Rates of Reaction

N4 & N5 Homework Questions

Answer questions as directed by your teacher.

National 4 level questions are first followed by National 5 level questions.

National 4 Questions

1. List the following in order of rate of reaction, fastest first:

   milk turning sour, an egg frying, a motor car rusting, a match igniting (1)

2. (i) Identify the factor that is responsible for the change in reaction rate in each of the following examples
   (ii) Give an explanation for each statement

   (a) A carton of milk goes sour more slowly in the fridge than an identical carton left on a work surface in a kitchen.
   (b) 1kg of wood shavings burns faster than a block of wood of equal mass.
   (c) Sulphuric acid causes iron nails to rust. Battery acid and acid rain both contain sulphuric acid. Iron nails corrode more slowly in acid rain water than in battery acid. (3)

3. A pupil added lumps of zinc to $100cm^3$ of 2 $moll^{-1}$ sulphuric acid in a flask. Every two minutes they noted the mass of the flask and contents.

Time/min	Total mass loss / mg
0	0
2	130
4	210
6	260
8	300
10	330
12	330

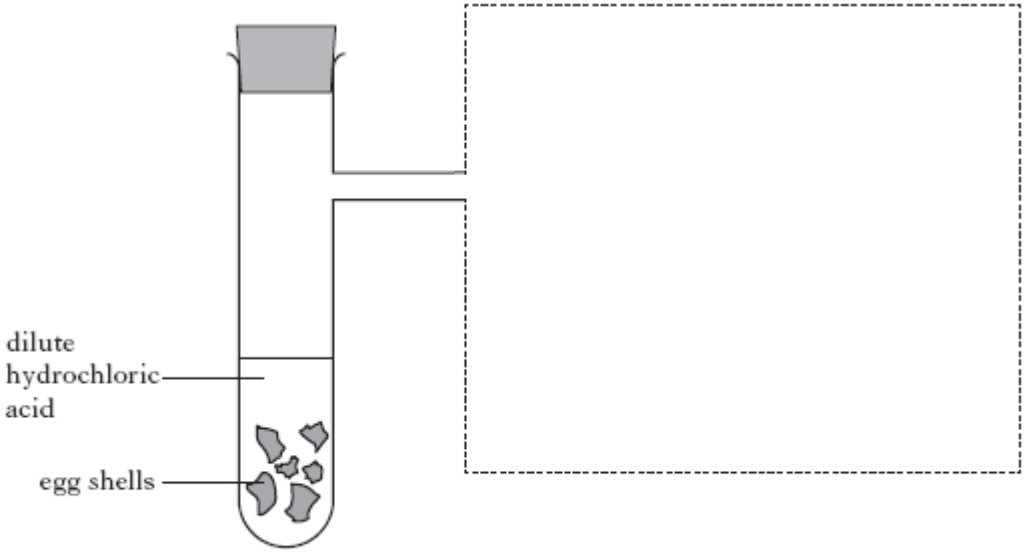
   (a) Draw a line graph of loss of mass against time. (3)
   Use appropriate scales to fill most of the graph paper you have been given.

   (b) Hydrogen gas is produced during this reaction.
   (i) Describe the test for hydrogen gas. (1)
   (ii) Suggest **how** the gas produced could be collected. (1)

   (c) Suggest one change that could be made to make the reaction **faster**. (1)

4. Egg shells are made up mainly of calcium carbonate. A pupil carried out an experiment to react egg shells with excess dilute hydrochloric acid. A gas was produced.

(a) Copy and complete the diagram to show the apparatus which could have been used to measure the volume of gas produced.



(2)

(b) Suggest two ways of increasing the rate at which the gas is produced. (2)

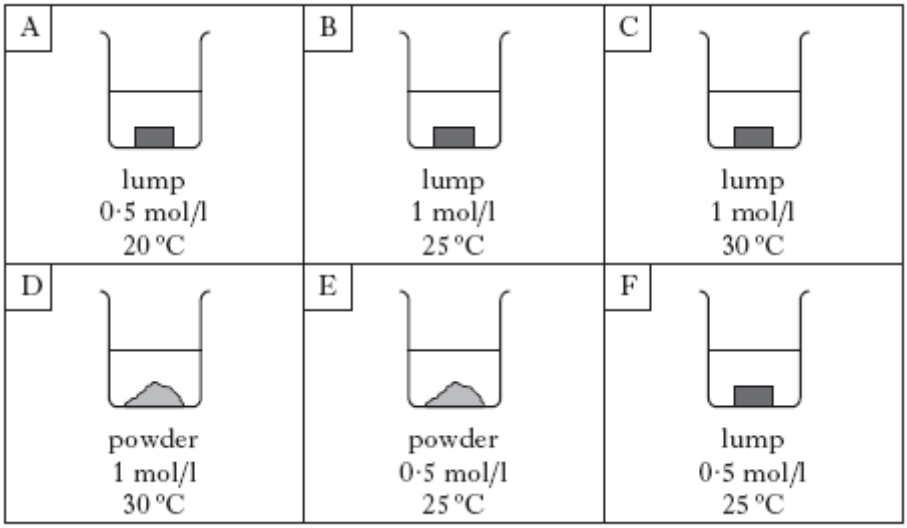
The volume of gas produced during the reaction was measured.

Time (min)	Volume of gas (cm^3)
0	0
2	47
4	92
6	114
8	118
10	118

(c) Plot these results as a line graph. (3)
Use appropriate scales to fill most of the graph paper you have been given.

(d) Add a labelled line to your graph to show what would happen if the egg shell had been crushed up into smaller pieces. (2)

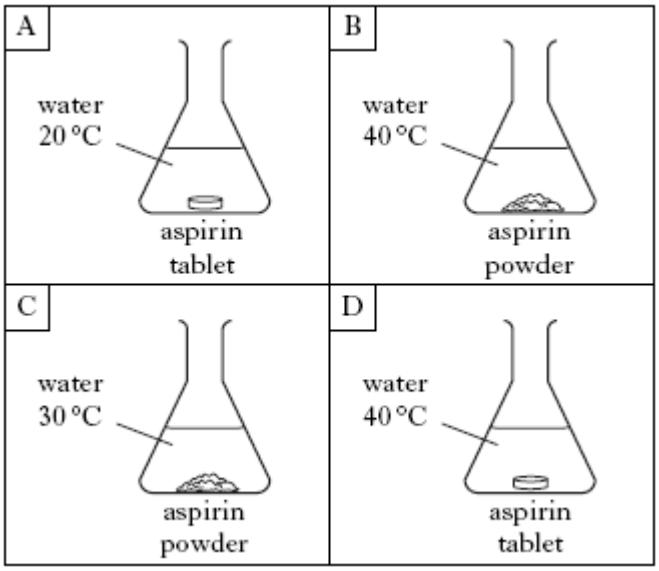
5. A student investigated the rate of reaction between chalk and dilute hydrochloric acid.



(a) Identify the **two** experiments that should be compared to show the effect of concentration on the rate of reaction.

(b) Identify the experiment with the **fastest** speed of reaction. (2)

6. A student set up four experiments to investigate the solubility of aspirin.



(a) Identify the experiment in which the aspirin would take the longest time to dissolve.

(b) Identify the **two** experiments which should be compared to show the effect of particle size on the speed of dissolving. (2)

7. Natural gas will burn in a bunsen burner.

(a) What happens to the temperature of the flame when the air hole is opened?

(b) Explain your answer. (2)

8. Which of the following pairs of reactants would produce hydrogen most **slowly**?

A magnesium powder and 4 $moll^{-1}$ acid
B magnesium ribbon and 2 $moll^{-1}$ acid
C magnesium powder and 2 $moll^{-1}$ acid
D magnesium ribbon and 4 $moll^{-1}$ acid

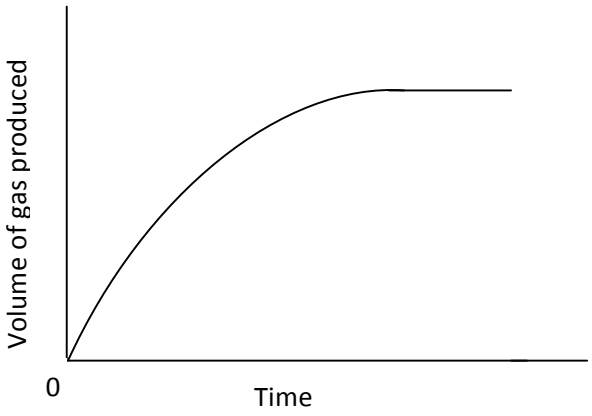
9. A student investigated the reaction between marble chips and excess hydrochloric acid. Which of the following would **not** affect the reaction rate?

A Increasing the volume of acid
B Decreasing the size of marble chips
C Decreasing the concentration of acid
D Increasing the temperature of the acid (2)

10. Sea shells (mainly calcium carbonate) react with vinegar to produce carbon dioxide gas. What would be the effect on the speed of reaction if:

(a) the shells were crumbled
(b) the vinegar was diluted with water
(c) hot vinegar was used
(d) the ordinary acid (5%) was replaced by another acid (7%) (4)

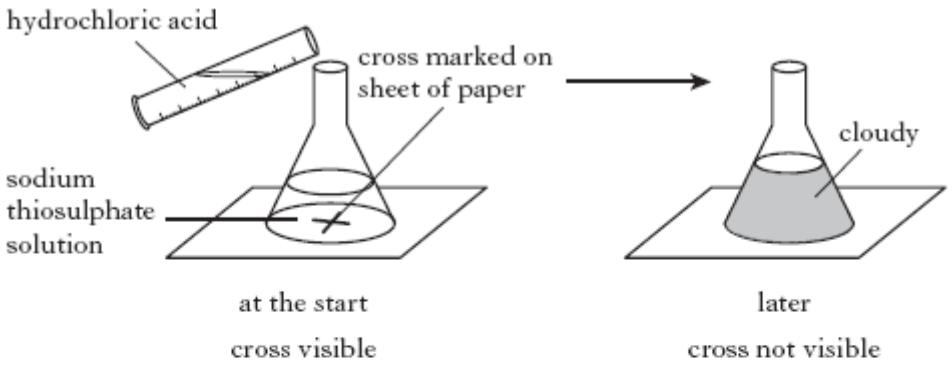
11. Tom, Sam and Fred were investigating the reaction between chalk and acid. They all used 100cm^3 of the same acid which in all cases was in excess. All of the chalk was used up. They each measured the rate at which carbon dioxide was given off. Tom used 5g chalk lumps and obtained the following graph:



Copy the graph above and add to it the curves you would expect for the experiments carried out by Sam and Fred:

(a) Sam used 2.5g chalk lumps which were the same size as Tom. (2)
(b) Fred used 5g of chalk lumps but ground them down to a powder. (2)

12. A student investigated the effect of temperature on the rate of the reaction between hydrochloric acid and sodium thiosulphate.
The student measured the time taken for enough sulphur to form to make the cross disappear.



The results are shown.

Temperature/°C	Time/s
25	89
30	64
35	44
40	33
45	27

(a) Write a general statement describing the effect of temperature on the rate of reaction. (1)

(b) Suggest another factor that could be changed during **this** reaction to speed up the reaction. (1)

13. A class was asked to measure how the rate at which ice melts is affected by salt.
They were provided with the following equipment:

ice cubes in tray, measuring cylinder, salt, filter funnel, stop clock

Describe the steps which could be used to carry out this investigation using all the equipment and chemicals above. You may wish to include a diagram. (2)

14. (a) What is the purpose of a catalyst? (1)
(b) Give 2 reasons why catalysts are used in many industrial reactions. (2)
(c) Research uses of everyday catalysts. Name 2 substances that are used as catalysts and describe the processes they are used in. (2)

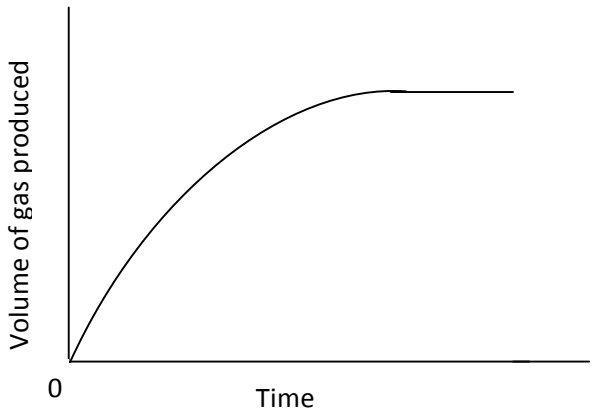
15. Most plastics are insoluble in water. Some hospitals collect dirty clothing and bedding in bags made from a special plastic which dissolves in hot water. These bags can be sealed and put into washing machines. The risk of infection from touching dirty material is less.

You have been given several samples of different water-soluble plastics and have been asked to find which of them dissolves fastest in warm water.

You are given the following instructions:
1. Pour water into beaker.
2. Add plastic being tested and start stop clock.
3. Stir once every 30s.
4. When the polymer has completely dissolved, stop the stop clock.

To make a fair comparison, state **two** factors which must be kept the same in all tests. (2)

16. Hydrogen peroxide solution decomposes naturally to give water and oxygen. The graph shows the volume of oxygen produced by the decomposition of hydrogen peroxide.



(a) Manganese dioxide is a catalyst for this reaction.
Copy the graph above and add a second curve to show the results that you would expect to obtain if the experiment was repeated with manganese dioxide. (2)

(b) How would the mass of manganese dioxide at the end of the experiment compare with the mass at the start? (1)

(c) This reaction can also be catalysed by a solution of Fe^{3+} ions which is amber in colour.
What colour would the solution be at the end of the reaction? (1)

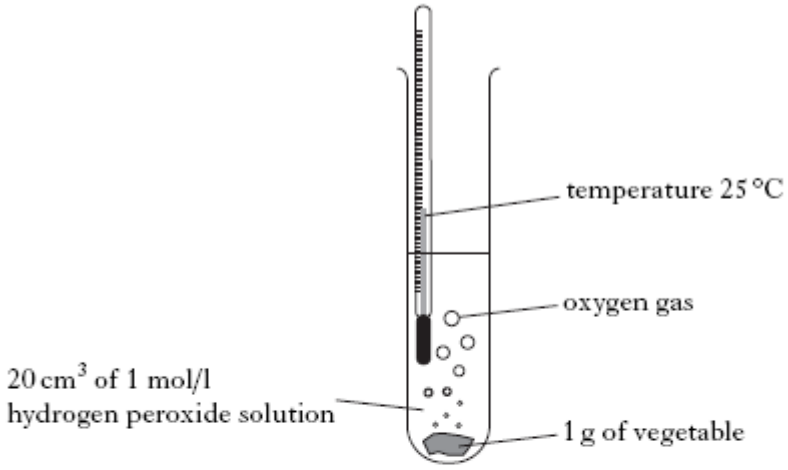
17. Zinc reacts with sulphuric acid to produce hydrogen. Adding copper sulphate solution is thought to speed up the reaction.

(a) What word is used to describe the copper sulphate solution in this example? (1)

You are given a bottle of sulphuric acid, a bottle of copper sulphate solution and a jar of zinc lumps.

(b) Describe how you would investigate the effect of adding copper sulphate solution on the speed of the reaction between zinc and sulphuric acid. (2)

18. A student investigated the amount of the biological catalyst, catalase, in different vegetables. Catalase breaks down hydrogen peroxide solution to produce water and oxygen.



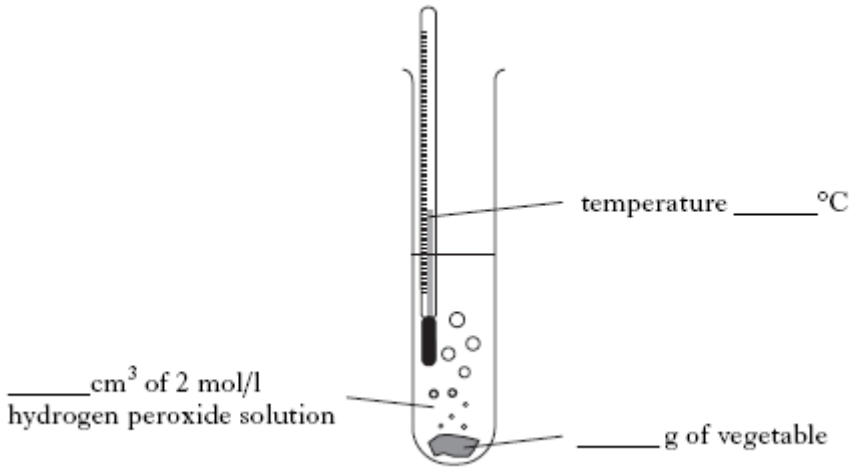
The results are shown in the table.

Vegetable	Number of bubbles of oxygen gas in 3 minutes
leek	40
potato	10
parsnip	65
horseradish	5

(a) Using the information in the table, name the vegetable which contains the largest amount of catalase. (1)

(b) What term is used to describe a biological catalyst such as catalase. (1)

(c) The experiment was repeated to find out if increasing the concentration of hydrogen peroxide solution would speed up the reaction.
Copy and complete the labels of the diagram to show how she would make her experiment a fair test. (1)



19. A student investigated how the concentration of sodium chloride in water affected the freezing point.
The table shows information about the freezing point of different sodium chloride solutions.

Concentration of sodium chloride solution (mol/l)	0	0·09	0·18	0·27	0·37	0·46
Freezing point (°C)	0	−0·2	−0·5	−0·8	−1·1	−1·5

(a) Describe the relationship between concentration and freezing point. (1)

(b) Predict the freezing point of a 0.55 mol/l sodium chloride solution. (1)

20. 'Handwarmers' are intended for use by people who spend time in cold conditions. They consist of an outer packet made of strong plastic plus metal foil. The packet contains colourless crystals and a weak inner bag which is full of a grey powder.

When the packet is rubbed between the hands, the inner bag breaks open and its contents mix with the crystals. The packet can then be placed in a pocket or glove to keep the hands warm for a period of time.

If the packet is opened after being used it is found to contain only a black powder.

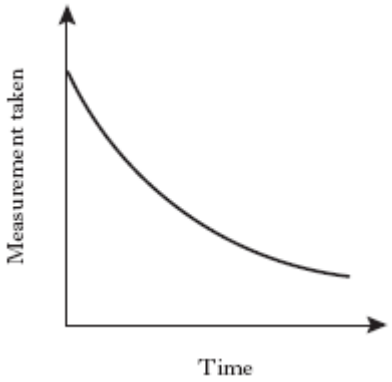
(a) Suggest two pieces of evidence to support the idea that handwarmers work by means of a chemical reaction. (2)
(b) What type of chemical reaction is taking place? (1)
(c) Do the products or reactants have more energy in this type of reaction? (1)

21. In an exothermic reaction

A there is no energy change
B energy is released to the surroundings
C energy is absorbed from the surroundings
D the energy of the products is greater than the energy of the reactants (1)

National 5 Questions

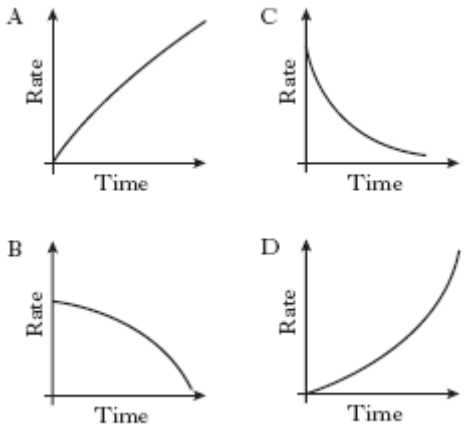
1. Excess marble chips (calcium carbonate) were added to 25cm^3 of hydrochloric acid, concentration 2 mol^{-1}.



Which of the following measurements, taken at regular intervals and plotted against time, would give the graph above?

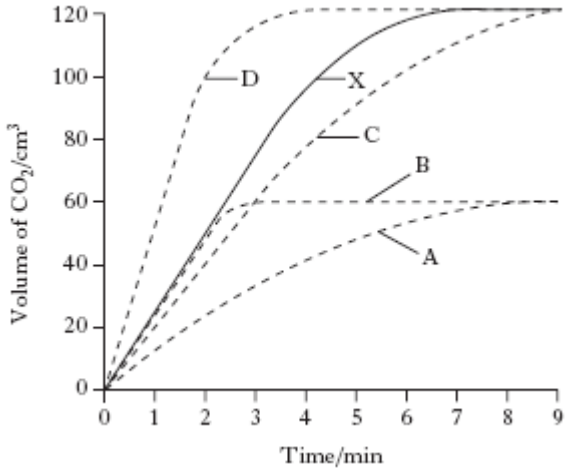
A Temperature
B Volume of gas produced
C pH of solution
D Mass of the beaker and contents (1)

2. Which of the following graphs could represent the change in the rate of reaction when magnesium ribbon reacts with dilute hydrochloric acid?



(1)

3. Graph X was obtained when 1g of calcium carbonate powder reacted with excess dilute hydrochloric acid at 20°C.



Which curve would best represent the reaction of 0.5g lump calcium carbonate with excess of the same dilute hydrochloric acid? (1)

4. During the first 20 seconds of a chemical reaction, 5.0cm3 of gas were given off. The average rate of the reaction, in $cm^3\ s^{-1}$, during the first 20 seconds is

A 20.0 B 5.0 C 4.0 D 0.25 (1)

5. The following results were obtained in the reaction between marble chips and dilute hydrochloric acid.

Time/minutes	0	2	4	6	8	10
Total volume of carbon dioxide produced/cm^3	0	52	68	78	82	84

What is the average rate of production of carbon dioxide, $cm^3\ min^{-1}$ between 2 and 8 minutes?

A 5 B 26 C 30 D 41 (1)

6. Hydrogen gas is produced when magnesium powder reacts with dilute sulphuric acid. The table shows the volume of hydrogen gas produced over fifty seconds.

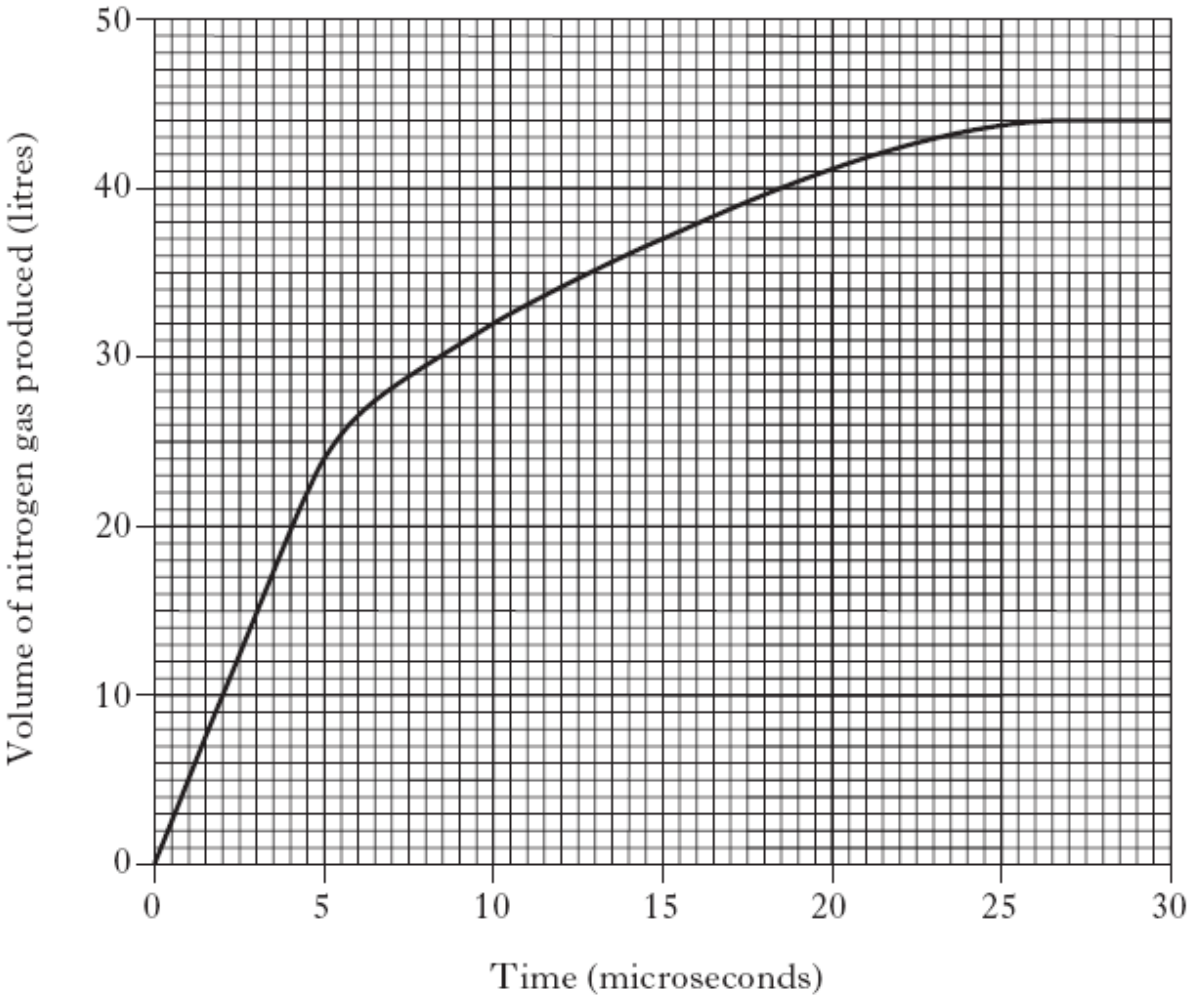
Time/s	Volume of gas/cm^3
0	0
10	20
20	40
30	55
40	65
50	72

(a) Draw a line graph to show these results.
Use appropriate scales to fill most of the graph paper you have been given. (3)

(b) Draw another line on your graph to show the results you would expect if the reaction was repeated with magnesium ribbon. (1)

(c) Calculate the average rate at which gas is produced between 20 and 30 seconds. (2)

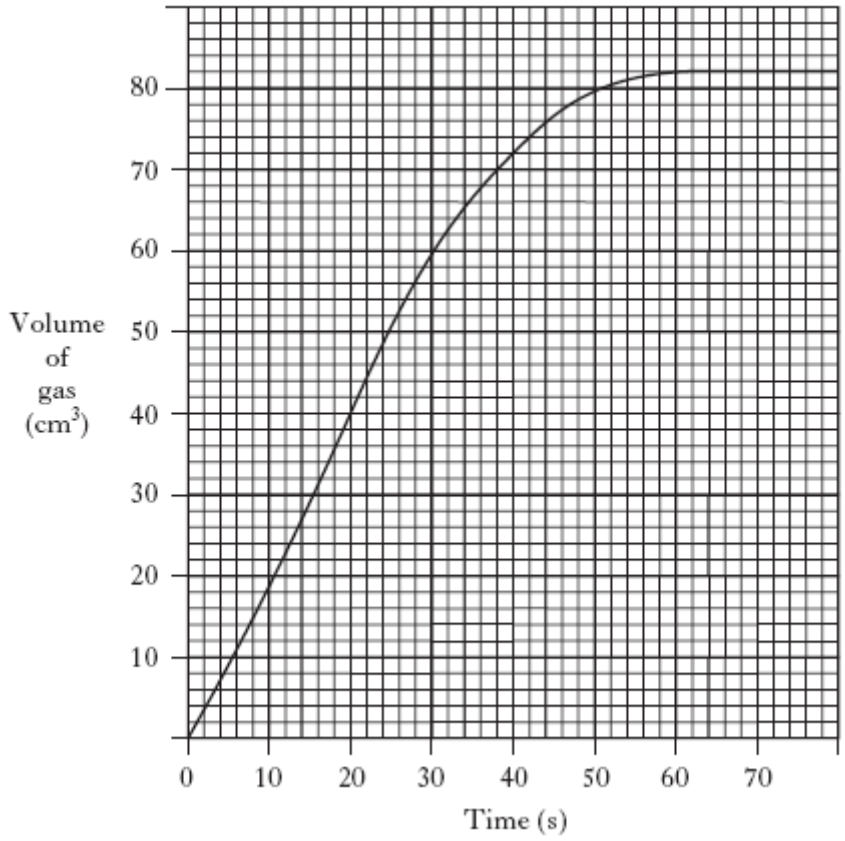
7. Rapid inflation of airbags in cars is caused by the production of nitrogen gas.
The graph gives information on the volume of gas produced over 30 microseconds.



(a) Calculate the average rate of reaction between 2 and 10 microseconds. (2)

(b) At what time has half the volume of nitrogen gas been produced? (1)

8. Magnesium reacts with dilute sulphuric acid to produce hydrogen gas.
A student carried out the experiment. A graph of the results was plotted.



(a) Calculate the average rate of reaction, in $cm^3\ s^{-1}$, for the first 40 seconds. (2)
(b) Predict the total volume of gas produced if the experiment was repeated using a catalyst. (1)
(c) The student repeated the experiment using $100cm^3$ of 1 $moll^{-1}$ sulphuric acid and the same mass of magnesium **powder**. How would this affect the rate of reaction? (1)

9. Research is being carried out into making chemicals that can be used to relieve the side effects of chemotherapy. Part of the process is shown

Chemical A + hydrogen $\xrightarrow{catalyst}$ chemical B

As the reaction proceeds the hydrogen is used up and the pressure decreases.

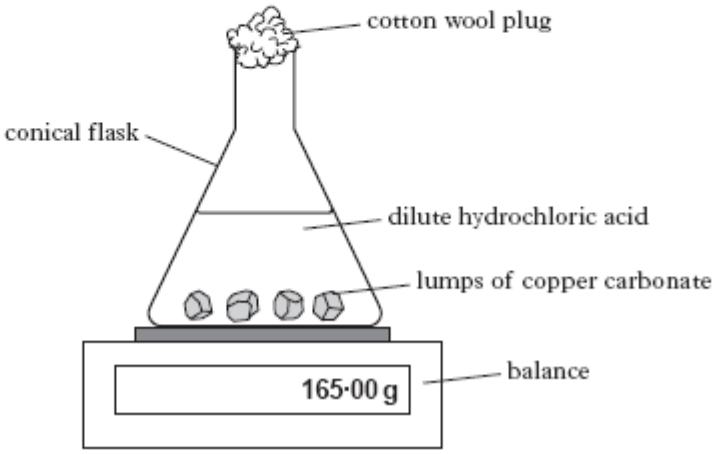
Time (min)	0	5	10	15	20	30	35	45
Decrease in pressure (bar)	0	0·6	1·2	1·7	2·2	2·9	3·1	3·1

(a) Draw a line graph showing the decrease in pressure as time proceeds.
Use appropriate scales to fill most of the graph paper you have been given. (3)
(b) Using **your** graph, at what time did the reaction finish? (1)
(c) Calculate the average rate of the reaction in $bar^{-1}\ min^{-1}$ between 10 and 20 min. (2)

10. Copper(II) carbonate reacts with dilute hydrochloric acid as shown.

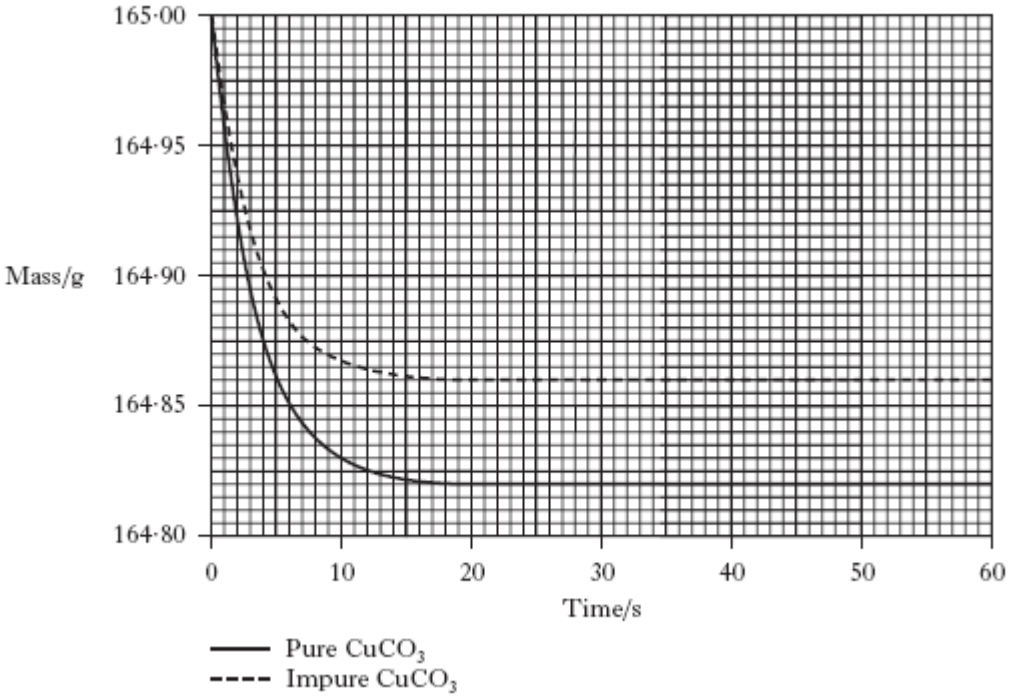
$$CuCO_3(s) + 2HCl(aq) \rightarrow CuCl_2(aq) + H_2O(\ell) + CO_2(g)$$

A student used the apparatus shown below to follow the progress of the reaction.



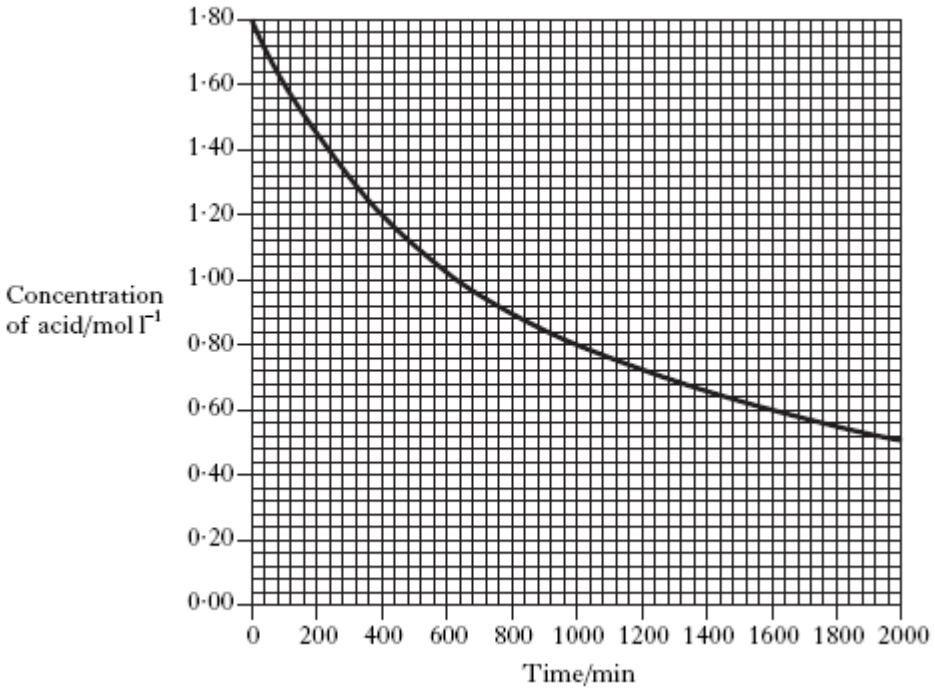
(a) Suggest why a cotton wool plug was placed in the mouth of the conical flask. (1)

The experiment was carried out using 0.50g samples of both pure and impure copper (II) carbonate. The graph below shows the results obtained.



(b) For the sample of pure copper (II) carbonate, calculate the average rate of reaction in gs^{-1} over the first 10 seconds. (2)

11. The graph shows how the concentration of hydrochloric acid changed over a period of time when a reaction was carried out at 20°C.



Calculate the average rate of reaction in mol^{-1} min^{-1} in the first 400 minutes. (2)