2.

.....

.....

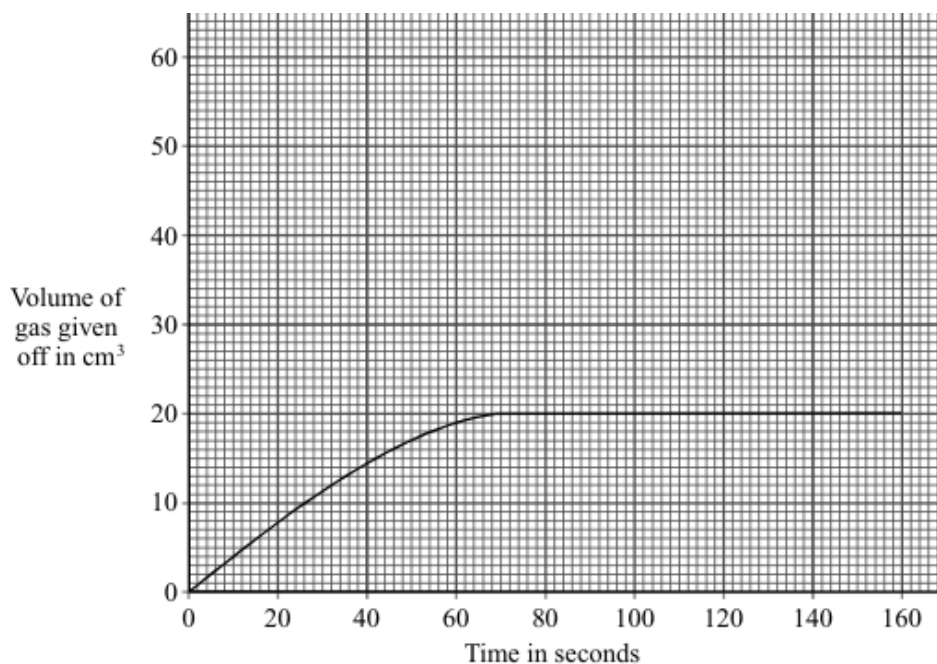
(2)

- (ii) What change can you make to the piece of solid to speed up the reaction? Explain in terms of the particles why the reaction is able to speed up.

.....
.....

(2)
(Total 8 marks)

- Q5.** The graph shows the volume of gas given off during an experiment using hydrogen peroxide solution and manganese oxide.

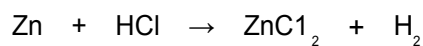


Draw, on the axes above, a graph to show the result you would expect if the volume of hydrogen peroxide solution had been the same, but it was **twice** as concentrated.

(Total 3 marks)

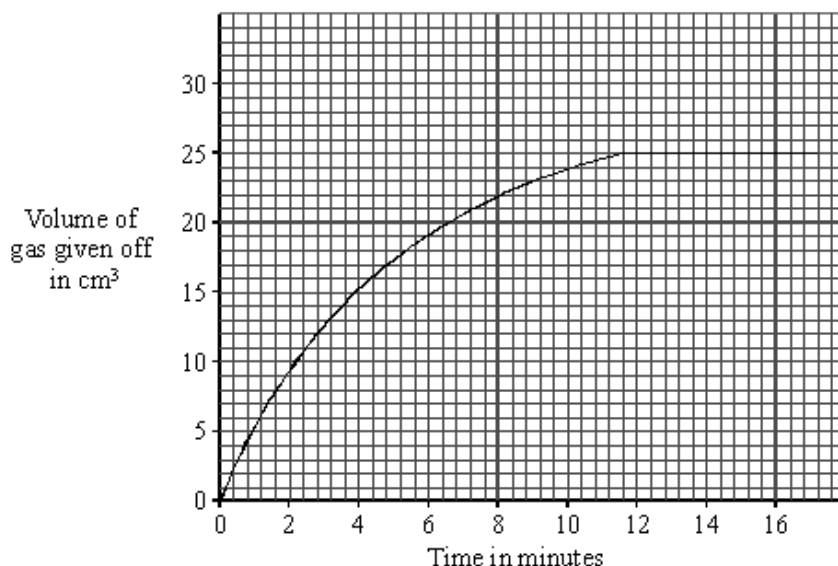
- Q6.** Zinc powder normally reacts slowly with hydrochloric acid.

- (a) Balance the symbol equation for the reaction.



(1)

The graph shows the results from a reaction of 1.0 g of zinc powder with 20 cm³ of dilute hydrochloric acid. It gives off a gas and forms zinc chloride, ZnCl₂. Some unreacted zinc is left at the end.



(b) Copper powder is a good catalyst for the reaction of zinc with hydrochloric acid.

- (i) A mixture of 10 cm³ of the same dilute hydrochloric acid and 1.0 g of copper powder was added to 1.0 g of zinc powder. What is the maximum volume of gas which could be given off?

..... cm³

(1)

- (ii) Draw a graph, on the axes above, for an experiment where 20 cm³ of the same dilute hydrochloric acid was added to 1.0 g of copper powder mixed with 1.0 g of zinc powder.

(2)

- (iii) Give **two** other ways the reaction described in part (i) could be made to go faster.

1.

2.

(2)

(c) Copper powder can be formed by adding copper sulphate solution to the mixture of zinc powder and acid.

- (i) Why does zinc react with copper sulphate solution to produce copper?

.....

.....

(1)

(ii) Write the word equation for the reaction.

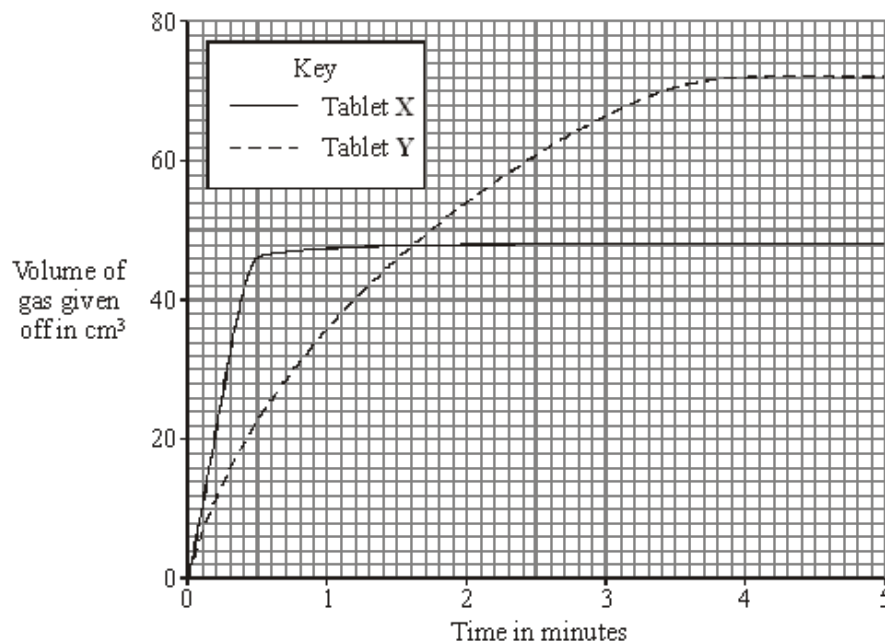
.....

(1)
(Total 8 marks)

Q7. Many indigestion tablets contain calcium carbonate as their only active ingredient. Calcium carbonate neutralises some of the hydrochloric acid in the stomach.

Two different indigestion tablets, **X** and **Y**, were separately reacted with excess hydrochloric acid. The volume of gas given off in each reaction was measured every minute.

The results are shown in the graph.



(i) Which tablet, **X** or **Y**, contained most calcium carbonate?

Explain the reason for your answer.

.....
.....

(1)

(ii) Which tablet, **X** or **Y**, reacted faster with hydrochloric acid?

Explain the reason for your answer.

.....
.....

(1)

(iii) Explain the shape of the graph for tablet **X** between 3 and 5 minutes.

.....

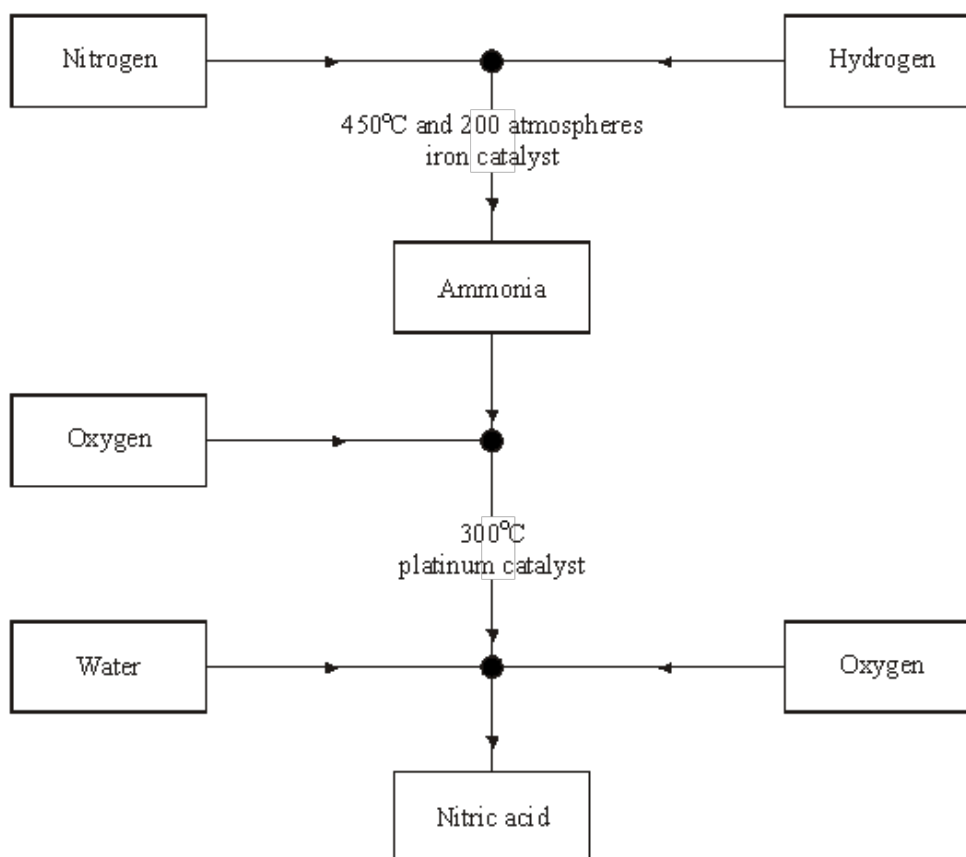
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.....

.....

(1)
(Total 3 marks)

Q8. The flow diagram shows how to make ammonia and nitric acid from the nitrogen in the air.



(a) A fertiliser is made by neutralising ammonia with nitric acid. What is the name of this fertiliser?

.....

(1)

(b) In the flow diagram, why are two different catalysts used?

.....

.....

(1)

(c) What happens to catalysts at the end of a reaction?

.....
.....

(1)

(d) Explain why catalysts are used in many industrial chemical reactions.

.....
.....
.....

(2)

(e) Explain, in terms of collisions between molecules, why a high pressure is used in the reaction between nitrogen and hydrogen.

.....
.....
.....
.....

(2)

(Total 7 marks)

Q9. Hydrogen peroxide slowly decomposes into water and oxygen.

hydrogen peroxide → water + oxygen

The reaction can be speeded up by adding manganese dioxide.

(a) (i) What do we call a substance that speeds up a chemical reaction without being changed itself?

.....

(1)

(ii) Give **two** other ways of increasing the rate of this reaction.

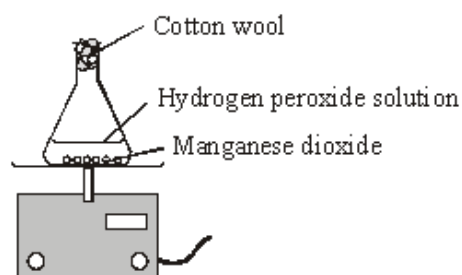
1

2

(2)

- (b) The diagram shows how the rate of this reaction can be measured.

As the hydrogen peroxide decomposes, the mass of the flask and its contents decreases.

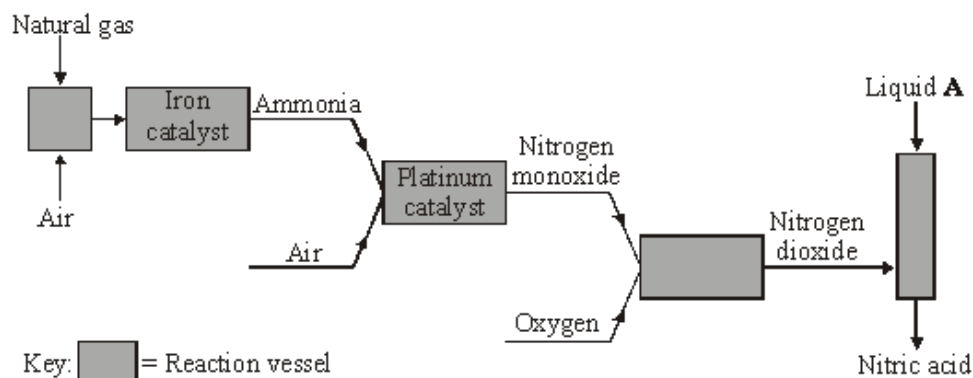


Why does this decrease in mass take place?

.....

(1)
 (Total 4 marks)

- Q10.** The flow diagram shows some stages in the manufacture of the fertiliser ammonium nitrate (NH_4NO_3).



- (a) The elements needed to make ammonia (NH_3) are obtained from natural gas and air. Which element is obtained from the air?

.....

(1)

- (b) The word equation for the formation of nitrogen monoxide is:



The platinum catalyst needs to be heated only at the start of the reaction.
Suggest why.

.....
.....
.....

(1)

- (c) Name the liquid **A** that reacts with nitrogen dioxide (NO_2) to produce nitric acid (HNO_3).

.....

(1)

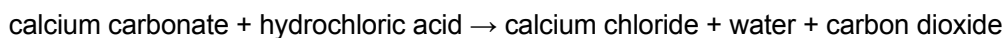
- (d) Describe how ammonium nitrate (NH_4NO_3) can be made from **two** of the products shown in the flow diagram.

.....
.....
.....
.....

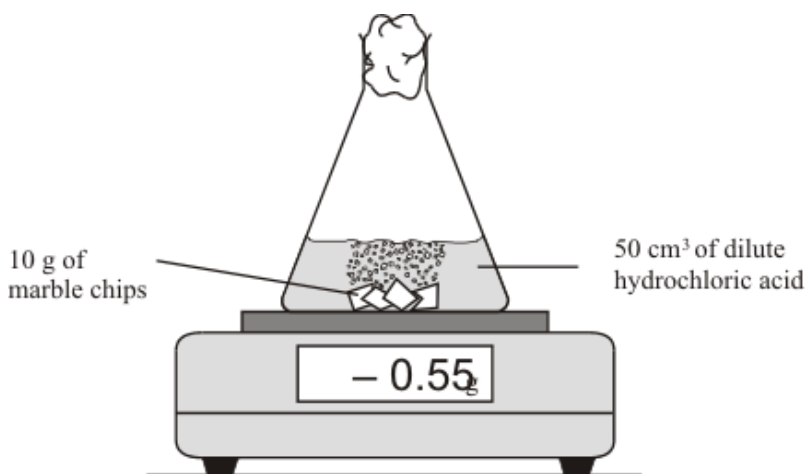
(2)

(Total 5 marks)

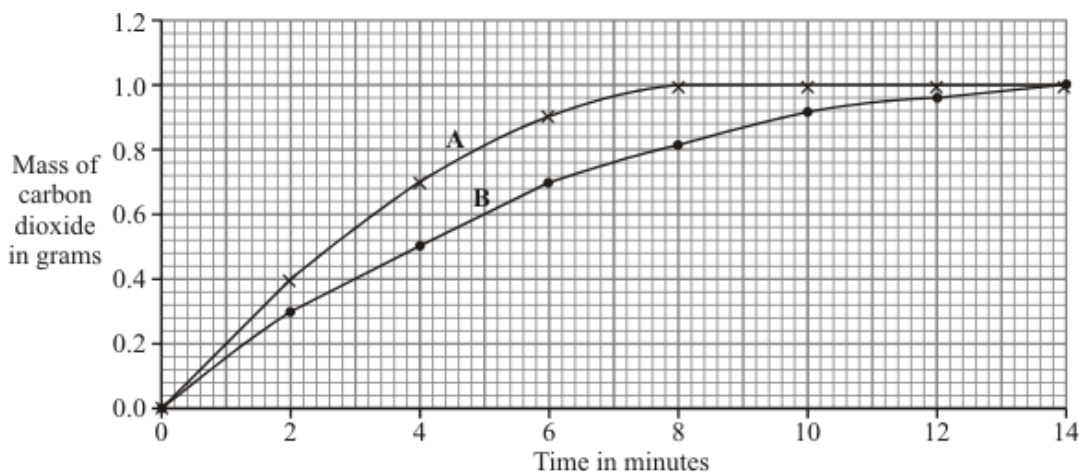
- Q11.** Marble is a rock that contains mainly calcium carbonate. This reacts with hydrochloric acid.



The rate of this reaction was followed by measuring the mass of carbon dioxide formed.



Two 10 g samples of marble, **A** and **B**, were each reacted with 50 cm³ of dilute hydrochloric acid, at different temperatures. The mass of carbon dioxide formed in each reaction was recorded and plotted to produce the graph below.



Each reaction stopped when no more carbon dioxide was formed.
In both experiments some marble was left unreacted when the reaction stopped.

- (a) Explain how you can tell which sample, **A** or **B**, reacted faster with the dilute hydrochloric acid.

.....

(2)

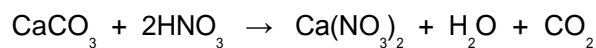
- (b) The faster rate of reaction was caused by using a higher temperature. Explain, in terms of particles, why a higher temperature causes a faster rate of reaction.

.....

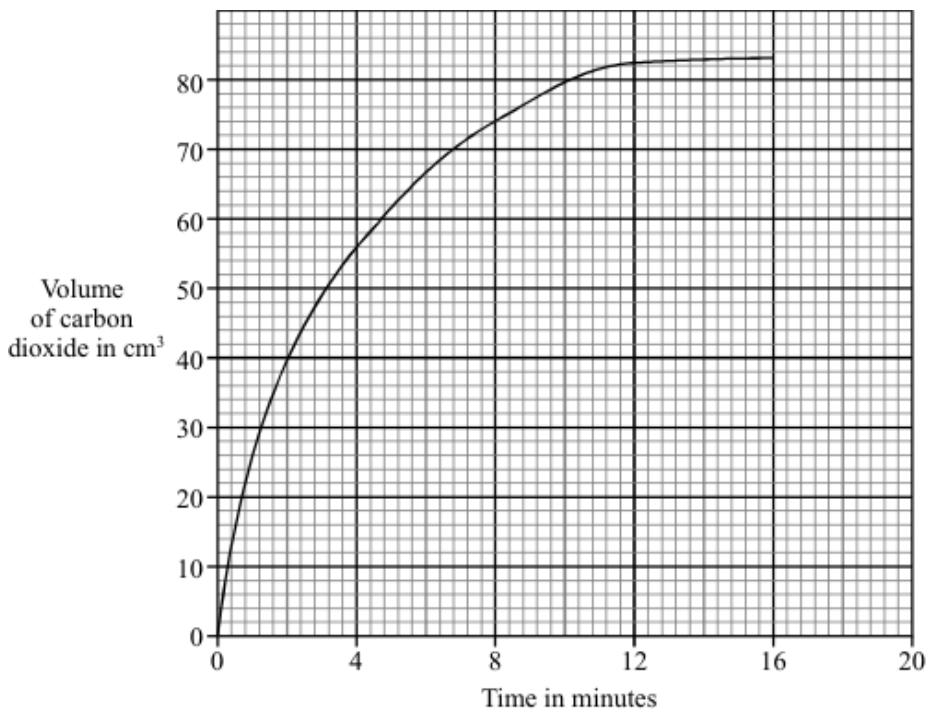
(3)

(Total 5 marks)

Q12. Calcium carbonate reacts with nitric acid to produce carbon dioxide.



A 10 g lump of calcium carbonate was reacted with 20 cm³ of dilute nitric acid. When the reaction was finished, some of the calcium carbonate was left unreacted. The graph shows the volume of carbon dioxide made in each minute for sixteen minutes.



- (a) The volume of carbon dioxide made in each minute decreases until it remains steady at 83 cm³. Explain why.

.....
.....
.....
.....

(2)

- (b) Draw a graph line, on the axes above, for an experiment where 20 cm³ of the same dilute nitric acid was reacted with 10 g of **powdered** calcium carbonate.

(2)

- (c) Give **one** way of changing the rate of this reaction (other than using powdered calcium carbonate).

.....

(1)

(Total 5 marks)

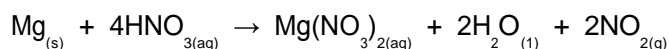
- Q13.** This item appeared in the *Wolverhampton Express and Star* on October 31st, 1997.
 Read the passage and answer the questions that follow.

Fumes scare at factory

Workers were forced to flee a factory after a chemical alert. The building was evacuated when a toxic gas filled the factory.

It happened when nitric acid spilled on to the floor and mixed with magnesium metal powder.

- (a) The equation which represents the reaction between magnesium and nitric acid is:



Give the formula of the toxic gas that was produced.

.....

(1)

- (b) Explain, in terms of particles, how the toxic gas was able to fill the factory quickly.

.....

(2)

- (c) The reaction of nitric acid with magnesium metal powder is more dangerous than if the acid had fallen on to the same mass of magnesium bars. Explain why.

.....

(1)

- (d) (i) Water was sprayed on to the magnesium and nitric acid to slow down the reaction. Explain, in terms of particles, why the reaction would slow down.

.....
.....
.....

(2)

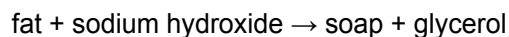
- (ii) Explain why it is better to add alkali, rather than just add water to the spillage.

.....
.....

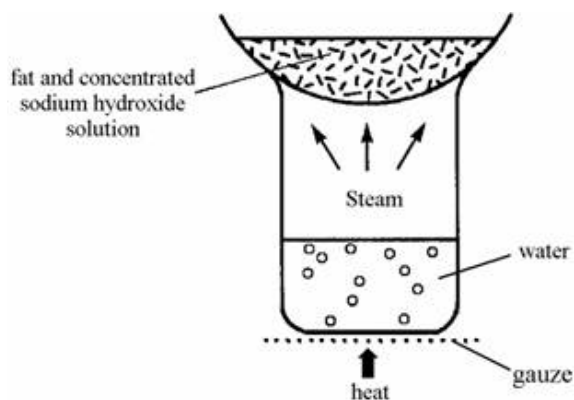
(1)

(Total 7 marks)

Q14. Soap can be made by reacting fats with sodium hydroxide solution.



The diagram shows a laboratory experiment to make soap.



From the information in the diagram, give **two** factors which increase the rate of this reaction. In each case explain, in terms of particles, why the rate of reaction increases.

Factor 1

.....

Reason

.....

.....

.....

.....

Factor 2

.....

Reason

.....

.....

.....

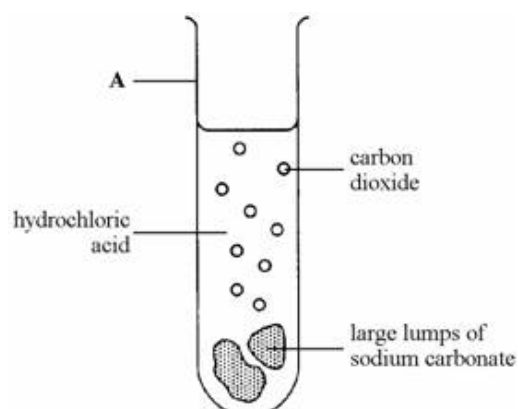
.....

(Total 7 marks)

Q15. Dilute hydrochloric acid reacts with sodium carbonate. The word equation for this reaction is:

sodium carbonate + hydrochloric acid → sodium chloride + water + carbon dioxide

(a) The diagram shows apparatus used by student X to investigate this reaction.



(i) Name the piece of apparatus labelled A.

.....

(1)

(ii) NaCO_3 NaCl Na_2CO_3 Na_2Cl

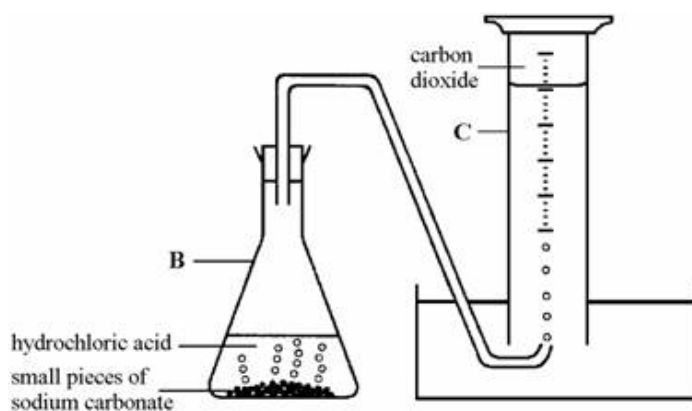
Use the Data Sheet to help you choose the correct formula from the list for:

sodium carbonate,

sodium chloride.

(2)

- (b) The diagram below shows a different apparatus used by student Y to investigate the same reaction.



- (i) Name the pieces of apparatus labelled **B** and **C**.

B

C

(2)

- (ii) Both students X and Y used the same

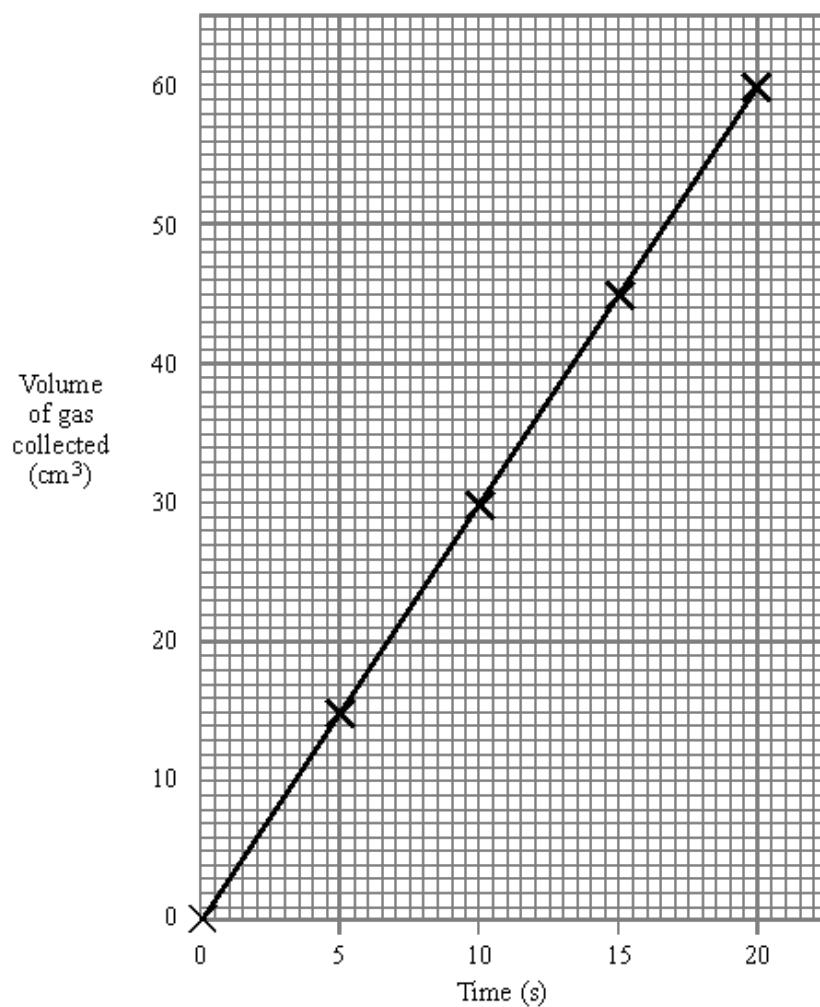
- volume of acid
- concentration of acid
- temperature
- mass of sodium carbonate

Use information from the diagrams to explain why the reaction that student Y carried out was faster.

.....

(2)

- (c) The results obtained by student Y were plotted as shown below.



- (i) Student Y repeated the experiment exactly as before but used warmer acid. This made the reaction faster.
On the graph draw a line for this faster reaction.

(2)

- (ii) Explain, in terms of particles, why the rate of the reaction is faster when warmer acid is used.

.....
.....
.....

(3)

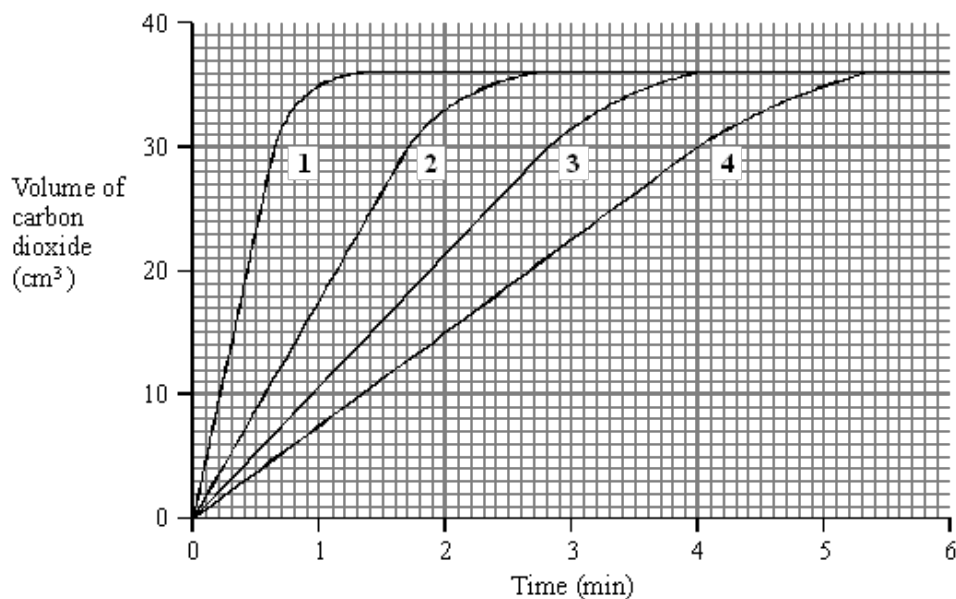
(Total 12 marks)

Q16. Calcium carbonate reacts with dilute hydrochloric acid as shown in the equation below.



The rate at which this reaction takes place can be studied by measuring the amount of carbon dioxide gas produced.

The graph below shows the results of four experiments, 1 to 4. In each experiment the amount of calcium carbonate, the volume of acid and the concentration of the acid were kept the same but the temperature of the acid was changed each time. The calcium carbonate was in the form of small lumps of marble.



- (a) Apart from altering the temperature, suggest **two** ways in which the reaction of calcium carbonate and hydrochloric acid could be speeded up.

1.
2.

(2)

- (b) Which graph, 1 to 4, shows the results of the experiment in which the acid had the highest temperature?

Experiment

Explain fully how you know.

.....
.....
.....
.....

(2)

- (c) (i) In experiment 2, how does the rate of reaction after one minute compare with the rate of reaction after two minutes?

.....

(1)

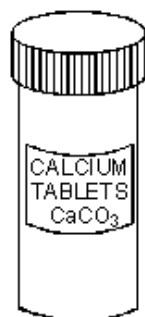
- (ii) Explain, as fully as you can, why the reaction rate changes during experiment 2.

.....

(2)

(Total 7 marks)

Q17. Calcium tablets are taken to build and maintain strong bones and teeth.



- (a) These tablets react with hydrochloric acid in the stomach.



- (i) Add all these missing state symbols a q g l s to the balanced chemical equation.

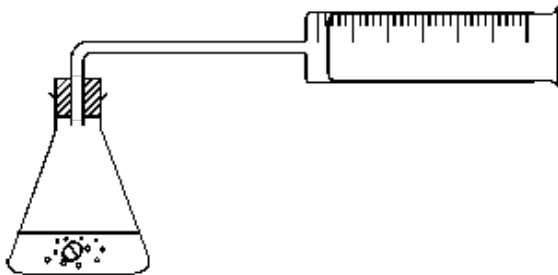
(2)

- (ii) The calcium salt that is formed is absorbed during digestion. What is the name of the calcium salt?

.....

(1)

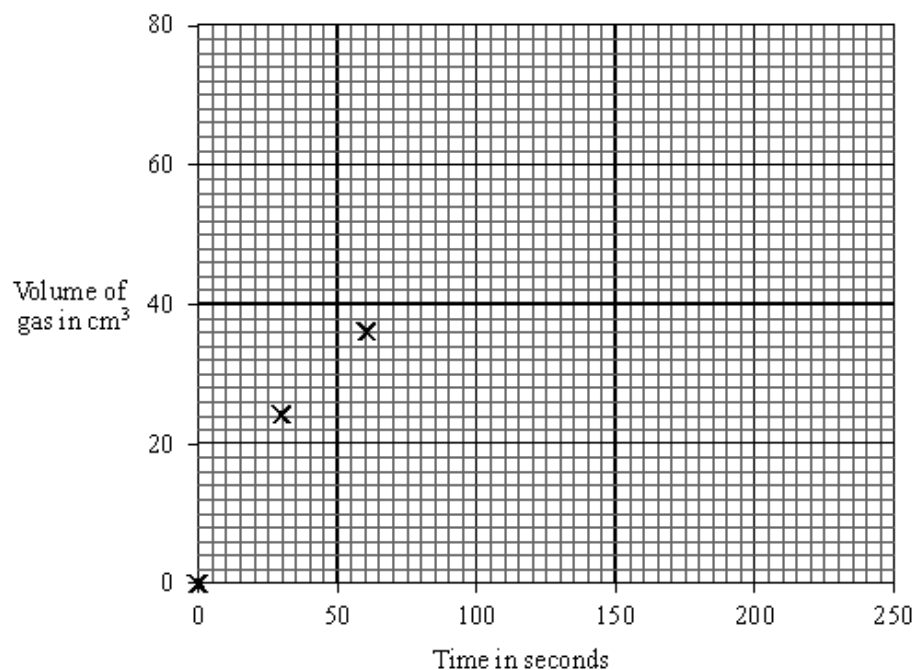
- (b) The volume of carbon dioxide produced by one calcium tablet in the stomach can be found as shown.



The volume of carbon dioxide was recorded every 30 seconds until the reaction stopped.

Time in seconds	0	30	60	90	120	150	180	210	240
Volume of gas in cm^3	0	24	36	46	52	56	59	60	60

- (i) Complete the graph of these results.



(3)

- (ii) Describe **one** way in which this reaction can be made to go faster.

.....

(1)

- (iii) A calculation, using the mass of this tablet, showed that 80 cm³ of carbon dioxide would be produced if the tablet was pure calcium carbonate. What do the results show about the purity of the tablet? Explain your answer by calculating the purity of this tablet.

.....

.....

.....

.....

.....

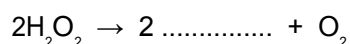
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(3)
(Total 10 marks)

Q18. This question is about rates of reaction.

- (a) Hydrogen peroxide (H₂O₂) decomposes very slowly at room temperature.

- (i) Complete the balanced chemical equation for this reaction by writing in the formula of the missing product.



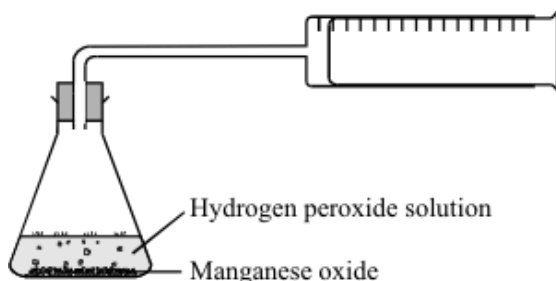
(1)

- (ii) The decomposition is much faster if manganese oxide is mixed with the hydrogen peroxide. Complete the sentence.

Manganese oxide acts as a for decomposition of hydrogen peroxide.

(1)

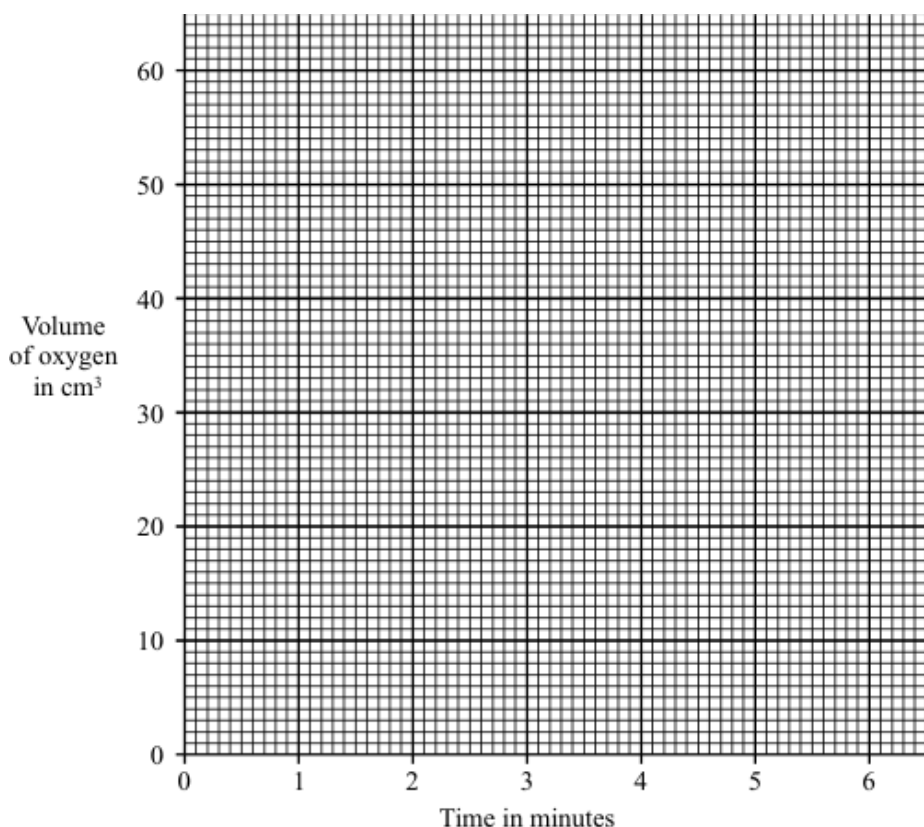
- (b) In an experiment 1g of manganese oxide was mixed with 50 cm³ of hydrogen peroxide solution.



The results show the volume of oxygen collected during six minutes.

Time in minutes	0	1	2	3	4	5	6
Volume of oxygen in cm ³	0	34.5	47.5	54.5	58.5	60.0	60.0

- (i) Draw a graph of these results.



(3)

- (ii) How long did it take for the decomposition to stop?

.....

(1)

- (iii) Why did the decomposition stop?

.....

(1)

- (c) In a second experiment water had been added to the hydrogen peroxide solution. Again 50 cm³ of this hydrogen peroxide solution was mixed with 1g of manganese oxide.

- (i) For this second experiment, sketch, on the same grid, a graph line you would expect to get.

(2)

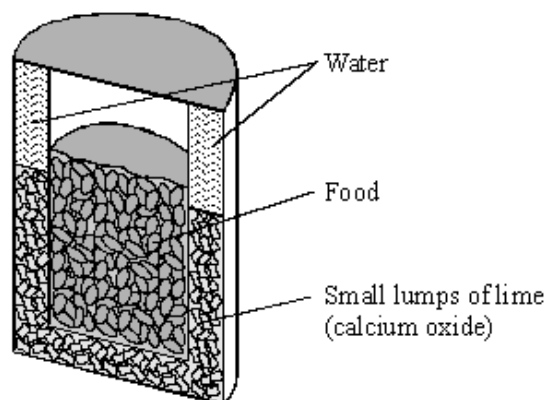
- (ii) In this second experiment, why would the rate of reaction be different to the first experiment?

.....

(1)

(Total 10 marks)

Q19. Mountaineers can warm their food in self-heating, sealed containers.



- (a) The water is allowed to react with the lime. The heat from the reaction warms the food. What type of reaction causes a rise in temperature?

.....

(1)

- (b) Some students investigated the effect of adding different sized lumps of lime to water. The results of their investigation are shown.

Time in minutes	Temperature in °C		
	Large lumps of lime	Small lumps of lime	Powdered lime
0	18	18	18
1	19	20	28
2	21	23	43
3	24	27	63
4	28	32	88
5	33	38	100

What do these results show? Give an explanation for your answer.

.....
.....
.....
.....

(2)

(c) Suggest and explain **one** disadvantage of using powdered lime to heat food.

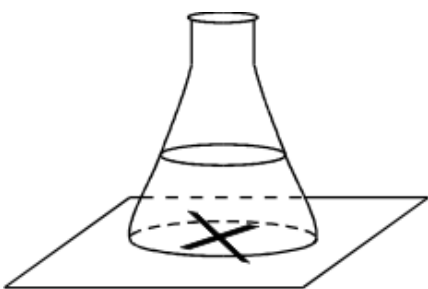
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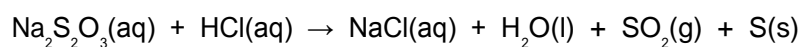
(2)
(Total 5 marks)

Q20. A student studied the effect of temperature on the rate of reaction between hydrochloric acid and sodium thiosulphate.



- The student mixed 50 cm³ of a sodium thiosulphate solution and 5 cm³ of hydrochloric acid in a flask.
- The flask was placed over a cross.
- The student timed how long after mixing the cross could no longer be seen.

(a) (i) Balance the chemical equation for this reaction.



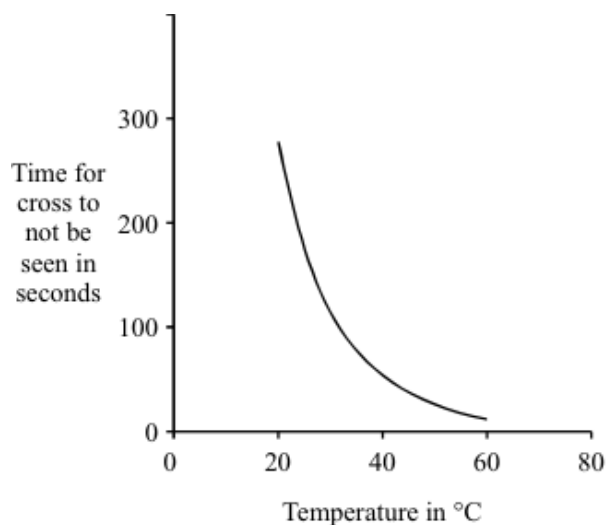
(1)

(ii) What causes the cross to be seen no longer?

.....

(1)

(b) A graph of the results is shown.



(i) What effect does temperature have on the rate of this reaction?

.....

(1)

(ii) Explain why temperature has this effect on the rate of reaction.

.....

(2)

(Total 5 marks)

Q21. Hydrogen peroxide, H_2O_2 , is often used as a bleach. It decomposes forming water and oxygen.

(a) (i) Write the balanced chemical equation for the decomposition of hydrogen peroxide.

.....

(3)

(ii) Give a test for oxygen.

Test

Result of test

.....

(2)

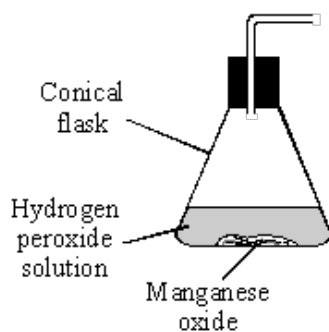
- (b) The rate of decomposition of hydrogen peroxide at room temperature is very slow. Manganese oxide is a catalyst which can be used to speed up the decomposition. Complete the sentence.

A catalyst is a substance which speeds up a chemical reaction. At the end of the reaction, the catalyst is

(1)

- (c) Two experiments were carried out to test if the amount of manganese oxide, MnO_2 , affected the rate at which the hydrogen peroxide decomposed.

- (i) Complete the diagram to show how you could measure the volume of oxygen formed during the decomposition.

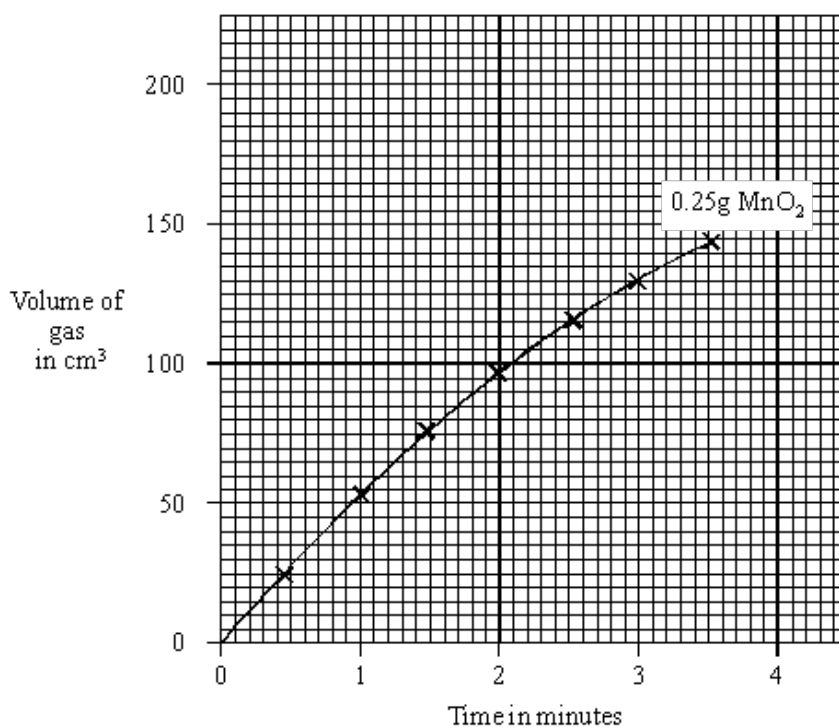


(2)

(ii) The results are shown in the table.

Time in minutes	0	0.5	1	1.5	2	2.5	3	3.5
Volume of gas in cm³ using 0.25 g MnO₂	0	29	55	77	98	116	132	144
Volume of gas in cm³ using 2.5 g MnO₂	0	45	84	118	145	162	174	182

Draw a graph of these results. The graph for 0.25 g MnO₂ has been drawn for you.



(3)

(iii) Explain why the slopes of the graphs become less steep during the reaction.

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(2)

- (iv) The same volume and concentration of hydrogen peroxide solution was used for both experiments. What **two** other factors must be kept the same to make it a fair test?

1

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2

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(2)

(Total 15 marks)

Q22.

- (a) Indigestion tablets called antacids can be taken to react with excess hydrochloric acid in the stomach. A student investigated two different antacid tablets labelled **X** and **Y**.

- (i) Both tablets, **X** and **Y**, contained calcium carbonate. Give the chemical symbol for each of the three elements in calcium carbonate.

.....

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(3)

- (ii) Name the gas formed when calcium carbonate reacts with hydrochloric acid.

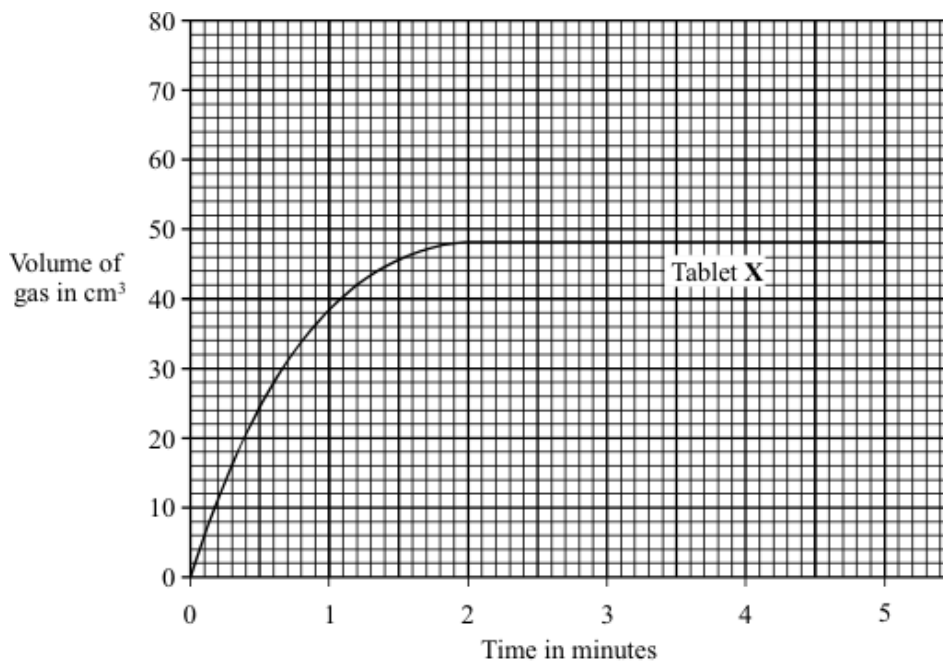
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(1)

- (b) The student first reacted tablet **X** and then tablet **Y**, with 100 cm³ of a hydrochloric acid solution. The student measured the volume of gas produced during the first five minutes. The results are shown in the table.

Time in minutes	0	1	2	3	4	5
Volume of gas in cm ³ Tablet X	0	38	48	48	48	48
Volume of gas in cm ³ Tablet Y	0	31	54	67	72	72

- (i) Draw a graph of the results for tablet **Y**. (A graph of the results for tablet **X** has been drawn for you.)



(3)

- (ii) Tablet **X** contains less calcium carbonate than tablet **Y**. How do the results show this?

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(1)

- (iii) Explain why the rate of reaction slows down for both tablets.

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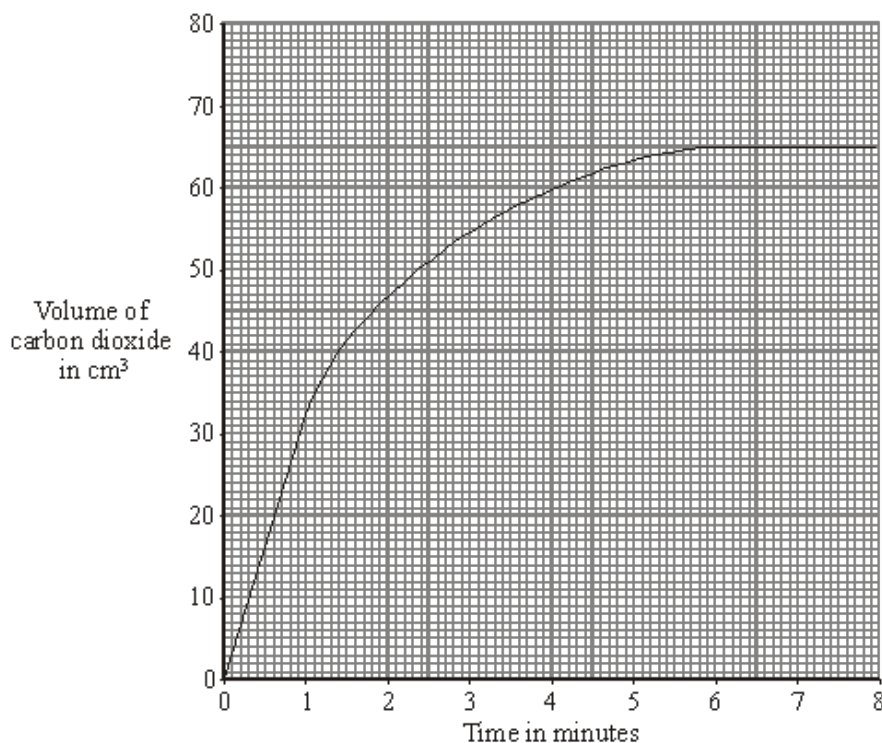
(2)

(Total 10 marks)

- Q23.** A student studied the reaction between dilute hydrochloric acid and an **excess** of calcium carbonate.

calcium carbonate + hydrochloric acid \rightarrow calcium chloride + water + carbon dioxide

The student measured the volume of carbon dioxide produced in the experiment. The results are shown on the graph.



- (a) After how many minutes had all the acid been used up?

..... minutes

(1)

- (b) The student wrote this conclusion for the experiment:

'The reaction gets slower and slower as the time increases.'

Explain why the reaction gets slower. Your answer should be in terms of particles.

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(2)

- (c) A second experiment was carried out at a higher temperature. All other factors were the same.

Draw a line on the graph above to show the results that you would expect.

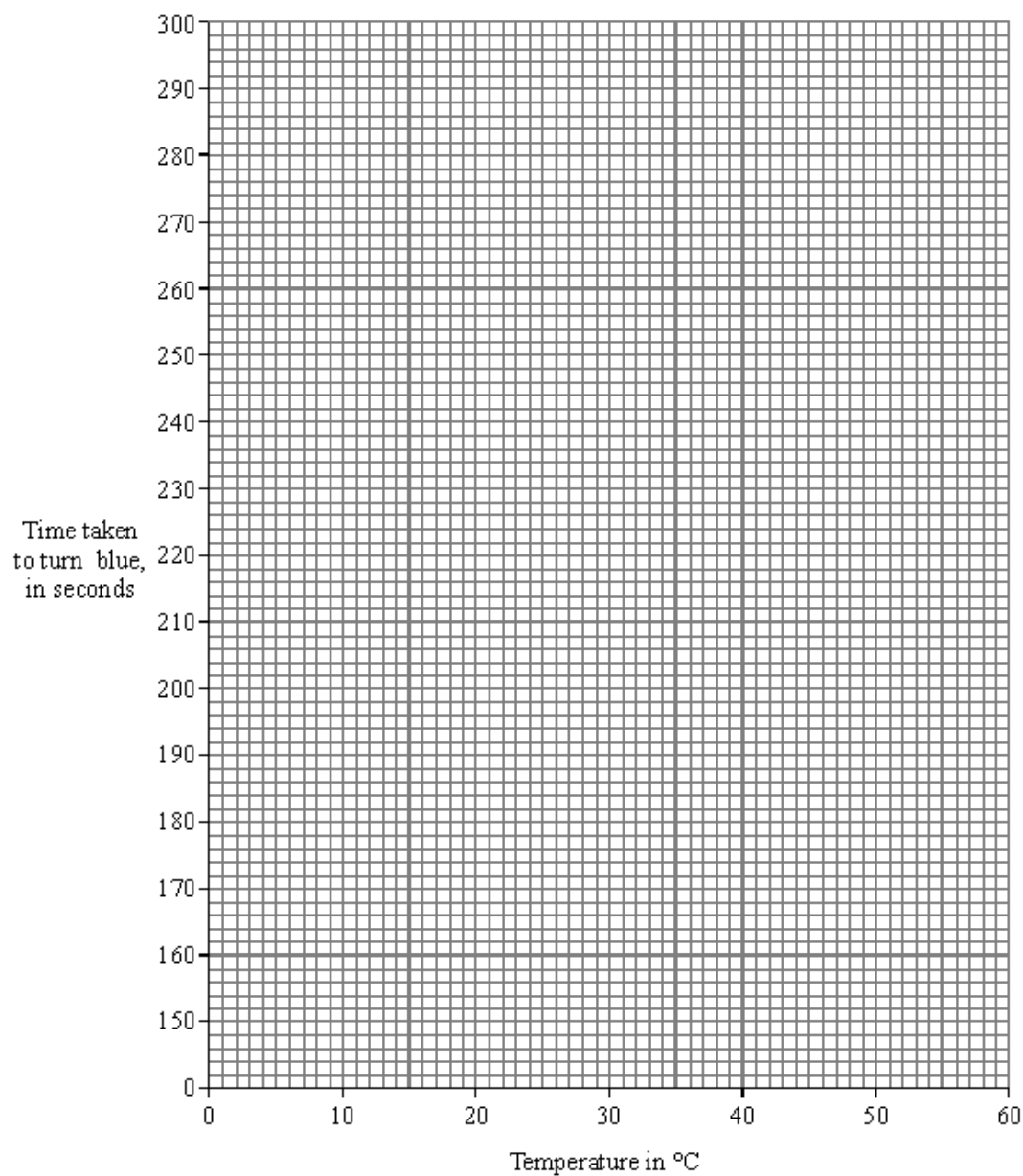
(2)
(Total 5 marks)

Q24. Solutions **A** and **B** are colourless. When they are mixed, they react and turn blue after a period of time. A student investigated how temperature affected the rate of reaction between solutions **A** and **B**. The rate was measured by timing how long the mixture took to turn blue.

The results are shown in the table.

Temperature in °C	22	25	34	45	51
Time taken to turn blue, in seconds	290	250	200	170	160

- (a) (i) Draw a graph for these results.



(3)

- (ii) Use your graph to find how long it takes the solution to turn blue at 40°C.

Time = s

(1)

- (b) (i) How does the rate of reaction change as the temperature is increased?

.....

(1)

- (ii) Explain, in terms of particles, why temperature has this effect on the rate of reaction.

*To gain full marks in this question you should write your ideas in good English.
Put them into a sensible order and use the correct scientific words.*

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(3)

- (c) State **one** variable that must be kept constant to make this experiment a fair test.

.....

(1)

(Total 9 marks)

Q25. Copper sulfate (CuSO_4) is a salt that has many uses.

An aqueous solution of copper sulfate can be made by reacting copper oxide (CuO) with an acid.

- (a) (i) Name this acid.

(1)

- (ii) Write a balanced symbol equation, including state symbols, for this reaction.

.....

(2)

- (b) Copper oxide reacts much faster with acid at 40 °C than at 20 °C.

Explain why in terms of particles.

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(2)

(Total 5 marks)

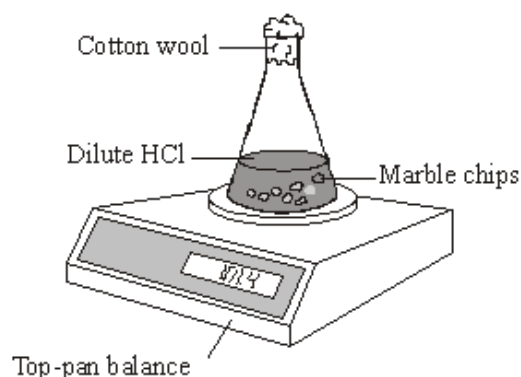
Q26. A student investigated the rate of reaction between marble and hydrochloric acid.

The student used an excess of marble.

The reaction can be represented by this equation.

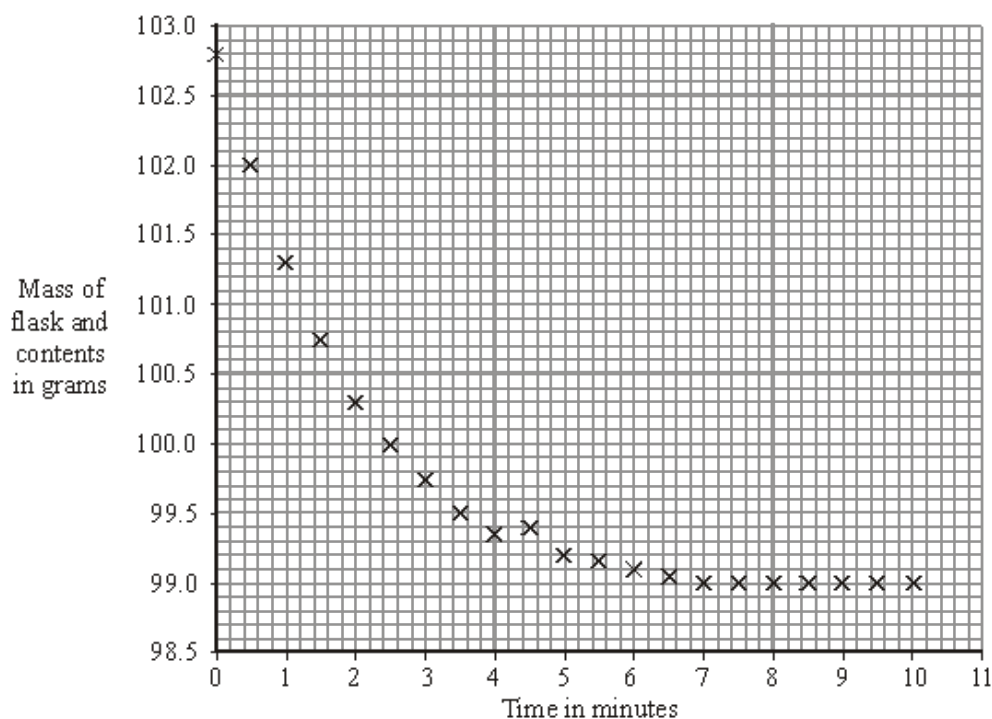


The student used the apparatus shown in the diagram.



The student measured the mass of the flask and contents every half minute for ten minutes.

The results are shown on the graph. Use the graph to answer the questions.



(a) **Complete the graph** opposite by drawing a line of best fit.

(1)

(b) Why did the mass of the flask and contents decrease with time?

.....
.....

(1)

(c) After how many minutes had all the acid been used up?

..... minutes

(1)

(d) The student repeated the experiment at a higher temperature. All other variables were kept the same as in the first experiment. The rate of reaction was much faster.

(i) Draw a line **on the graph** to show what the results for this second experiment might look like.

(2)

(ii) Why does an increase in temperature increase the rate of reaction?

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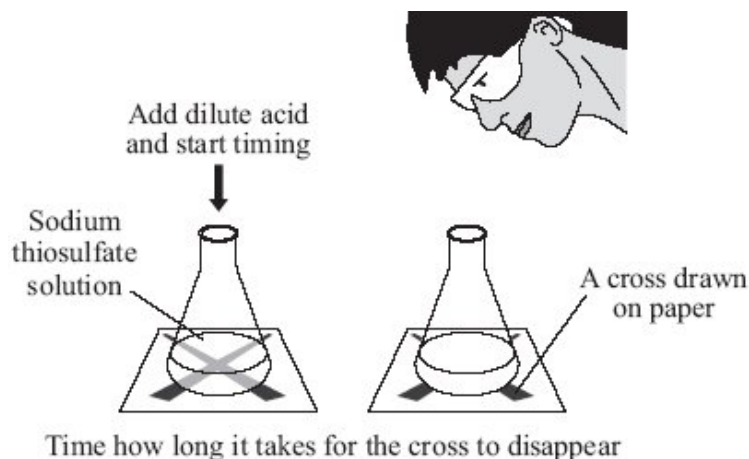
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(3)

(Total 8 marks)

Q27. Sodium thiosulfate solution reacts with hydrochloric acid. As the reaction takes place the solution slowly turns cloudy.

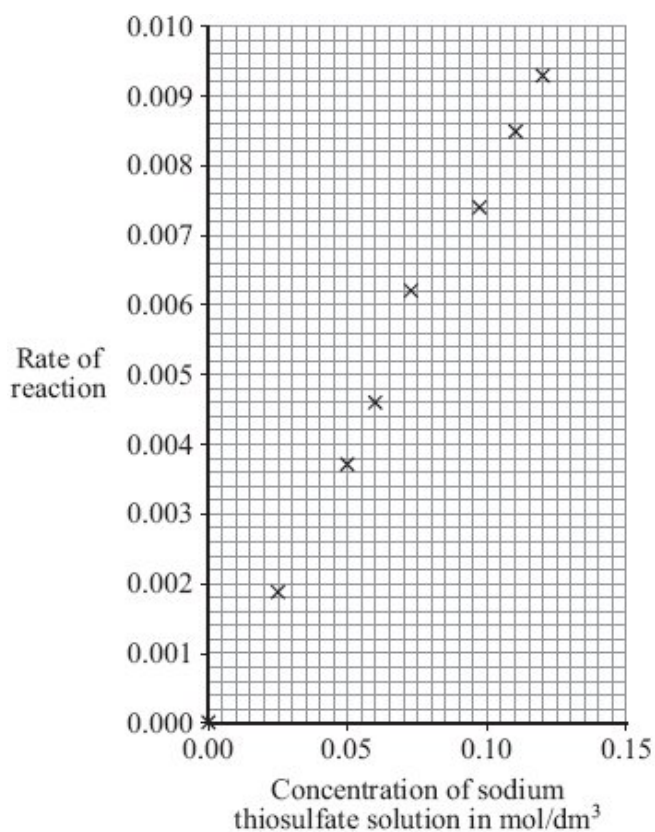
The diagram shows a method of measuring the rate of this reaction.



A student used this method to investigate how changing the concentration of the sodium thiosulfate solution affects the rate of this reaction.

The student used different concentrations of sodium thiosulfate solution. All the other variables were kept the same.

The results are shown on the graph below.



(a) (i) Draw a line of best fit on the graph.

(1)

(ii) Suggest **two** reasons why all of the points do not lie on the line of best fit.

- 1
-
- 2
-

(2)

(b) (i) In a conclusion to the investigation the student stated that:

‘The rate of this reaction is directly proportional to the concentration of the sodium thiosulfate solution.’

How does the graph support this conclusion?

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(1)

- (ii) Explain, in terms of particles, why the rate of reaction increases when the concentration of sodium thiosulfate is increased.

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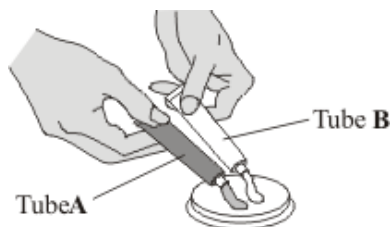
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(2)
(Total 6 marks)

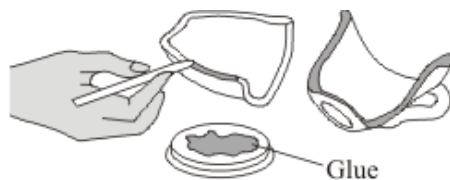
Q28. The following steps show how to use a type of glue.

Step 1 Measure out equal amounts of the liquids from tubes **A** and **B**.

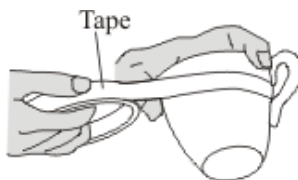


Step 2 Mix the liquids to make the glue.

Put a thin layer of the glue onto each of the surfaces to be joined.



Step 3 Assemble the pieces to be joined and then hold them together with tape.



Step 4 Leave the glue to set.

(a) When liquids **A** and **B** are mixed a chemical reaction takes place.

- (i) This reaction is exothermic.

State how the temperature of the mixture will change as the glue is mixed.

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.....

(1)

- (ii) When the glue sets it forms a giant covalent structure.

Explain why substances with giant covalent structures have high melting points.

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(2)

- (b) The time taken for the glue to set at different temperatures is given in the table below.

Temperature in °C	Time taken for the glue to set
20	3 days
60	6 hours
90	1 hour

Explain, in terms of particles, why increasing the temperature changes the rate of the reaction which causes the glue to set.

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(2)

(Total 5 marks)

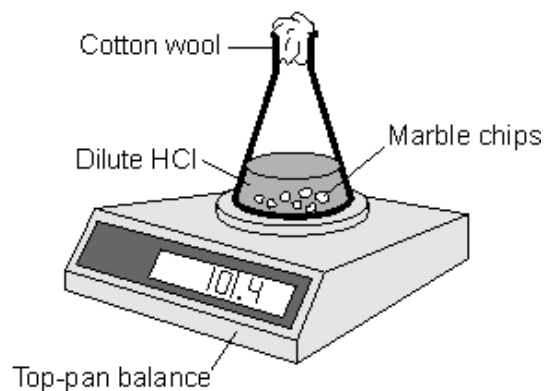
Q29. A student investigated the rate of reaction between marble and hydrochloric acid.

The student used an excess of marble.

The reaction can be represented by this equation:

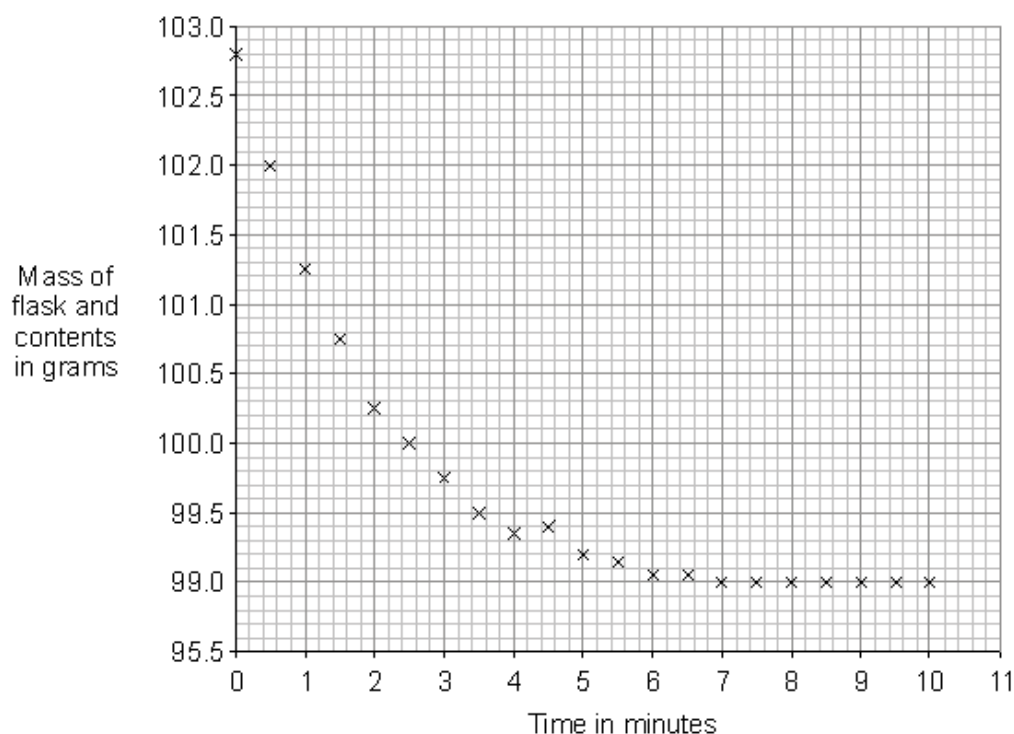


The student used the apparatus shown in the diagram.



The student measured the mass of the flask and contents for ten minutes.

The results are shown on the graph. Use the graph to answer the questions.



(a) (i) Complete the graph by drawing a line of best fit.

(1)

(ii) Use the graph to find the mass of the flask and contents after 1.8 minutes.

..... grams

(1)

- (iii) The rate of reaction can be measured by the steepness of the graph line.

Describe, as fully as you can, how the rate of reaction changes with time in this experiment.

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(2)

- (b) The mass of the flask and contents decreased during the experiment.

Use the equation for this reaction to help you explain why.

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(2)

- (c) A balance is used to measure the mass of the apparatus.

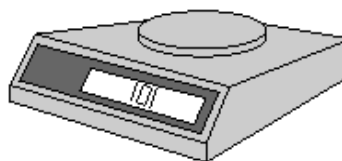
- (i) Which balance, **A**, **B**, or **C**, has the highest resolution?



Balance A



Balance B



Balance C

The balance with the highest resolution is balance

(1)

- (ii) The balance used for this experiment should have a high resolution.

Explain why.

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(2)

- (d) The student repeated the experiment using powdered marble instead of marble chips.

The rate of reaction between the marble and hydrochloric acid particles was much faster with the powder.

Explain why.

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(2)
(Total 11 marks)

- Q30.** The picture shows a lump of phosphate rock.



Rob Lavinsky, iRocks.com – CC-BY-SA-3.0 [CC-BY-SA-3.0], via Wikimedia Commons

Phosphoric acid is made by adding sulfuric acid to phosphate rock.

- (a) The rate of reaction between sulfuric acid and phosphate rock can be increased if the mixture is heated to a higher temperature.

Explain, in terms of particles, why an increase in temperature increases the rate of reaction.

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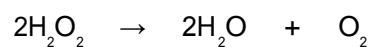
(2)

- (b) State **one** other way in which the rate of reaction between sulfuric acid and phosphate rock can be increased.

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(1)
(Total 3 marks)

- Q31.** The symbol equation for the decomposition of hydrogen peroxide is:



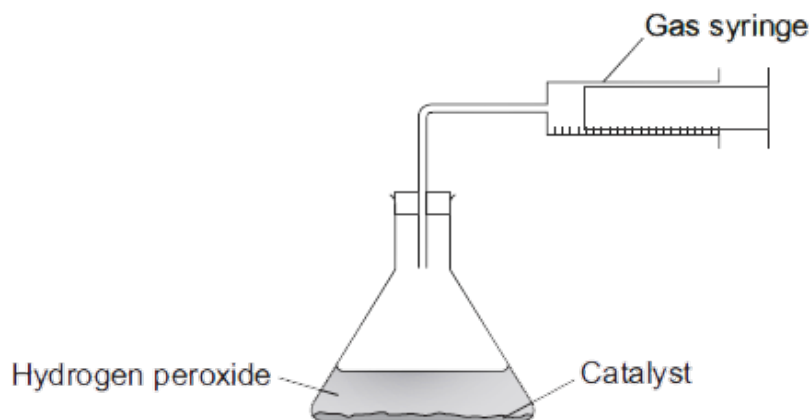
- (a) This reaction is *exothermic*.

What is an *exothermic* reaction?

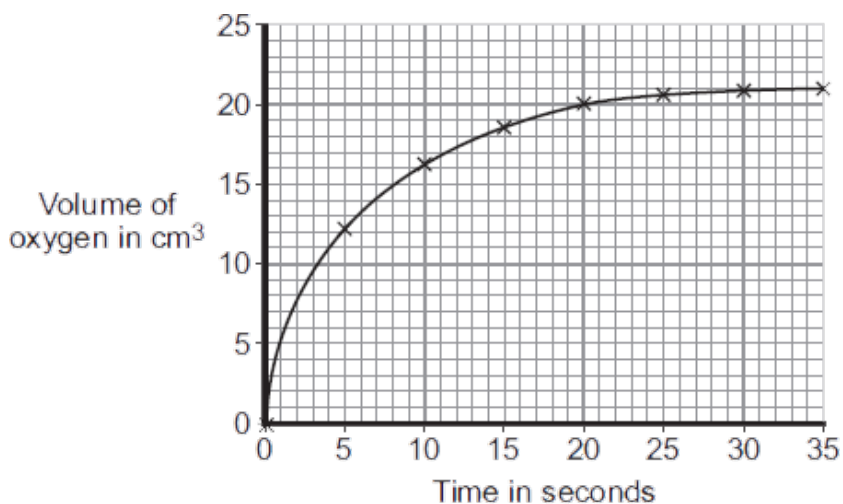
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(1)

- (b) A student measured the volume of oxygen produced by 50 cm³ of hydrogen peroxide.



The graph shows the results.



- (i) Use the graph to describe the changes in the rate of the reaction from 0 to 35 seconds.

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.....
.....

(3)

- (ii) What was the total volume of oxygen gas collected?

..... cm³

(1)

- (iii) The student had calculated that the hydrogen peroxide used should produce 25 cm³ of oxygen.

Calculate the percentage yield of oxygen.

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Answer =

(2)

- (c) An increase in the temperature of the hydrogen peroxide increases the rate of the reaction.

Use your knowledge of particles to explain why.

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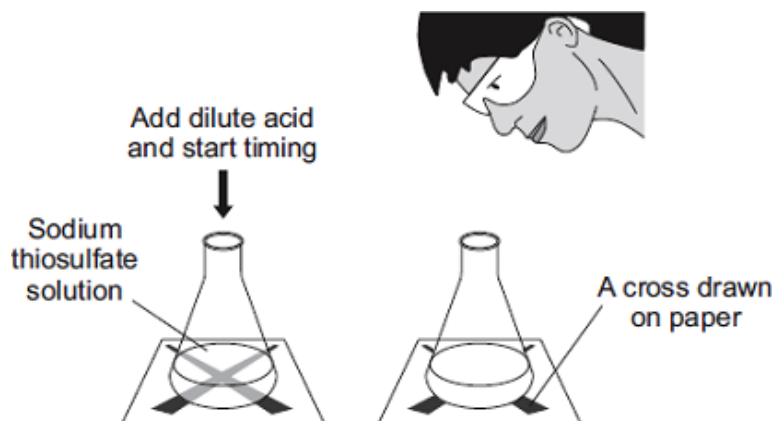
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(3)
(Total 10 marks)

- Q32.** Sodium thiosulfate solution reacts with hydrochloric acid. As the reaction takes place the solution slowly turns cloudy.

The diagram shows a method of measuring the rate of this reaction.



A student used this method to study how changing the concentration of the sodium thiosulfate solution alters the rate of this reaction.

The student used different concentrations of sodium thiosulfate solution. All the other variables were kept the same.

The results of the experiments are shown on the graph below.

- (a) (i) Draw a line of best fit on the graph.

(1)

- (ii) Suggest **two** reasons why all of the points do not lie on the line of best fit.

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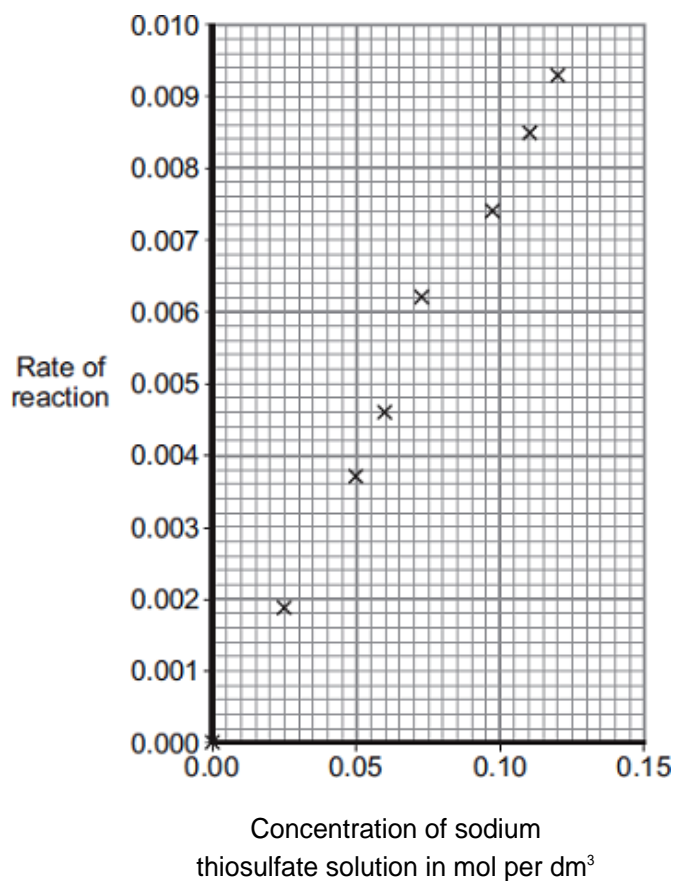
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(2)



- (b) (i) In a conclusion to the experiment the student stated that:

'The rate of this reaction is directly proportional to the concentration of the sodium thiosulfate.'

How does the graph support this conclusion?

.....

.....

(1)

- (ii) Explain, in terms of particles, why the rate of reaction increases when the concentration of sodium thiosulfate is increased.

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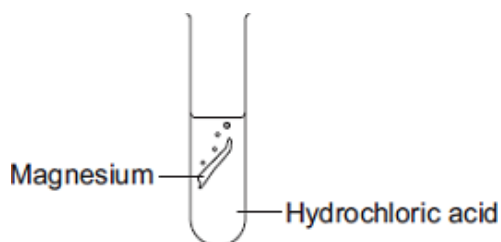
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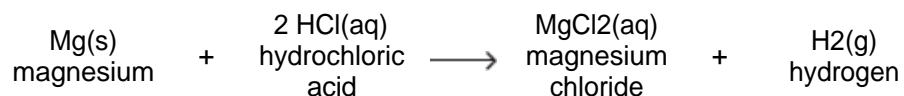
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(2)
(Total 6 marks)

Q33. A student investigated the reaction between magnesium and hydrochloric acid.



The equation for the reaction is:



- (a) Give **two** observations the student could make during the reaction.

1

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2

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(2)

- (b) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

The student investigated how the rate of this reaction changed when the concentration of hydrochloric acid was changed.

Write a plan the student could use.

In your plan you should:

- describe how you would carry out the investigation and make it a fair test
- describe the measurements you would make.

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(6)
(Total 8 marks)

