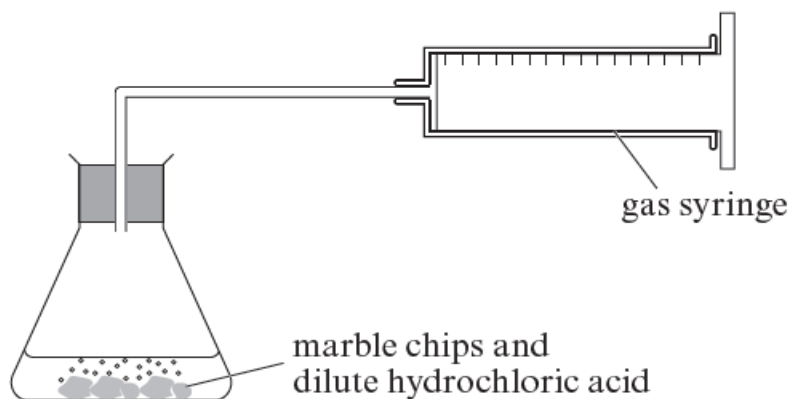


## Rates Past Paper Questions – Foundation

4. Marble chips are made of calcium carbonate and react with dilute hydrochloric acid to give off carbon dioxide.

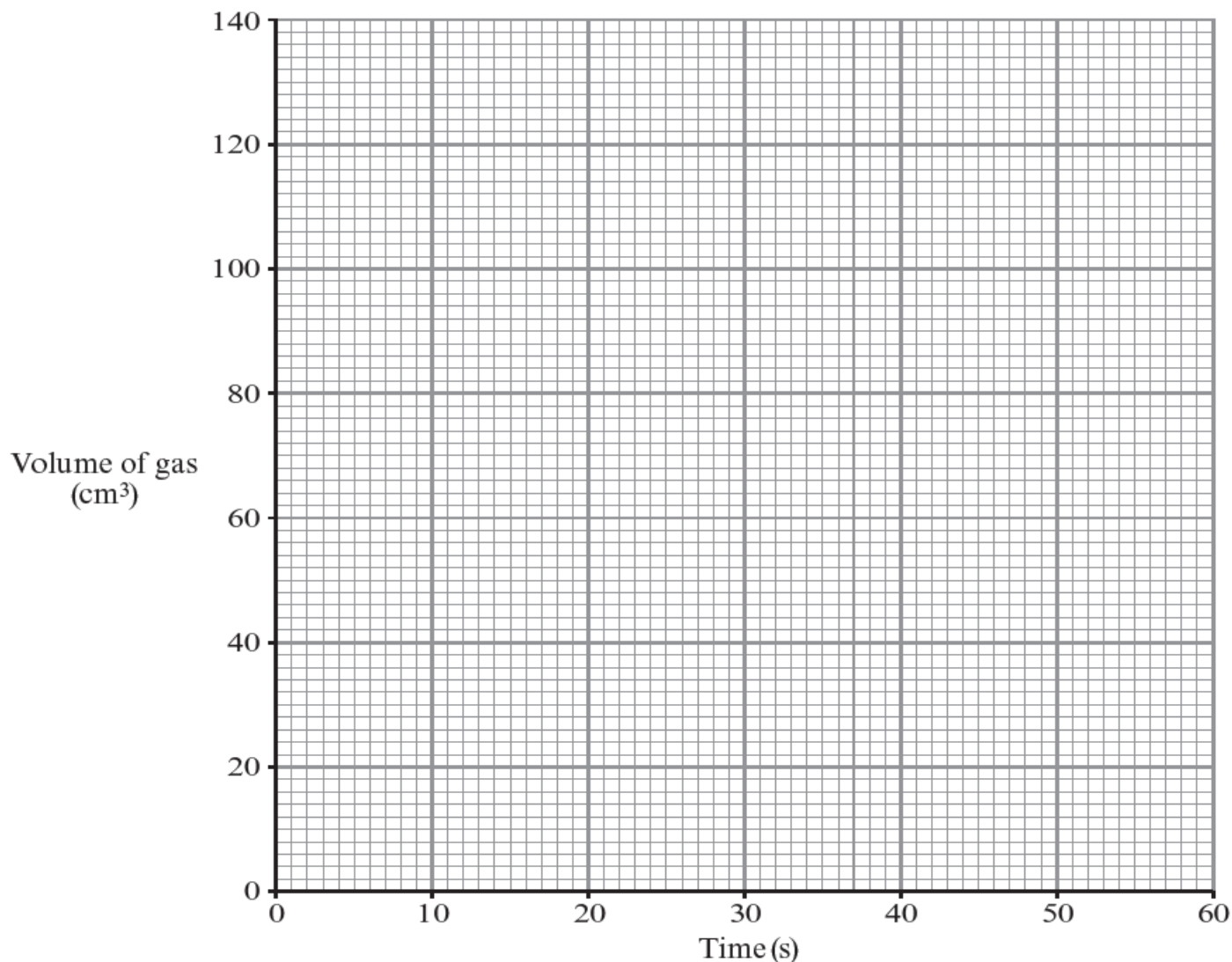
*Excess* marble chips and 100 cm<sup>3</sup> of hydrochloric acid were placed in the flask in the apparatus shown below.



The volume of gas given off was measured every 10 seconds and recorded in the table below.

Time (s)	0	10	20	30	40	50	60
Volume of gas (cm <sup>3</sup> )	0	52	80	92	114	120	120

- (a) (i) Plot the results from the table on the grid below and draw a smooth curve of best fit. [3]



(ii) Find the time taken for the reaction to finish and state how you reached your answer. [2]

.....  
.....

(iii) Complete the following statement by placing a tick (✓) in the box next to the correct answer.  
Using the **graph**, give the reason for your choice.

The reaction is proceeding at its fastest rate from [2]

- |         |                          |
|---------|--------------------------|
| 0-10 s  | <input type="checkbox"/> |
| 10-20 s | <input type="checkbox"/> |
| 20-30 s | <input type="checkbox"/> |
| 30-40 s | <input type="checkbox"/> |
| 40-50 s | <input type="checkbox"/> |
| 50-60 s | <input type="checkbox"/> |

*Reason* .....

.....

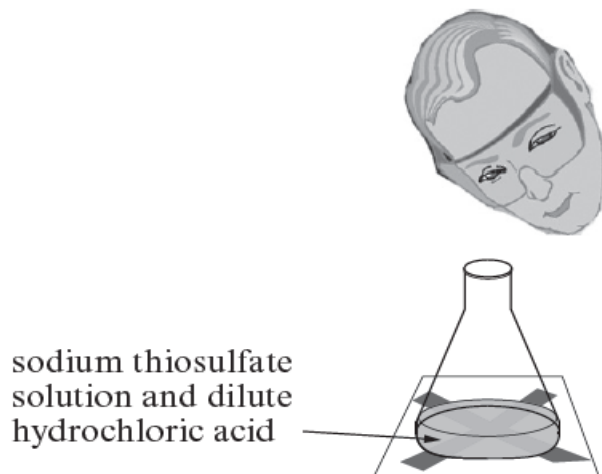
(b) State **two** ways in which this reaction could be made to go faster. [2]

1. ....  
.....
2. ....  
.....

(c) If the acid had been in *excess*, instead of the marble chips, state **one** different observation that would have been made at the end of the experiment. [1]

.....  
.....

9. 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<sup>3</sup> of dilute hydrochloric acid was added separately to 50 cm<sup>3</sup> sodium thiosulfate solutions of five different concentrations. The results are shown below.

Concentration of sodium thiosulfate solution (g/dm <sup>3</sup> )	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<sup>3</sup>

Reason .....

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

- (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]

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

7. The following word equation represents the reaction between zinc and dilute hydrochloric acid.



You are asked to carry out an experiment to show how **particle size** affects the speed of this reaction.

- (a) (i) Describe how you would carry out the experiment. [2]

.....

.....

.....

.....

- (ii) State how you would make it a fair test. [2]

.....

.....

.....

- (iii) State how you would know which particle size gives the fastest reaction. [1]

.....

.....

(b) A catalyst was added to the reaction mixture above.

- (i) State how the catalyst would affect the **time** needed to produce a given volume of hydrogen. [1]

.....

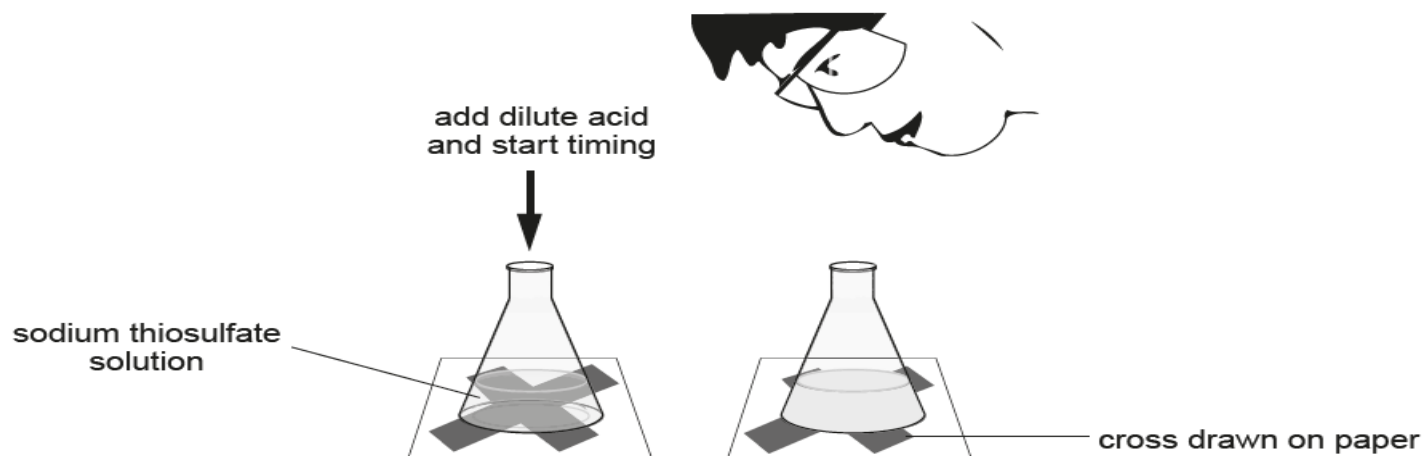
.....

- (ii) State how you would expect the catalyst to affect the total **volume** of hydrogen produced. [1]

.....

.....

6. When sodium thiosulfate solution reacts with dilute acid, sulfur forms as a precipitate. The precipitate causes the solution to go cloudy. The rate of reaction can be measured by placing a cross beneath the flask and measuring the time taken for the cross to disappear.

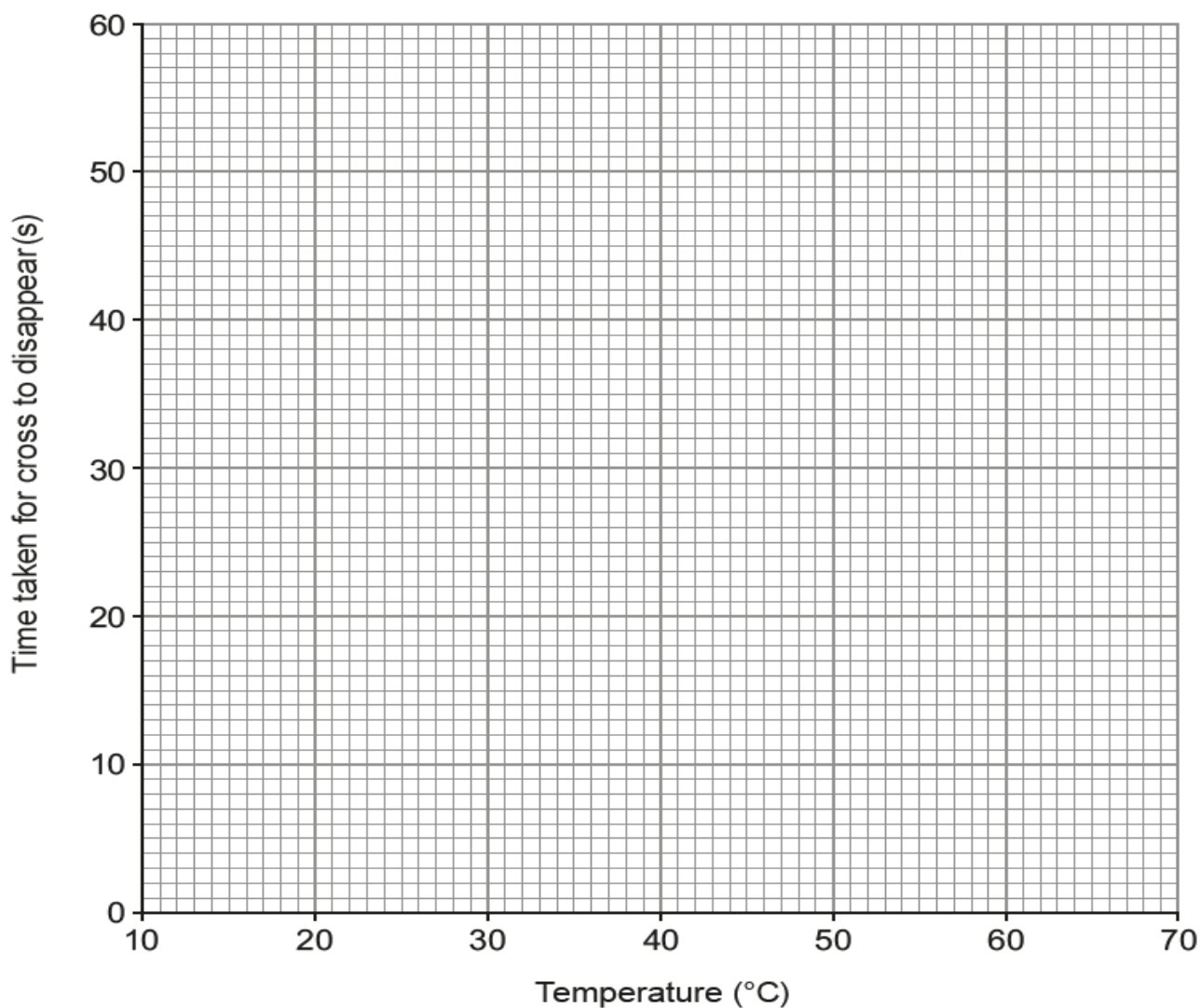


A pupil studied the effect of temperature on the reaction and obtained the following results.

Temperature ( $^{\circ}\text{C}$ )	20	30	40	50	60
Time taken for cross to disappear (s)	50	32	25	20	17

- (a) (i) Plot the results on the grid below and draw a suitable line.

[3]

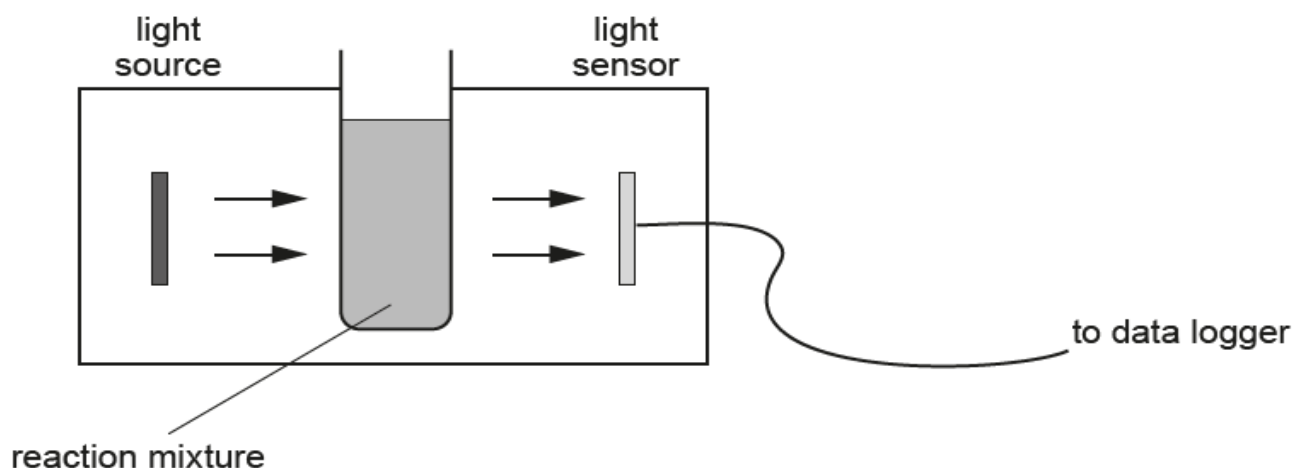


(ii) Describe the trend in the results.

[1]

(iii) A second student carried out the same experiment using a higher concentration of acid. Draw the line you would expect him to obtain on the same grid. [1]

(b) Another student suggested using a light sensor and data logger to study the reaction rate.



Describe how the light intensity detected by the sensor would change during the reaction and give **one** advantage of using a light sensor. [2]

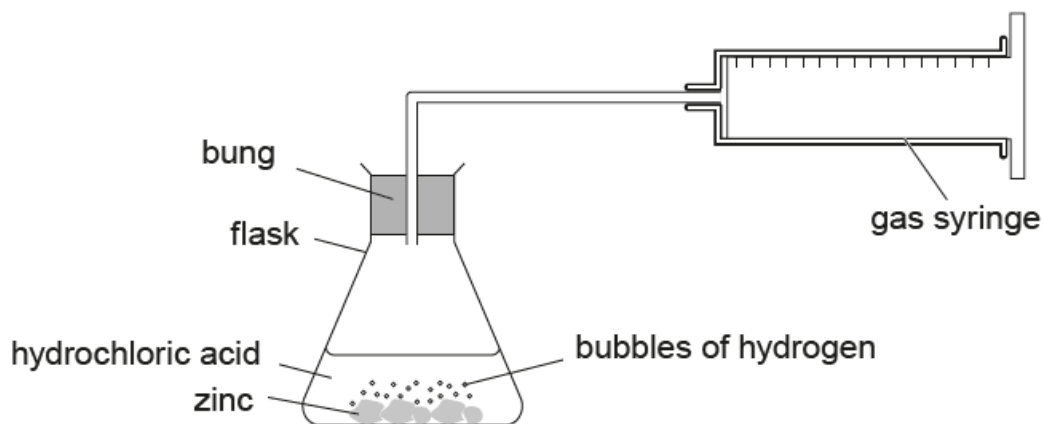
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5. (a) Zinc reacts with dilute hydrochloric acid to produce hydrogen gas.

The diagram below shows apparatus that can be used to investigate the rate of the reaction between zinc and hydrochloric acid. A small amount of copper sulfate is added because it acts as a catalyst for the reaction.



A few pieces of zinc were placed in excess dilute hydrochloric acid and the volume of hydrogen produced was recorded every 10 seconds. The experiment was carried out at room temperature. The results obtained are shown below.

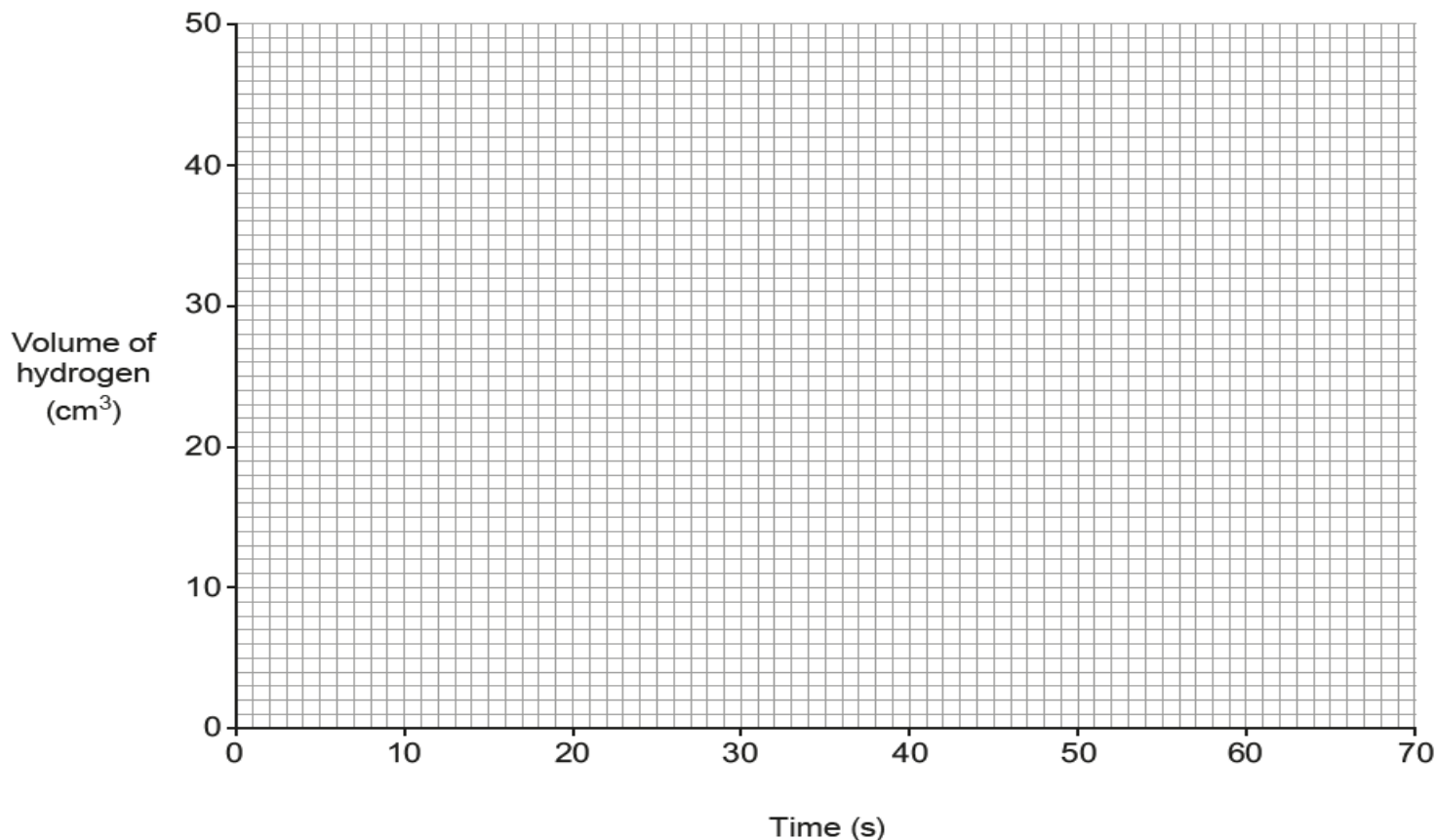
Time (s)	0	10	20	30	40	50	60	70
Volume of hydrogen (cm <sup>3</sup> )	0	8	33	40	45	48	49	49

(i) All the results were measured accurately but the volume recorded after 10 seconds is lower than expected. Suggest a possible reason for this. [1]

.....

.....

(ii) Plot all the results from the table on the grid below and draw a suitable line. [3]



(iii) Use your graph to give the volume of hydrogen expected after 10 seconds. [1]

..... cm<sup>3</sup>

(iv) State how the graph shows that the reaction has stopped. [1]

.....  
.....

(v) Choose statements from the box below to complete the following sentences.

less time	more time	the same time
-----------	-----------	---------------

Each statement may be used once, more than once or not at all. [2]

Using zinc **powder** instead of the larger pieces of zinc the reaction takes

.....

When the experiment is repeated without the copper sulfate catalyst the reaction takes .....

(b) A chemical reaction takes twice as long if the temperature is decreased by 10 °C.

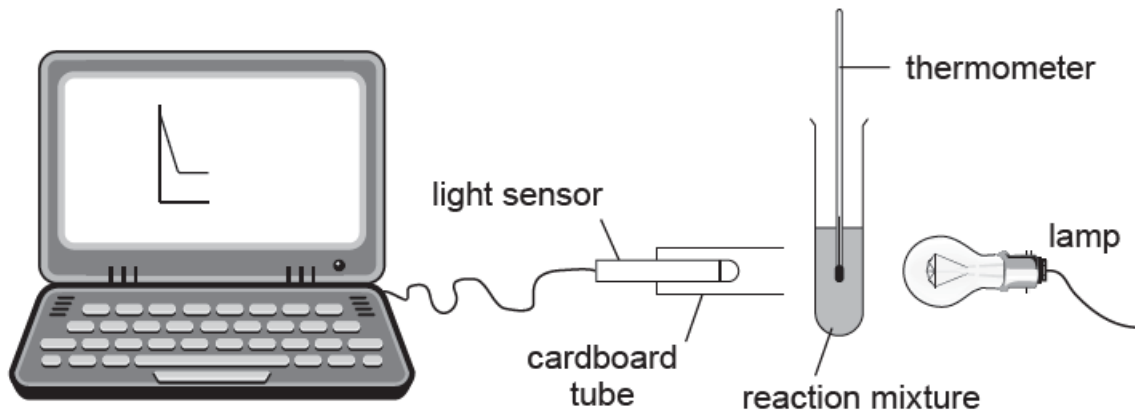
At 30 °C, milk undergoes a chemical reaction that makes it go sour in 1 day.

Calculate how long it will take milk to go sour at 10 °C. [2]

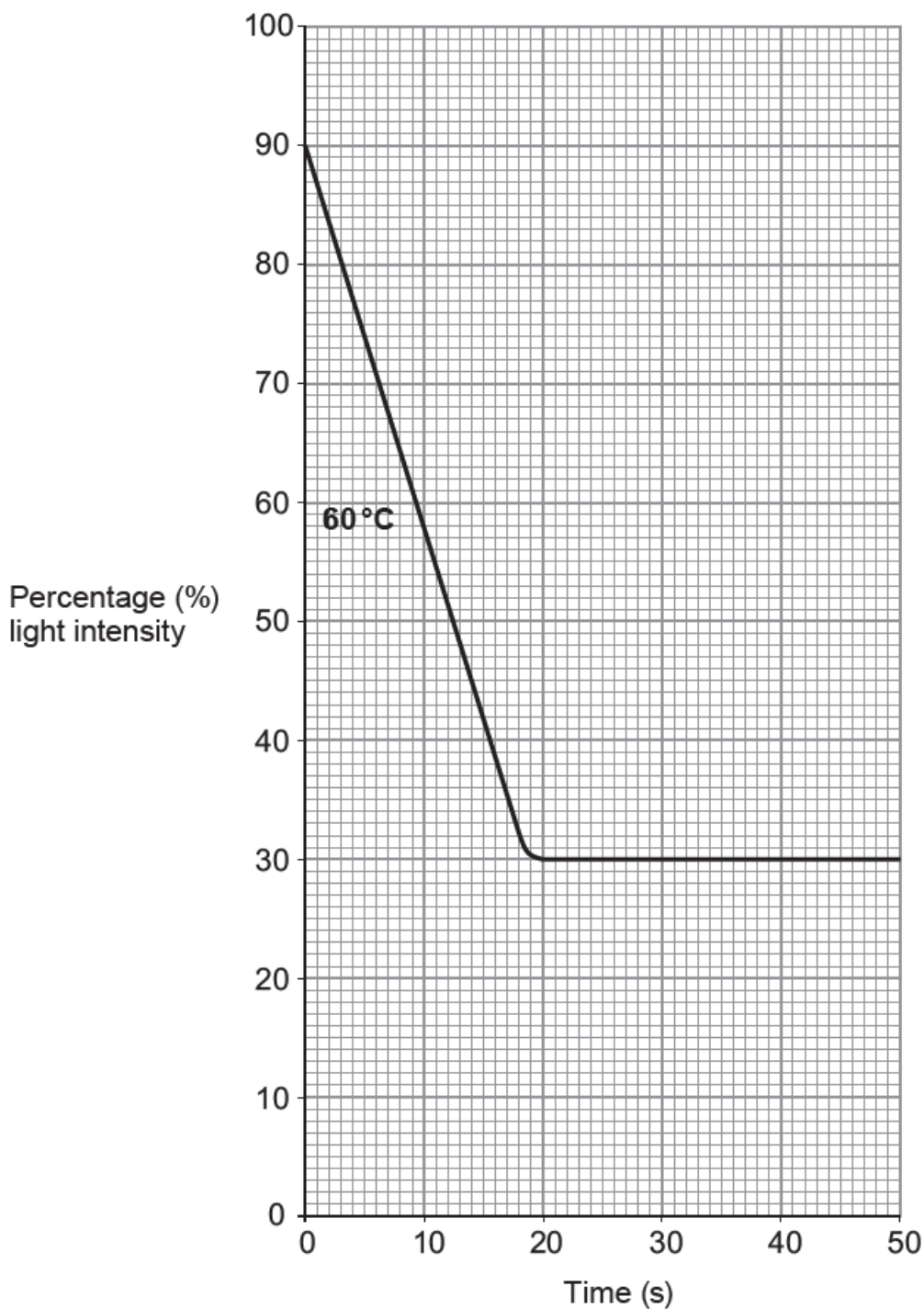
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.....



5. Sodium thiosulfate solution reacts with dilute hydrochloric acid forming a yellow precipitate. This reaction was investigated using the equipment below.



5 cm<sup>3</sup> of dilute hydrochloric acid was added to 10 cm<sup>3</sup> sodium thiosulfate solution at 60 °C and the light intensity was measured over time. The results are shown on the grid below.



(a) Use the graph to find the time taken for the reaction to stop. [1]

Time = ..... s

(b) The experiment was repeated at 40 °C. The reaction stopped after 35 s. Carefully draw the graph of this experiment on the same grid. [1]

(c) Explain why the light intensity decreases as this reaction takes place. [2]

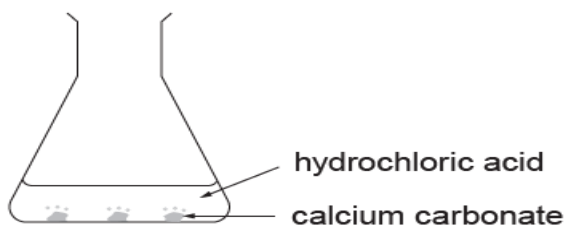
.....

.....

(d) Suggest **one** possible reason why the light intensity does not fall to 0%. [1]

.....

3. An investigation was carried out to find the effect of different factors on the rate of reaction of calcium carbonate and hydrochloric acid.



The time taken for the calcium carbonate to disappear in each experiment is shown in the table below.

Experiment number	Form of calcium carbonate	Temperature of acid (°C)	Time taken for calcium carbonate to disappear (s)
1	marble chips	20	600
2	powder	20	150
3	marble chips	40	400

- (a) (i) Use the results to describe the effect of changing temperature on reaction time. [1]

.....  
 .....

- (ii) Name the factor that has changed between experiments 1 and 2 and describe what effect this factor has on reaction time. [2]

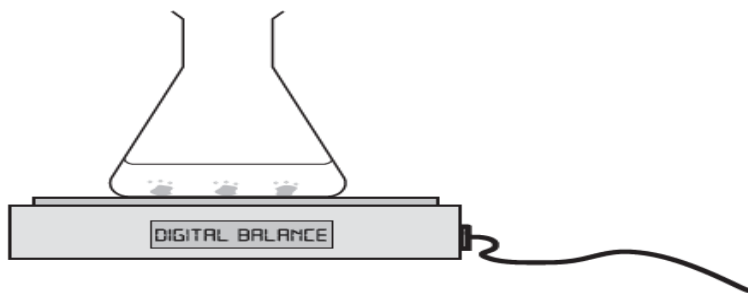
.....  
 .....

- (iii) State **two other** factors that should be kept the same in order to make this investigation a fair test. [2]

Factor 1 .....

Factor 2 .....

- (b) The rate of reaction can also be investigated by recording the change in mass.



Explain what will happen to the mass during the reaction.

[2]

.....  
 .....