

Name:

Date:

C6 - Test 4
RATE OF REACTION
Intermediate

GCSE

CHEMISTRY

AQA - Triple Science

Mark

Grade

Materials

For this paper you must have:

- Ruler
- Pencil and Rubber
- Scientific calculator, which you are expected to use when appropriate

Instructions

- Answer all questions
- Answer questions in the space provided
- All working must be shown

Information

- The marks for the questions are shown in brackets

1.

When sodium thiosulfate solution reacts with dilute hydrochloric acid, the solution becomes cloudy.

The equation for the reaction is:

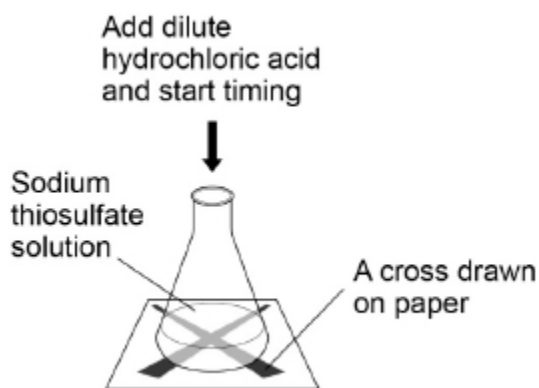


(a) Why does the solution become cloudy?

(2)

Some students used this reaction to investigate the effect of concentration on rate of reaction.

The diagram shows the apparatus used.



This is the method used.

1. Measure 25 cm³ sodium thiosulfate solution into a conical flask.
2. Stand the conical flask on a cross drawn on paper.
3. Add 10 cm³ of dilute hydrochloric acid.
4. Time how long it takes the cross to become no longer visible.
5. Repeat steps 1–4 with sodium thiosulfate solutions of different concentrations.

(b) The students used a measuring cylinder to measure 25 cm³ of sodium thiosulfate solution.

Suggest a more accurate way of measuring 25 cm³ of sodium thiosulfate solution.

(1)

(c) Name one control variable the students should use in this investigation.

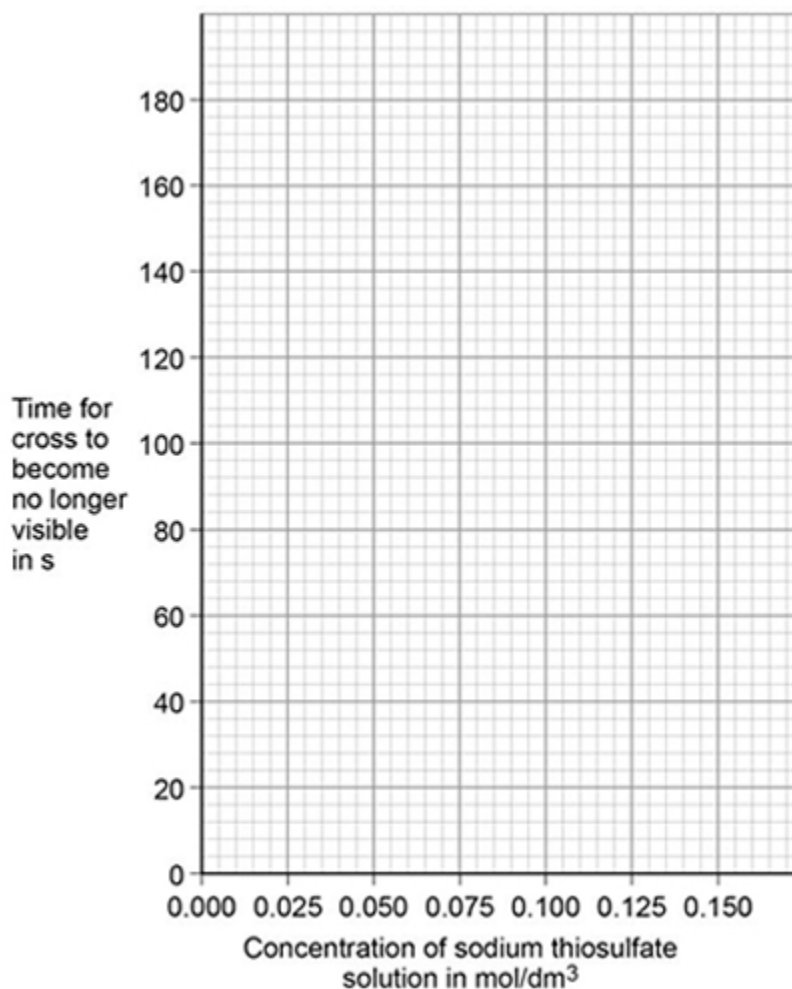
(1)

The table shows the students' results.

Concentration of sodium thiosulfate solution in mol / dm ³	Time for cross to become no longer visible in s
0.020	170
0.040	90
0.060	82
0.080	42
0.100	34
0.120	30
0.140	28

(d) Plot the data from the table above on the graph below.

Draw a line of best fit.



(3)

The students repeated the investigation two more times.

They obtained similar results each time.

- (e) What word describes an investigation by the same students which gives similar results each time?

(1)

- (f) Describe how the students can use their results to improve the accuracy of the investigation.

(2)

- (g) The students analysed their results to give a conclusion and an explanation for their investigation.

Conclusion: 'The higher the concentration, the lower the rate of reaction.'

Explanation: 'At higher concentrations, the particles have more energy, so they are moving faster. Therefore the collisions are more energetic.'

The students are not correct.

Give a **correct** conclusion **and** explanation for the results of the investigation.

Conclusion _____

Explanation _____

(3)

- (h) A solution containing 0.18 g of sodium thiosulfate reacts with dilute hydrochloric acid in 2 minutes.

Calculate the mean rate of reaction in g / s.

Give your answer in standard form.

Mean rate of reaction = _____ g / s

(3)

(Total 16 marks)

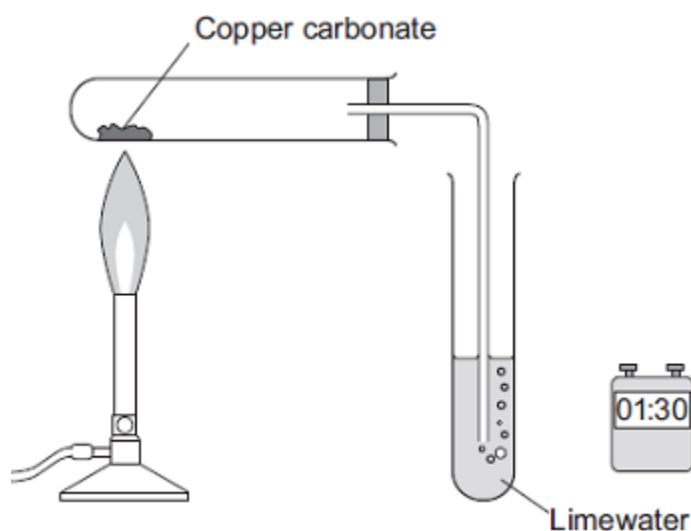
2.

Carbon dioxide is produced when copper carbonate is heated.

A student investigated heating copper carbonate.

The student used the apparatus to measure how long it took for carbon dioxide to be produced.

The student also noted what happened during each minute for three minutes.



- (a) The student used changes to the limewater to measure how long it took for carbon dioxide to be produced.

Describe how.

(2)

(b) The student wrote down her observations.

Time interval in minutes	Observations
Between 0 and 1	A slow release of gas bubbles. The limewater did not change. The solid in the test tube was green.
Between 1 and 2	A fast release of gas bubbles. The limewater changed at 1 minute 10 seconds.
Between 2 and 3	No release of gas bubbles. The solid in the test tube was black.

(i) Suggest the reason for the student's observations between 0 and 1 minute.

(2)

(ii) Explain the student's observations between 1 and 2 minutes.

(2)

(iii) Explain the student's observations between 2 and 3 minutes.

(2)

3.

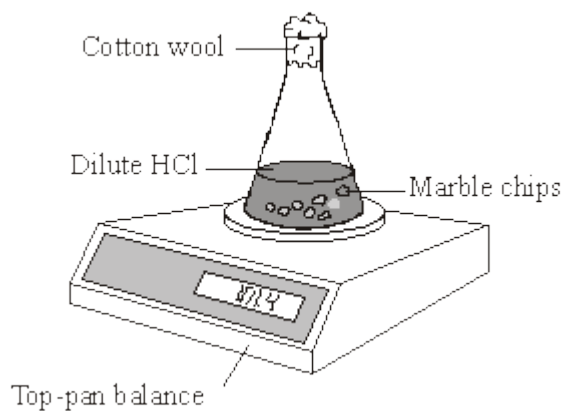
A student investigated the rate of reaction between marble and hydrochloric acid.

The student used an excess of marble.

The reaction can be represented by this equation.

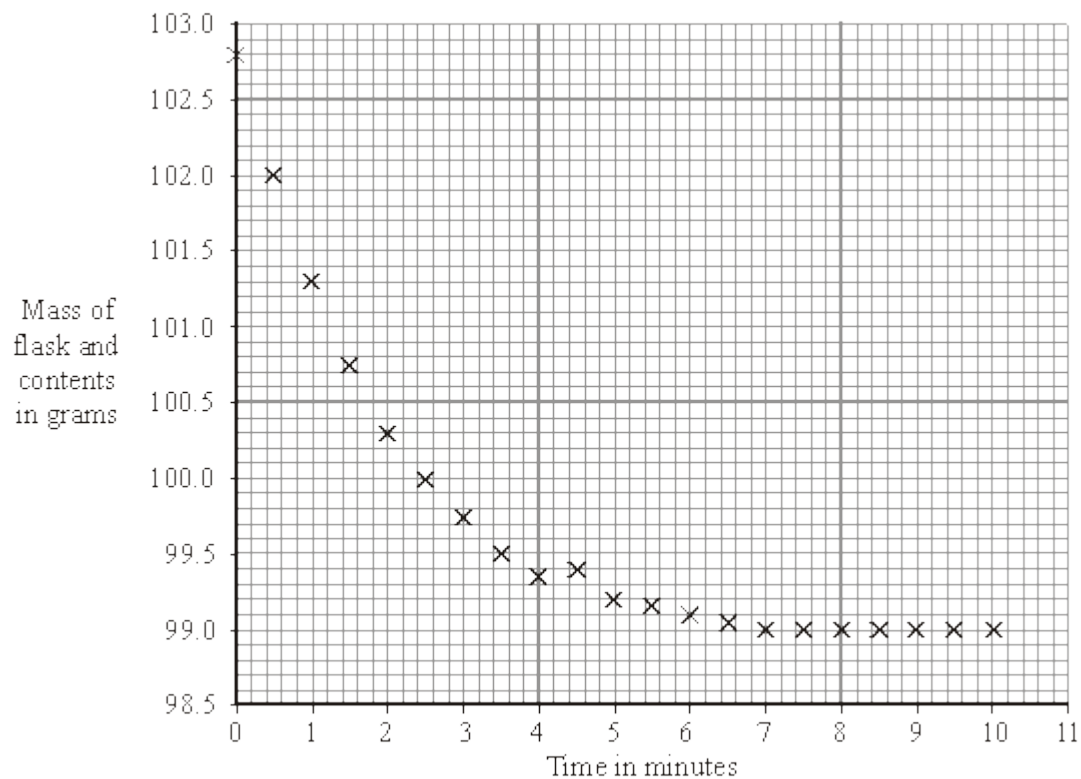


The student used the apparatus shown in the diagram.



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)

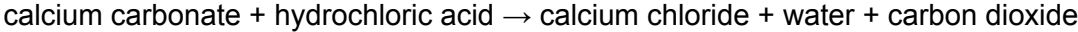
(ii) Why does an increase in temperature increase the rate of reaction?

(3)

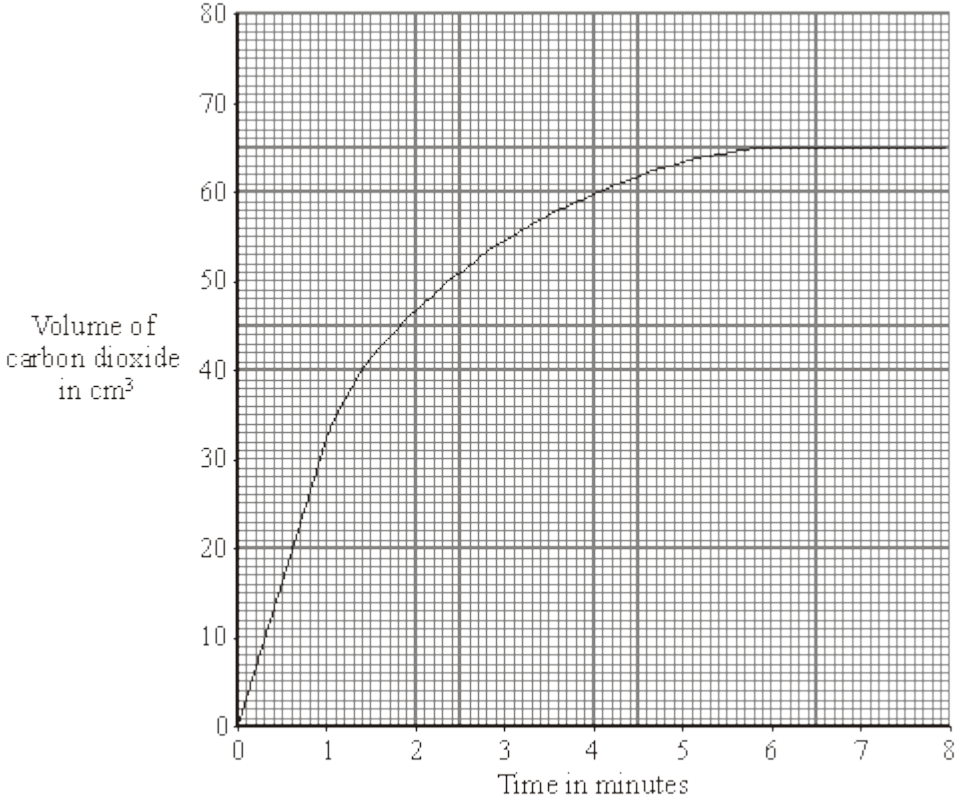
(Total 8 marks)

4.

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



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.

(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)

5.

- (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.

(3)

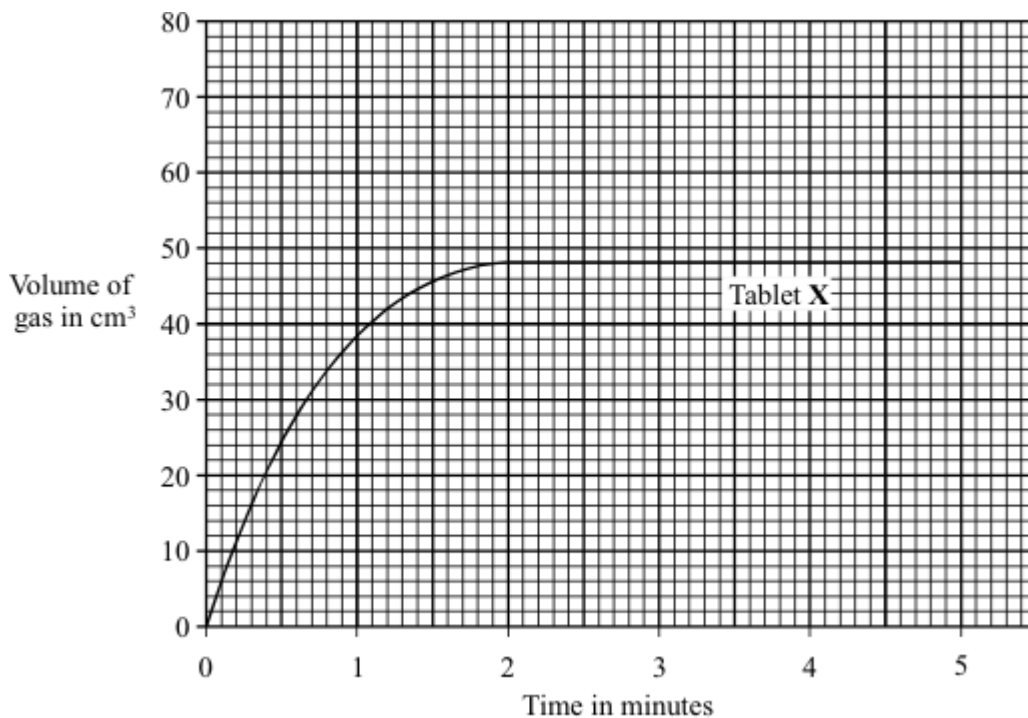
- (ii) Name the gas formed when calcium carbonate reacts with hydrochloric acid.

(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 cm³ Tablet X	0	38	48	48	48	48
Volume of gas in cm³ 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?

(1)

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

(2)

(Total 10 marks)

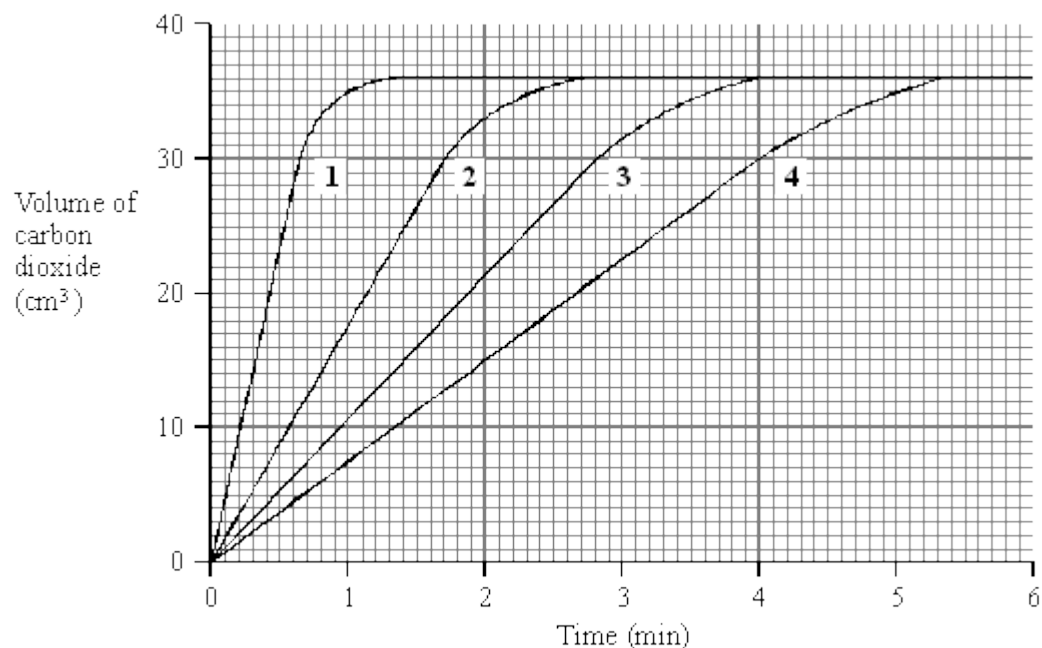
6.

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)

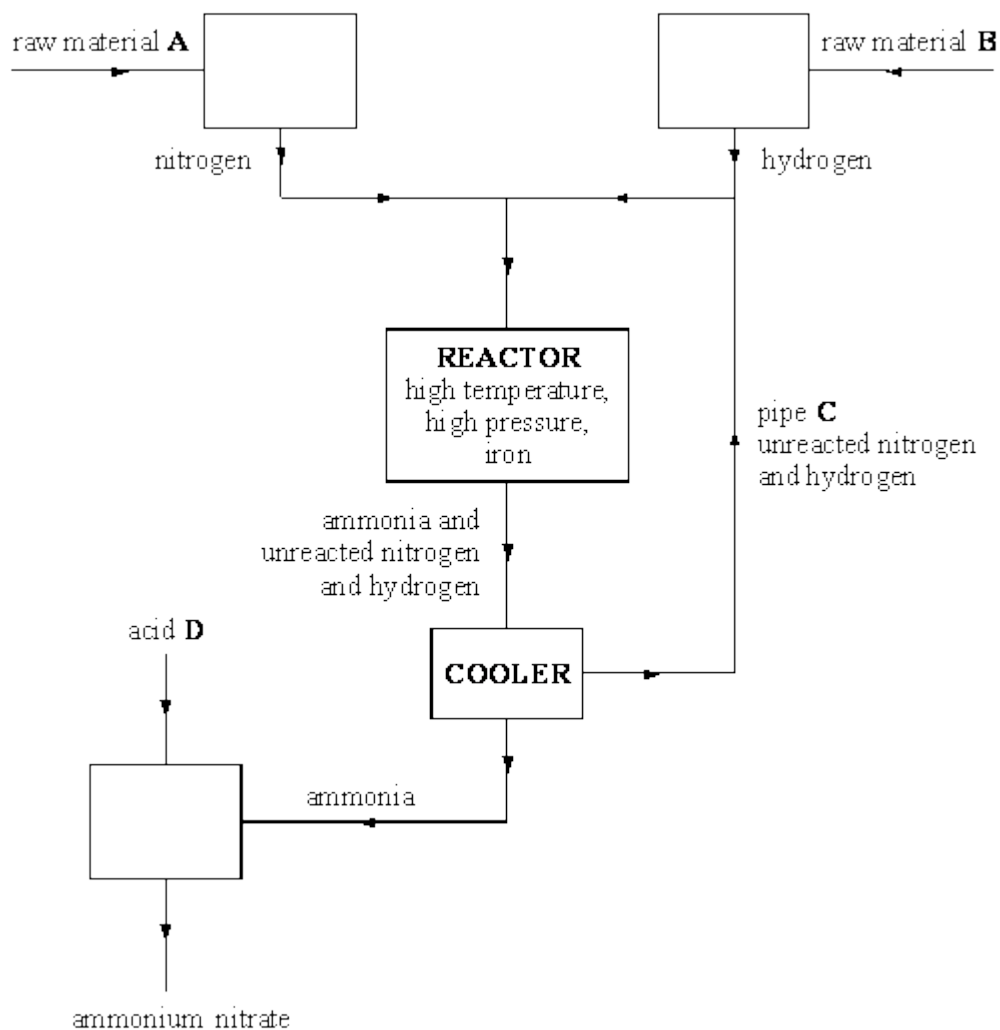
- (ii) Explain, as fully as you can, why the reaction rate changes during experiment 2.

(2)

(Total 7 marks)

7.

The flow chart below shows the main stages in the production of ammonium nitrate.



- (i) Name the **two** raw materials shown in the flow chart as **A** and **B** by choosing words from the list.

air coke limestone natural gas

Raw material **A** _____

Raw material **B** _____

(2)

- (ii) Complete the word equation for the reaction which makes ammonia.

_____ + _____ → ammonia

(1)

- (iii) What is the purpose of the iron in the reactor?

(1)

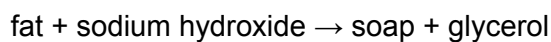
- (iv) What is the purpose of pipe **C**?

(1)

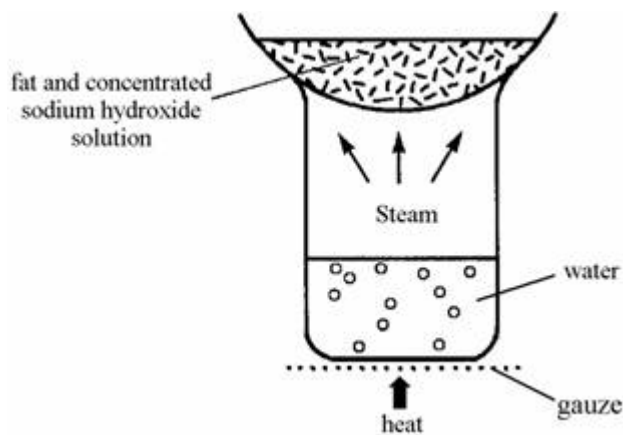
(Total 5 marks)

8.

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)

9.

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)

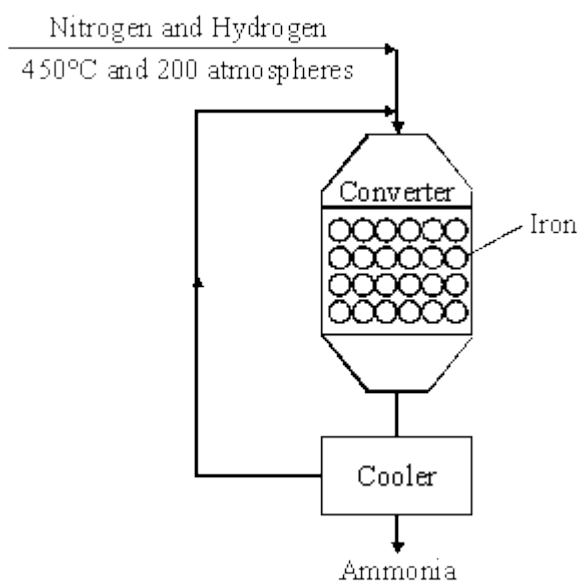
(ii) Explain why it is better to add alkali, rather than just add water to the spillage.

(1)

(Total 7 marks)

10.

The diagram shows the final stages in the manufacture of ammonia.



(a) Why is iron used in the converter?

(1)

(b) Write the word equation for the reaction in the converter.



(1)

(c) The yield of ammonia is only about 15%.

(i) Why can the yield **not** be 100%?

(1)

(ii) Describe what happens to the mixture of gases after it leaves the converter.

(2)

(Total 5 marks)