

# Rate(speed) of Reaction

## Question Paper 2

<b>Level</b>	IGCSE
<b>Subject</b>	Chemistry
<b>Exam Board</b>	CIE
<b>Topic</b>	Chemical Reactions
<b>Sub-Topic</b>	Rate (speed) of Reactions
<b>Paper Type</b>	Alternative to Practical
<b>Booklet</b>	Question Paper 2

**Time Allowed:** 59 minutes

**Score:** /49

**Percentage:** /100

- 1 A student investigated the speed of reaction when iodine was produced by the reaction of solution L with potassium iodide at different temperatures.

Five experiments were carried out.

### *Experiment 1*

A burette was filled with the aqueous solution L to the 0.0 cm<sup>3</sup> mark. 10.0 cm<sup>3</sup> of solution L was added from the burette into a boiling tube and the initial temperature of the solution was measured.

Using a measuring cylinder, 5 cm<sup>3</sup> of aqueous potassium iodide and 3 cm<sup>3</sup> of aqueous sodium thiosulfate were poured into a second boiling tube. Starch solution was added to this boiling tube and the mixture shaken.

The mixture in the second boiling tube was added to the solution L, shaken and the clock started. These chemicals reacted to form iodine which reacted with the starch. When a blue colour appeared, the clock was stopped and the time measured and recorded in the table. The final temperature of the mixture was measured.

### *Experiment 2*

Experiment 1 was repeated but solution L was heated to about 40 °C. The temperature of the solution was measured before adding the mixture in the second boiling tube. When a blue colour appeared, the clock was stopped and the time measured and recorded in the table. The final temperature of the mixture was measured.

### *Experiment 3*

Experiment 2 was repeated, heating solution L to about 50 °C.

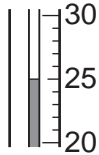
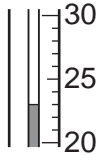
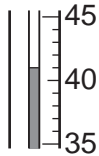
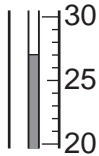
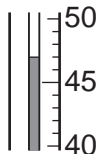
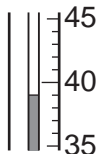
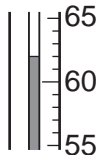
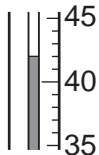
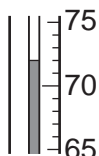
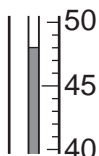
### *Experiment 4*

Experiment 2 was repeated, heating solution L to about 60 °C.

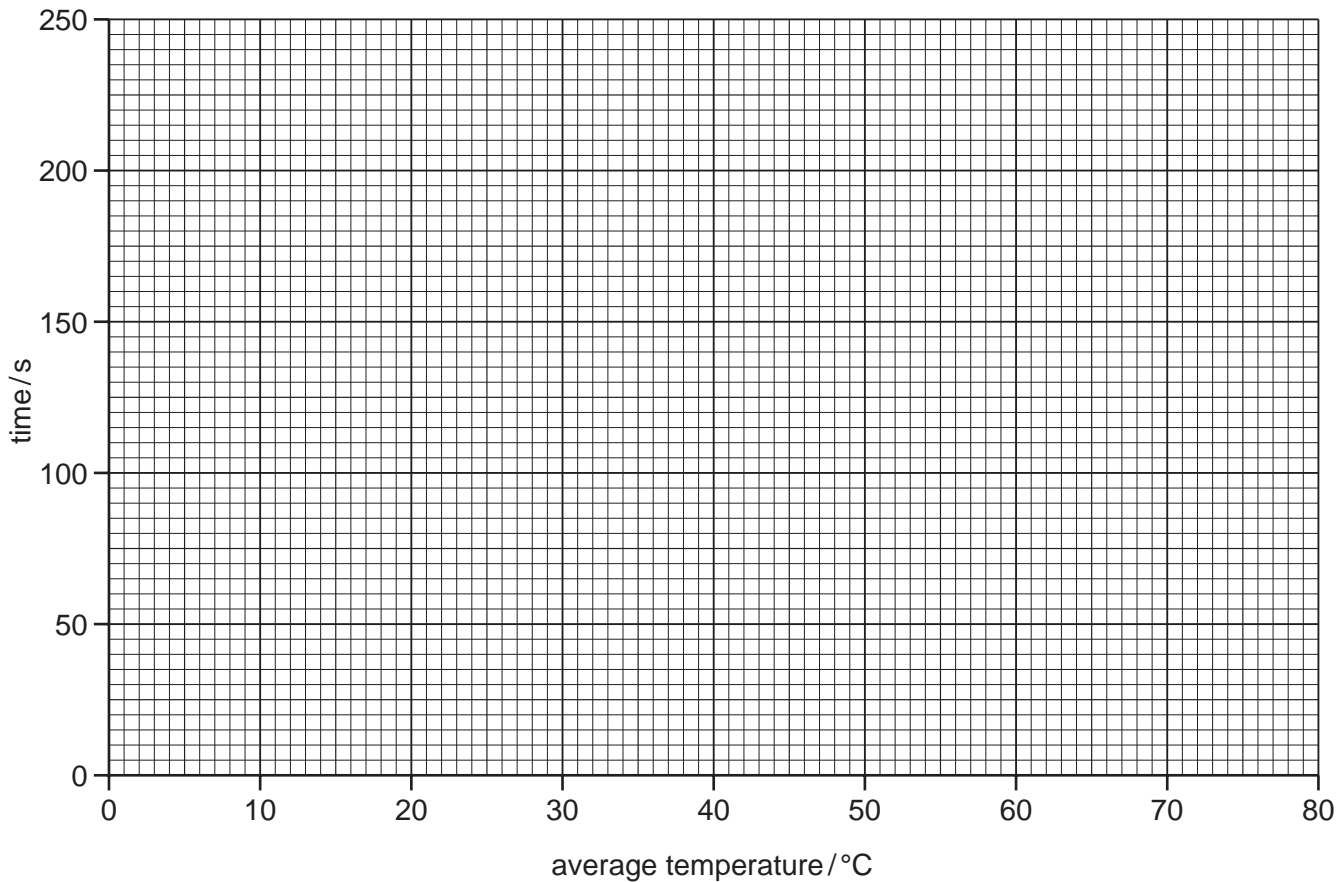
### *Experiment 5*

Experiment 2 was repeated, heating solution L to about 70 °C.

(a) Use the thermometer diagrams in the table to record the temperatures and complete the table.

experiment	thermometer diagram	initial temperature /°C	thermometer diagram	final temperature /°C	average temperature /°C	time /s
1						215
2						105
3						60
4						40
5						35

(b) Plot the results on the grid below and draw a smooth line graph.



[5]

(c) From your graph, work out the time taken for the blue colour to appear if solution L was heated to 80 °C. The final temperature of the reaction mixture was 64 °C. Show clearly on the grid how you obtained your answer.

..... [2]

(d) Suggest the purpose of the starch solution in the experiments.

..... [1]

(e) (i) In which experiment was the reaction speed fastest?

..... [1]

(ii) Explain, using ideas about particles, why this experiment was the fastest.

.....

..... [2]

- (f) Predict the effect on the time and speed of the reaction in Experiment 5 if it was repeated using a less concentrated solution of **L**.

time .....

speed ..... [2]

- (g) Why was a burette used to measure solution **L** instead of a measuring cylinder?

.....

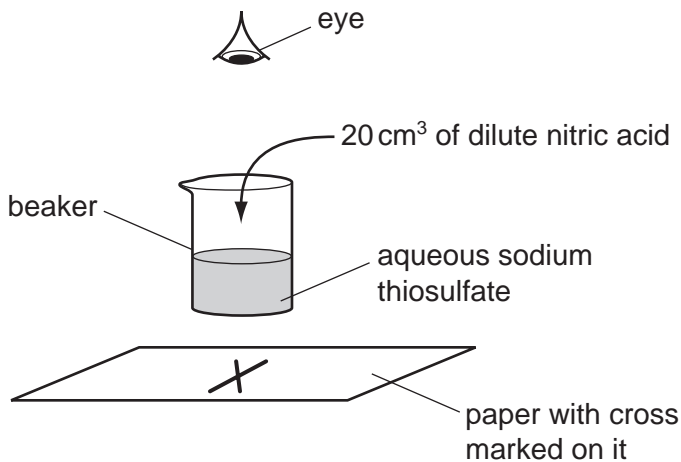
..... [1]

[Total: 19]

- 2 A student carried out an experiment to investigate the speed of reaction between sodium thiosulfate solution and dilute nitric acid. Sulfur is formed during this reaction and the mixture turns cloudy.

*Experiment 1*

Using a measuring cylinder, 100 cm<sup>3</sup> of sodium thiosulfate solution was poured into a 250 cm<sup>3</sup> beaker. The beaker was placed on a cross drawn on a piece of paper. 20 cm<sup>3</sup> of dilute nitric acid was added to the beaker and the timer started.



The time until the cross could not be seen was taken. The time was recorded in the table.

Experiment 1 was repeated using different volumes of sodium thiosulfate as shown in the table.

All experiments were carried out at 20 °C.

**Table of results**

experiment	volume of sodium thiosulfate solution / cm <sup>3</sup>	volume of water / cm <sup>3</sup>	time for cross to disappear / s
1	100	0	10
2	80	20	12
3	40	60	24
4	20	80	51
5	10	90	98

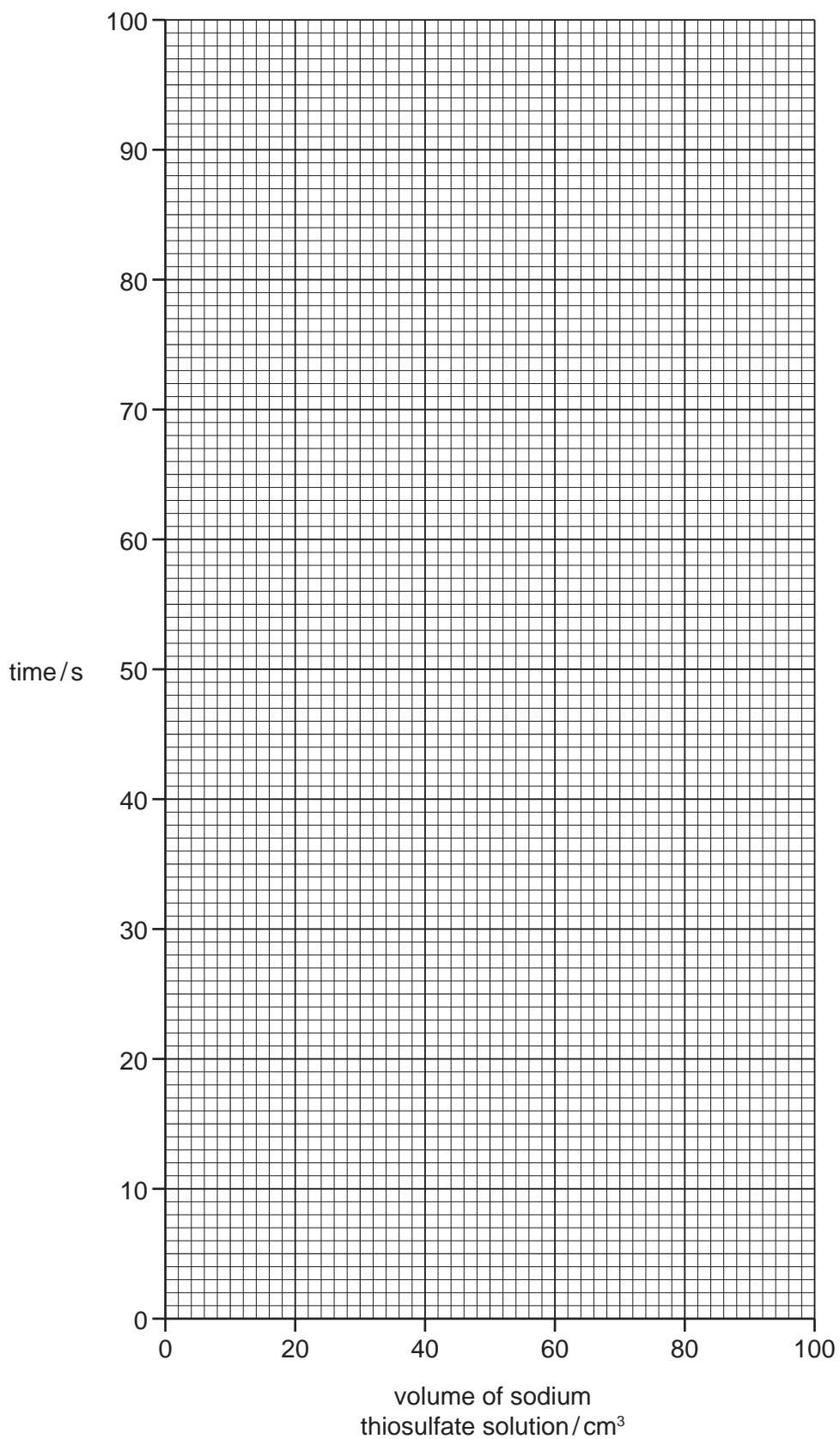
- (a) Why was the total volume of solution kept constant?

.....  
 ..... [1]

- (b) In Experiment 2, which is the last liquid to be added to the beaker?

..... [1]

(c) (i) Plot the results on the grid below. Draw a smooth line graph.



- (ii) **Use your graph** to work out the time taken for the cross to disappear when  $55 \text{ cm}^3$  of sodium thiosulfate solution and  $45 \text{ cm}^3$  of water were used. Indicate **on the graph** how you worked out your answer.

..... [2]

- (d) The experiments were repeated at  $40^\circ\text{C}$ . Suggest how the results would differ. Explain your answer.

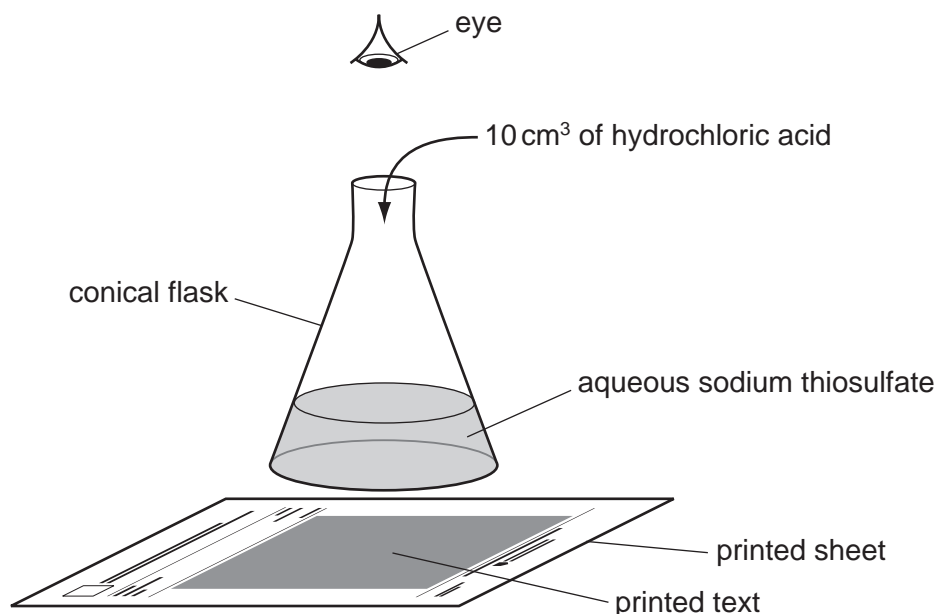
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..... [2]

[Total: 10]



- 3 A student investigated the effect of temperature on the speed of reaction between hydrochloric acid and aqueous sodium thiosulfate. When these chemicals react they form a precipitate, which makes the solution go cloudy. The formation of this precipitate can be used to show how fast the reaction proceeds, using the set up shown below.



Five experiments were carried out.

### *Experiment 1*

By using a measuring cylinder 50 cm<sup>3</sup> of aqueous sodium thiosulfate was poured into a flask. The temperature of the solution was measured. The conical flask was placed on the printed text.

10 cm<sup>3</sup> of hydrochloric acid was added to the flask and the timer started. The time taken for the printed text to disappear from view was recorded in the table. The final temperature of the mixture was measured.

### *Experiment 2*

50 cm<sup>3</sup> of aqueous sodium thiosulfate was poured into a conical flask. The solution was heated until the temperature was about 30 °C. The temperature of the solution was measured.

10 cm<sup>3</sup> of hydrochloric acid was added to the flask and *Experiment 1* was repeated. The final temperature of the liquid was measured.

### *Experiment 3*

*Experiment 2* was repeated but the sodium thiosulfate solution was heated to about 40 °C before adding the hydrochloric acid.

The initial and final temperatures were measured.

### *Experiment 4*

*Experiment 2* was repeated but the sodium thiosulfate solution was heated to about 50 °C before adding the hydrochloric acid.

The initial and final temperatures were measured.

Experiment 5

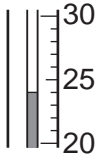
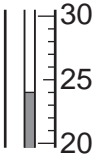
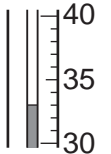
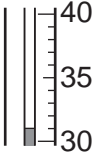
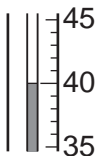
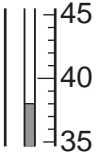
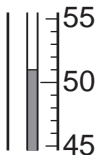
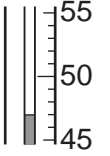
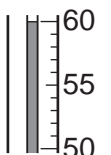
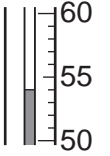
Experiment 2 was repeated but the sodium thiosulfate solution was heated to about 60 °C before adding the hydrochloric acid.

The initial and final temperatures were measured.

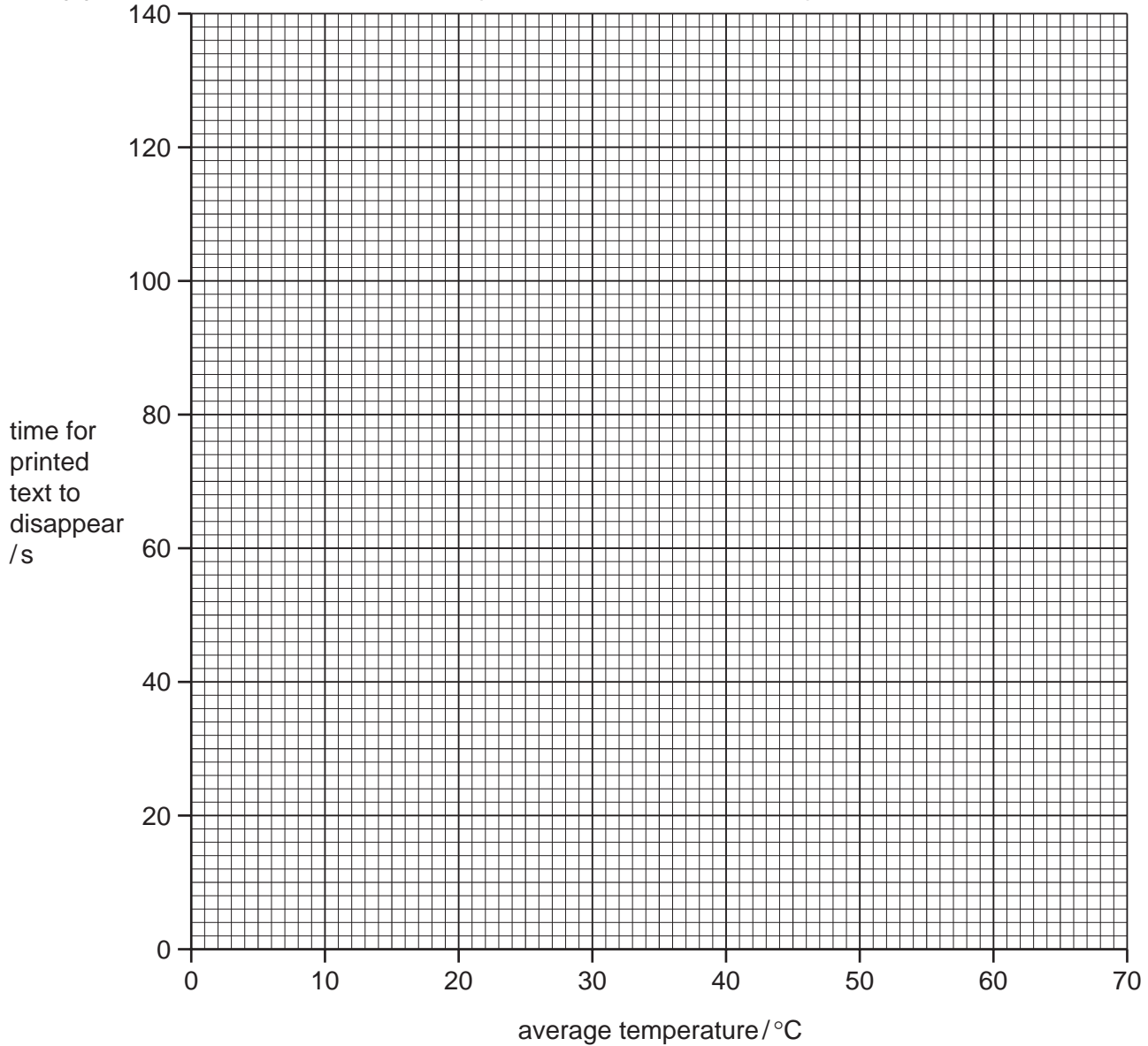
Use the thermometer diagrams to record all of the initial and final temperatures in the table.

(a) Complete the table of results to show the average temperatures.

**Table of results**

experiment	thermometer diagram	initial temperature /°C	thermometer diagram	final temperature /°C	average temperature /°C	time for printed text to disappear /s
1						130
2						79
3						55
4						33
5						26

(b) Plot the results obtained on the grid and draw a smooth line graph.



[4]

(c) (i) In which experiment was the speed of reaction greatest?

..... [1]

(ii) Explain why the speed was greatest in this experiment.

.....  
.....  
..... [3]

(d) Why was the same volume of sodium thiosulfate solution and the same volume of hydrochloric acid used in each experiment?

.....  
..... [1]

(e) (i) From your graph, deduce the time for the printed text to disappear if *Experiment 2* was to be repeated at 70 °C.

Show clearly on the grid how you worked out your answer.

..... [3]

(ii) Sketch on the grid the curve you would expect if all the experiments were repeated using 50 cm<sup>3</sup> of more concentrated sodium thiosulfate solution. [1]

(f) Explain **one** change that could be made to the experimental **method** to obtain more accurate results.

change .....

explanation ..... [2]

[Total: 20]