OXFORD
INTERNATIONAL
AQA EXAMINATIONS

INTERNATIONAL GCSE
CHEMISTRY

9202/2 PAPER 2

Specimen material 1 hour 30 minutes

Materials
For this paper you must have:
- a ruler with millimetre measurements
- a calculator
- the periodic table (enclosed).

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the bottom of this page.
- Answer **all** questions.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 90.

Please write clearly, in block capitals, to allow character computer recognition.

Centre number ☐☐☐☐☐ Candidate number ☐☐☐☐

Surname ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

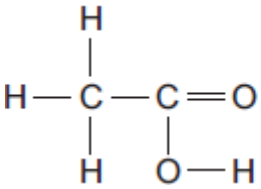
Forename(s) ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Candidate signature _____

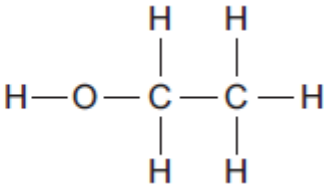
Answer **all** questions in the spaces provided.

1 This question is about two compounds, **A** and **B**.

Compound A



Compound B

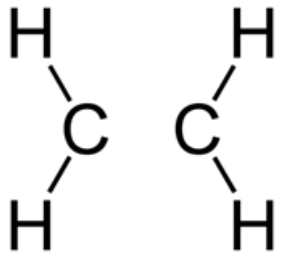


0 1 . 1 Compound **B** is an alcohol and can be made by reacting ethene with steam using a catalyst

$$C_2H_4 + H_2O \rightarrow C_2H_5OH$$

Complete the diagram below for the structure of ethene

[1 mark]



0 1 . 2 Describe how molecules of ethene form poly(ethene).

[3 marks]

0 1 . 3 Complete the sentence below using the correct answer from the box.

[1 mark]

burned	**decomposed**	**oxidised**	**reduced**

To form compound **A**, compound **B** is _____ .

0 1 . 4 Name compound **B**.

[1 mark]

_____

0 1 . 5 Compounds **A** and **B** are both colourless liquids.

A test tube contains a colourless liquid, which could be either compound **A** or compound **B**.

Describe a simple **chemical** test to show which compound, **A** or **B**, is in the test tube.

[2 marks]

_____

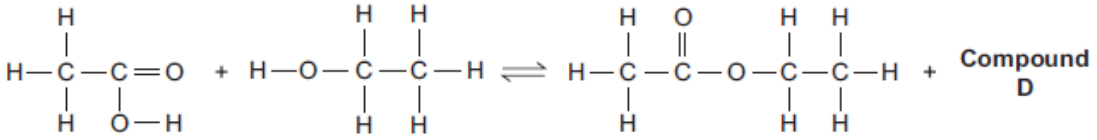
_____

_____

_____

Compounds **A** and **B** react to produce compound **C** and compound **D**.

Compound A **Compound B** **Compound C**



0 1 . 6 What is the formula of compound **D**?

[1 mark]

_____

0 1 . 7 Compound **C** is an ester.

Name compound **C**.

[1 mark]

_____

0 1 . 8 State **one** use of esters.

[1 mark]

_____

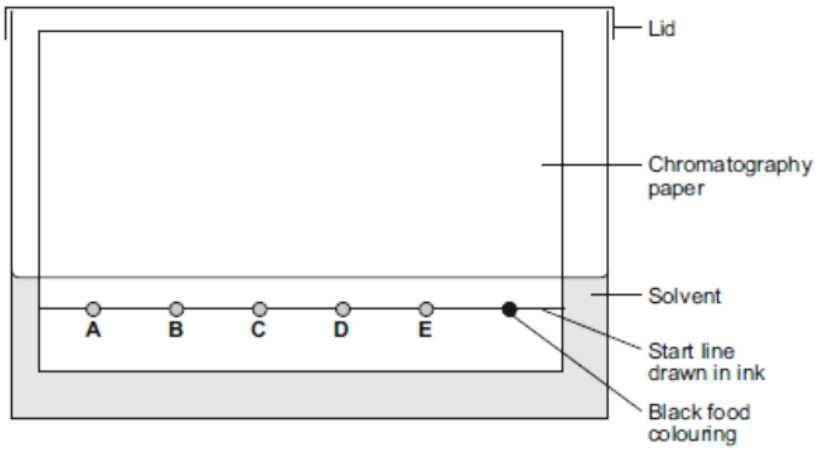
2 Chromatography can be used to separate components of a mixture.

A student used paper chromatography to analyse a black food colouring.

The student placed spots of known food colours, **A**, **B**, **C**, **D** and **E**, and the black food colouring on a sheet of chromatography paper.

The student set up the apparatus as shown in **Figure 1**.

Figure 1



The student made **two** errors in setting up the apparatus.

0 2 . 1 Identify the **two** errors and describe the problem each error would cause.

[4 marks]

Error

Problem

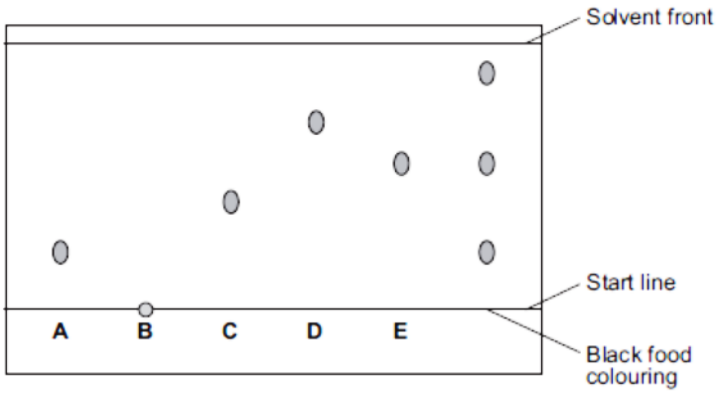
Error

Problem

A different student set up the apparatus without making any errors.

The chromatogram in **Figure 2** shows the student's results.

Figure 2



0 2 . 2 What do the results tell you about the composition of the black food colouring?

[2 marks]

0 2 . 3 Take measurements from **Figure 2** to complete **Table 1**.

[2 marks]

Table 1

	Distance in mm
Distance from start line to solvent front	.....
Distance moved by food colour **C**	.....

0 2 . 4 Use your answers in part **02.3** to calculate the Rf value for food colour **C**.

[1 mark]

Rf value = _____

Table 2 gives the results of chromatography experiments that were carried out on some known food colours, using the same solvent as the students.

Table 2

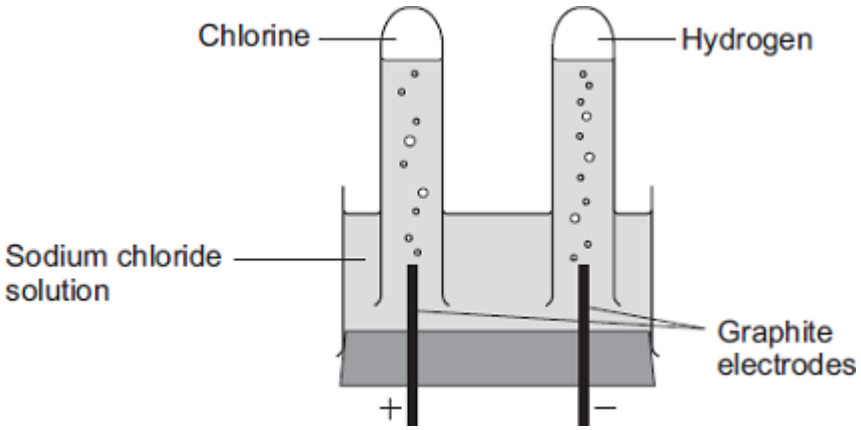
Name of food colour	Distance from start line to solvent front in mm	Distance moved by food colour in mm	R_f value
Ponceau 4R	62	59	0.95
Carmoisine	74	45	0.61
Fast red	67	27	0.40
Erythrosine	58	17	0.29

0 2 . 5 Which of the food colours in **Table 2** could be food colour **C** from the chromatogram?

[1 mark]

3 The electrolysis of sodium chloride solution is an industrial process.

The diagram shows the apparatus used in a school experiment.



0 3 . 1 State why chloride ions move to the positive electrode.

[1 mark]

0 3 . 2 Describe how a chloride ion changes into a chlorine atom?

[1 mark]

Sodium chloride solution contains two types of positive ions, sodium ions (Na^+) and hydrogen ions (H^+).

0 3 . 3 Tick the reason why hydrogen is produced at the negative electrode and **not** sodium.

[1 mark]

Reason	Tick
Hydrogen is a gas.	
Hydrogen is less reactive than sodium.	
Hydrogen is a non-metal.	
Hydrogen ions travel faster than sodium ions.	

0 3 . 4 Balance the half equation for the reaction at the negative electrode.

[1 mark]

_____ H^+ + _____ e^- → H_2

The electrolysis of sodium chloride solution also produces chlorine and sodium hydroxide.

In industry, the electrolysis of sodium chloride solution can be done in several types of electrolysis cell.

Some information about two different types of electrolysis cell is given below.

	Mercury cell	**Membrane cell**
Cost of construction	Expensive.	Relatively cheap.
Additional substances used	Mercury, which is recycled. Mercury is toxic so any traces of mercury must be removed from the waste.	Membrane, which is made of a polymer. The membrane must be replaced every 3 years.
Amount of electricity used for each tonne of chlorine produced in kWh	3400	2950
Quality of chlorine produced	Pure.	Needs to be liquefied and distilled to make it pure.
Quality of sodium hydroxide solution produced	50% concentration. Steam is used to concentrate the sodium hydroxide solution produced.	30% concentration. Steam is used to concentrate the sodium hydroxide solution produced.

0 3 . 5 Compare the environmental and economic advantages and disadvantages of these **two** types of electrolysis cell.

Use the information above and your knowledge and understanding.

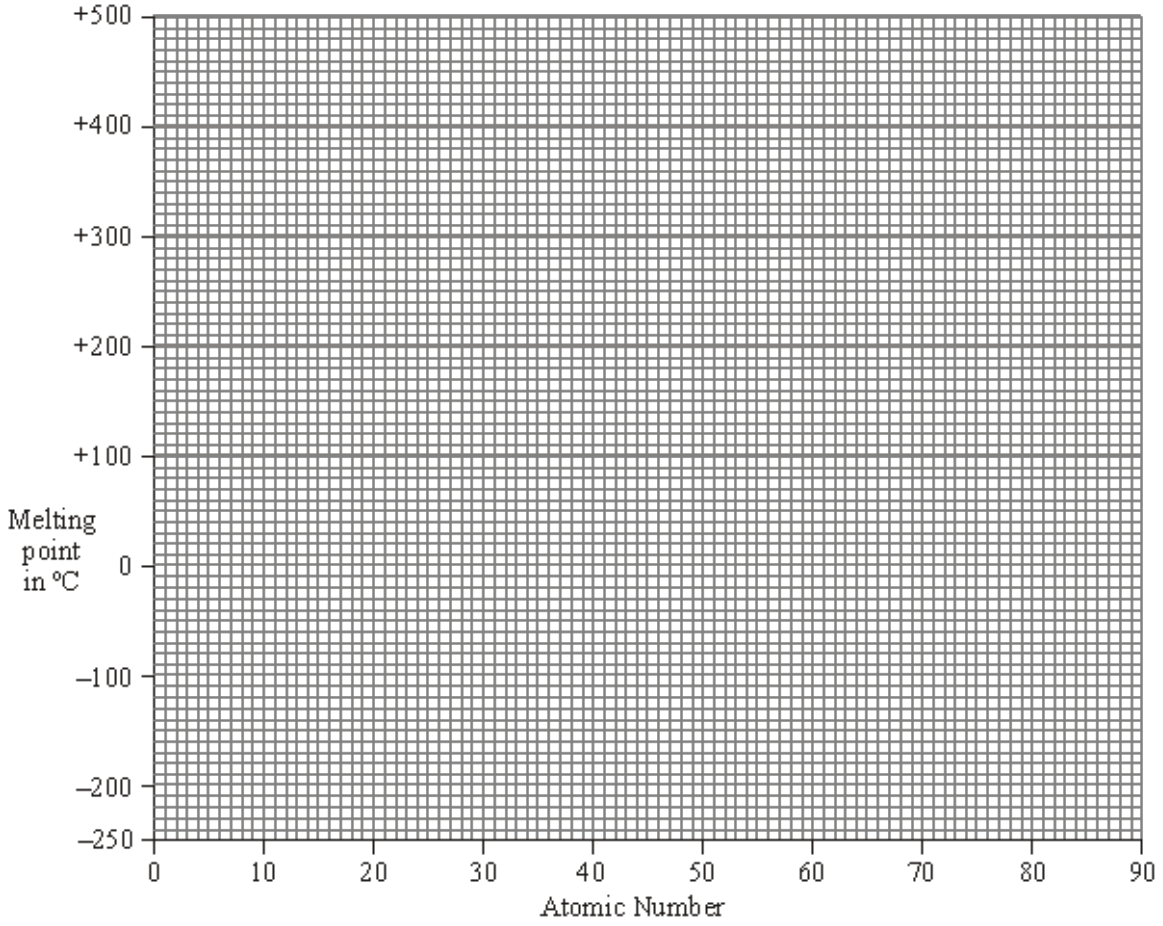
[6 marks]

4 The table gives the melting points of some of the elements of Group 7.

Element	Atomic number	Melting point in ºC
Fluorine	9	–220
Chlorine	17	–101
Bromine	35	–7
Iodine	53	114
Astatine	85	?

0 4 . 1 Plot a graph of the melting point against atomic number and draw a line of best fit.

[2 marks]



0 4 . 2 Extend your line to estimate a value for the melting point of astatine.

Estimate the melting point of astatine.

[2 marks]

_____ °C

0 4 . 3 Which of the Group 7 elements are solids at 20 °C?

[1 mark]

_____

A student investigated the reactivity of the Group 7 elements

The student added:

- aqueous chlorine to potassium bromide and potassium iodide solutions
- aqueous bromine to potassium chloride and potassium iodide solutions
- aqueous iodine to potassium chloride and potassium bromide solutions.

The student's results are shown below.

Solution	Potassium chloride	Potassium bromide	Potassium iodide
Chlorine		Solution turned orange-brown	Solution turned brown
Bromine	No reaction		Solution turned brown
Iodine	No reaction	No reaction	

0 4 . 4 Explain how these results show the trend in reactivity of these Group 7 elements.

[2 marks]

0 4 . 5 Complete the equation below, which represents the reaction between chlorine and potassium bromide.

[1 mark]

Cl_2 + 2 KBr → _____ + 2 KCl

5 A student has a colourless solution.

The student thinks the solution is dilute hydrochloric acid.

The student adds universal indicator to this solution.

0 5 . 1 What colour would the universal indicator change to if the solution is hydrochloric acid?

[1 mark]

_____

0 5 . 2 Describe how the student could show that there are chloride ions in this solution.

[2 marks]

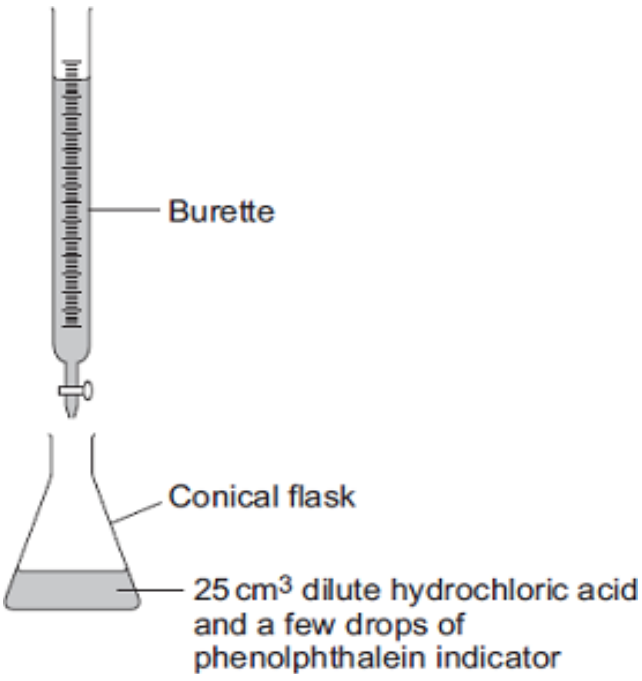
_____

_____

_____

_____

The results of a titration can be used to find the concentration of an acid.



0 5 . 3 Describe how to use the apparatus to do a titration using 25 cm^3 of dilute hydrochloric acid.

In your answer you should include:

- how you will determine the end point of the titration
- how you will make sure the result obtained is accurate.

[4 marks]

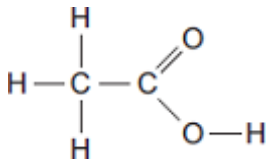
0 5 . 4 Hydrochloric acid is a strong acid.

Ethanoic acid is a *weak acid.*

What is meant by the term *weak acid*?

[1 mark]

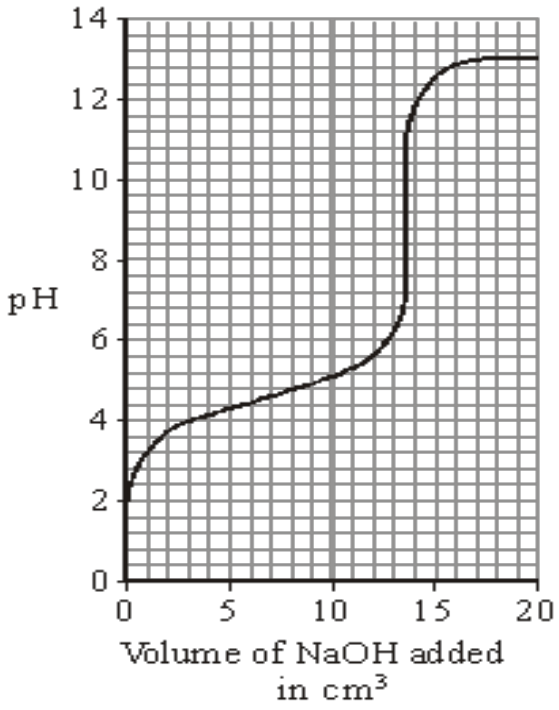
The displayed formula of ethanoic acid is:



0 5 . 5 On the formula, draw a circle around the functional group in ethanoic acid.

[1 mark]

The graph shows how the pH of the solution changes during a titration between a weak acid and sodium hydroxide.



0 5 . 6 A student has two indicators:

Phenolphthalein changes colour between pH 8.2 and pH 10.0.

Methyl orange changes colour between pH 3.2 and pH 4.4.

Suggest why she chose phenolphthalein to use in this titration.

[1 mark]

_____

_____

_____

6 This question is about lithium and aluminium.

0 6 . 1 The reaction of lithium with water generates a gas.

Describe the test you would use to positively identify this gas and the observation you would expect.

[2 marks]

Test

_____

_____

Observation

_____

_____

0 6 . 2 Aluminium is made by the electrolysis of aluminium oxide.

The equation for the reaction is shown below.

$$2\ Al_2O_3 \rightarrow 4\ Al + 3\ O_2$$

Calculate the mass of aluminium that can be obtained from 5100g of Al_2O_3

[3 marks]

_____

_____

_____

Mass of Al = _____ g

0 6 . 3 Most current rechargeable batteries use metallic lithium. A new type of battery based on metallic aluminium has been developed. Some facts about lithium and aluminium are shown below:

	Lithium	**Aluminium**
Melting Point / °C	180	660
Density g/cm^3	0.53	2.70
Storage	Stored under oil	In air – forms a protective oxide layer
Abundance in the Earth's crust in ppm	20	82,000
Mass mined tonne/yr	37,000	44,900,000
Reactivity	Ignites easily in air	Requires high temperatures before ignites
Charge/Recharge cycles at 100 efficiency	1000	200
Metal Cost $/Ib	300	0.87

Evaluate the replacement of lithium with aluminium in rechargeable batteries.

Use the data above.

[6 marks]

7 A student is investigating the electroplating of metal objects.

She wants to test the hypothesis:

'The mass of metal deposited depends on the time the current is flowing.'

This is the method the student used:

1. Take a metal object and measure its mass
2. Connect the object to a negative pole of a battery
3. Dip in a solution of copper sulfate
4. Let the electricity flow for 1 minute
5. Remove the metal object from the solution and measure its mass
6. Put the electrode back in the copper sulphate solution. Reconnect the metal object to the battery and let the electricity flow for a further minute
7. Repeat steps 5 and 6 for a further 5 times

0 7 . 1 The student has made no notes about which variable she would need to control.

Give **two** variables that the student should control to make this a fair test.

[2 marks]

1 _____

2 _____

The student collected the following results

Time, in minutes	Increase in mass of object, in grams
1	2.4
2	3.4
3	4.2
4	4.7
5	4.9
6	4.9
7	4.9

0 7 . 2 Draw a sketch graph of the student's results on the axes below.

[2 marks]

0 7 . 3 Describe the trend in the student's results.

Do the results support the student's hypothesis that 'The mass of metal deposited depends on the time the current is flowing'?

Explain your answer.

[4 marks]

0 7 . 4 Describe **two** ways the student's method could be improved to make the results more accurate.

[2 marks]

0 7 . 5 When doing a similar investigation another student noticed the reading on the balance was 0.11 g when nothing was on it.

Describe **two** ways the student could overcome this error.

[2 marks]

8 Magnesium reacts with dilute sulfuric acid in a reaction that makes hydrogen gas.

magnesium + sulfuric acid → magnesium sulfate + hydrogen

Mg + 1 → 2 + 3

0 8 . 1 Which row in the table gives the correct formulae for the missing substances in the equation above?

Tick **one** box.

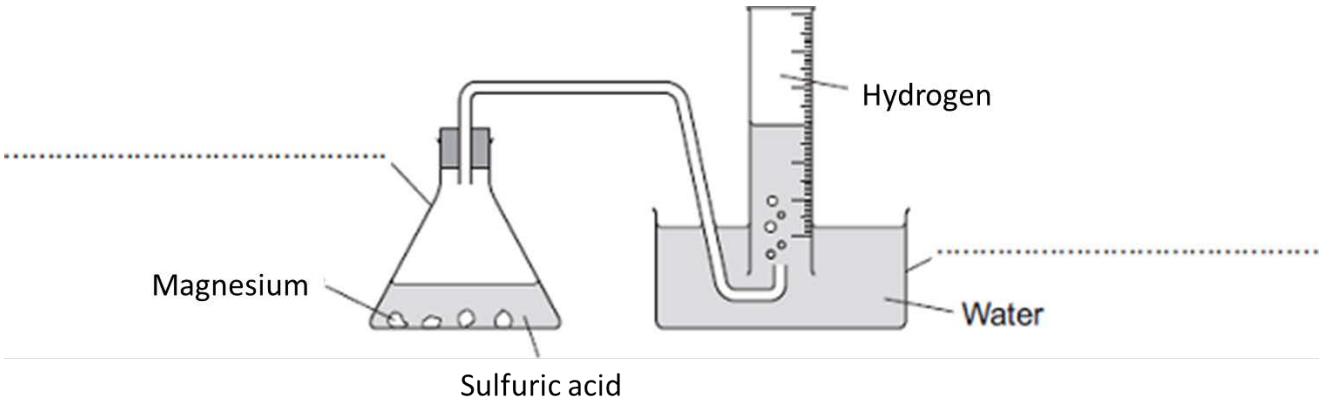
[1 mark]

1	2	3	Tick
H_2SO_3	$MgSO_3$	H_2	
H_2SO_4	$MgSO_4$	2H	
HSO_4	$MgSO_4$	H	
H_2SO_4	$MgSO_4$	H_2	

A student wanted to investigate the rate of this reaction.

He added an unknown mass of magnesium to an excess of sulfuric acid.

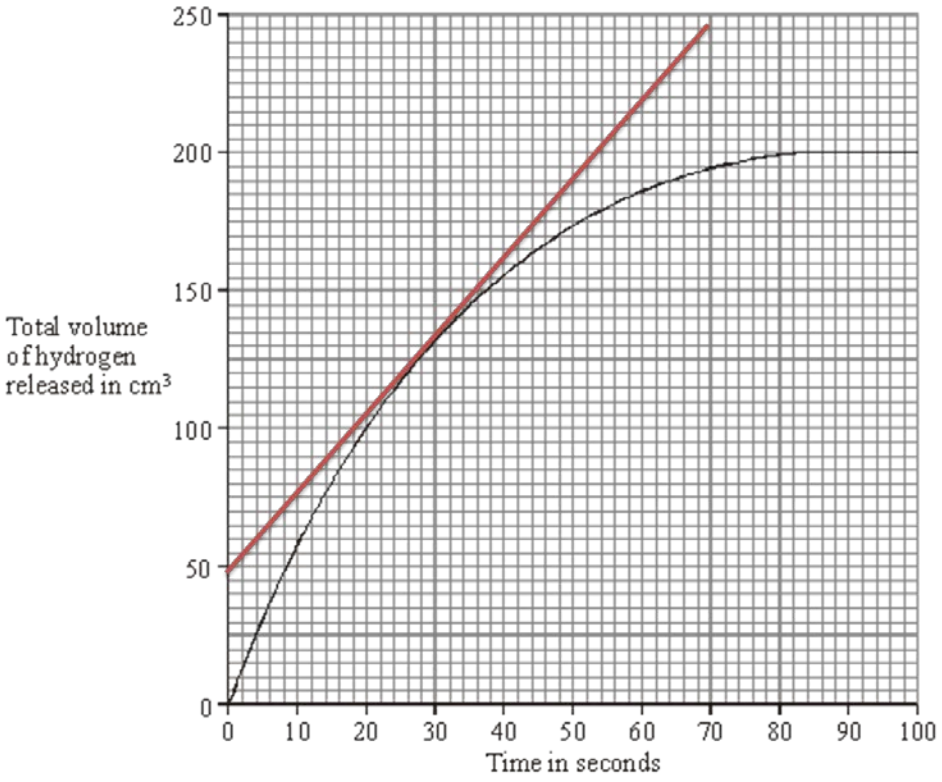
He measured the volume of hydrogen given off every 10 seconds using the apparatus shown below:



0 8 . 2 Complete the **two** labels for the apparatus on the diagram.

[2 marks]

The student's results are shown on the graph.



0 8 . 3 The rate of reaction can be calculated from the gradient of the tangent to the line of best fit through the data.

Calculate from the tangent shown on the graph the rate of reaction at 30 seconds.

Give your answer to 2 significant figures.

[3 marks]

Rate = _____ cm^3 per second

0 8 . 4 Give the rate of reaction at 90 seconds.

[1 mark]

Rate = _____ cm^3 per second

0 8 . 5 Calculate the number of moles of hydrogen produced by the reaction at completion.

1 mole of a gas occupies 24,000cm^3

[2 marks]

Moles of hydrogen = _____

0 8 . 6 The number of moles of hydrogen produced is equal to the number of moles of magnesium used.

Calculate the mass of magnesium used in the reaction.

Give your answer to 2 significant figures.

[3 marks]

Mass = _____ g

9 The table shows some properties of gases in dry air.

Gas in dry air	Density in kg/m^3	Melting point in °C	Boiling point in °C	Percentage (%) in air
Nitrogen	1.2506	–210	–196	78.08
Oxygen	1.4290	–219	–183	20.95
Carbon dioxide	1.977	–57	–57	0.033
Helium	0.1785	–272	–269	0.00052
Neon	0.8999	–249	–246	0.0019
Argon	1.7837	–189	–186	0.934
Krypton	3.74	–157	–153	0.00011
Xenon	5.86	–112	–108	0.0000087

In 1895, Lord Rayleigh isolated nitrogen from dry air by removing the other known gases, oxygen and carbon dioxide.

He then discovered that nitrogen from dry air had a different density to pure nitrogen produced from chemical reactions.

He concluded that nitrogen extracted from dry air was mixed with another gas.

0 9 . 1 The density of nitrogen extracted from dry air was higher than the density of pure nitrogen.

Explain why.

Use the information above.

[2 marks]

Gases from the air are separated to provide raw materials used in many different industrial processes.

Steps in dry air separation:

Step 1: Filter to remove solid particles

Step 2: Remove carbon dioxide

Step 3: Cool the remaining air to –200 °C

Step 4: Separate by allowing the liquefied gases to warm up.

0 9 . 2 Carbon dioxide is removed before the air is cooled to –200 °C.

Suggest **one** reason why.

[1 mark]

_____

_____

0 9 . 3 Which two gases do **not** condense when the remaining air is cooled to –200 °C?

[1 mark]

_____ and _____

0 9 . 4 Two gases in air do **not** separate completely when the liquefied gases are allowed to warm up.

Name the two gases.

Give a reason for your answer.

[2 marks]

_____

_____

_____

_____

END OF QUESTIONS

There are no questions printed on this page