Cambridge Assessment International Education

Cambridge IGCSE™

5: Reaction rates – Topic questions

Paper 6

The questions in this document have been compiled from a number of past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
2	2016	June	62
2	2016	November	62
2	2016	March	62

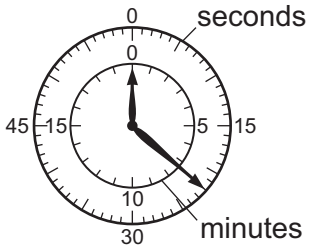
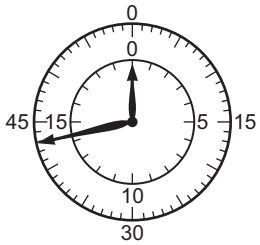
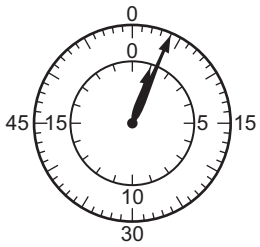
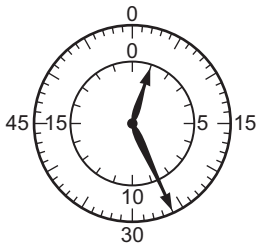
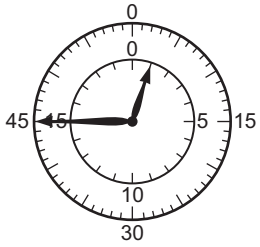
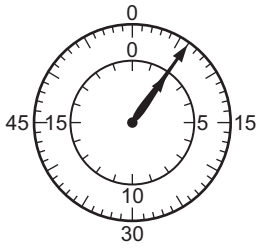
The mark scheme for each question is provided at the end of the document.

You can find the complete question papers and the complete mark schemes (with additional notes where available) on the School Support Hub at www.cambridgeinternational.org/support

2 A student investigated the rate of reaction between hydrogen peroxide and aqueous potassium iodide. When these chemicals react they form iodine. Sodium thiosulfate solution reacts with iodine and can be used to show how fast the reaction proceeds.

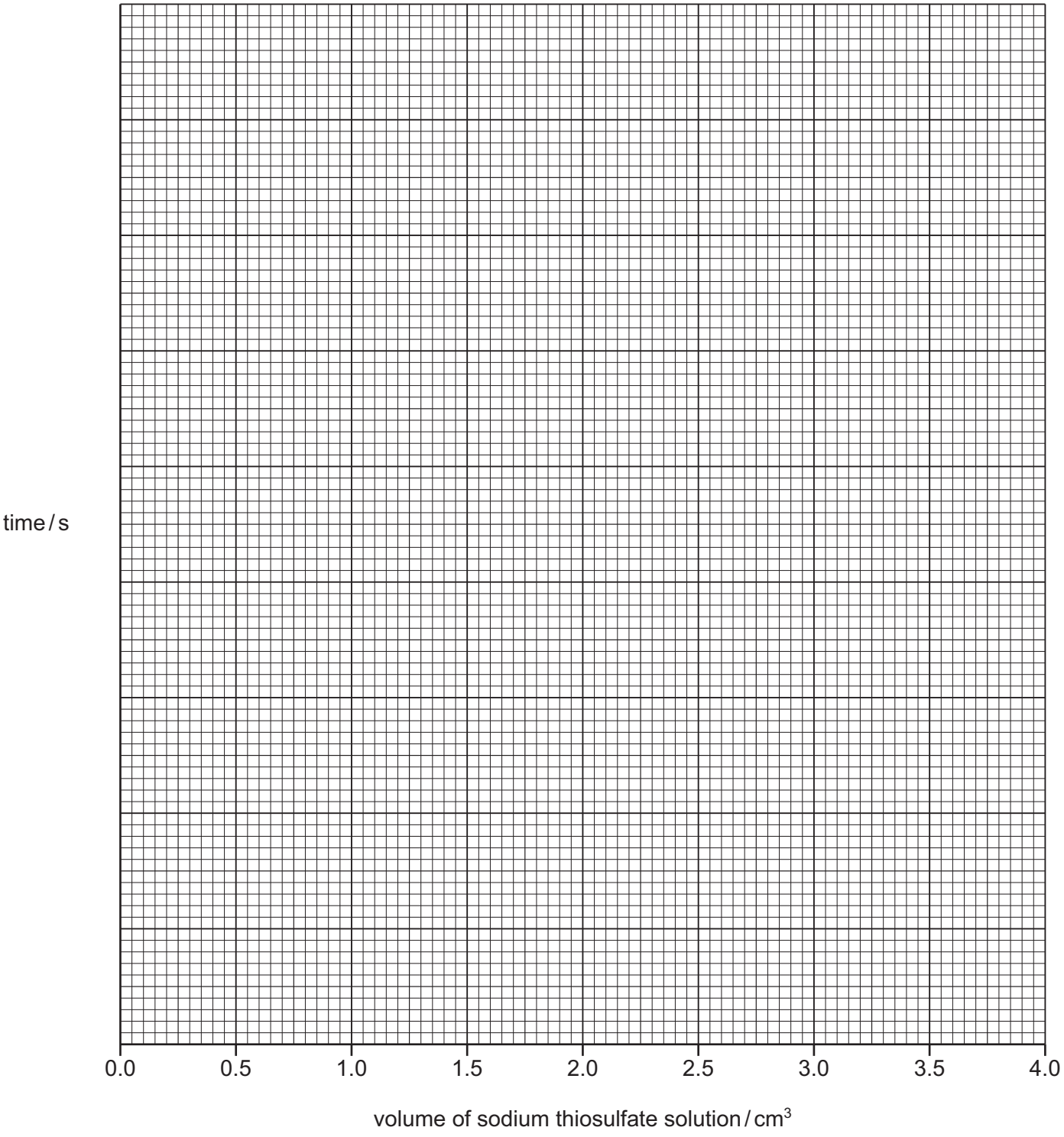
(a) A burette was filled up to the 0.0 cm^3 mark with sodium thiosulfate solution.
Using a large measuring cylinder, 100 cm^3 of distilled water were poured into a conical flask.
Using a small measuring cylinder, 6 cm^3 of sulfuric acid, 1 cm^3 of starch solution and 4 cm^3 of aqueous potassium iodide were added to the flask.
0.5 cm^3 of sodium thiosulfate solution was added from the burette to the mixture in the flask and swirled to mix.
The reaction was then started by adding 3 cm^3 of hydrogen peroxide solution to the mixture, and the timer started.
The time taken for a blue colour to appear was noted.
A further 0.5 cm^3 of sodium thiosulfate solution was added to the mixture in the conical flask, swirled and the blue colour disappeared. The time when the blue colour reappeared was noted.
The experiment continued by adding further 0.5 cm^3 portions of sodium thiosulfate solution until a total of 3.0 cm^3 of sodium thiosulfate solution had been added, noting the times at which the blue colour reappeared.

Use the timer diagrams on page 4 to record the times in seconds in the table.

total volume of sodium thiosulfate solution added / cm^3	timer diagram	time at which blue colour appeared / s
0.5		
1.0		
1.5		
2.0		
2.5		
3.0		

[3]

(b) Plot the results you have obtained on the grid and draw a best-fit straight-line graph.



[5]

(c) (i) **From your graph** deduce the time at which the blue colour would appear if a total of 4.0 cm^3 of sodium thiosulfate solution were added to the mixture in the conical flask.
Show clearly **on the grid** how you worked out your answer.

..... [3]

(ii) Sketch **on the grid** the graph you would expect if the experiment was repeated at a higher temperature. [1]

(d) Suggest the purpose of the starch solution.

..... [1]

(e) **(i)** Suggest **one** advantage of using a pipette to measure the volume of the hydrogen peroxide.

..... [1]

(ii) Suggest and explain **one** disadvantage of using a pipette to measure the volume of the hydrogen peroxide.

.....

..... [2]

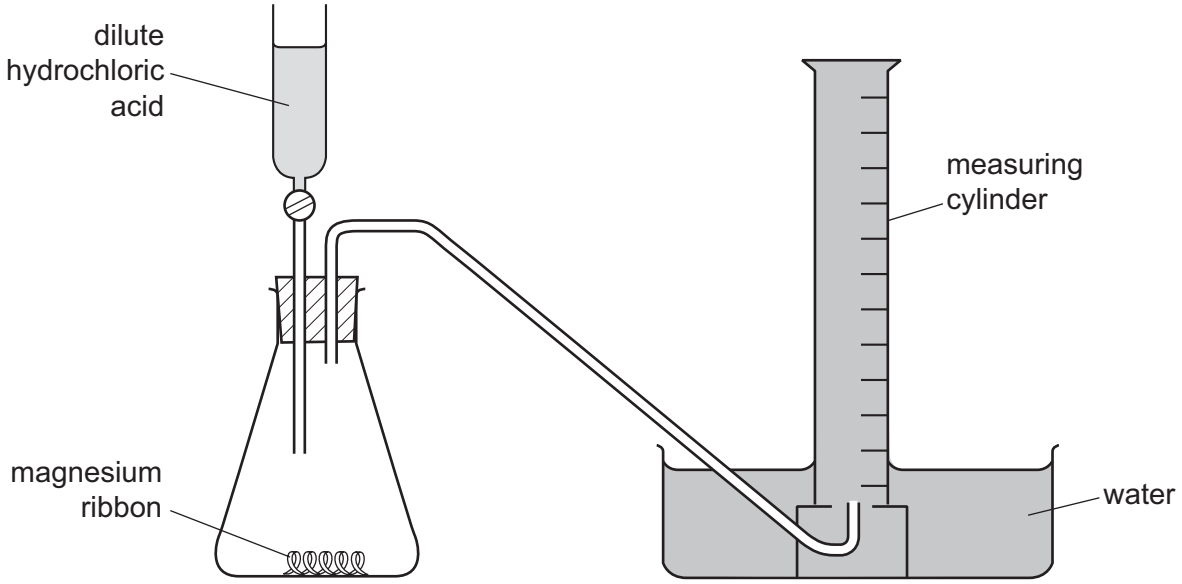
(f) Explain **one** disadvantage of using a beaker instead of a conical flask.

.....

..... [1]

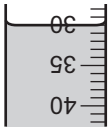
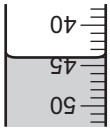
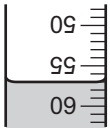
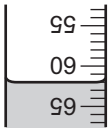
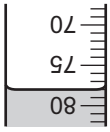
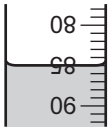
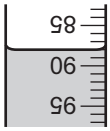
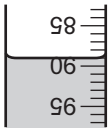
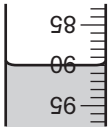
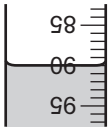
[Total: 17]

2 A student investigated the rate of reaction between dilute hydrochloric acid and excess magnesium at room temperature.
The apparatus was set up as shown in the diagram.



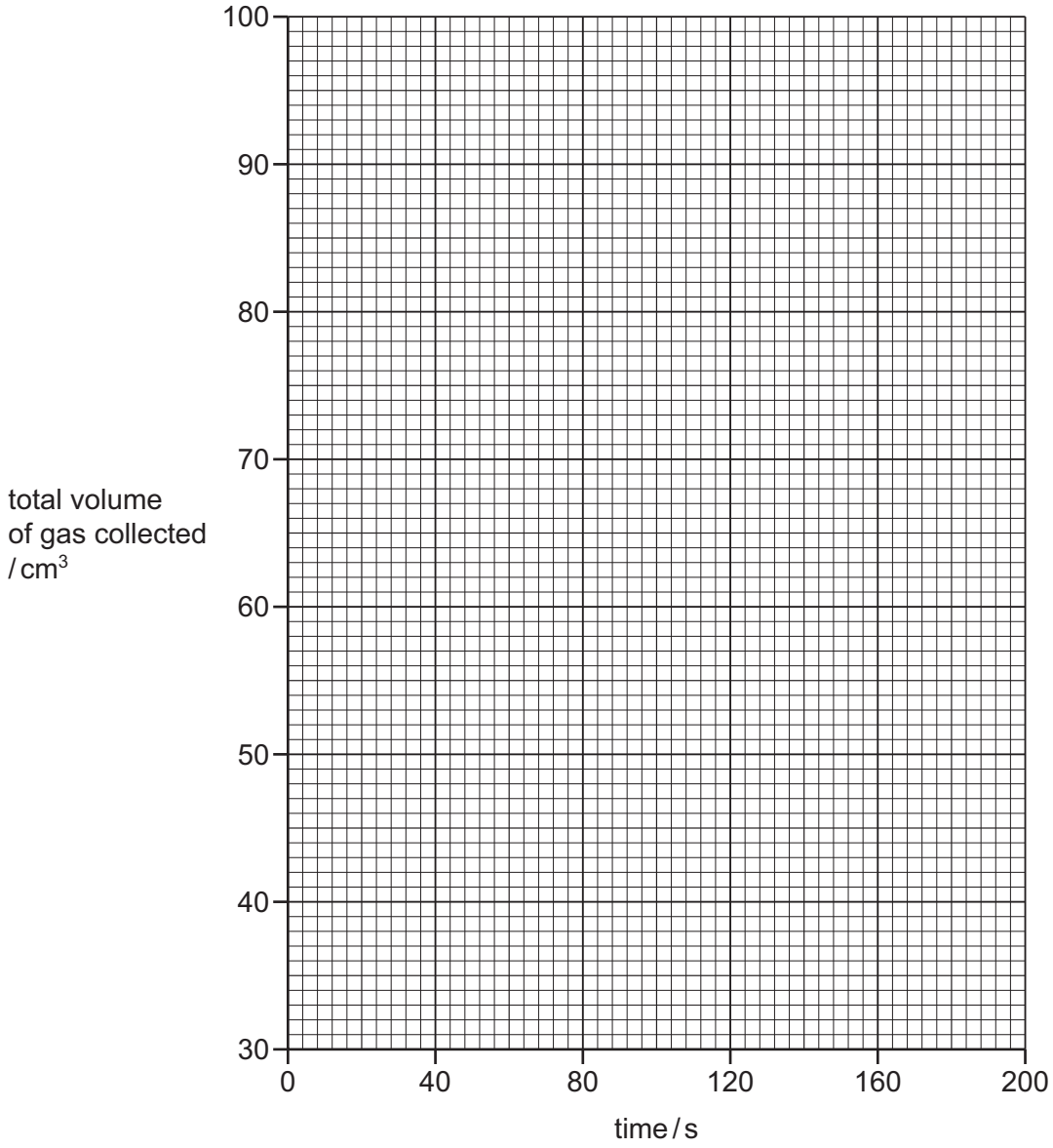
30 cm^3 of dilute hydrochloric acid were added to the conical flask containing magnesium ribbon. The timer was then started and the volume of gas collected in the measuring cylinder was measured every 20 seconds for 180 seconds (3 minutes).

(a) Use the measuring cylinder diagrams to record the total volume of gas collected in the table.

time / s	measuring cylinder diagram	total volume of gas collected / cm^3
0		30
20		
40		
60		
80		
100		
120		
140		
160		
180		

[2]

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



[3]

(c) (i) Which result is anomalous?

..... [1]

(ii) Suggest a possible reason for this anomalous result.

..... [1]

(iii) **Use your graph** to deduce the total volume of gas that you would have expected to collect instead of this anomalous volume.
Show clearly **on the grid** how you worked out your answer.

..... cm^3 [2]

(d) Explain why the total volume of gas collected does **not** increase after 160 seconds.

.....

..... [2]

(e) The average rate of the reaction can be calculated using the equation shown.

$$\text{average rate of reaction} = \frac{\text{volume of gas collected / cm}^3}{\text{time / s}}$$

(i) Calculate the volume of gas collected between 20 seconds and 40 seconds.

..... [1]

(ii) Calculate the average rate of reaction between 20 seconds and 40 seconds.
Include the unit.

average rate of reaction = ... [2]

(f) Room temperature was 20 °C.

Sketch **on the grid** the graph you would expect if the experiment were repeated at 30 °C. [2]

(g) Suggest why the reading on the measuring cylinder was 30 cm^3 after the acid had been added and before the timer had been started.

.....

..... [1]

(h) Suggest and explain **one** improvement to this experiment.

.....

.....

..... [2]

[Total: 19]

2 A teacher investigated the rate of a reaction between two solutions, **J** and **K**, and sulfuric acid at different temperatures.

Four experiments were carried out.

(a) *Experiment 1*

A large measuring cylinder was used to pour 50 cm^3 of distilled water and 40 cm^3 of sulfuric acid into a 250 cm^3 conical flask.
A small measuring cylinder was used to add 2 cm^3 of methyl orange and 5 cm^3 of solution **J** to the mixture in the conical flask. The temperature of the mixture was measured.
The reaction was started by adding 5 cm^3 of solution **K** to the conical flask, immediately starting the timer and swirling the mixture.
The time taken for the mixture to turn pale yellow was measured. The final temperature of the mixture was measured.

Experiment 2

Experiment 1 was repeated but the mixture in the conical flask was heated to about 30 °C **before** adding the solution **K**. The temperature of the mixture was measured.
5 cm^3 of solution **K** was added to the conical flask. The timer was started and the mixture swirled.
The time taken for the mixture to turn pale yellow was measured. The final temperature of the mixture was measured.

Experiment 3

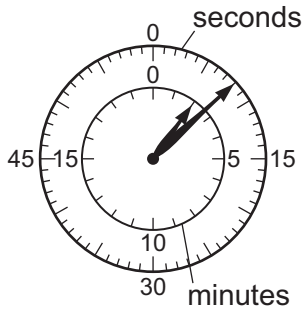
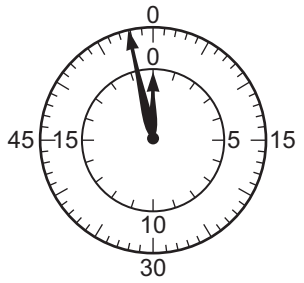
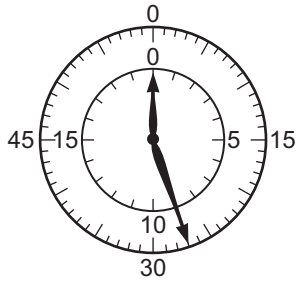
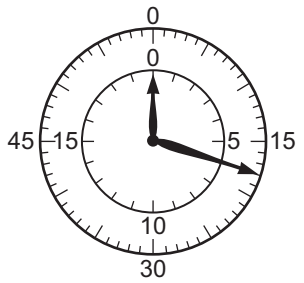
Experiment 1 was repeated but the mixture in the conical flask was heated to about 40 °C before adding the solution **K** to the flask. The same measurements were taken.

Experiment 4

Experiment 1 was repeated but the mixture in the conical flask was heated to about 50 °C before adding the solution **K** to the flask. The same measurements were taken.

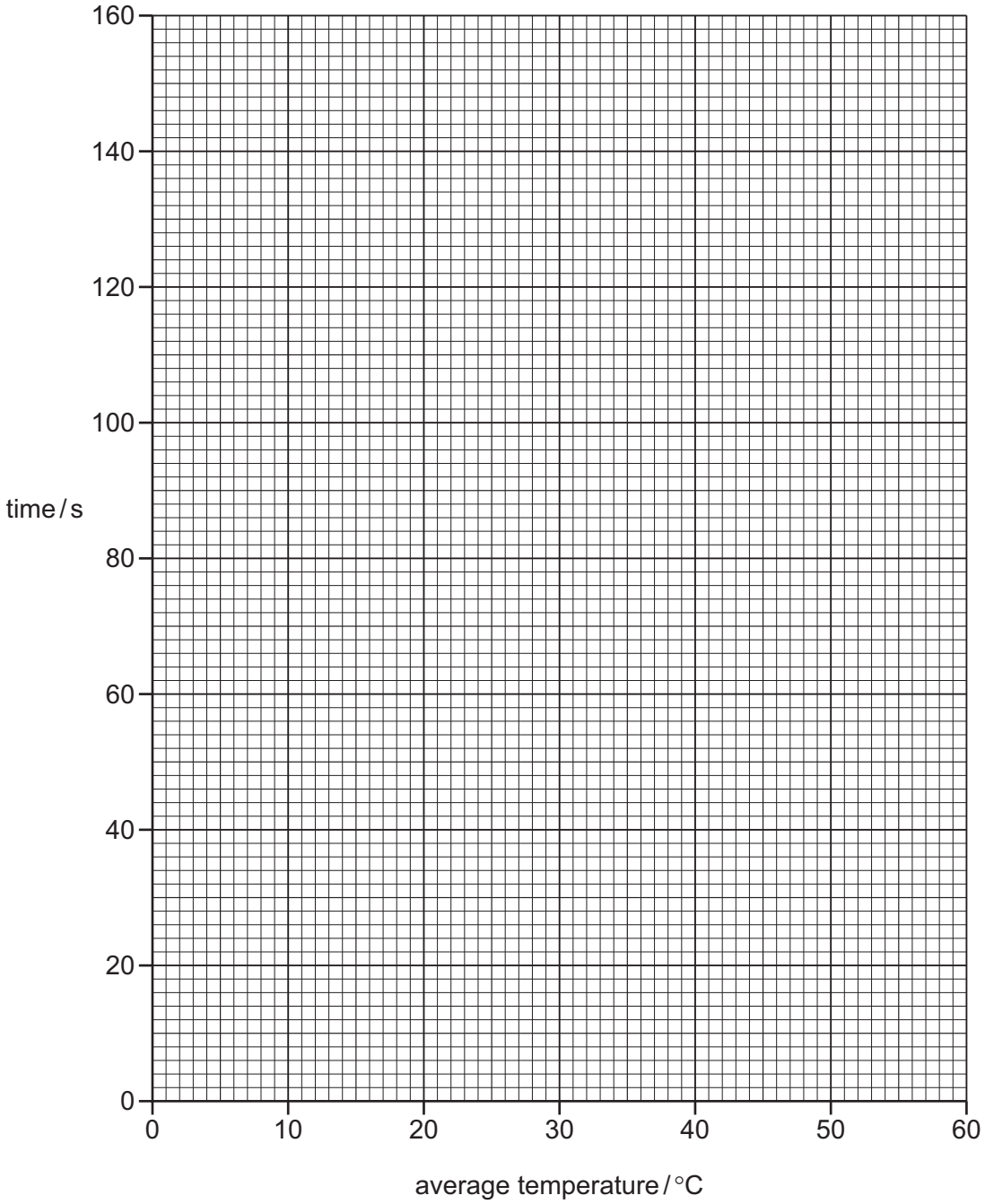
Use the stop-clock diagrams to record the times in the table.

Work out the average temperatures to complete the table.

experiment	stop-clock diagram	time taken for mixture to turn pale yellow / s	initial temperature / °C	final temperature / °C	average temperature / °C
1			17	15	
2			28	26	
3			42	40	
4			51	49	

[4]

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



[4]

(c) **From your graph** deduce the time taken for the mixture to turn pale yellow if Experiment 1 was repeated at an average temperature of 60 °C.
Show clearly **on the grid** how you worked out your answer.

..... [2]

(d) (i) In which experiment was the rate of reaction greatest?

..... [1]

(ii) Explain why the rate of reaction was greatest in this experiment.

.....

.....

..... [2]

(e) (i) Suggest and explain the effect **on the results** of using a burette to measure the volume of solution **J**.

.....

..... [2]

(ii) Suggest and explain one **other** improvement to these experiments.

.....

..... [2]

[Total: 17]

Question	Answer	Mark
2 (a)	all 6 times completed correctly (2 marks) (22, 43, 64, 86, 105, 126) 5 times completed correctly (1 mark); in seconds;	2 1
2 (b)	appropriate scale for y-axis / increasing at 20 s per large square; y-axis is a linear scale; all 6 points plotted correctly ± half a small square (2 marks); 5 points plotted correctly ± half a small square (1 marks); best-fit straight-line graph;	1 1 2 1
2 (c) (i)	value from graph ± half a small square (typically 167–170); units / s; extrapolation;	1 1 1
2 (c) (ii)	sketch line below original line and diverging	1
2 (d)	as an indicator	1
2 (e) (i)	(more) accurate	1
2 (e) (ii)	solution slow to run out of pipette difficult to know when to start time/reaction does not start at once/inaccurate time measurement owtte	1 1
		Total: 16
2 (a)	table of results volume boxes completed correctly (30), 44, 57, 62, 78, 85, 88, 89, 90, 90	2
2 (b)	all points correctly plotted smooth line graph	2 1
2 (c) (i)	point at 60 s / 62 cm^3 / fourth point / measurement 4	1
2 (c) (ii)	misread measuring cylinder/read too early	1
2 (c) (iii)	value from graph (68–70) shown clearly	1 1
2 (d)	the Reaction has finished all the acid has reacted/HC*l* is the limiting factor	1 1
2 (e) (i)	value from graph or table (57–44 = 13$cm^{3)}$	1
2 (e) (ii)	13/20 = 0.65 cm^3 / s	1 1
		Total: 14

Question	Answer	Mark
2 (a)	In each column 4 correct = [2] 3 correct = [1] average temperature boxes completed correctly: 16, 27, 41, 50 times completed in seconds correctly: 128, 58, 27, 18	4
2 (b)	all points plotted correctly = [3] smooth line graph	4
2 (c)	value from graph: 12–13s extrapolation	2
2 (d) (i)	Experiment 4	1
2 (d) (ii)	any **2** from: highest temperature more energy more (chance of) collisions	2
2 (e) (i)	more accurate than a measuring cylinder	2
2 (e) (ii)	insulation/use a lid; to reduce heat losses OR repeats; averages results OR measure water or sulfuric acid or methyl orange using a burette/use a 2 d.p. stopwatch/digital thermometer, reference to accuracy	2
		Total: 17