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CANDIDATE
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CHEMISTRY

9701/51

Paper 5 Planning, Analysis and Evaluation

October/November 2016

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

Electronic calculators may be used.

You may lose marks if you do not show your working or if you do not use appropriate units.

Use of a Data Booklet is unnecessary.

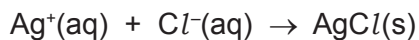
At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

This document consists of **11** printed pages and **1** blank page.

- 1 When hydrated barium chloride, $\text{BaCl}_2 \cdot x\text{H}_2\text{O}$, dissolves in water, $\text{Ba}^{2+}(\text{aq})$ and $\text{Cl}^{-}(\text{aq})$ ions are formed.

The concentration of chloride ions in solution can be determined by titration with aqueous silver nitrate of known concentration.



The indicator for the reaction is aqueous potassium chromate(VI), $\text{K}_2\text{CrO}_4(\text{aq})$. At the endpoint of the titration, it forms a red precipitate in the presence of excess silver ions.

- (a) The solubilities, in g dm^{-3} , of different ionic compounds at 20°C are given in the table below.

	anion		
cation	Cl^{-}	CrO_4^{2-}	SO_4^{2-}
Ag^{+}	0.0019	0.022	293
Ba^{2+}	358	0.0028	0.00245

With reference to these data, where relevant, answer the following questions.

- (i) Name the red precipitate and give an equation for its formation.

name:

equation:

[2]

Sulfuric acid must be added to the solution to prevent the $\text{Ba}^{2+}(\text{aq})$ ions from interfering with the action of the potassium chromate(VI) indicator.

- (ii) How would $\text{Ba}^{2+}(\text{aq})$ ions interfere with the action of this indicator?

.....

..... [1]

- (iii) How does the addition of sulfuric acid prevent $\text{Ba}^{2+}(\text{aq})$ ions from interfering with the action of this indicator?

.....

..... [1]

- (b) In an initial rough titration, excess silver nitrate solution is added so that the endpoint is exceeded.

Draw a sketch graph to show how the mass of silver chloride varies with the volume of silver nitrate added.

Label both axes.



[2]

(c) You are to plan a titration experiment to determine the value of x in $\text{BaCl}_2 \cdot x\text{H}_2\text{O}$.

You are provided with the following materials.

3.00 g of hydrated barium chloride, $\text{BaCl}_2 \cdot x\text{H}_2\text{O}$

$0.050 \text{ mol dm}^{-3}$ aqueous silver nitrate

1.0 mol dm^{-3} potassium chromate(VI) solution

1.0 mol dm^{-3} sulfuric acid

(i) Name **three** pieces of volumetric apparatus you would use, with their capacities in cm^3 .

1

2

3 [2]

(ii) Describe how you would make a solution of barium chloride that is suitable for use in your titration.

.....

.....

.....

.....

.....

..... [2]

(iii) A known volume of barium chloride solution is transferred to a conical flask.

In what order should the other three solutions then be added to the flask?

first

second

third [1]

(iv) How would you ensure that your titration result is reliable?

.....

..... [1]

- (v) In another experiment, a student dissolved 3.13 g of hydrated barium chloride, $\text{BaCl}_2 \cdot x\text{H}_2\text{O}$, in distilled water to give 1.00 dm^3 of solution.

It was calculated that the concentration of $\text{Ba}^{2+}(\text{aq})$ ions was $0.0128 \text{ mol dm}^{-3}$.

Determine the value of x in $\text{BaCl}_2 \cdot x\text{H}_2\text{O}$.

[A_r : Ba, 137.3; Cl, 35.5; H, 1.0; O, 16.0]

$x = \dots\dots\dots$

[2]

- (d) The following information gives some of the hazards associated with the chemicals used in the procedure.

Barium chloride	Solid barium chloride is classified as toxic . Solutions equal to or more concentrated than 0.4 mol dm^{-3} are classified as moderate hazard and are harmful if swallowed. Solutions less concentrated than 0.4 mol dm^{-3} are classified as non-hazardous.
Potassium chromate(VI)	All solutions more concentrated than 0.9 mol dm^{-3} are classified as health hazard . They may cause skin, eye and respiratory irritation.
Silver nitrate	Solutions equal to or more concentrated than 0.18 mol dm^{-3} are classified as corrosive . Solutions equal to or more concentrated than 0.06 mol dm^{-3} but less than 0.18 mol dm^{-3} are classified as moderate hazard and cause skin and eye irritation. Solutions less concentrated than 0.06 mol dm^{-3} are classified as non-hazardous.

Identify **one** hazard that must be considered when planning the experiment and describe a precaution, other than eye protection, that should be taken to keep risks from this hazard to a minimum.

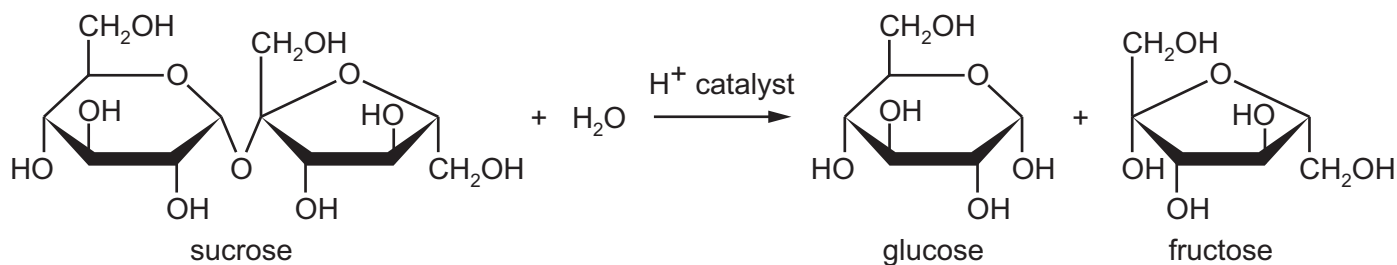
hazard:

precaution:

..... [1]

[Total: 15]

- 2 Sucrose, $C_{12}H_{22}O_{11}$, is a naturally occurring sugar found in sugarcane and many fruits. It can be hydrolysed in acidic solution to give glucose and fructose. All three molecules are chiral and will rotate the plane of polarised light. The degree of rotation is known as the **optical rotation**, α .



In the presence of excess water, the reaction can be considered to be first order with respect to sucrose concentration.

The progress of the reaction can be monitored using a polarimeter, which measures the optical rotation, α , of the solution. The more concentrated the solution, the greater the optical rotation of the solution.

The concentration of sucrose at time t can be represented as $(\alpha - \alpha_{\text{final}})$, where α_{final} is the optical rotation of the solution after 6 hours.

The mathematical relationship is given by the following equation.

$$\log_{10}(\alpha - \alpha_{\text{final}}) = A - \frac{kt}{2.30}$$

A is a constant.

k is the rate constant.

- (a) The experimentally determined values of optical rotation during the hydrolysis of sucrose at 298 K are recorded below.

Process the results to allow you to plot a graph of $\log_{10}(\alpha - \alpha_{\text{final}})$ against time, t .

Calculate $(\alpha - \alpha_{\text{final}})$ and record it to 1 decimal place.

Calculate $\log_{10}(\alpha - \alpha_{\text{final}})$ and record it to 2 decimal places.

time / s	optical rotation, α	$(\alpha - \alpha_{\text{final}})$	$\log_{10}(\alpha - \alpha_{\text{final}})$
0	39.9		
300	29.1		
600	21.3		
900	15.5		
1200	10.6		
1500	6.2		
1800	2.4		
2100	-0.3		
2400	-2.5		
2700	-4.5		

α_{final}	-12.0
-------------------------	-------

[2]

- (b) (i) Plot a graph on the grid on page 9 to show how $\log_{10}(\alpha - \alpha_{\text{final}})$ varies with time, t . Use a cross (x) to plot each data point. Draw the line of best fit.

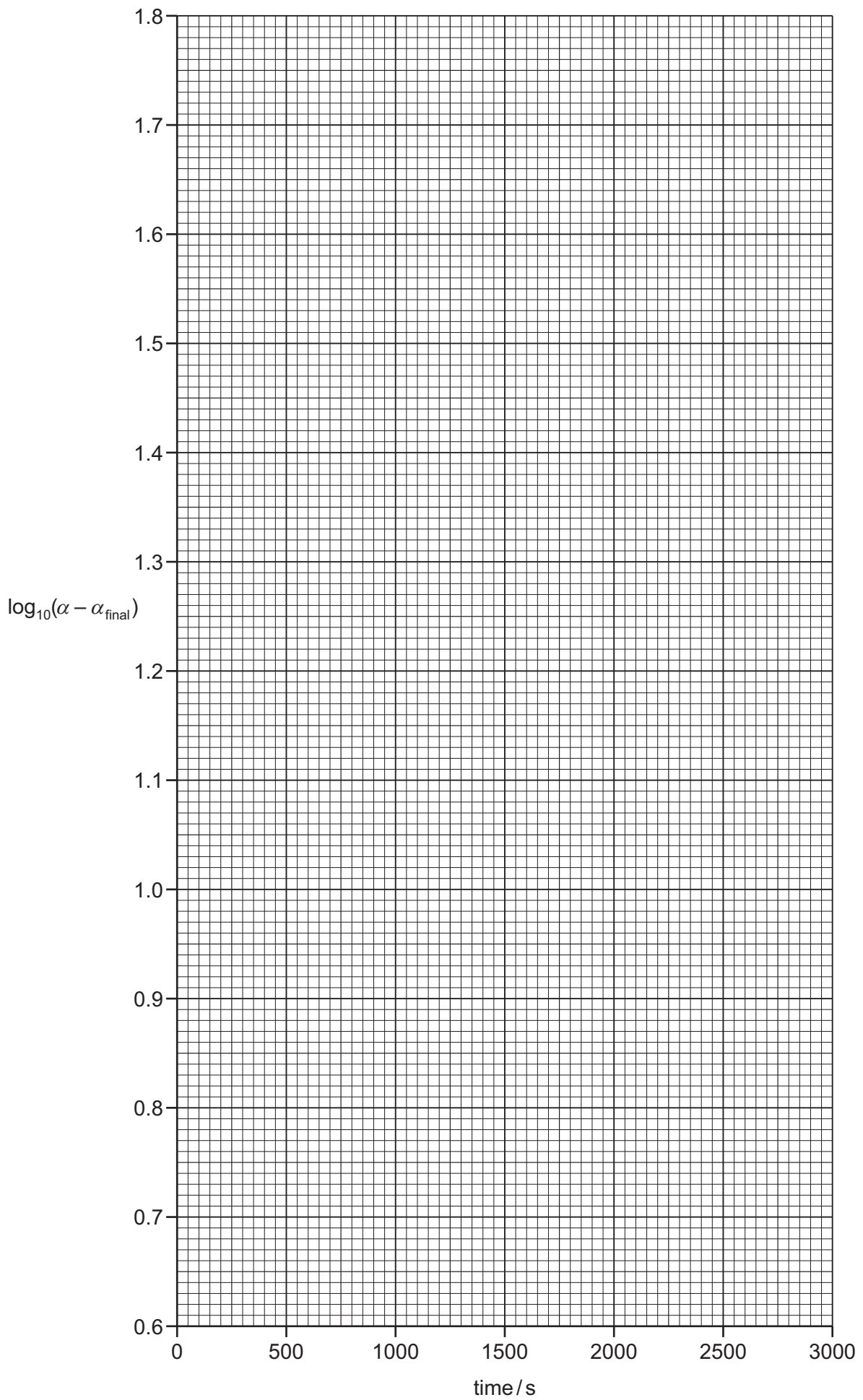
[2]

- (ii) State and explain whether the results and your graph confirm the relationship $\log_{10}(\alpha - \alpha_{\text{final}}) = A - \frac{kt}{2.30}$.

.....

.....

..... [1]



- (c) (i) Determine the gradient of the graph.
 State the co-ordinates of both points you used for your calculation.
 Record the value of the gradient to **three significant figures**.

co-ordinates 1 co-ordinates 2

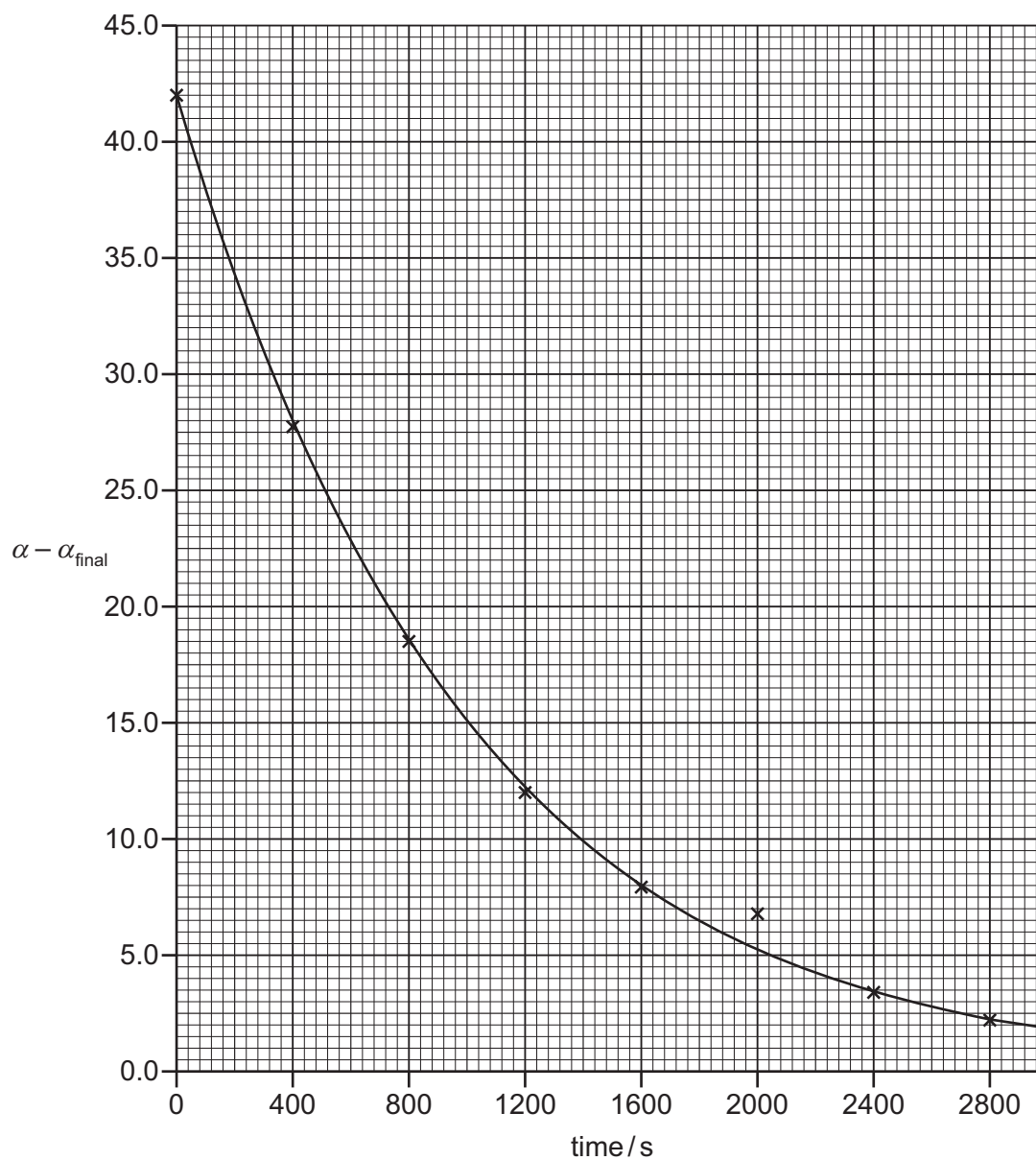
gradient = ... s⁻¹
 [2]

- (ii) Use the gradient value to calculate a value for k in the expression shown.

$$\log_{10}(\alpha - \alpha_{\text{final}}) = A - \frac{kt}{2.30}$$

[2]

- (d) The graph below shows the results obtained from a second hydrolysis of sucrose reaction performed at a different temperature.



- (i) The point at time = 2000 s is considered to be anomalous. Suggest what caused the anomaly.

.....

.....

..... [1]

- (ii) Use the graph to determine the half-life, $t_{1/2}$, of this reaction.
State the co-ordinates of both points you used in your calculation.

co-ordinates 1 co-ordinates 2

half-life = ... s [2]

- (iii) For a first-order reaction, the following relationship exists.

$$\text{half-life, } t_{1/2} = \frac{0.693}{k'}$$

Use this relationship and your answer to (ii) to determine k' , the rate constant for this second hydrolysis reaction.

If you have been unable to determine the half-life of the reaction in (ii), you may use the value $t_{1/2} = 500$ s, though this is not the correct answer.

$k' = \dots\dots\dots \text{ s}^{-1}$ [1]

- (iv) State whether the temperature of the second reaction was higher or lower than that of the first.

Explain your answer with reference to the answers you obtained in (c)(ii) and (d)(iii).

If you have been unable to calculate a value for k in (c)(ii), you may use the value $k = 8.00 \times 10^{-4}$, though this is not the correct answer.

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

- (v) Would the value of the half-life change if the reaction were repeated with twice the initial concentration of sucrose? Give a reason for your answer.

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

[Total: 15]

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CHEMISTRY

9701/52

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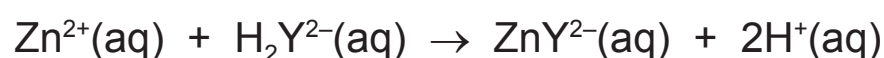
The number of marks is given in brackets [] at the end of each question or part question.

This document consists of **12** printed pages.

- 1 Titrations using ethylenediaminetetraacetic acid (EDTA) can be used to determine the concentration of metal ions in solution, such as $\text{Zn}^{2+}(\text{aq})$.

A solution of EDTA is usually prepared from the hydrated disodium salt, $\text{Na}_2\text{H}_2\text{Y} \cdot 2\text{H}_2\text{O}$. The anion of EDTA is H_2Y^{2-} , where Y represents the organic part of the ion.

The equation for the reaction between $\text{Zn}^{2+}(\text{aq})$ and EDTA is shown.



The indicator for the reaction is Solochrome Black, which changes colour at the endpoint from purple to blue. The indicator only works at pH 10, so a buffer solution is added to the metal ion solution to maintain the pH.

- (a) Explain why the pH would change during the titration if the buffer were not present.

.....

 [1]

- (b) You are to plan a titration experiment to determine the concentration of zinc ions in a solution of zinc sulfate of concentration approximately 0.1 mol dm^{-3} .

You are provided with the following materials.

20.0 g of hydrated disodium EDTA, $\text{Na}_2\text{H}_2\text{Y} \cdot 2\text{H}_2\text{O}$ ($M_r = 372.2$)
 aqueous zinc sulfate of approximate concentration 0.1 mol dm^{-3}
 buffer solution, pH 10
 Solochrome Black indicator solution

- (i) Name **three** pieces of volumetric apparatus you would use, with their capacities in cm^3 .

1
 2
 3 [2]

- (ii) Calculate the mass of hydrated disodium EDTA that would be required for the preparation of a standard solution of concentration $0.100 \text{ mol dm}^{-3}$, using the apparatus you have specified in (i).

mass of hydrated disodium EDTA = ... g [1]

- (iii) Describe how you would prepare this standard solution for use in your titration.

.....
.....
.....
.....
.....
..... [2]

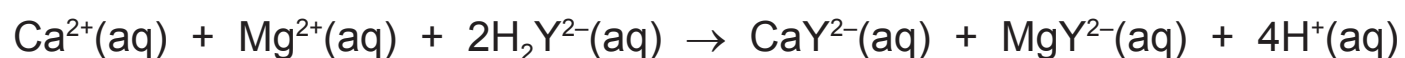
- (iv) After you have performed a rough titration, how would you ensure that your next titration is accurate?

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

- (v) How would you ensure that your titration result is reliable?

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

- (c) The term *hard water* is used to describe water containing the dissolved metal ions, $\text{Ca}^{2+}(\text{aq})$ and $\text{Mg}^{2+}(\text{aq})$. Both of these metal ions react with EDTA anions, H_2Y^{2-} .



In an experiment to determine the concentration of each of these metal ions, two separate titrations with EDTA need to be performed.

For titration **1**, a 25.0 cm^3 sample of hard water is titrated with $0.0100\text{ mol dm}^{-3}$ EDTA solution using Solochrome Black solution as indicator.

For titration **2**, another 25.0 cm^3 sample of the same hard water is first treated with excess 2 mol dm^{-3} $\text{NaOH}(\text{aq})$ which precipitates **all** of the $\text{Mg}^{2+}(\text{aq})$ ions as $\text{Mg}(\text{OH})_2(\text{s})$. After this treatment, no $\text{Mg}^{2+}(\text{aq})$ ions remain in solution, leaving only dissolved $\text{Ca}^{2+}(\text{aq})$ ions in solution. This solution is then titrated with $0.0100\text{ mol dm}^{-3}$ EDTA solution using Solochrome Black solution as indicator.

The following information gives some of the hazards associated with the chemicals used in the procedure.

Sodium hydroxide Solutions equal to or more concentrated than 0.5 mol dm^{-3} are classified as **corrosive**.

Solochrome Black Solid Solochrome Black is classified as **health hazard** and is irritating to eyes, respiratory system and skin. All solutions are made up in ethanol and so are classified as **flammable** and **health hazard**.

- (i) Identify **one** hazard that must be considered when planning the experiment and describe a precaution, other than eye protection, that should be taken to keep risks from this hazard to a minimum.

hazard:

precaution:

.....

[1]

(ii) Results obtained from this experiment are shown.

titre 1, 22.70 cm³

titre 2, 16.60 cm³

Use the results of the titrations to determine the concentrations of Ca²⁺(aq) and Mg²⁺(aq) in the hard water.

concentration of Ca²⁺(aq) mol dm⁻³

concentration of Mg²⁺(aq) mol dm⁻³
[4]

[Total: 13]

- 2 Benzenediazonium chloride, $\text{C}_6\text{H}_5\text{N}_2\text{Cl}$, is readily hydrolysed at temperatures above 5°C , forming phenol, nitrogen gas and hydrochloric acid.



The progress of the reaction can be monitored by measuring the volume of gas produced over time. The volume of gas produced, V , after time, t , is proportional to the amount of benzenediazonium chloride that has been hydrolysed. The final volume of gas produced, V_{final} , is proportional to the original concentration of benzenediazonium chloride.

The order of reaction can be determined from these results.

- (a) (i) The experimentally determined volumes of gas produced during the hydrolysis of benzenediazonium chloride at 50°C are recorded below.

Process the results to allow you to plot a graph of $(V_{\text{final}} - V)$ against time, t .

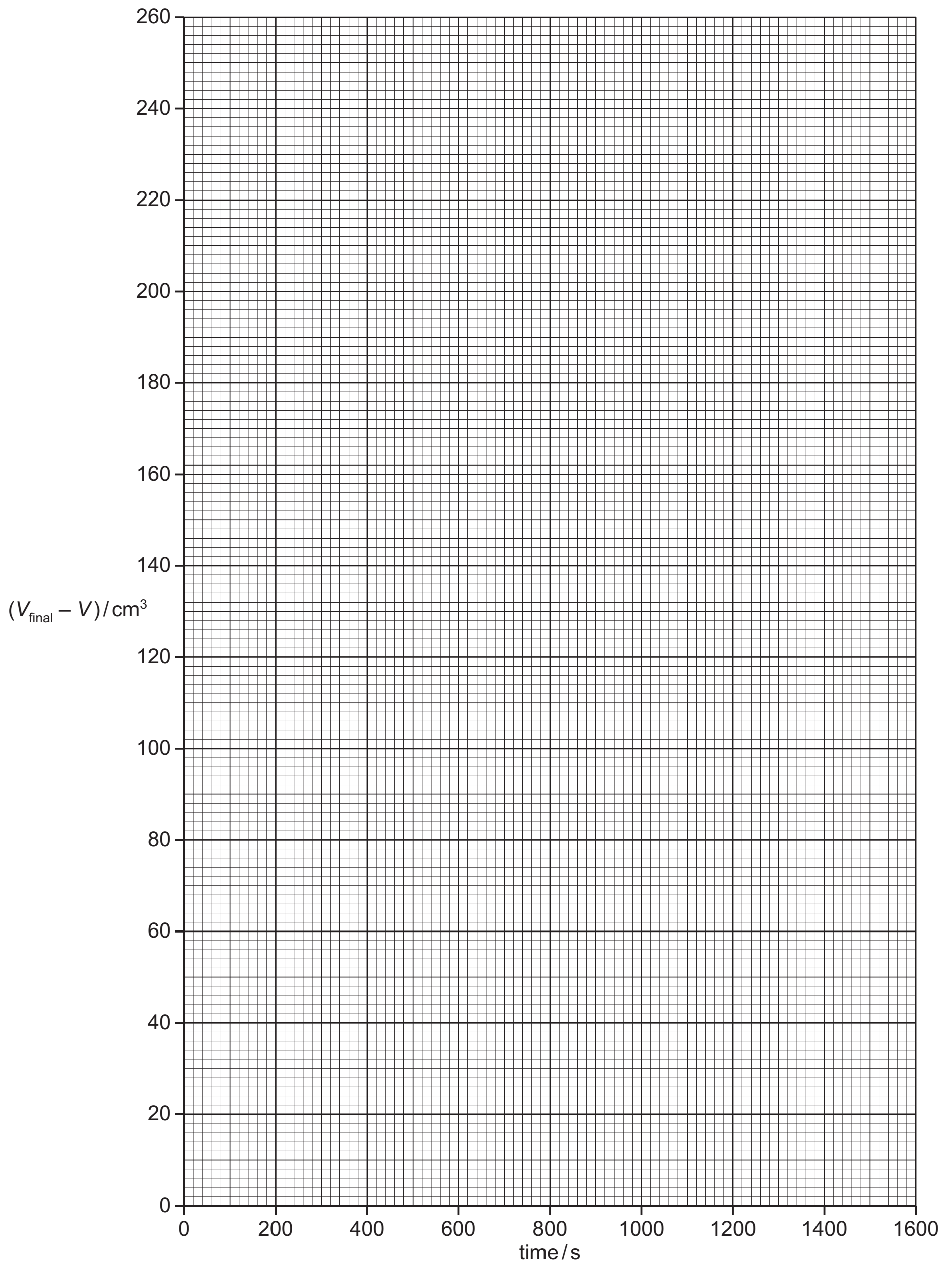
$$V_{\text{final}} = 252 \text{ cm}^3$$

time/s	volume, V/cm^3	$(V_{\text{final}} - V)/\text{cm}^3$
0	0	
150	32	
300	62	
450	87	
600	110	
750	129	
900	146	
1050	160	
1200	173	
1350	184	
1500	193	

[1]

- (ii) Plot a graph to show how $(V_{\text{final}} - V)/\text{cm}^3$ varies with time/s.

Use a cross (x) to plot each data point. Draw the curve of best fit.



[2]

- (iii) Do you think the results obtained in (i) are reliable? Explain your answer.

.....

 [1]

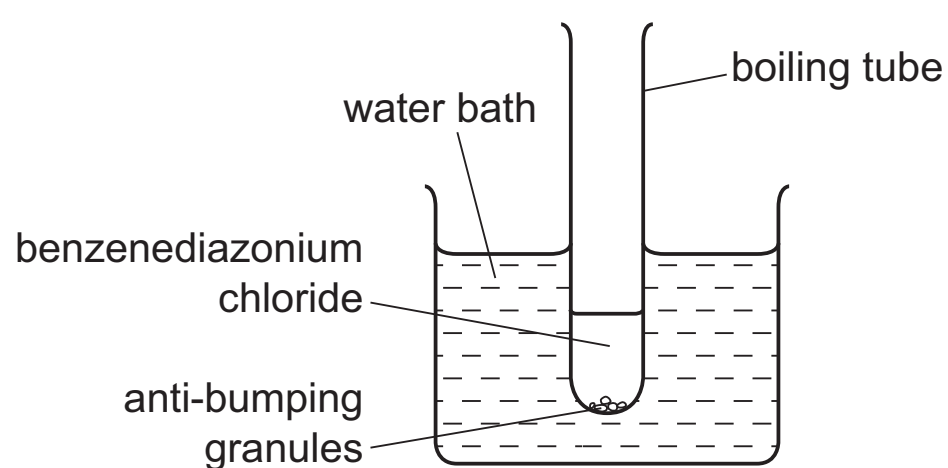
- (iv) Use the graph to determine the half-life, $t_{1/2}$, of this reaction.

State the co-ordinates of both points you used in your calculation.

co-ordinates 1 co-ordinates 2

half-life = ... s
 [2]

- (b) A student set up an experiment to determine the order of the reaction in (a). Part of the experimental set-up is shown below.



- (i) Complete the diagram above to show the experimental set-up the student could have used to collect and measure the volume of gas evolved by the reaction. [2]
- (ii) The water bath was set at 60 °C.

At a reaction temperature of 60 °C, the measurements made would be less accurate than measurements made at room temperature.

State why the measurements made at a higher temperature are less accurate.

.....

.....

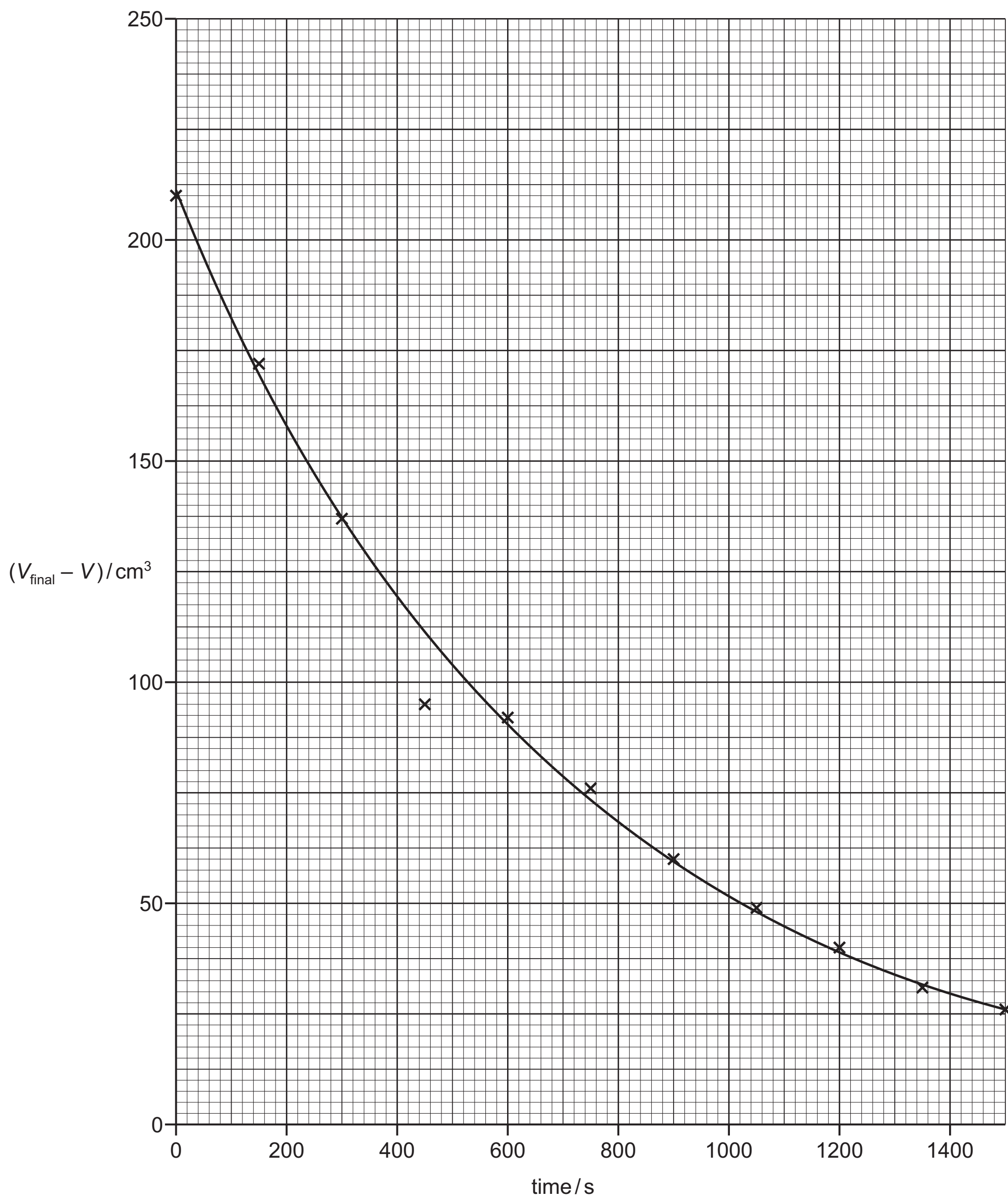
State the effect this will have on the values of $V_{\text{final}} - V$.

.....

.....

[2]

- (c) The graph below shows the results obtained from another benzenediazonium chloride hydrolysis reaction performed at a different temperature.



- (i) The point at time = 450 s is considered to be anomalous.

Suggest what caused the anomaly.

.....

.....

..... [1]

Question 2 continues on page 12.

- (ii) The rate of reaction at different times can be calculated by drawing tangents to the best-fit line. The gradient of the tangent is equal to the rate of reaction, in cm^3s^{-1} .

Use the graph in (c) to read the value of $(V_{\text{final}} - V)$ at time $t = 200\text{ s}$ and write this value in the table below.

Draw a tangent to the curve at time $t = 200\text{ s}$. Use the tangent to determine the gradient at time $t = 200\text{ s}$.

State the co-ordinates of both points you used in your calculation.

co-ordinates 1 co-ordinates 2

gradient at 200 s = ... cm^3s^{-1}

Use your gradient to complete the table.

time / s	$(V_{\text{final}} - V) / \text{cm}^3$	rate of reaction / cm^3s^{-1}
200		
500	104	-0.143
600	91	-0.127
900	59	-0.0867
1000	52	-0.0720
1400	30	-0.0417

[4]

- (iii) The concentration of benzenediazonium chloride is directly proportional to $(V_{\text{final}} - V)$.

Use the data in the table in (ii) to calculate the order of reaction with respect to benzenediazonium chloride.

You must show your working.

[2]

[Total: 17]

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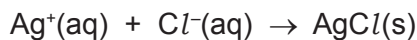
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- 1 When hydrated barium chloride, $\text{BaCl}_2 \cdot x\text{H}_2\text{O}$, dissolves in water, $\text{Ba}^{2+}(\text{aq})$ and $\text{Cl}^{-}(\text{aq})$ ions are formed.

The concentration of chloride ions in solution can be determined by titration with aqueous silver nitrate of known concentration.



The indicator for the reaction is aqueous potassium chromate(VI), $\text{K}_2\text{CrO}_4(\text{aq})$. At the endpoint of the titration, it forms a red precipitate in the presence of excess silver ions.

- (a) The solubilities, in g dm^{-3} , of different ionic compounds at 20°C are given in the table below.

	anion		
cation	Cl^{-}	CrO_4^{2-}	SO_4^{2-}
Ag^{+}	0.0019	0.022	293
Ba^{2+}	358	0.0028	0.00245

With reference to these data, where relevant, answer the following questions.

- (i) Name the red precipitate and give an equation for its formation.

name:

equation:

[2]

Sulfuric acid must be added to the solution to prevent the $\text{Ba}^{2+}(\text{aq})$ ions from interfering with the action of the potassium chromate(VI) indicator.

- (ii) How would $\text{Ba}^{2+}(\text{aq})$ ions interfere with the action of this indicator?

.....

..... [1]

- (iii) How does the addition of sulfuric acid prevent $\text{Ba}^{2+}(\text{aq})$ ions from interfering with the action of this indicator?

.....

..... [1]

- (b) In an initial rough titration, excess silver nitrate solution is added so that the endpoint is exceeded.

Draw a sketch graph to show how the mass of silver chloride varies with the volume of silver nitrate added.

Label both axes.



[2]

(c) You are to plan a titration experiment to determine the value of x in $\text{BaCl}_2 \cdot x\text{H}_2\text{O}$.

You are provided with the following materials.

3.00 g of hydrated barium chloride, $\text{BaCl}_2 \cdot x\text{H}_2\text{O}$

$0.050 \text{ mol dm}^{-3}$ aqueous silver nitrate

1.0 mol dm^{-3} potassium chromate(VI) solution

1.0 mol dm^{-3} sulfuric acid

(i) Name **three** pieces of volumetric apparatus you would use, with their capacities in cm^3 .

1

2

3 [2]

(ii) Describe how you would make a solution of barium chloride that is suitable for use in your titration.

.....

.....

.....

.....

.....

..... [2]

(iii) A known volume of barium chloride solution is transferred to a conical flask.

In what order should the other three solutions then be added to the flask?

first

second

third [1]

(iv) How would you ensure that your titration result is reliable?

.....

..... [1]

- (v) In another experiment, a student dissolved 3.13 g of hydrated barium chloride, $\text{BaCl}_2 \cdot x\text{H}_2\text{O}$, in distilled water to give 1.00 dm^3 of solution.

It was calculated that the concentration of $\text{Ba}^{2+}(\text{aq})$ ions was $0.0128 \text{ mol dm}^{-3}$.

Determine the value of x in $\text{BaCl}_2 \cdot x\text{H}_2\text{O}$.

[A_r : Ba, 137.3; Cl, 35.5; H, 1.0; O, 16.0]

$x = \dots\dots\dots$

[2]

- (d) The following information gives some of the hazards associated with the chemicals used in the procedure.

Barium chloride	Solid barium chloride is classified as toxic . Solutions equal to or more concentrated than 0.4 mol dm^{-3} are classified as moderate hazard and are harmful if swallowed. Solutions less concentrated than 0.4 mol dm^{-3} are classified as non-hazardous.
Potassium chromate(VI)	All solutions more concentrated than 0.9 mol dm^{-3} are classified as health hazard . They may cause skin, eye and respiratory irritation.
Silver nitrate	Solutions equal to or more concentrated than 0.18 mol dm^{-3} are classified as corrosive . Solutions equal to or more concentrated than 0.06 mol dm^{-3} but less than 0.18 mol dm^{-3} are classified as moderate hazard and cause skin and eye irritation. Solutions less concentrated than 0.06 mol dm^{-3} are classified as non-hazardous.

Identify **one** hazard that must be considered when planning the experiment and describe a precaution, other than eye protection, that should be taken to keep risks from this hazard to a minimum.

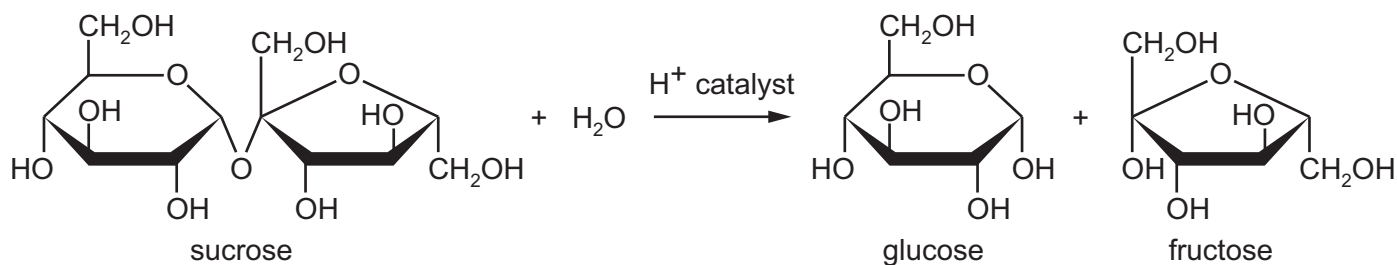
hazard:

precaution:

..... [1]

[Total: 15]

- 2 Sucrose, $C_{12}H_{22}O_{11}$, is a naturally occurring sugar found in sugarcane and many fruits. It can be hydrolysed in acidic solution to give glucose and fructose. All three molecules are chiral and will rotate the plane of polarised light. The degree of rotation is known as the **optical rotation**, α .



In the presence of excess water, the reaction can be considered to be first order with respect to sucrose concentration.

The progress of the reaction can be monitored using a polarimeter, which measures the optical rotation, α , of the solution. The more concentrated the solution, the greater the optical rotation of the solution.

The concentration of sucrose at time t can be represented as $(\alpha - \alpha_{\text{final}})$, where α_{final} is the optical rotation of the solution after 6 hours.

The mathematical relationship is given by the following equation.

$$\log_{10}(\alpha - \alpha_{\text{final}}) = A - \frac{kt}{2.30}$$

A is a constant.

k is the rate constant.

- (a) The experimentally determined values of optical rotation during the hydrolysis of sucrose at 298 K are recorded below.

Process the results to allow you to plot a graph of $\log_{10}(\alpha - \alpha_{\text{final}})$ against time, t .

Calculate $(\alpha - \alpha_{\text{final}})$ and record it to 1 decimal place.

Calculate $\log_{10}(\alpha - \alpha_{\text{final}})$ and record it to 2 decimal places.

time / s	optical rotation, α	$(\alpha - \alpha_{\text{final}})$	$\log_{10}(\alpha - \alpha_{\text{final}})$
0	39.9		
300	29.1		
600	21.3		
900	15.5		
1200	10.6		
1500	6.2		
1800	2.4		
2100	-0.3		
2400	-2.5		
2700	-4.5		

α_{final}	-12.0
-------------------------	-------

[2]

- (b) (i) Plot a graph on the grid on page 9 to show how $\log_{10}(\alpha - \alpha_{\text{final}})$ varies with time, t . Use a cross (x) to plot each data point. Draw the line of best fit.

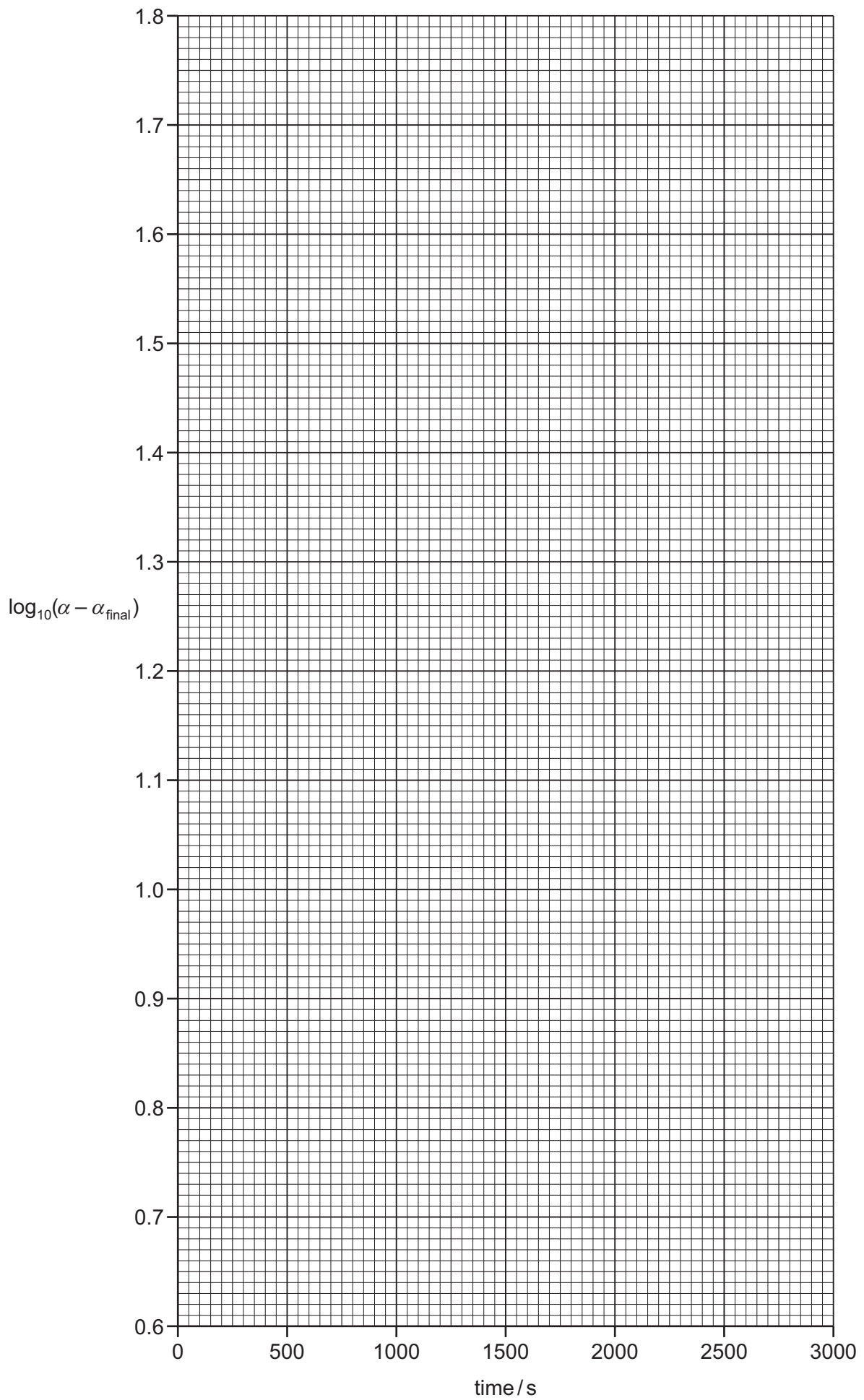
[2]

- (ii) State and explain whether the results and your graph confirm the relationship $\log_{10}(\alpha - \alpha_{\text{final}}) = A - \frac{kt}{2.30}$.

.....

.....

..... [1]



- (c) (i) Determine the gradient of the graph.
 State the co-ordinates of both points you used for your calculation.
 Record the value of the gradient to **three significant figures**.

co-ordinates 1 co-ordinates 2

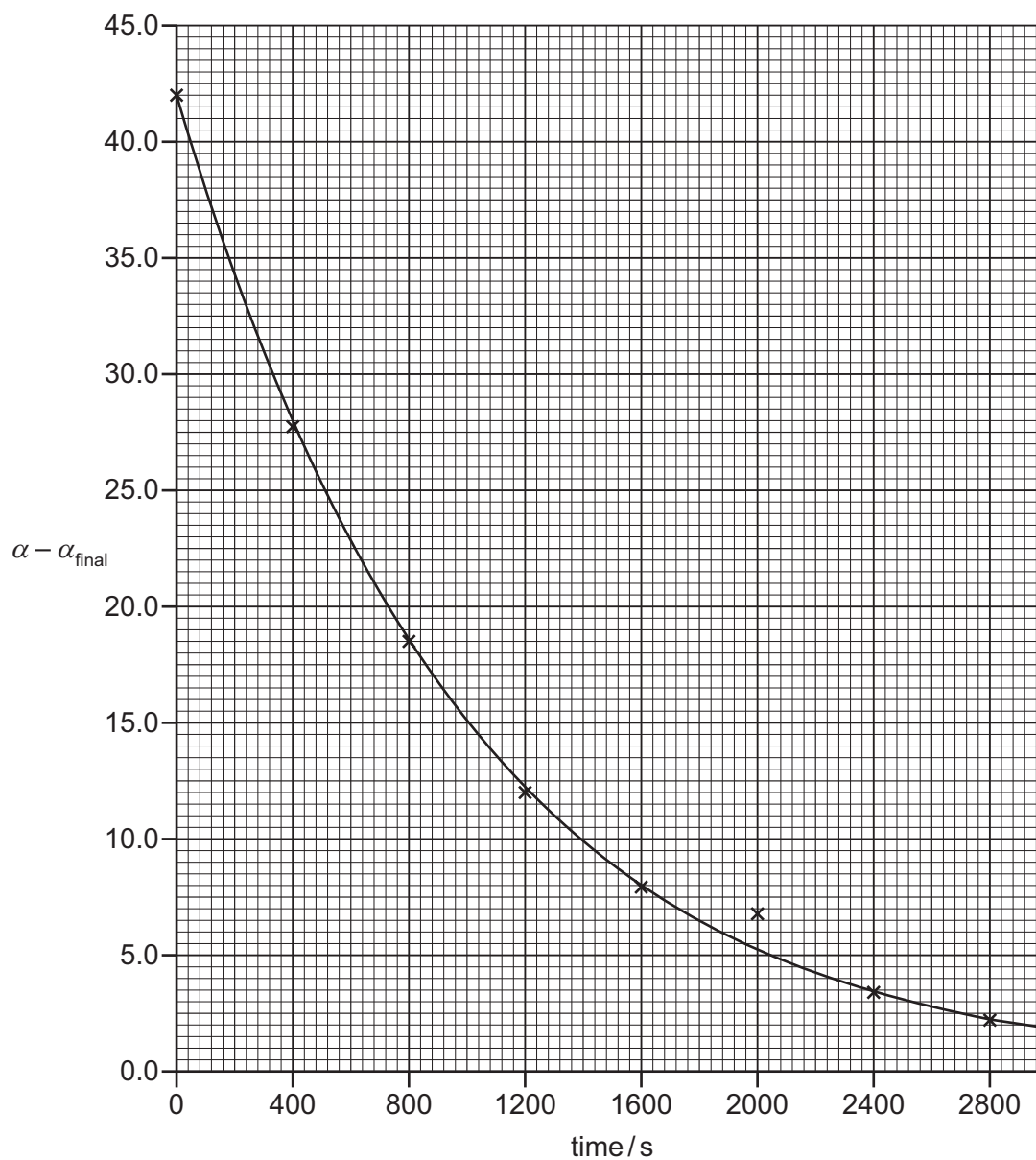
gradient = ... s⁻¹
 [2]

- (ii) Use the gradient value to calculate a value for k in the expression shown.

$$\log_{10}(\alpha - \alpha_{\text{final}}) = A - \frac{kt}{2.30}$$

[2]

- (d) The graph below shows the results obtained from a second hydrolysis of sucrose reaction performed at a different temperature.



- (i) The point at time = 2000 s is considered to be anomalous. Suggest what caused the anomaly.

.....

.....

..... [1]

- (ii) Use the graph to determine the half-life, $t_{1/2}$, of this reaction.
State the co-ordinates of both points you used in your calculation.

co-ordinates 1 co-ordinates 2

half-life = ... s [2]

- (iii) For a first-order reaction, the following relationship exists.

$$\text{half-life, } t_{1/2} = \frac{0.693}{k'}$$

Use this relationship and your answer to (ii) to determine k' , the rate constant for this second hydrolysis reaction.

If you have been unable to determine the half-life of the reaction in (ii), you may use the value $t_{1/2} = 500$ s, though this is not the correct answer.

$k' = \dots\dots\dots \text{s}^{-1}$ [1]

- (iv) State whether the temperature of the second reaction was higher or lower than that of the first.

Explain your answer with reference to the answers you obtained in (c)(ii) and (d)(iii).

If you have been unable to calculate a value for k in (c)(ii), you may use the value $k = 8.00 \times 10^{-4}$, though this is not the correct answer.

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

- (v) Would the value of the half-life change if the reaction were repeated with twice the initial concentration of sucrose? Give a reason for your answer.

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

[Total: 15]

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