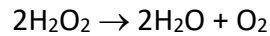


# RATE OF REACTION 2

Q1.

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

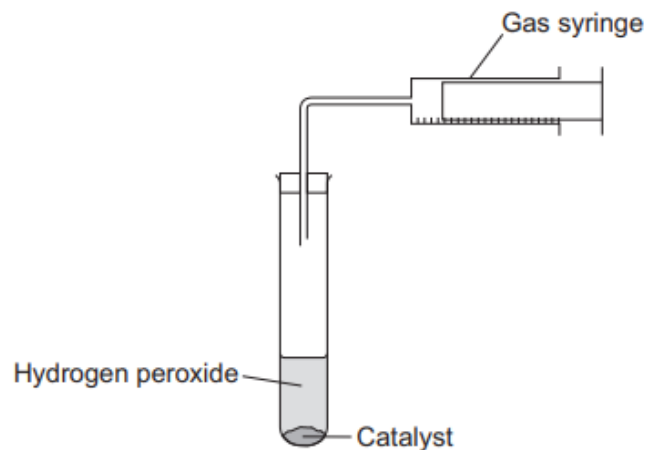


Complete the word equation for the decomposition of hydrogen peroxide.

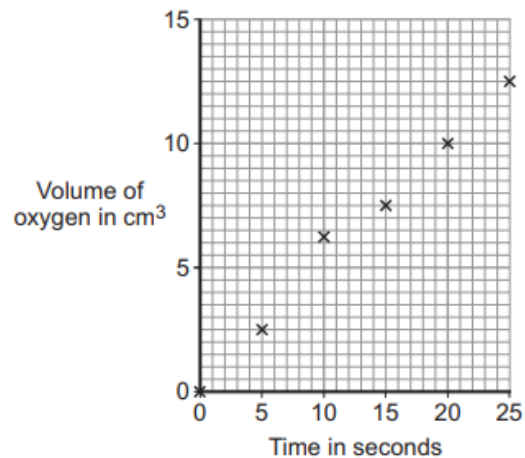
Hydrogen peroxide  $\rightarrow$  ..... + .....

(1 mark)

(b) A student did an experiment to see how quickly hydrogen peroxide decomposes. The student used the apparatus shown below to measure the volume of oxygen.



(i) Draw a straight line of best fit to complete the graph.



(1 mark)

(ii) Draw a circle around the anomalous point on the graph.

(1 mark)

(iii) What is the volume of oxygen given off after 15 seconds?

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(1 mark)

(iv) How did the volume of oxygen change between 0 and 25 seconds?

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(1 mark)

(c) The student wanted to make the reaction faster.

Draw a ring around the correct answer to complete each sentence.

(i)

To make the reaction faster, the temperature should be

higher.

lower.

the same.

(1 mark)

(ii)

To make the reaction faster, the hydrogen peroxide should be

more dilute.

more concentrated.

the same.

(1 mark)

**Q2.** The picture shows a student with two glow sticks.



Glow sticks contain several chemicals. When a glow stick is bent the chemicals mix. A chemical reaction takes place which causes light to be given out.

A student investigated three glow sticks. One was placed in water at 5 °C, one in water at 40 °C and one in water at 70 °C.

The results are shown in the table.

Temperature in °C	Effect on glow stick	
	Brightness of light	Time it gave out light, in hours
5	dim	7
40	bright	3
70	very bright	1

**(a)** How did increasing the temperature affect the brightness of the glow stick?

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(1 mark)

**(b)** How did increasing the temperature affect the time it gave out light?

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(1 mark)

(c) The student was asked why an increase in temperature changes the rate of the chemical reaction. The student listed five ideas. Only three of them are correct.

Put ticks (✓) next to the three correct ideas.

Ideas	Tick (✓)
The particles will collide more often.	
The particles will be more concentrated.	
The particles will move faster.	
The particles will have more energy.	
The particles will get bigger.	

(3 marks)

(d) Suggest one way the student could improve this investigation.

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(1 mark)

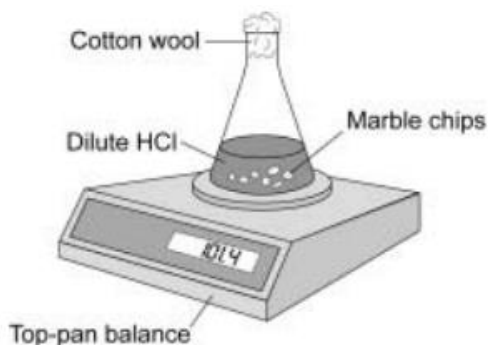
**Q3.** A student investigated the rate of reaction between marble and hydrochloric acid.

The student used an excess of marble.

The reaction can be represented by this equation:

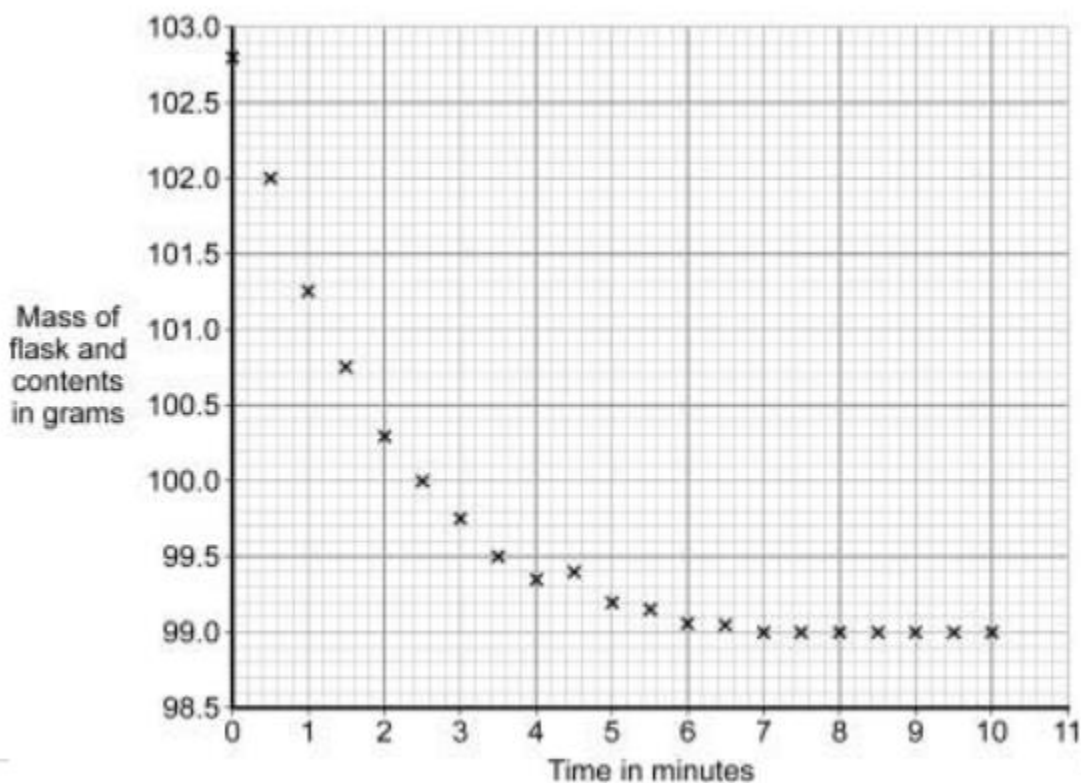


The student used the apparatus shown in the diagram.



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 mark)

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

(1 mark)

**(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 marks)

**(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 marks)

**(c)** The student repeated the experiment using powdered marble instead of marble chips.

**(i)** The rate of reaction between the marble and hydrochloric acid particles was much faster with the powder. Explain why.

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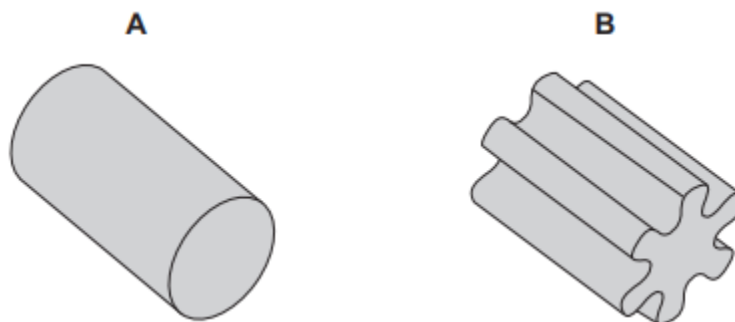
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(2 marks)

**(ii)** A catalyst is used for the reaction. The gases pass through a layer containing pieces of the catalyst.

The figure shows the shapes of pieces of catalyst.



Suggest and explain why shape B is more effective as a catalyst than shape A.

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(2 marks)

**(d)** The reaction is carried out at a high temperature to provide the reactants with the activation energy.

What is meant by the activation energy?

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(1 mark)

Total marks (24)