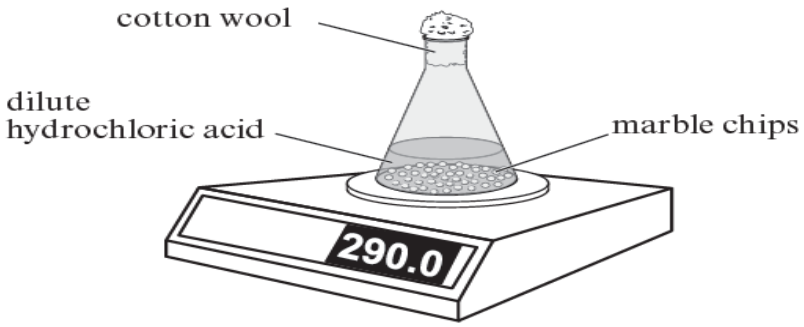
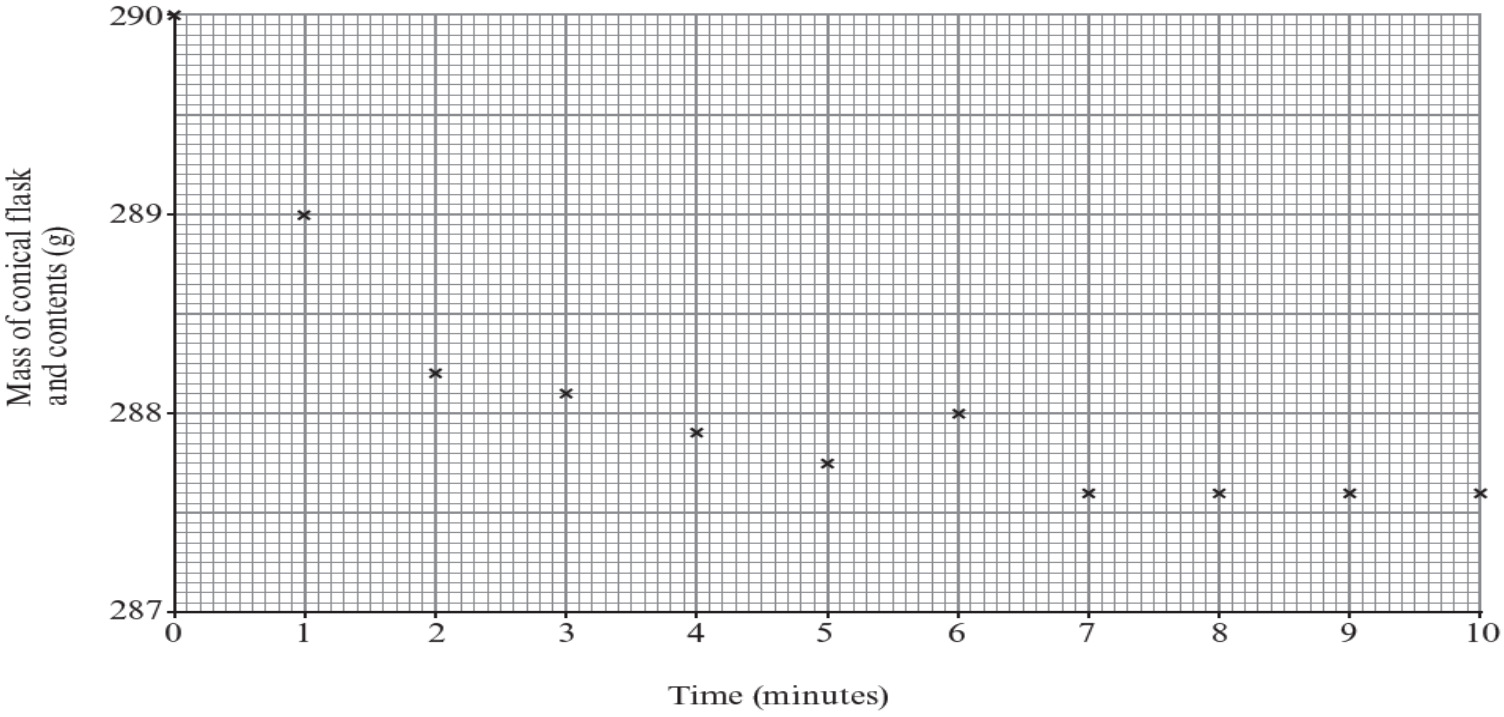
Rates Past Paper Questions – Higher

6. In order to study the effect of particle size on the rate of a reaction, marble chips (calcium carbonate) were reacted with *excess* dilute hydrochloric acid using the apparatus shown below.



The results were plotted on the graph below.



(a) Draw a line of best fit for the points plotted. [1]

(b) State why the mass decreases during the experiment. [1]

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(c) State the reason for placing cotton wool in the neck of the conical flask. [1]

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(d) The experiment was then repeated using the same mass of calcium carbonate powder instead of marble chips.

On the grid on the previous page, draw the curve you would expect to get. [2]

(e) The experiment was repeated once more, again using the same mass of calcium carbonate powder and the same volume of acid at half the concentration. The acid was still in excess. Give the total decrease in mass in this experiment and give a reason for your answer.

[2]

Decrease in mass = ... g

Reason .....

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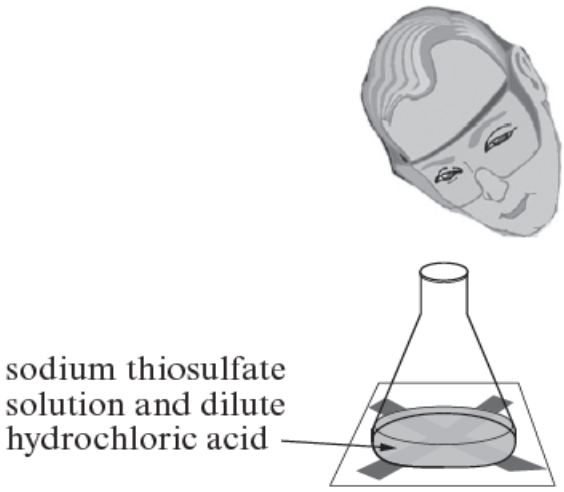
2. Sodium thiosulfate solution reacts with dilute hydrochloric acid forming a yellow precipitate. This reaction can be investigated using the 'disappearing cross' experiment. The yellow precipitate formed during the reaction causes a cross marked on a piece of white paper to disappear (see diagram below). The time taken for this to happen can be measured.



10 cm^3 of dilute hydrochloric acid was added separately to 50 cm^3 sodium thiosulfate solutions of five different concentrations. The results are shown below.

Concentration of sodium thiosulfate solution (g/dm^3)	Time for cross to disappear (s)			
	1	2	3	Mean
8	37	38	39	38
16	20	17	17	18
24	10	8	12	10
32	10	7	7	8
40	3	7	8	6

(a) State which concentration gave the most repeatable set of reaction times. Give the reason for your choice. [2]

Concentration ..... g/dm^3

Reason .....

(b) Apart from taking more readings, suggest **one** way to improve the repeatability of the readings. [1]

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(c) Apart from the volumes of both reactants and the concentration of the acid, name the **most** important factor which must be kept the same during each experiment. [1]

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(d) State and explain, using particle theory, your conclusion from the investigation. [3]

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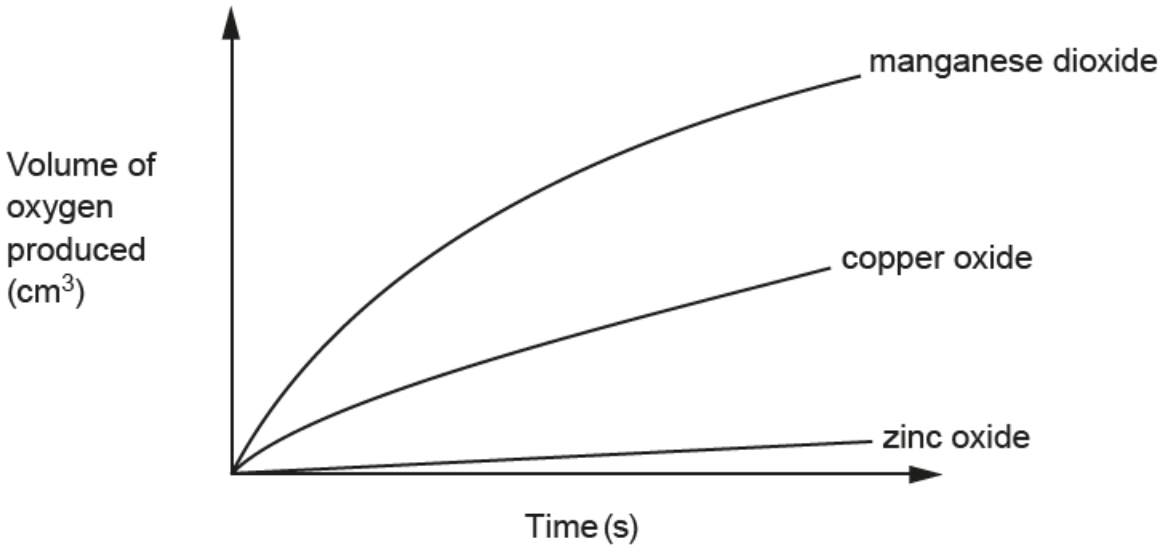
10. Explain, using particle theory, how the rate of a chemical reaction depends on concentration and temperature. [6 QWC]

5. Hydrogen peroxide solution, H_2O_2, decomposes to form oxygen and water.

$$2H_2O_2 \longrightarrow O_2 + 2H_2O$$

The reaction is very slow at room temperature but can be speeded up by adding certain metal oxide powders, which act as catalysts.

The rate of reaction can be measured by recording the volume of oxygen produced over time. The following graph shows the volume of oxygen produced using three different metal oxides.



(a) (i) Compare the results for each metal oxide. [2]

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(ii) Give **three** ways of ensuring that the experiment is a fair test. [2]

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(b) Catalysts are used to speed up industrial processes. Explain why this is important. [2]

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5. *(a)* One of the main dangers in the coal mining industry is that coal dust can form an explosive mixture with air.

Explain why an explosion is more likely to occur with coal dust than with lumps of coal. [2]

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(b) A chemical reaction goes twice as fast if the temperature is increased by 10 °C.

At 5 °C, milk undergoes a chemical reaction that makes it go sour in 8 days.

Calculate how long it will take milk to go sour at 35 °C. [2]

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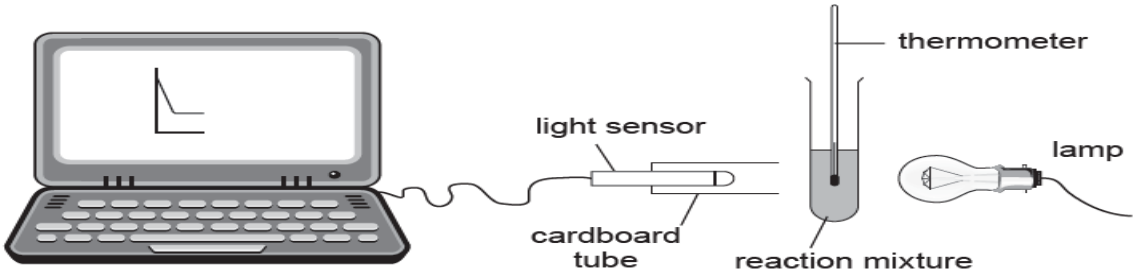
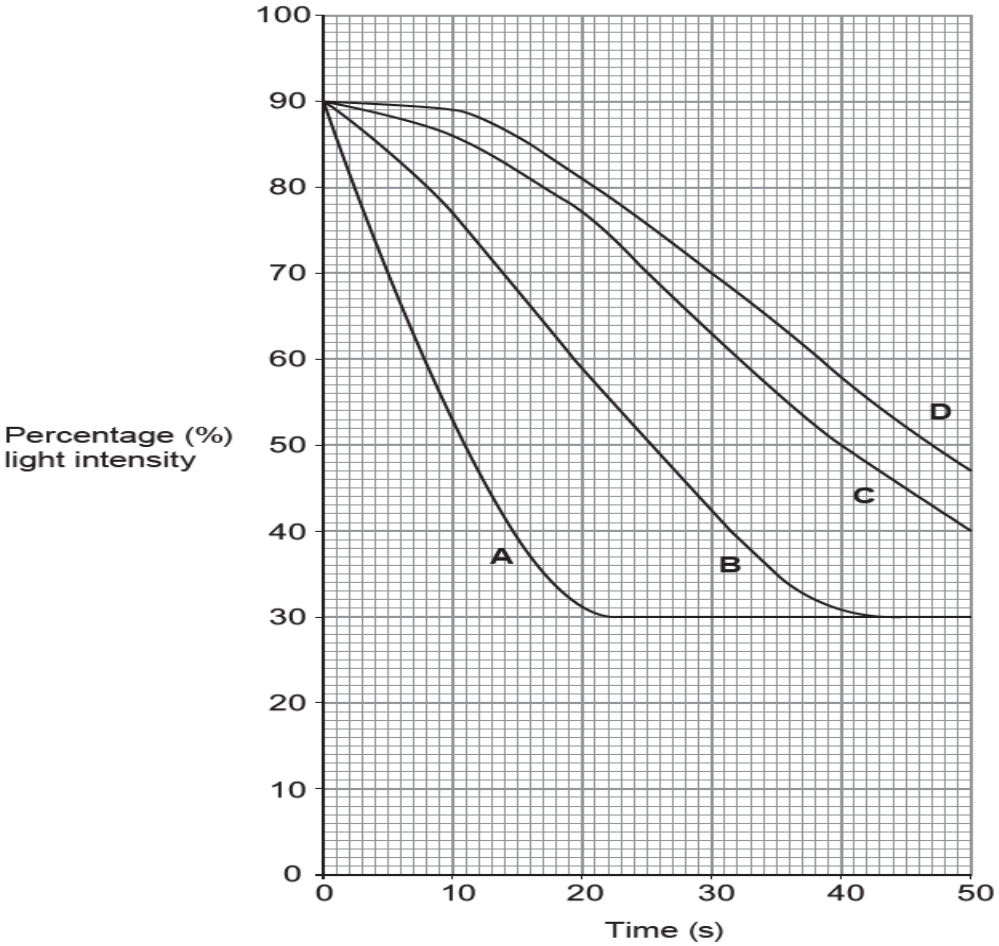
6. Sodium thiosulfate solution reacts with dilute hydrochloric acid forming a yellow precipitate. This reaction can be investigated using the equipment below. The yellow precipitate formed during the reaction causes a reduction in the amount of light reaching the light sensor.



5 cm^3 of dilute hydrochloric acid was added separately to 10 cm^3 sodium thiosulfate solutions at four different temperatures. All other factors were kept the same. The results are shown on the grid below.



(a) Give the letter **A**, **B**, **C** or **D** of the graph which represents the reaction carried out at the highest temperature and give the reason for your choice. [1]

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(b) The rate of reaction can be calculated using the formula:

$$\text{rate} = \frac{1}{\text{time}}$$

The reaction is considered to be complete when the percentage light intensity reaches 30 %. Use the formula to find the mean rate for experiment **A**. [2]

Rate = ... / s

(c) State and explain, using particle theory, the conclusion you draw from the investigation. [3]

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