iG ALL EQ Graph Questions

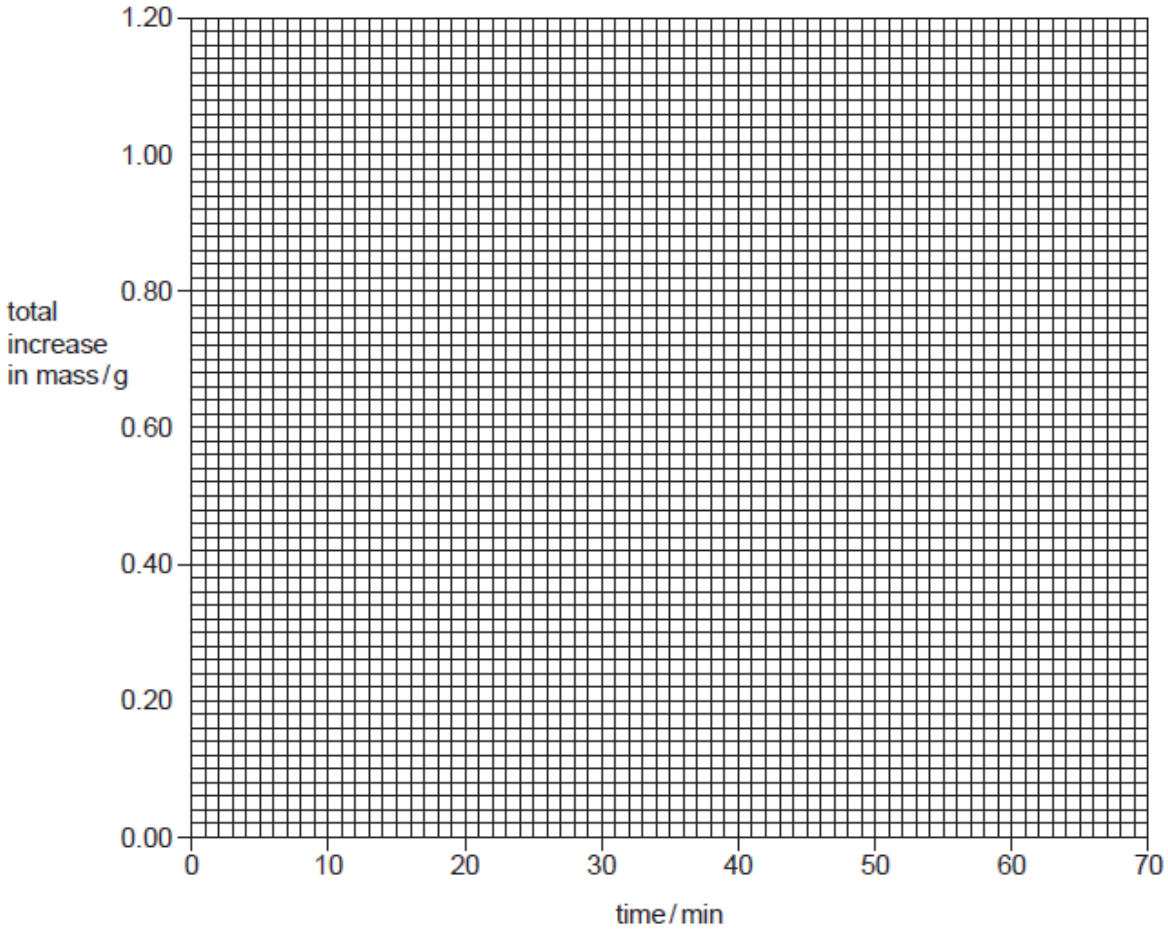
12w6 Q2

Table of results

time / min	mass of electrode / g	total increase in mass / g
0	3.75	0.00
10	4.00	0.25
20	4.25	0.50
30	4.50	
40	4.75	
50	4.90	
60	4.90	
70	4.90	

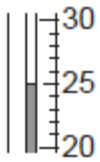
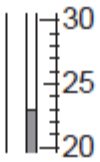
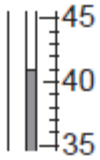
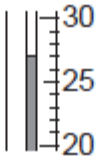
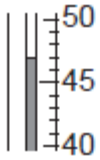
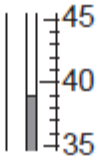
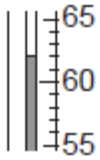
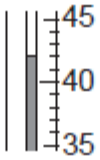
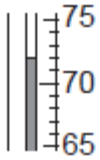
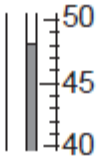
(e) Complete the table by calculating the total increase in mass for the remaining time intervals. [1]

(f) Plot the points on the grid below. Draw a graph with two intersecting straight lines.



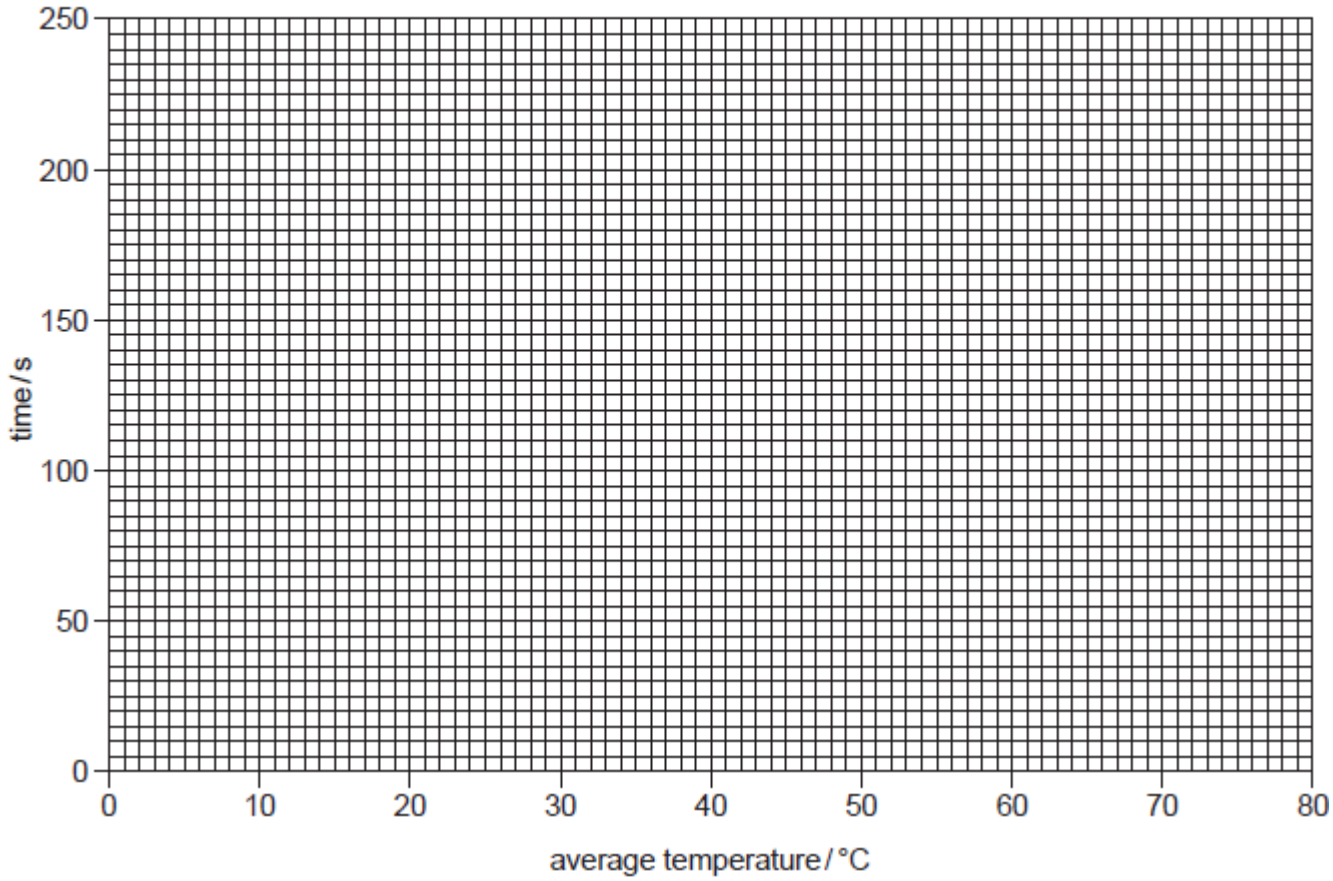
[3]

(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

[5]

(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]

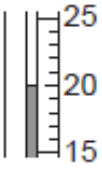
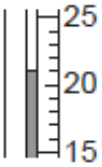
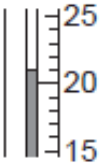
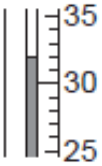
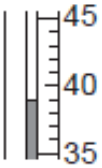
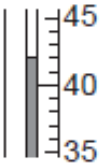
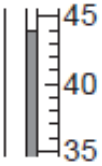
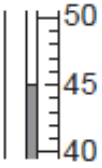
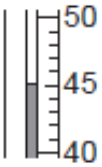
11w6

4 A student investigated the reaction between aqueous copper(II) sulfate and two different metals, zinc and iron.
Two experiments were carried out.

Experiment 1
Using a measuring cylinder, 25 cm^3 of aqueous copper(II) sulfate was poured into a polystyrene cup. The temperature of the solution was measured. The timer was started and the temperature was measured every half a minute for one minute.

At 1 minute, 5 g of zinc powder was added to the cup and the mixture stirred with the thermometer. The temperature of the mixture was measured every half minute for an additional three minutes.

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

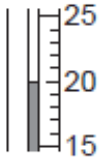
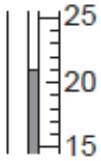
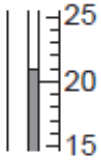
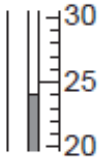
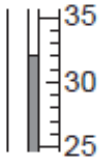
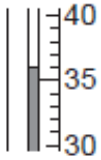
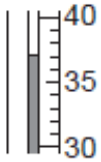
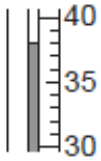
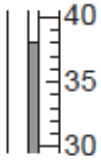
time / min	thermometer diagrams	temperature / °C
0.0		
0.5		
1.0		
1.5		
2.0		
2.5		
3.0		
3.5		
4.0		

[3]

Experiment 2

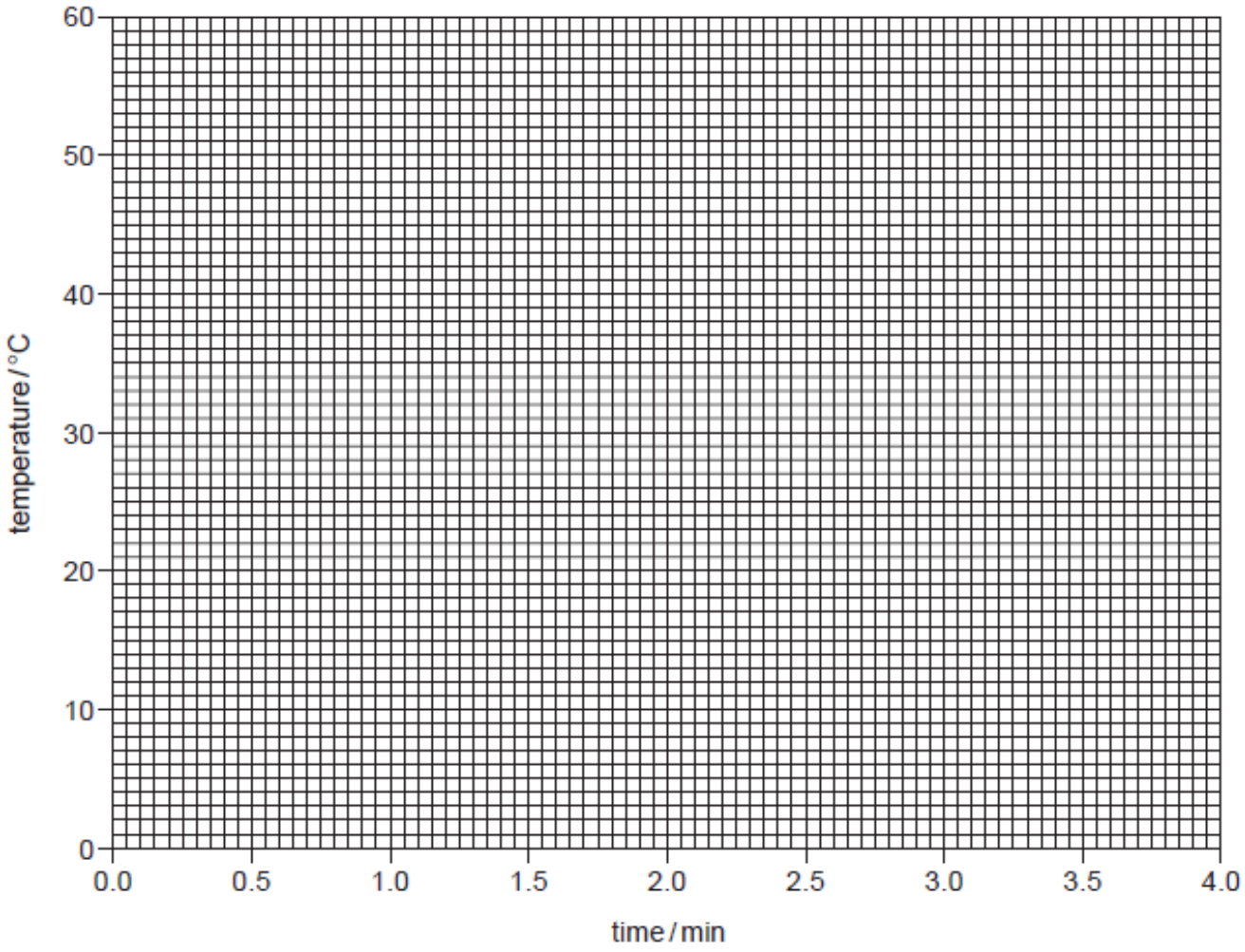
Experiment 1 was repeated using 5 g of iron powder instead of the zinc powder.

(b) Use the thermometer diagrams in the table to record the temperatures.

time / min	thermometer diagrams	temperature / °C
0.0		
0.5		
1.0		
1.5		
2.0		
2.5		
3.0		
3.5		
4.0		

[3]

(c) Plot the results of both experiments on the grid below. Draw two smooth line graphs. Clearly label your graphs.



[5]

(d) **From your graph**, work out the temperature of the reaction mixture in Experiment 1 after 1 minute 15 seconds. Show clearly **on the graph** how you worked out your answer.

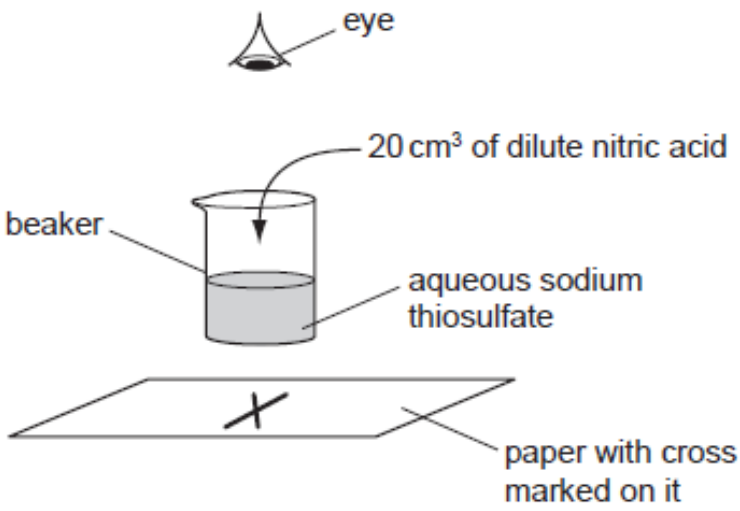
..... [3]

10w6

3 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^3 of sodium thiosulfate solution was poured into a 250 cm^3 beaker. The beaker was placed on a cross drawn on a piece of paper. 20 cm^3 of dilute nitric acid was added to the beaker and the timer started.



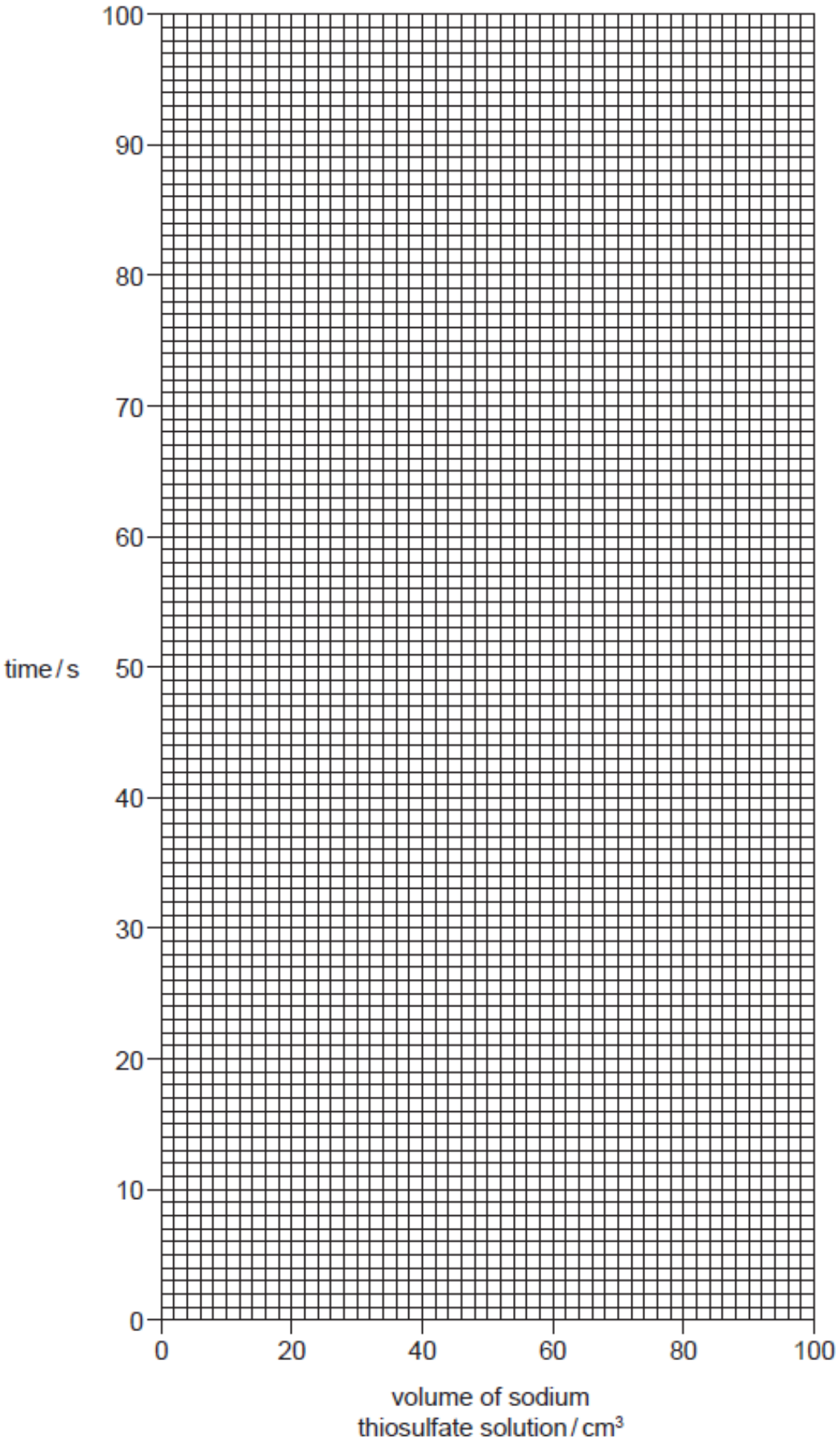
The time until the cross could not be seen was taken. The time was recorded in the table.

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^3	volume of water / cm^3	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

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



[4]

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

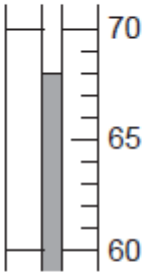
..... [2]

10w6

4 A student investigated the solubility of salt **A** in water at various temperatures.
Five experiments were carried out.

Experiment 1

The student was provided with a boiling tube containing 12 g of salt **A**.
A burette was filled with distilled water and 10.0 cm^3 of water was added to the boiling tube.
The mixture of salt **A** and water was heated until all of the solid had dissolved.
The boiling tube was removed from the heat and the solution was stirred with a thermometer and allowed to cool.
The temperature at which crystals first appeared was measured.
Use the thermometer diagram to record the temperature in the table of results.



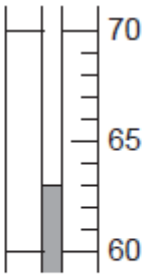
The boiling tube and contents were kept for the next four experiments.

Experiment 2

From the burette, 1.0 cm^3 more of water was added into the boiling tube and contents from Experiment 1.

The experiment was repeated exactly as before to find the temperature at which crystals first appeared.
The boiling tube was dipped for short periods of time in a beaker of cold water to speed up the cooling.

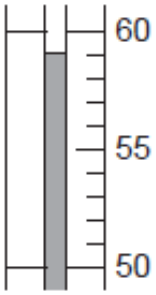
Record, in the table of results, the total volume of water in the boiling tube.
Use the thermometer diagram to record the temperature at which crystals first appeared.



Experiment 3

From the burette 1.0 cm^3 more of water was added into the boiling tube and contents from Experiment 2. The experiment was repeated exactly as before.

Record, in the table of results, the total volume of water used.
Use the thermometer diagram to record the temperature at which crystals first appeared.



This procedure was continued for Experiments 4 and 5 with two more successive additions of 1.0 cm^3 of water. Note all the results in the table.

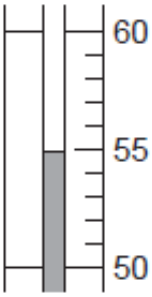


diagram for Experiment 4

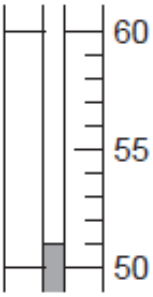


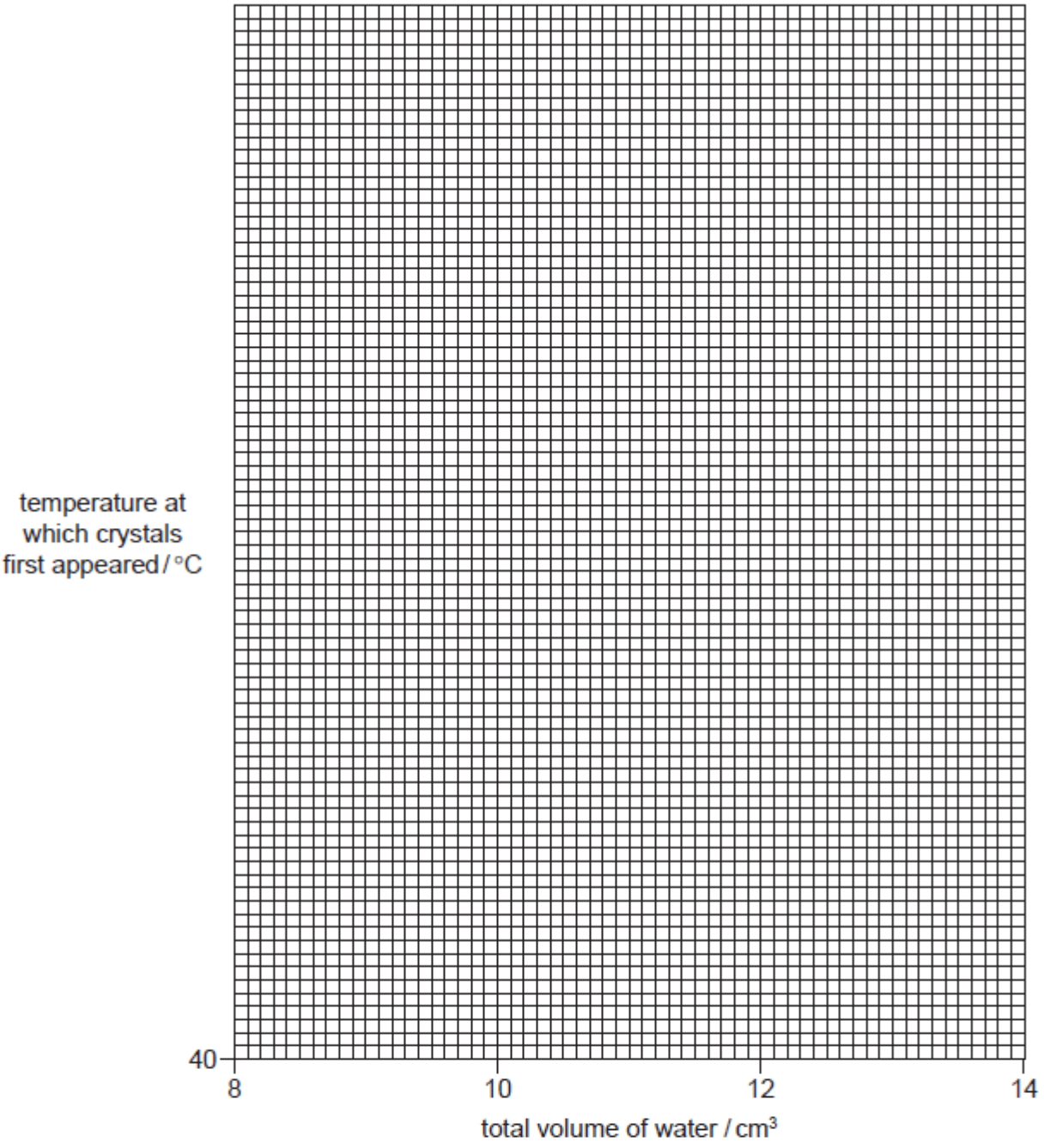
diagram for Experiment 5

Table of results

experiment	total volume of water / cm^3	temperature at which crystals first appeared / °C
1	10.0	
2		
3		
4		
5		

[5]

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



[6]

(b) How did the student know when salt **A** was completely dissolved in the water?

.....

[1]

(c) **From your graph**, find the temperature at which crystals of salt **A** would first appear if the total volume of water in the solution was 9.0 cm^3.

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

.....

[2]

4 A student investigated the temperature change produced when equal lengths of magnesium ribbon reacted with excess dilute sulfuric acid of different concentrations (labelled solutions **A**, **B**, **C**, **D** and **E**).

Five experiments were carried out.

Experiment 1

Using a measuring cylinder, 20 cm^3 of sulfuric acid solution **A** was poured into a beaker. The initial temperature of the solution was measured. A length of magnesium ribbon was added to the solution and stirred. The highest temperature reached was measured.

Experiment 2

Experiment 1 was repeated using solution **B** instead of solution **A**. The initial and highest temperatures were measured as before.

Experiment 3

Experiment 1 was repeated using solution **C**. The initial and highest temperatures were measured.

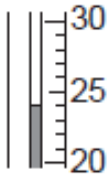
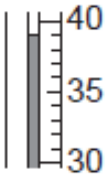
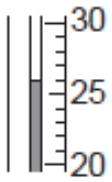
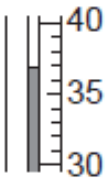
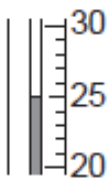
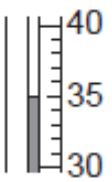
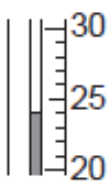
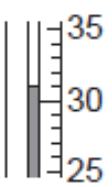
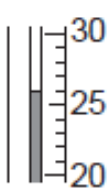
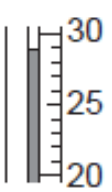
Experiment 4

Experiment 1 was repeated using solution **D**. The initial and highest temperatures were measured.

Experiment 5

Experiment 1 was repeated using solution **E**. The initial and highest temperatures were measured.

Use the thermometer diagrams in the table on page 6, to record the initial and highest temperatures in each experiment.

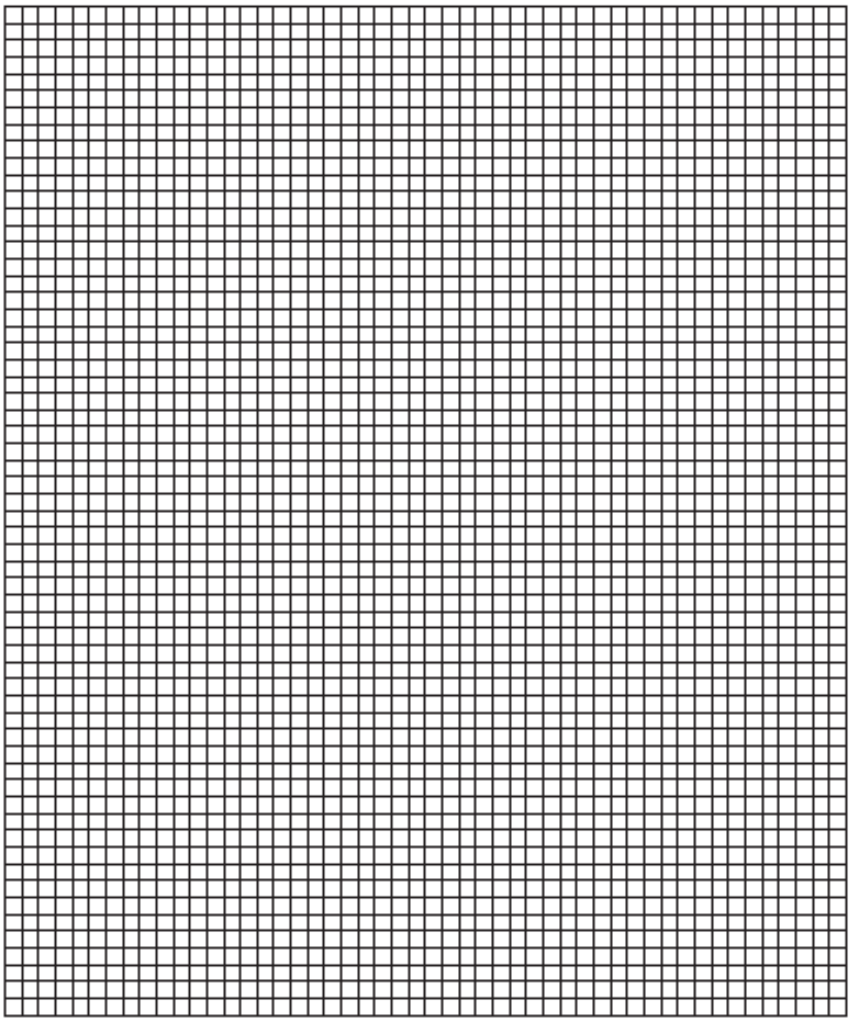
solution of sulfuric acid	thermometer diagram	initial temperature /°C	thermometer diagram	highest temperature /°C	change in temperature /°C
A					
B					
C					
D					
E					

[4]

(a) Work out the temperature change for each experiment and record the values in the table. [1]

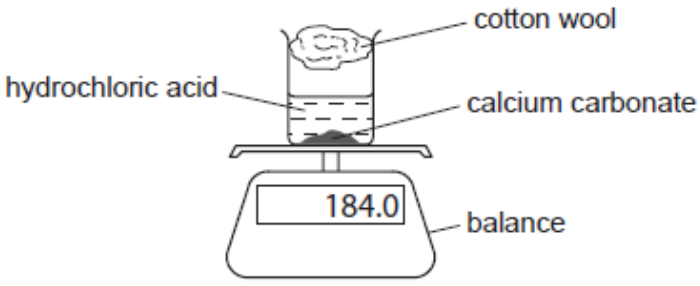
(b) Draw a labelled bar chart of the results for Experiments 1, 2, 3, 4 and 5 on the grid below. [4]

change in temperature /°C



09w6

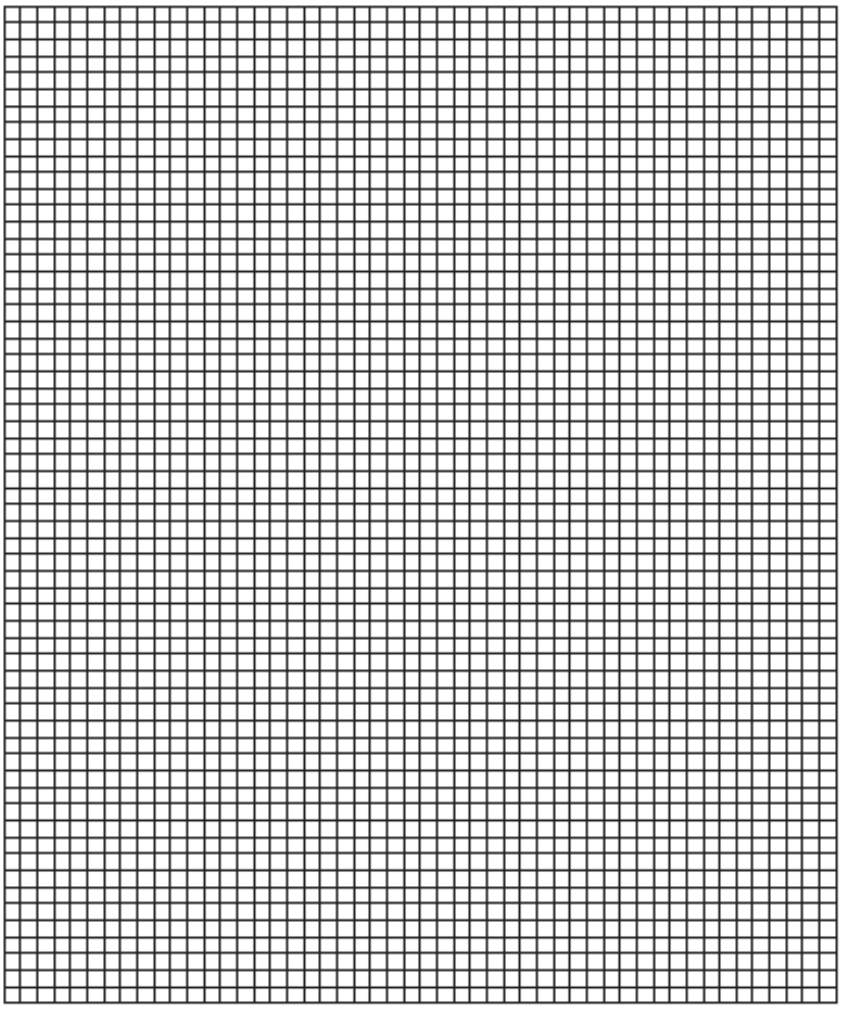
6 Dilute hydrochloric acid was added to excess calcium carbonate in a beaker as shown.



The beaker was placed on a balance and the mass of the beaker and contents recorded every minute.
The results are shown in the table.

mass of beaker and contents / g	184.0	178.0	175.6	174.6	174.0	174.0
time / min	0	1	2	3	4	5

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



[5]

(b) Use your graph to determine the mass of the beaker and contents after 30 seconds. Show clearly on your graph how you worked out your answer.

..... [2]

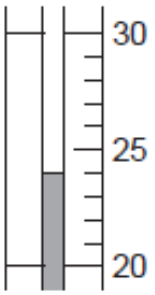
08w6

4 A student investigated the addition of four different solids, **A**, **B**, **C** and **D**, to water.

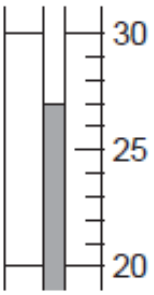
Five experiments were carried out.

Experiment 1

By using a measuring cylinder, 30 cm^3 of distilled water was poured into a polystyrene cu
and the initial temperature of the water was measured. 4 g of solid **A** was added to the cu
and the mixture stirred with a thermometer. The temperature of the solution was measure
after 2 minutes.



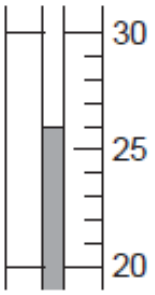
initial temperature



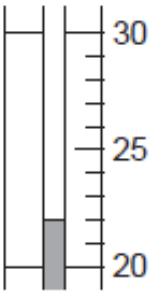
final temperature

Experiment 2

Experiment 1 was repeated using 4 g of solid **B**.



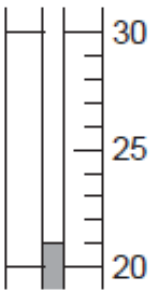
initial temperature



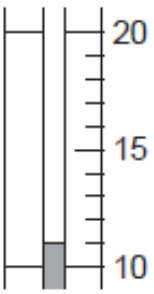
final temperature

Experiment 3

Experiment 1 was repeated using 4 g of solid **C**.



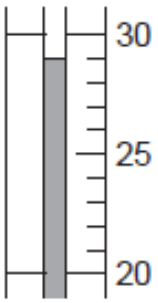
initial temperature



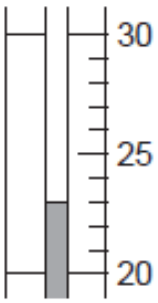
final temperature

Experiment 4

Experiment 1 was repeated using 4 g of solid **D**.



initial temperature



final temperature

Experiment 5

A little of the solution from Experiment 4 was added to a little of the solution from Experiment 2 in a test-tube. The observations were recorded.

observations *A fast reaction. Vigorous effervescence and bubbles produced.*

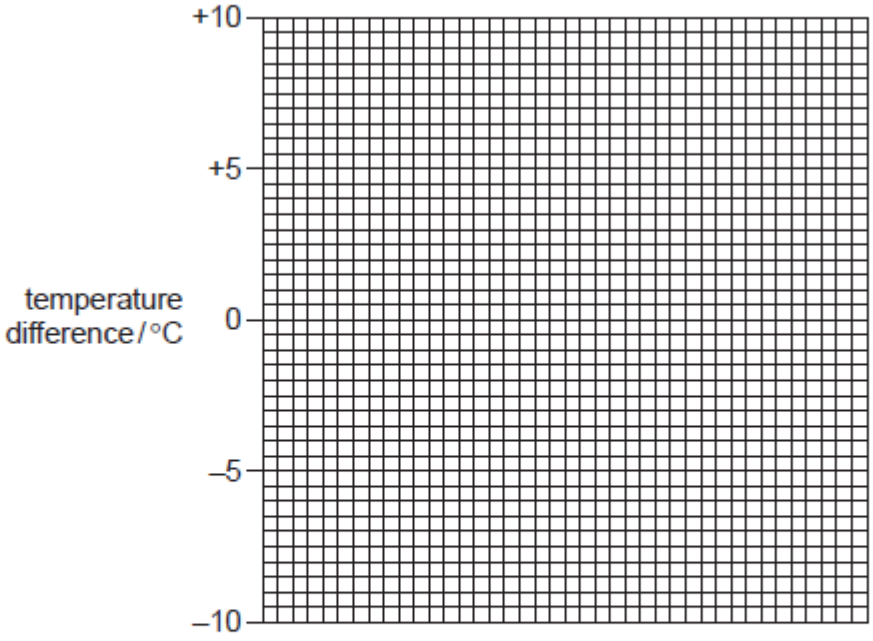
(a) Use the thermometer diagrams for Experiments 1-4 to record the initial and final temperatures in Table 4.1.
Calculate and record the temperature difference in Table 4.1.

Table 4.1

experiment	initial temperature / °C	final temperature / °C	difference / °C
1			
2			
3			
4			

[4]

(b) Draw a labelled bar chart of the results to Experiments 1, 2, 3 and 4 on the grid below.



[4]

Use the results and observations from Experiments 1-5 to answer the following questions.

(c) **(i)** Which solid dissolves in water to produce an exothermic reaction?

..... [1]

(ii) Give a reason why you chose this solid.

..... [1]

(d) Which Experiment produced the largest temperature change?

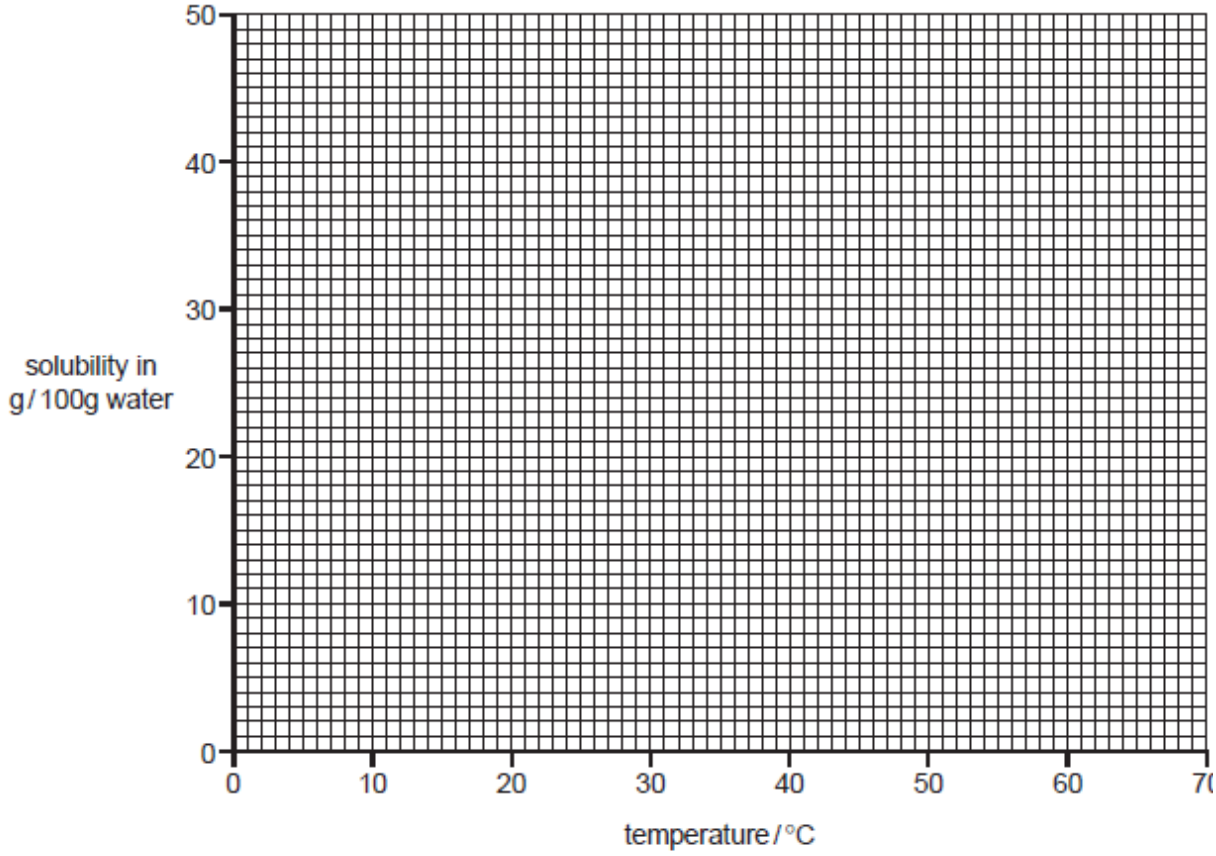
..... [1]

08w6

6 An experiment was carried out to determine the solubility of potassium chlorate at different temperatures. The solubility is the mass of potassium chlorate that dissolves in 100 g of water.
The results obtained are shown in the table below.

temperature / °C	0	10	20	30	40	50	60
solubility in g / 100 g water	14	17	20	24	29	34	40

(a) On the grid, draw a smooth line graph to show the solubility of potassium chlorate at different temperatures.



[4]

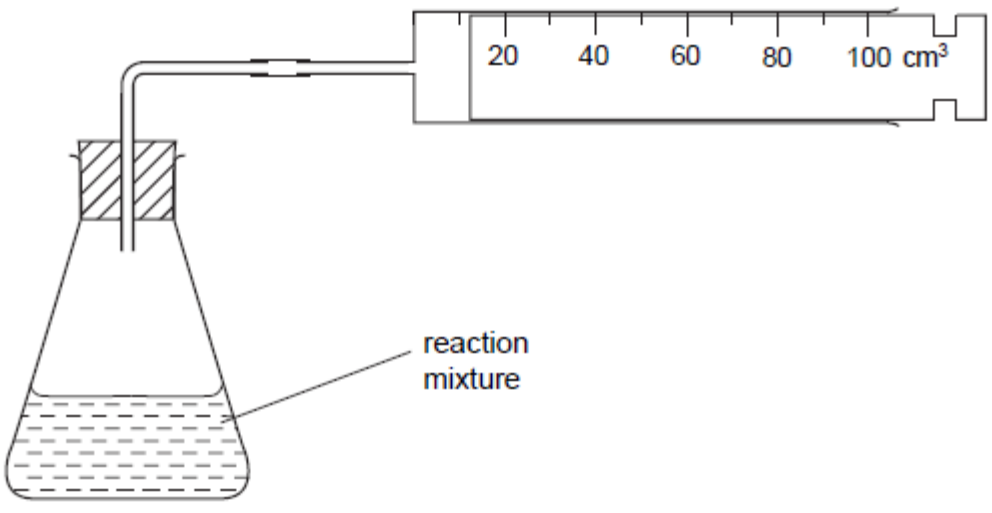
(b) Use your graph to determine the solubility of potassium chlorate at 70 °C. Show clearly on the graph how you obtained your answer.

.....

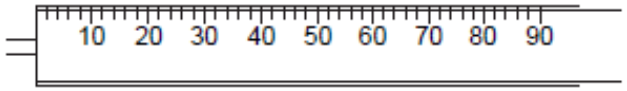
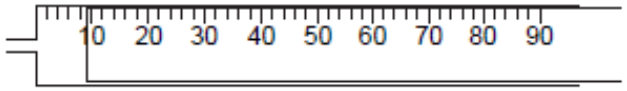
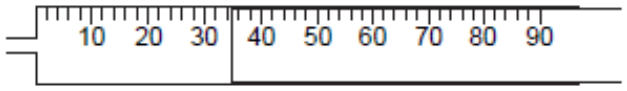
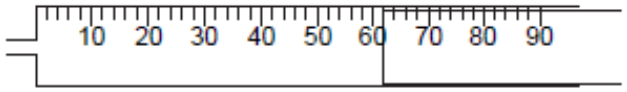
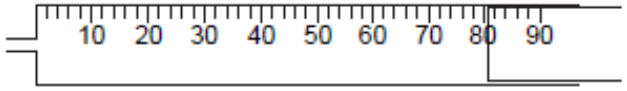
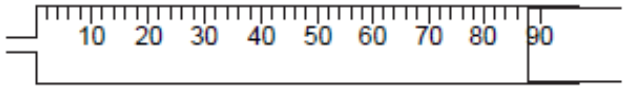
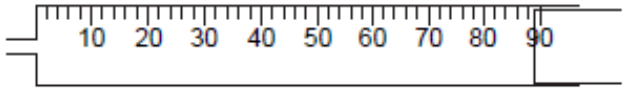
[2]

06w6

3 An investigation into the reaction of calcium with water was carried out using the apparatus below. The temperature of the water increased during the experiment.

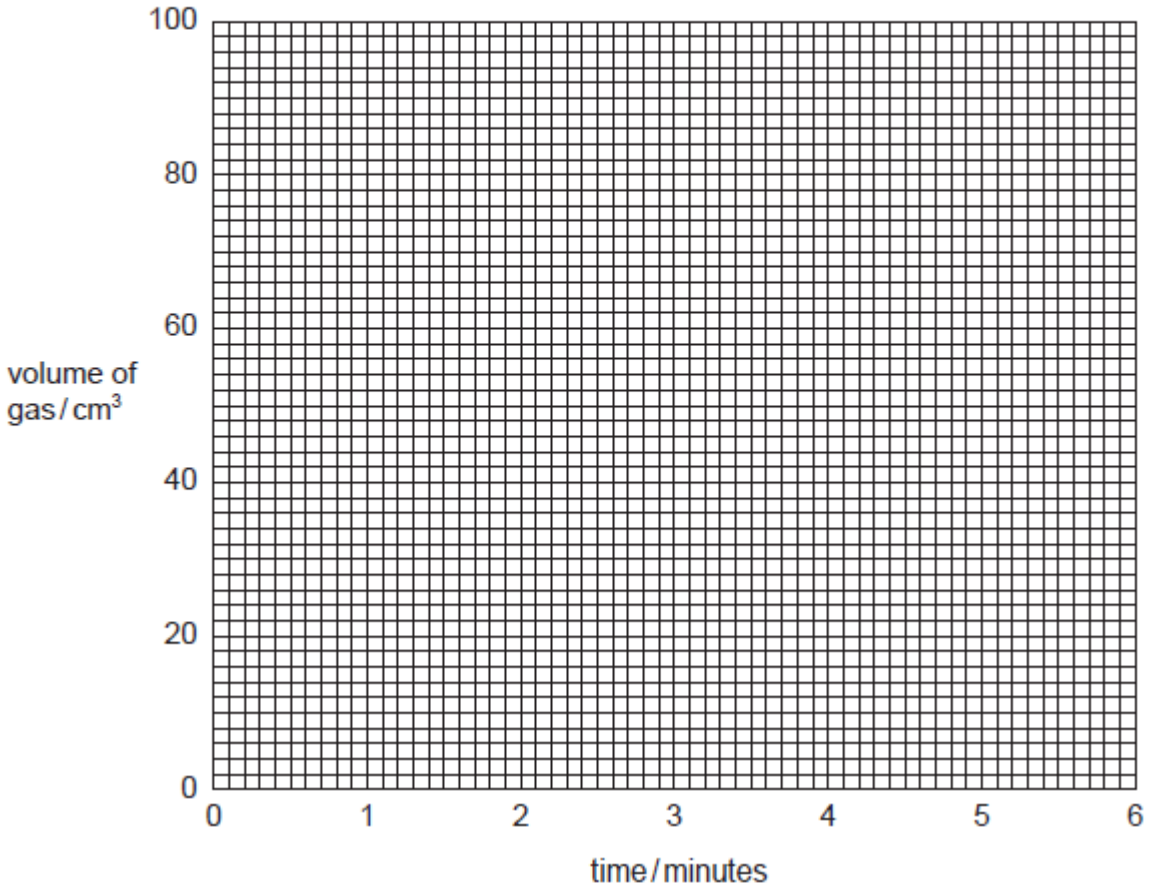


The volume of hydrogen collected at one minute intervals was measured. Use the diagrams to record the volumes in the table.

time / minutes	syringe diagram	volume of gas / cm^3
0		
1		
2		
3		
4		
5		
6		

[2]

(a) Plot the results on the grid. Join **all** of the results with a smooth curve.



[3]

(b) What type of chemical reaction occurs when calcium reacts with cold water?

..... [1]

06w6

4 An investigation was carried out into the reactions of aqueous copper(II) sulphate with magnesium, iron and zinc.

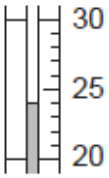
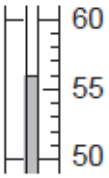
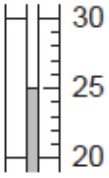
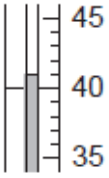
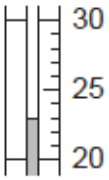
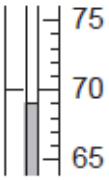
Experiment 1

By using a measuring cylinder, 5 cm^3 of aqueous copper(II) sulphate was added to each of three test-tubes. The initial temperature of the solution was measured. Zinc powder was added to the first test-tube, iron powder to the second tube and magnesium powder to the third tube. The mixtures were stirred with the thermometer. All the observations were recorded and the maximum temperature reached measured.

(a) Use the thermometer diagrams to complete the results table.

Table of results

Table of results

metal added	temperature of solution / °C				temperature difference / °C	observations
	initial		maximum			
zinc		.....		.....		moderate effervescence, solution paler, brown solid.
iron		.....		.....		little effervescence, brown solid.
magnesium		.....		.....		rapid effervescence, pops with lighted splint, brown solid.

[4]

(c) The reactions of magnesium and zinc with aqueous copper(II) sulphate were investigated in more detail.

Experiment 2

By using a measuring cylinder 10 cm^3 of aqueous copper(II) sulphate was poured into a polystyrene cup. The initial temperature of the solution was measured.
A 1 g sample of magnesium powder was added to the cup and the temperature measured every 10 seconds for 1 minute.

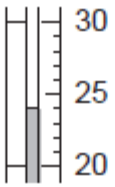
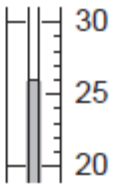
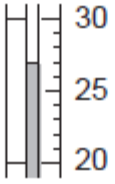
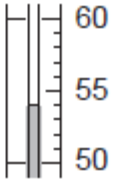
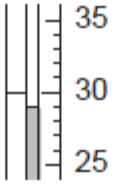
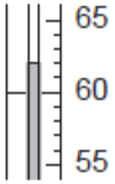
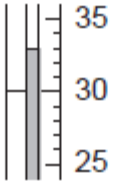
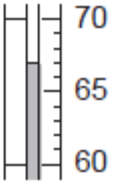
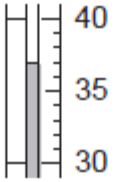
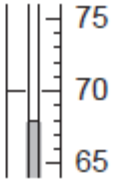
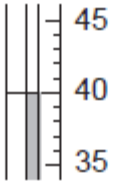
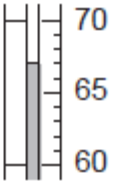
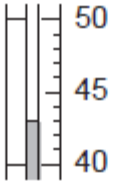
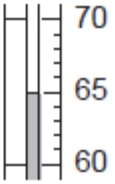
Use the thermometer diagrams on **page 8** to complete the results table.

Experiment 3

Experiment 2 was repeated using zinc powder instead of magnesium.

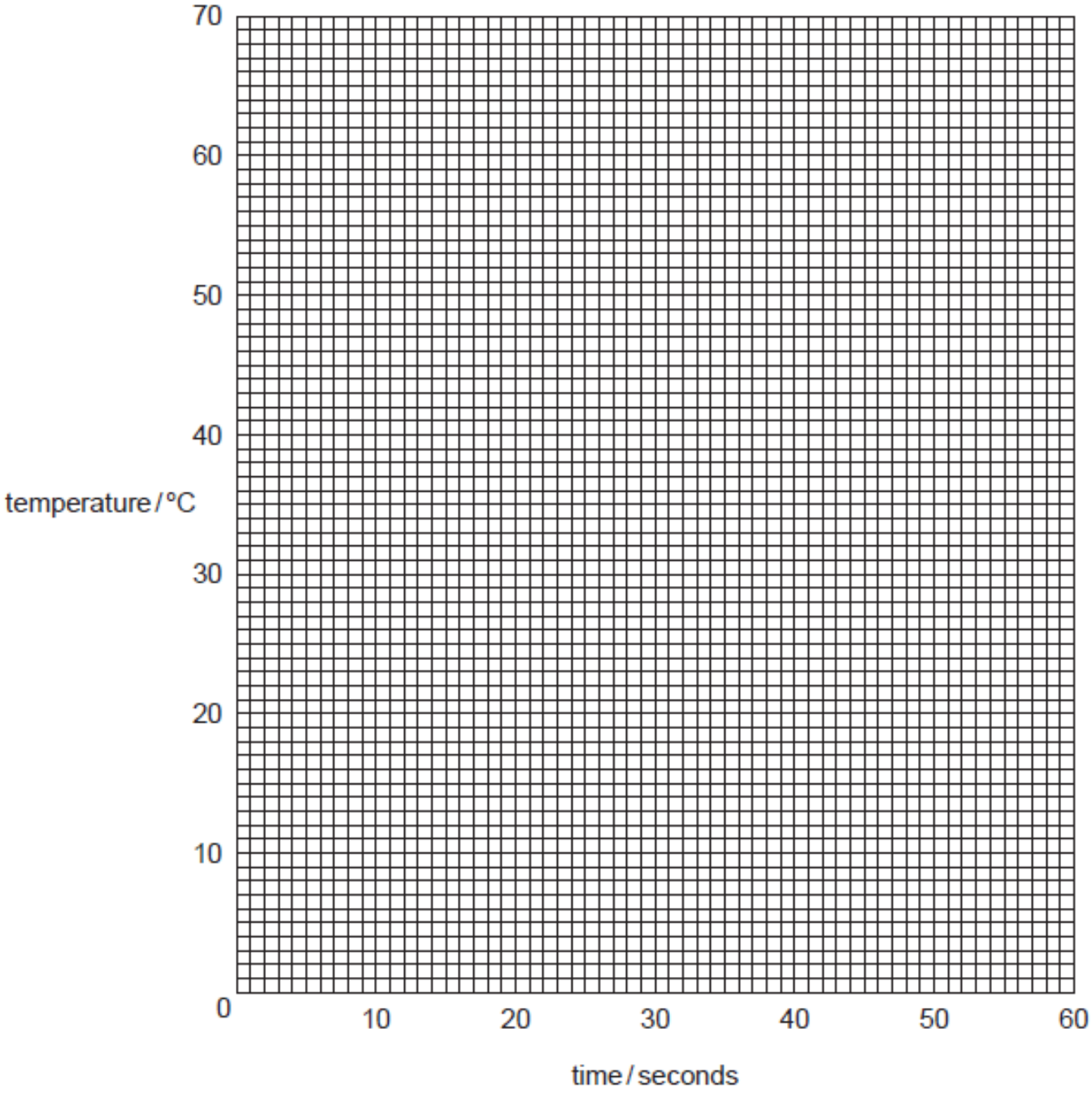
Use the thermometer diagrams on **page 8** to complete the results table.

Table of results

time / seconds	temperature / °C			
	Experiment 2		Experiment 3	
0		.....		.....
10		.....		.....
20		.....		.....
30		.....		.....
40		.....		.....
50		.....		.....
60		.....		.....

[6]

(d) Plot the results of both Experiments on the grid below. Draw two smooth line graphs. Clearly label the graphs.



[4]

(e) **Use your graph** to estimate the temperature of the reaction mixture in Experiment 2 after 5 seconds. Indicate **clearly** on the graph how you obtained your answer.

.....

[2]

Mark Scheme

12w6
2

(e) increase in masses completed correctly (1) [1]

0.75 1.00 1.15 1.15 1.15 accept 1 for 1.00

(f) points plotted correctly (2), –1 any incorrect [3]

two straight lines through points (1)

12w6

4 **(a)** Table of results for Experiments [5]

all initial temperature boxes completed correctly (2)

25 41 47 62 72

all final temperature boxes completed correctly (2)

23 27 39 42 48

average temperatures completed correctly (1)

24 34 43 52 60

(b) points plotted correctly (4) [5]

smooth line graph (1)

(c) value from graph at 72 °C (1) ≈ 30–35 s [2]

extrapolation shown on grid (1)

11w6

4 **(a)** Table of results for Experiment 1
temperature boxes completed correctly (3)
20, 21, 21, 32, 39, 42, 44, 45, 45 [3]

(b) Table of results for Experiment 2
temperature boxes completed correctly (3)
20, 21, 21, 24, 32, 36, 37, 38, 38 [3]

(c) all points correctly plotted (3) -1 for each incorrect
best fit smooth line graphs (1)
labels (1) [5]

(d) value from graph ≈28°C ± half small square (1) unit (1) shown clearly (1) [3]

10w6

3 **(a)** idea of fair test / only one variable [1]

(b) nitric acid [1]

(c) **(i)** points plotted (3), –1 for each incorrect
smooth curve (1) [4]

(ii) value from graph 18 s (1) indication on graph (1) [2]

(d) times would be less / reaction quicker (1)
particles have more energy / increased collisions (1) [2]

[Total: 10]

10w6

4 total volume of water boxes correctly completed (1)
10, 11, 12, 13, 14
temperature boxes completed (4) –1 each incorrect
68, 63, 59, 55, 51 [5]

(a) appropriate scale for y-axis (1)
points plotted correctly (4), –1 for each incorrect
best fit straight line graph (1) [6]

(b) clear liquid formed / no solid visible owtte [1]

(c) value from graph for 9cm^3 of water, around 72 °C (1)
extrapolation of straight line shown (1) [2]

(d) temperatures at which crystals appear lower (1)
solution more dilute in same volume of water / less saturated owtte (1) [2]

(e) sketch graph below line (1) label (1) [2]

09w6

4 **(a)** Table of results

Initial temperature boxes correctly completed (2)

24
26
25
24
26

Highest temperature boxes correctly completed (2)

39
37
35
31
29 [4]

Differences correctly completed (1) 15, 11, 10, 7, 3, allow ecf [1]

(b) all 5 bars correctly drawn (2) - 1 for each incorrect

labelled in the centre (1)

correct scale (at least half the grid for 'y' axis) (1) [4]
If plotting instead of bars only scale mark available

09w6

6 **(a)** points plotted correctly (2) - 1 for any incorrect
smooth curve (1) suitable scale (1) axes labelled (units not essential) (1) [5]
accept plot of loss in mass against time

(b) from graph, 180 g (ignore no units) (1)
indication on graph (1) [2]

(c) gas given off [1]

08w6

4 **(a)** Table of results

Initial boxes correctly completed (1)

24
26
21
29

Final boxes correctly completed (1)

27
22
11
23

Differences correctly completed (1)

+3 signs correct (1)
-4
-10
-6 [4]

08w6

6 **(a)** Points plotted correctly (3), –1 for each incorrect
smooth curve (1) not a straight line [4]

(b) 47±1 or reading from graph (1) curve extrapolated on grid (1) [2]

(c) solid/crystals form owtte (1) 20g (1) [2]
not solubility decreases

[Total: 8]

06w6

3 table of results
all volumes correct (2) 0, 9, 35, 62, 81, 88, 89 **[2]**
-1 for any incorrect

(a) graph
points (2) S-shaped curve joining all points(1) **[3]**

(b) exothermic/displacement/oxidation/redox(1) **[1]**

06w6

4 table of results

(a) temperatures correctly completed(3) differences(1)

zinc	24	56	32
iron	25	41	16
magnesium	23	69	46

-1 for each incorrect **[4]**

(b) (i) magnesium(1) **[1]**

(ii) gas evolved rapidly/reacts(1) greatest (temperature) difference(1) **[2]**

(iii) hydrogen(1) **[1]**

(c) Table of results temperatures correct (6) **[6]**

Time /s	zinc	magnesium
0	24	26
10	27	54
20	29	62
30	33	67
40	37	68
50	40	67
60	43	65

(d) Graph. Points plotted correctly(2) - 1 for each incorrect
Smooth lines(1) labels(1) **[4]**

(e) temperature after 5s/ 25-26°C ± 0.5°C(1) indication on grid(1) **[2]**

(f) sketch line for Mg below powder Mg(1)
sketch line for iron powder below zinc/ any line below top curve(1) **[2]**

(g) prevent heat loss/insulation(1) **[1]**

(h) one improvement e.g. use a burette/pipette to measure solution/ lid(1) **[1]**