# Specimen Paper

| Centre Number | | | | | | Candidate Number | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Surname | | | | | | | | | | |
| Other Names | | | | | | | | | | |
| Candidate Signature | | | | | | | | | | |

| For Examiner's Use | |
|---|---|
| Examiner's Initials | |
| Question | Mark |
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| TOTAL | |

AQA Level 1/2 Certificate in Chemistry
Specimen Paper

# Chemistry

**Paper 2**

**For this paper you must have:**
- a ruler
- the Chemistry Data Sheet (enclosed)
- a calculator.

**Time allowed**
- 1 hr 30 minutes

**Instructions**
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

**Information**
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 90.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- Question 3(b) should be answered in continuous prose.
  In this question you will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

**Advice**
- In all calculations, show clearly how you work out your answer.

Answer **all** questions in the spaces provided.

**There are no questions printed on this page**

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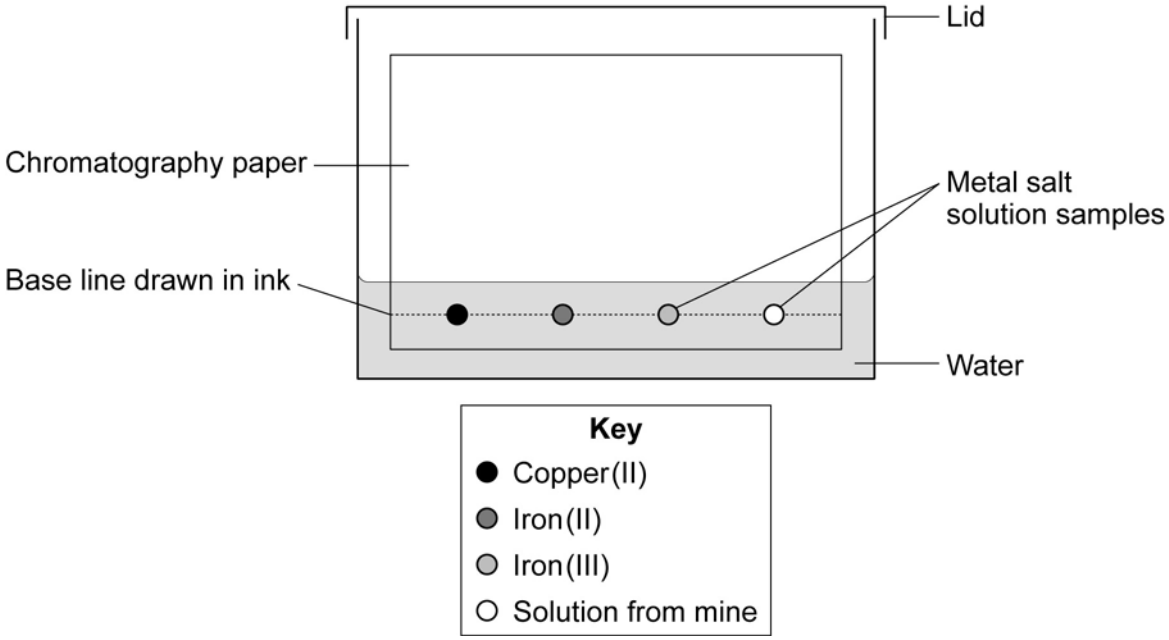
**ANSWER IN THE SPACES PROVIDED**

**1** A student analysed a sample of water from a disused mine to find out which metal ions were in the water.

He used paper chromatography of the sample of water from the mine and of solutions containing known metal ions.

He set the apparatus up as shown in the diagram.




**1 (a)** Give **one** error the student made in the way he set up his apparatus.
Explain the problem this error would have caused.

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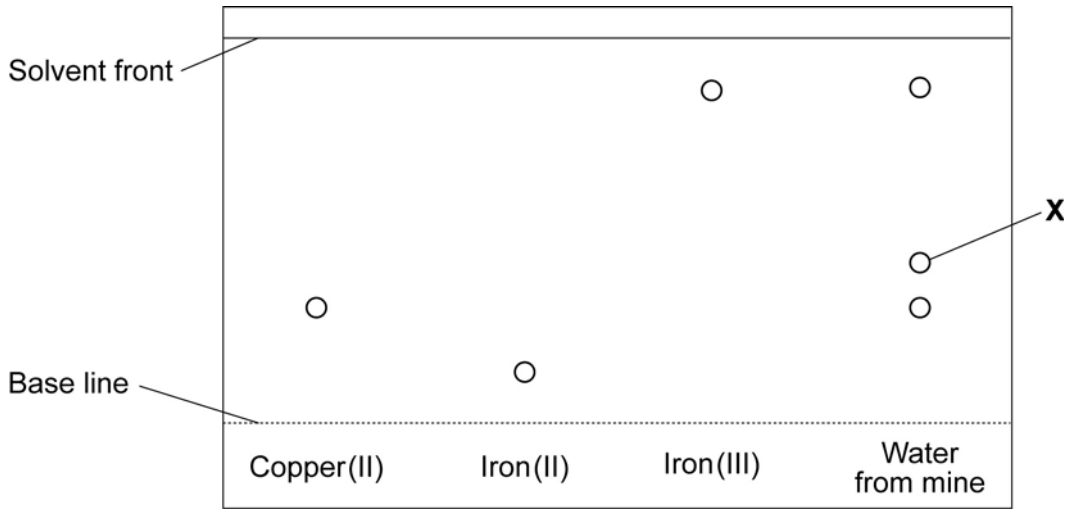
*(2 marks)*

**Question 1 continues on the next page**

**1 (b)** Another student repeated the experiment, but without making any errors.

After the water had soaked up the chromatography paper he sprayed it with a dilute solution of sodium hydroxide. Coloured spots appeared on the paper.

The results he obtained are shown in the diagram.




**1 (b) (i)** Identify **two** of the metal ions in the sample of water from the mine.

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*(1 mark)*

**1 (b) (ii)** State the colour of the spot formed from the iron(III) ions.

.....

*(1 mark)*

**1 (b) (iii)** Give the formula of the iron(III) compound responsible for the colour you stated in **(b)(ii)**.

.....

*(1 mark)*

**1 (c)** Spots obtained by chromatography can be compared by their $R_f$ values.

**1 (c) (i)** Use the diagram of the results to help you to complete the table.

Include the units.

| | |
|---|---|
| distance moved by spot **X** from base line | …….. |
| distance moved by solvent from base line | …….. |

*(2 marks)*

**1 (c) (ii)** Use the values you recorded in the table to calculate the $R_f$ value for spot **X**.

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.....

$R_f$ value = .....

*(1 mark)*

**Question 1 continues on the next page**

**1 (d)** Paper chromatography of a mixture using water as the solvent gave a spot with an $R_f$ value of 0.54.

The data in the table below was used to identify the substance that caused the spot.

| **Substance** | **$R_f$ value when the solvent is:** | | |
|---|---|---|---|
| | **Water** | **Ethanol** | **Propanone** |
| **A** | 0.72 | 0.54 | 0.00 |
| **B** | 0.53 | 0.62 | 0.84 |
| **C** | 0.04 | 0.16 | 0.54 |
| **D** | 0.55 | 0.45 | 0.31 |

**1 (d) (i)** Use the data in the table to suggest **two** possible identities for the substance that caused the spot with an $R_f$ of 0.54.

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*(1 mark)*

**1 (d) (ii)** Describe a further chromatography experiment that should be carried out to confirm which one of the substances you have identified in **(d)(i)** actually caused the spot. Explain why you chose this experiment.

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*(2 marks)*

**11**

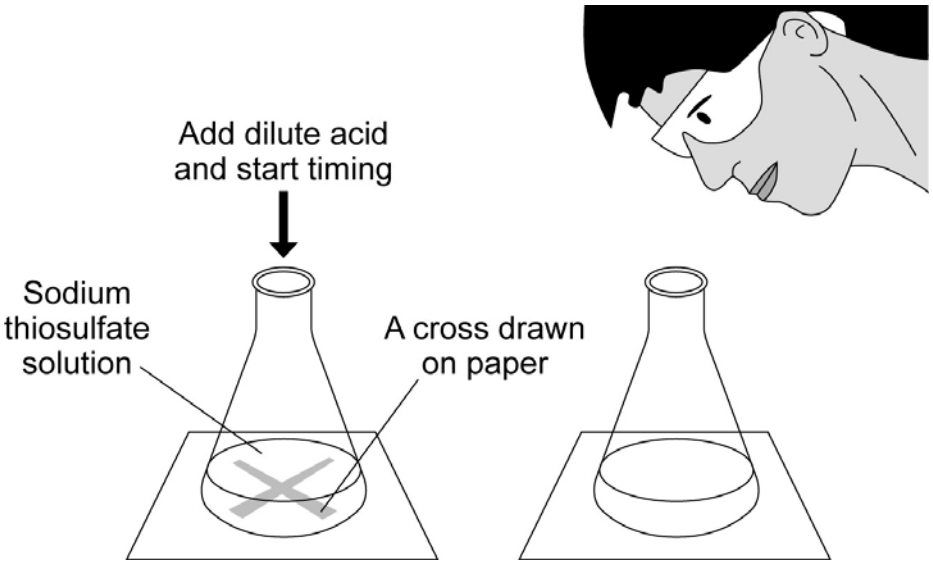
**2** Sodium thiosulfate solution reacts slowly with dilute hydrochloric acid.

$$Na_2S_2O_3 + 2HCl \longrightarrow 2NaCl + S + SO_2 + H_2O$$

During the reaction a solid is made. This makes the reaction mixture become cloudy. The speed of the reaction can be followed by timing how long it takes for the reaction mixture to become too cloudy to be able to see through.

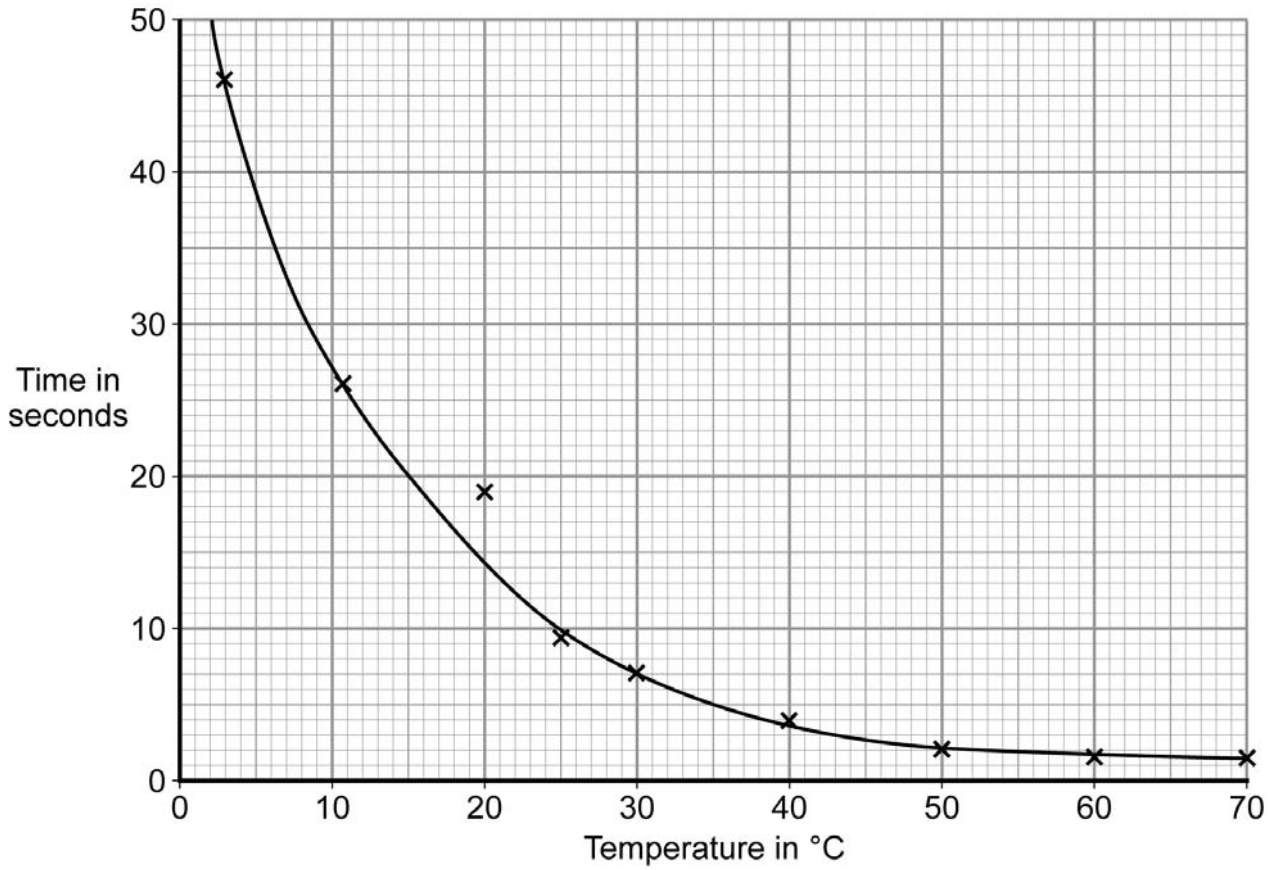
A student investigated how temperature affects the speed of the reaction.

- She used a measuring cylinder to measure out 10 $cm^3$ of sodium thiosulfate solution and 30 $cm^3$ of water. She mixed them together in a conical flask.
- She stood the conical flask on a cross drawn on a sheet of paper.
- She then added 5 $cm^3$ of dilute hydrochloric acid to the mixture and started her stopwatch.
- Once the mixture became so cloudy she could no longer see the cross, she recorded the time taken.
- She repeated the experiment at different temperatures by warming the reagents before she mixed them.




**Question 2 continues on the next page**

**2 (a)** The student's results are shown on the graph.




**2 (a) (i)** One of the points on the graph is anomalous. Draw a circle around this point.
Suggest what could have happened in the experiment that may have caused this anomalous result.

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*(2 marks)*

**2 (a) (ii)** What conclusions can you draw from the graph?

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*(2 marks)*

**2 (a) (iii)** Use the graph to estimate how long it would have taken for the mark on the paper to no longer be visible at 15 °C.

..... seconds

*(1 mark)*

**2 (a) (iv)** Use the equation

rate = 1 ÷ time taken

to calculate the rate of reaction at 15 °C.

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Rate of reaction = ..... $s^{-1}$

*(1 mark)*

**2 (a) (v)** For many reactions the rate of reaction doubles with every 10 °C increase in temperature.

Is this statement correct for this reaction? Justify your answer.

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*(2 marks)*

**Question 2 continues on the next page**

**2 (b)** The teacher suggested that the student's results were less accurate at 60 °C than at 40 °C.

**2 (b) (i)** Explain why the results may be less accurate at 60 °C.

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*(2 marks)*

**2 (b) (ii)** Suggest **one** change that the student could make to reduce error in this experiment.

Explain why this change would make the results more accurate.

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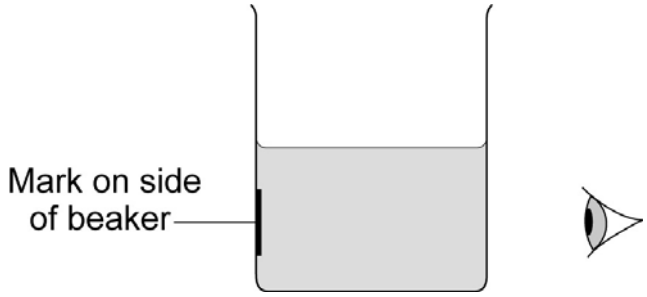
*(2 marks)*

**2 (c)** A second student did the experiment, but used apparatus that was slightly different.




Both students timed how long it would take for the mark to become invisible at 20°C. The results they obtained are given in the table.

| | **Time taken for mark to become invisible in s** |
|---|---|
| first student using conical flask | 18 |
| second student using beaker | 10 |

Both students then repeated the experiment using double the volume of all of the solutions.

**2 (c) (i)** The student using the conical flask found that the time taken for the mark to become invisible was much shorter when the volumes were doubled.

Explain why the mark became invisible in a shorter time.

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*(1 mark)*

**2 (c) (ii)** What would happen to the result obtained by the student using the beaker when the volumes were doubled?

Explain your answer.

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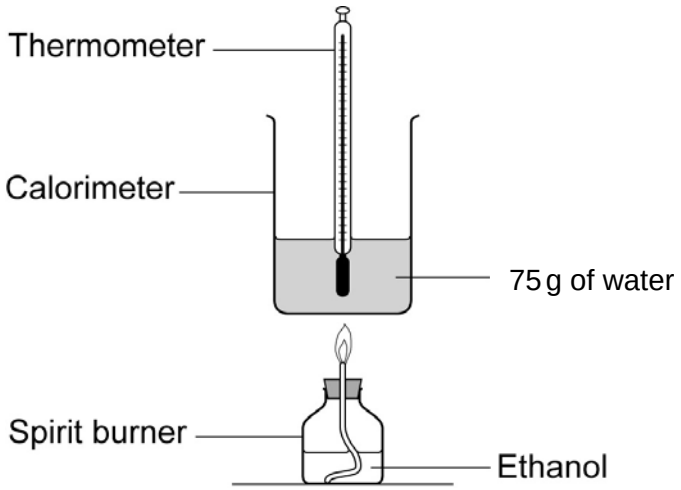
*(2 marks)*

**15**

**3** Ethanol is a liquid fuel which can be used as an alternative to gasoline.

**3 (a)** All fuels release energy when they are burned. A student did an experiment to find out how much heat energy is produced when ethanol is burned.

She used the apparatus shown in the diagram.




The student's results are shown in the table.

| Experiment number | Mass of ethanol used in g | Temperature change of water in °C | Energy used to heat water in kJ | Energy given out by 1.00 g of fuel in kJ |
|---|---|---|---|---|
| 1 | 0.78 | 52 | 16.4 | 21.0 |
| 2 | 0.64 | 43 | 13.5 | 21.1 |
| 3 | 0.68 | 45 | 14.2 | ..... |

**3 (a) (i)** Complete the table to show the energy given out by 1 g of ethanol in experiment number 3.

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*(1 mark)*

**3 (a) (ii)** What measurements must the student have made during the experiment to be able to record the temperature change of the water and the mass of ethanol used?

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*(2 marks)*

**3 (a) (iii)** The student used the same burner and calorimeter in each experiment.

Give **two** other variables that the student should have controlled.

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*(2 marks)*

**3 (a) (iv)** Explain why the student repeated the experiment three times?

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*(2 marks)*

**3 (a) (v)** The student looked in a data book and found that 1.00 g of ethanol should have given out 29.8 kJ.

Suggest **two** reasons why the results she obtained are much less than this.

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*(2 marks)*

**Question 3 continues on the next page**

**3 (b)** *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

Ethanol for fuel can be made by fermentation of plant materials. Ethanol that is produced by this process is a biofuel.

Evaluate the advantages and disadvantages of using ethanol made by fermentation as an alternative to gasoline. Remember to give a conclusion in your answer.

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*(6 marks)*

**15**

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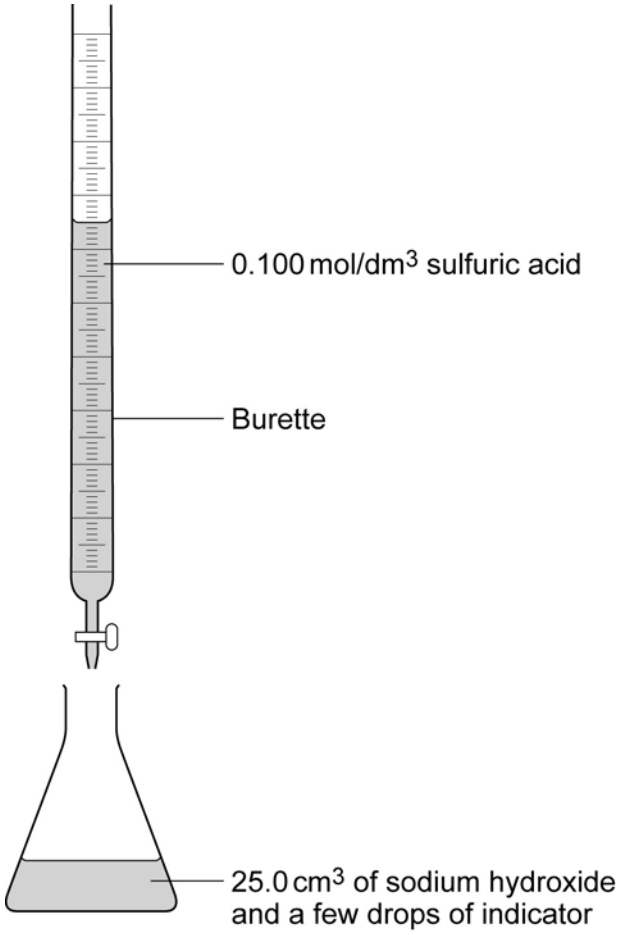
**4** Some students were titrating sodium hydroxide solution against 0.100 mol/dm$^3$ sulfuric acid using the apparatus shown in the diagram.



**4 (a) (i)** A student first carried out a trial titration to find the approximate volume of 0.100 mol/dm$^3$ sulfuric acid needed to neutralise 25.0 cm$^3$ of sodium hydroxide solution.

Describe how the student would use the same apparatus to obtain an accurate value for the volume required to neutralise the sodium hydroxide.

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*(6 marks)*

**4 (a) (ii)** Give **one** safety precaution the student should use when doing the titration.

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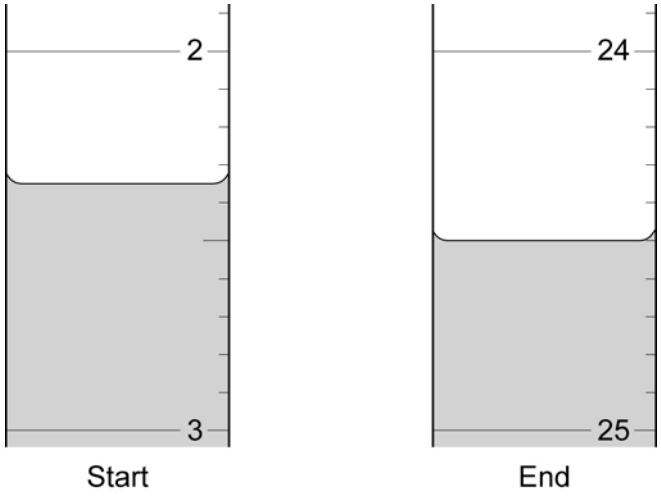
*(1 mark)*

**Question 4 continues on the next page**

**4 (b)** The diagrams show the level of the sulfuric acid in the burette at the start and the end of one titration.




Use the diagrams to work out the volume of sulfuric acid added in the titration.

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.....

..... $cm^3$

*(3 marks)*

**4 (c)** The table shows the colours of some indicators that could be used in the titration.

| Name of indicator | Colour in acid | Colour in alkali | Colour at end point |
|---|---|---|---|
| litmus | red | blue | purple |
| phenolphthalein | colourless | red | colourless |
| bromothymol blue | yellow | green | blue |

Litmus is **not** a good choice for this titration.

Suggest why.

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*(1 mark)*

**4 (d)** Another student obtained the following results.

| | | | | |
|---|---|---|---|---|
| end reading in $cm^3$ | 26.85 | 28.15 | 26.90 | 24.95 |
| start reading in $cm^3$ | 1.75 | 4.85 | 3.65 | 1.65 |
| volume added in $cm^3$ | 25.10 | 23.30 | 23.25 | 23.30 |

**4 (d) (i)** Which results should the student use to calculate the mean volume of acid added?

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*(1 mark)*

**4 (d) (ii)** Calculate the mean from the results. Give your answer to 2 decimal places.

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Mean = .....$cm^3$

*(2 marks)*

**Question 4 continues on the next page**

**4 (e)** One student found that 25.0 $cm^3$ of sodium hydroxide solution was neutralised by exactly 22.30 $cm^3$ of 0.100 $mol/dm^3$ sulfuric acid solution.

**4 (e) (i)** Calculate the number of moles of sulfuric acid that this student used in the titration.

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number of moles = .....

*(2 marks)*

**4 (e) (ii)** The equation for the reaction of sulfuric acid with sodium hydroxide solution is:

$$H_2SO_4(aq) + 2\,NaOH(aq) \longrightarrow Na_2SO_4(aq) + 2\,H_2O(l)$$

Use your answer to **(e)(i)** and the equation to calculate the number of moles of sodium hydroxide that must have been used.

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number of moles = .....

*(1 mark)*

**4 (e) (iii)** Calculate the concentration, in $mol/dm^3$, of the sodium hydroxide solution used.
Give your answer to 3 decimal places.

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Concentration = ..... $mol/dm^3$

*(2 marks)*

**19**

**5** Poly(propene) is a polymer made from propene. Propene is made by cracking long-chain saturated hydrocarbons from crude oil.

**5 (a) (i)** Use words from the box to complete the sentences.

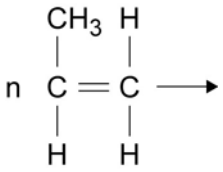
| | | | |
|---|---|---|---|
| **alkanes** | **alkenes** | **catalyst** | **fuel** |

Cracking involves heating the ..... to make a vapour.

The vapour is either passed over a hot ..... or mixed with steam and heated to a very high temperature.

*(2 marks)*

**5 (a) (ii)** Complete the equation to represent the formation of poly(propene) from propene.




*(3 marks)*

**Question 5 continues on the next page**

**5 (b)** Propene and poly(propene) behave in different ways when shaken with bromine water.

**5 (b) (i)** What colour is bromine water?

Draw a ring around the correct answer.

**green** **orange** **purple**

*(1 mark)*

**5 (b) (ii)** Complete the table to show the colour changes that are seen when bromine water is shaken with propene and poly(propene).

| | **Colour when shaken with bromine water** |
|---|---|
| Propene | |
| Poly(propene) | |

*(2 marks)*

**5 (c) (i)** Why can disposal of waste poly(propene) result in problems?

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*(1 mark)*

**5 (c) (ii)** Poly(propene) has a low melting point. This means that waste poly(propene) can be melted down and moulded into new products.
Explain why poly(propene) has a low melting point.

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*(3 marks)*

**5 (d) (i)** Some polymers are described as being **thermosetting**.

How are the polymer chains held together in thermosetting polymers?

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*(1 mark)*

**5 (d) (ii)** Describe a simple experiment you could use to see if a polymer is a thermosetting polymer. State the result you would expect to obtain if the polymer was thermosetting.

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*(3 marks)*

**16**

**Turn over for the next question**

**6 (a)** Sodium hydrogencarbonate decomposes when heated strongly. One of the products is carbon dioxide gas.

Complete the sentence about the test for carbon dioxide.

Carbon dioxide gas turns limewater ..... . .

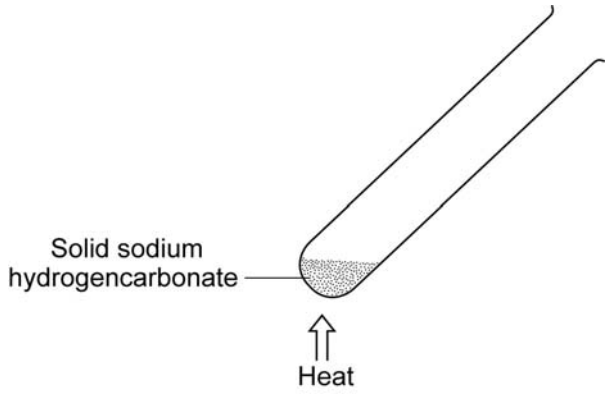
*(1 mark)*

**6 (b)** A student heated 0.672 g of sodium hydrogencarbonate and collected the carbon dioxide produced. She measured the volume of carbon dioxide she had collected every minute until the sodium hydrogencarbonate had all decomposed.
The student's results are shown in **Table 1**.

**Table 1**

| Time in minutes | Volume of carbon dioxide collected in $cm^3$ |
|---|---|
| 0 | 0 |
| 1 | 46 |
| 2 | 70 |
| 3 | 85 |
| 4 | 94 |
| 5 | 96 |
| 6 | 96 |
| 7 | 96 |

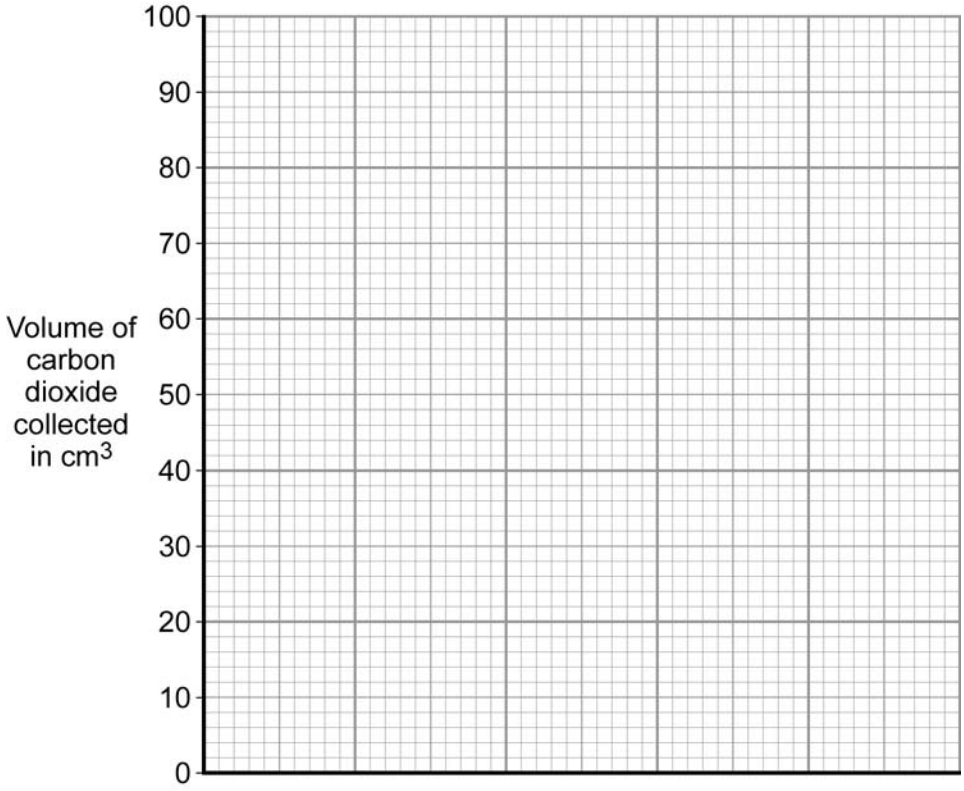
**6 (b) (i)** Complete the diagram to show how the student could collect the gas produced and measure its volume.




*(2 marks)*

**6 (b) (ii)** Plot a graph of the student's results on the grid below.

Label the *x* axis and draw a line of best fit.




*(4 marks)*

**6 (b) (iii)** How does the graph show that the sodium hydrogencarbonate had fully decomposed?

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.....

*(1 mark)*

**Question 6 continues on the next page**

**6 (c)** The student did the experiment twice more, starting with the same mass of sodium hydrogencarbonate as in the first experiment.

Her results are shown in **Table 2**.

**Table 2**

| Time in minutes | Volume of carbon dioxide collected in $cm^3$ | |
|---|---|---|
| | First repeat | Second repeat |
| 0 | 0 | 0 |
| 1 | 45 | 20 |
| 2 | 70 | 43 |
| 3 | 84 | 60 |
| 4 | 95 | 74 |
| 5 | 96 | 85 |
| 6 | 96 | 92 |
| 7 | 96 | 96 |

The gas volumes the student measured in the second repeat do not agree with either of the first two sets of data. The student suggested that this could be because there was a gas leak from the apparatus.

**6 (c) (i)** Explain how the results show that this suggestion must be wrong.

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*(1 mark)*

**6 (c) (ii)** Suggest what the student did differently that might have caused the difference in results.

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*(1 mark)*

**6 (d)** The equation for the decomposition of sodium hydrogencarbonate is:

$$2\ NaHCO_3 \longrightarrow Na_2CO_3 + CO_2 + H_2O$$

**6 (d) (i)** Calculate the mass of sodium carbonate, $Na_2CO_3$, that would be produced if 0.672 g of sodium hydrogencarbonate was fully decomposed.

Relative formula mass ($M_r$): Na $HCO_3$ = 84
Relative formula mass ($M_r$): $Na_2$ $CO_3$ = 106

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Mass = ..... g

*(2 marks)*

**6 (d) (ii)** A student heated 0.672 g of sodium hydrogencarbonate for five minutes. Instead of measuring the volume of carbon dioxide given off, she measured the mass of solid remaining in the test tube. The mass obtained was more than that calculated in **(d)(i)**.

Suggest a reason for the difference in mass, and suggest what the student should do to validate this reason.

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*(2 marks)*

**14**

**END OF QUESTIONS**

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