

**OXFORD CAMBRIDGE AND RSA EXAMINATIONS**  
**GCSE**

**B742/02**

**GATEWAY SCIENCE**  
**CHEMISTRY B**

**Chemistry modules C4, C5, C6**  
**(Higher Tier)**

**MONDAY 20 JUNE 2016: Morning**

**DURATION: 1 hour 30 minutes**  
**plus your additional time allowance**

**MODIFIED ENLARGED**

<b>Candidate forename</b>		<b>Candidate surname</b>	
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<b>Centre number</b>						<b>Candidate number</b>				
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**Candidates answer on the Question Paper.**  
**A calculator may be used for this paper.**

**OCR SUPPLIED MATERIALS:**  
**A copy of the Periodic Table**

**OTHER MATERIALS REQUIRED:**  
**Pencil**  
**Ruler (cm/mm)**

**READ INSTRUCTIONS OVERLEAF**



## **INSTRUCTIONS TO CANDIDATES**

**Write your name, centre number and candidate number in the boxes on the first page. Please write clearly and in capital letters.**

**Use black ink. HB pencil may be used for graphs and diagrams only.**

**Answer ALL the questions.**

**Read each question carefully. Make sure you know what you have to do before starting your answer.**

**Write your answer to each question in the space provided. If additional space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.**

## **INFORMATION FOR CANDIDATES**

**The quality of written communication is assessed in questions marked with a pencil ().**

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

**The total number of marks for this paper is 85.**

**Any blank pages are indicated.**

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**Answer ALL the questions.**

**SECTION A – Module C4**

- 1 Look at the table. It shows some information about four atoms.**

<b>Atom</b>	<b>Atomic number</b>	<b>Mass number</b>	<b>Number of protons</b>	<b>Number of neutrons</b>	<b>Number of electrons</b>	<b>Electronic structure</b>
<b>W</b>	<b>17</b>	<b>37</b>	<b>17</b>	<b>20</b>	<b>17</b>	<b>2.8.7</b>
<b>X</b>	<b>17</b>	<b>35</b>	<b>17</b>	<b>18</b>	<b>17</b>	<b>2.8.7</b>
<b>Y</b>	<b>3</b>	<b>7</b>			<b>3</b>	<b>2.1</b>
<b>Z</b>	<b>6</b>		<b>6</b>	<b>6</b>	<b>6</b>	

**(a) Complete the table. [3]**

**(b) Atom W and atom X are both chlorine atoms.**

**What is the name given to chlorine atoms such as W and X?**

\_\_\_\_\_

**Explain your answer.**

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ [2]

**[TOTAL: 5]**

**2 At very low temperatures some metals can be SUPERCONDUCTORS.**

**This means that they can conduct electricity with little or no resistance.**

**(a) Write about TWO potential benefits of superconductors.**

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[2]

**(b) Explain ONE drawback of using superconductors.**

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[1]

**[TOTAL: 3]**

### 3 Look at the table.

It shows information about the Group 7 elements.

ELEMENT	APPEARANCE	MELTING POINT IN °C	BOILING POINT IN °C	ORDER OF REACTIVITY
fluorine	yellow gas	-220		<div> <div>most reactive</div> <div> <div></div> <div></div> </div> <div>least reactive</div> </div>
chlorine	green gas	-101	-34	
bromine	red/brown liquid	-7	59	
iodine		114	184	
astatine	black solid		337	

**(a) Complete the table. Use ideas about trends down a group. [3]**

**(b) Fluorine is more reactive than astatine.**

**Explain the trend in the reactivity of the Group 7 elements.**

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**[2]**

**[TOTAL: 5]**

- 4 Jed is testing iron(III) chloride and some unknown compounds.

He does some tests.

These are the tests that Jed does on solutions of the compounds:

adding sodium hydroxide solution

adding silver nitrate solution.

Look at his results.

COMPOUND	ADDING SODIUM HYDROXIDE SOLUTION	ADDING SILVER NITRATE SOLUTION
iron(III) chloride	brown solid made	white solid made
A	blue solid made	white solid made
B	green solid made	cream solid made

Iron(III) chloride,  $\text{FeCl}_3$ , reacts with silver nitrate,  $\text{AgNO}_3$ , to make silver chloride,  $\text{AgCl}$ , and iron(III) nitrate,  $\text{Fe}(\text{NO}_3)_3$ .

Write a **BALANCED SYMBOL** equation for this reaction.

Identify the unknown compounds A and B and explain your answers.





\_\_\_\_\_ [6]

9

- 5 Fluorine reacts with chlorine to make a compound called chlorine fluoride,  $\text{ClF}$ .**

**$\text{ClF}$  is a COVALENT compound.**

**The electronic structure of chlorine is 2.8.7.**

**The electronic structure of fluorine is 2.7.**

- (a) Draw a 'dot and cross' diagram to show the covalent bonding in chlorine fluoride.**

**[2]**

**(b) Chlorine fluoride has a SIMPLE MOLECULAR structure.**

**Predict TWO physical properties of chlorine fluoride.**

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[2]

**(c) Chlorine and fluorine are in Group 7 of the Periodic Table.**

**One scientist who helped to develop the Periodic Table was called Mendeleev.**

**Write about how Mendeleev helped in the development of the Periodic Table.**

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[2]

**[TOTAL: 6]**

## **SECTION B – Module C5**

**6 Kate and Steve are testing some water samples.**

**They use lead nitrate solution and barium chloride solution.**

**They add each solution to different samples of water.**

**Look at the table. It shows their results.**

<b>WATER SAMPLE</b>	<b>EFFECT OF ADDING LEAD NITRATE SOLUTION</b>	<b>EFFECT OF ADDING BARIUM CHLORIDE SOLUTION</b>
<b>A</b>	<b>white precipitate</b>	<b>no reaction</b>
<b>B</b>	<b>yellow precipitate</b>	<b>white precipitate</b>
<b>C</b>	<b>no reaction</b>	<b>white precipitate</b>

**Which negative ions are in each water sample?**

**Explain your answers.**

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**[3]**

**[TOTAL: 3]**

**7 Hydrochloric acid is a STRONG acid.**

**Ethanoic acid is a WEAK acid.**

**Both acids can either be concentrated or dilute.**

**(a) Explain the difference between acid STRENGTH and acid CONCENTRATION.**

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**[2]**

**(b) Nick and Lesley add 25 cm<sup>3</sup> of hydrochloric acid to 1 g of calcium carbonate.**

**They also add 25 cm<sup>3</sup> of ethanoic acid to 1 g of calcium carbonate.**

**Both acids have the SAME CONCENTRATION.**

**Carbon dioxide is made in both reactions.**

**(i) The hydrochloric acid reacts faster with calcium carbonate than the ethanoic acid.**

**Use ideas about particles to explain why.**

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**[1]**

**(ii) Both acids make the SAME VOLUME of carbon dioxide.**

**Explain why.**

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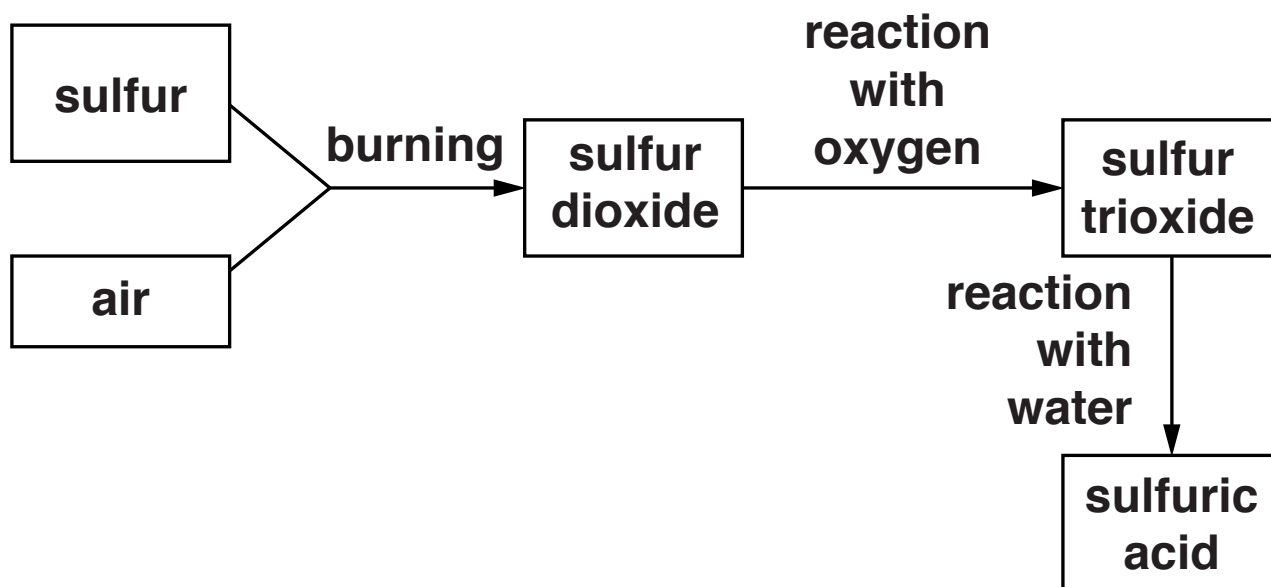
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[1]

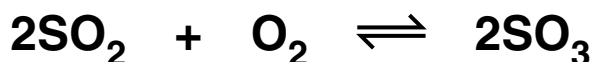
**[TOTAL: 4]**

**8 This question is about the Contact Process used for the manufacture of sulfuric acid.**

**Look at the flow chart for the process.**



**In the process, sulfur dioxide reacts with oxygen to make sulfur trioxide.**



**The forward reaction is EXOTHERMIC.**

**Two of the conditions used are:**

**a temperature of 450 °C**

**a low pressure of 3 atmospheres.**

**(a) Write down ONE OTHER condition used in the process.**

\_\_\_\_\_ [1]



**(b) Explain the choice of conditions used in the process.**

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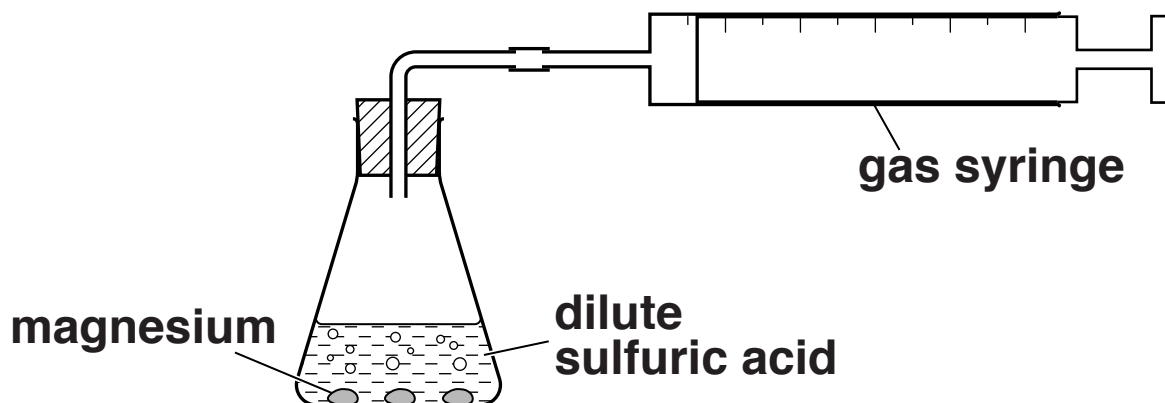
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**[3]**

**[TOTAL: 4]**

- 9 Hayley and Andy investigate the reaction between magnesium and sulfuric acid.

Look at the diagram. It shows the apparatus they use.



They add 0.1 g of magnesium to 50 cm<sup>3</sup> of sulfuric acid.

They measure the total volume of gas in the syringe every 10 seconds.

All the magnesium is used up at the end of the reaction.

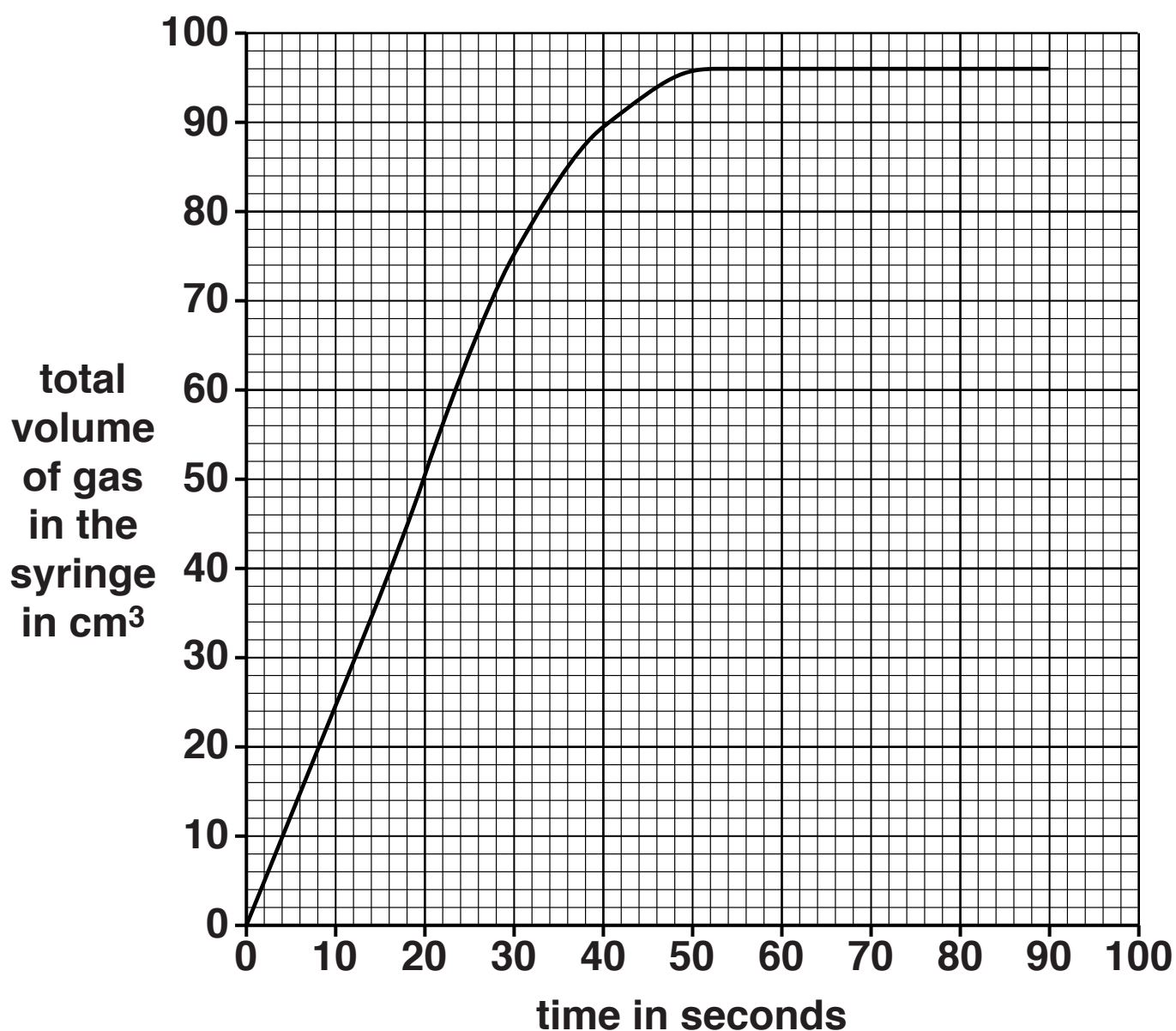
Look at the graph of their results opposite.

- (a) (i) What is the total volume of gas in the syringe after 30 seconds?

answer \_\_\_\_\_ cm<sup>3</sup> [1]

- (ii) How long does it take for the reaction to stop?

answer \_\_\_\_\_ seconds [1]



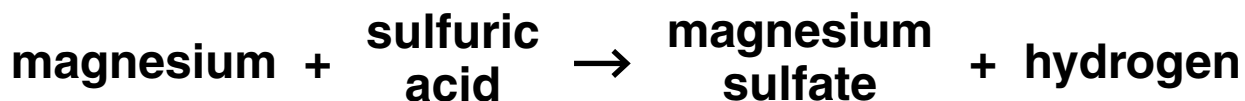
**(iii) Hayley and Andy do the experiment again.**

**They use the same volume and concentration of sulfuric acid.**

**This time they only use 0.05 g of magnesium.**

**ON THE GRID ABOVE, sketch the graph they should get.** [2]

**(b) Look at the equation for the reaction.**



**Hayley and Andy investigate this reaction with different masses of magnesium.**

**They calculate the mass of sulfuric acid used and the masses of magnesium sulfate and hydrogen made.**

<b>Mass of magnesium in g</b>	<b>Mass of sulfuric acid in g</b>	<b>Mass of magnesium sulfate in g</b>	<b>Mass of hydrogen in g</b>
<b>0.50</b>	<b>2.04</b>	<b>2.50</b>	<b>0.04</b>
<b>1.00</b>	<b>4.08</b>	<b>5.00</b>	<b>0.08</b>
<b>1.50</b>	<b>6.12</b>	<b>7.50</b>	<b>0.12</b>
<b>2.00</b>	<b>8.16</b>	<b>10.00</b>	<b>0.16</b>

- (i) Calculate the mass of magnesium sulfate made if 10 g of magnesium completely reacts with sulfuric acid.**

**Explain how you worked out your answer.**

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**[2]**

- (ii) A sample of 2.00 g of magnesium makes 0.16 g of hydrogen.

Calculate the number of moles in 0.16 g of hydrogen,  $\text{H}_2$ .

The relative atomic mass,  $A_r$ , of H = 1.

number of moles = \_\_\_\_\_ [1]

- (iii) Calculate the volume of 0.16 g of hydrogen at room temperature and pressure.

1 mole of hydrogen occupies  $24\,000\text{ cm}^3$  at room temperature and pressure.

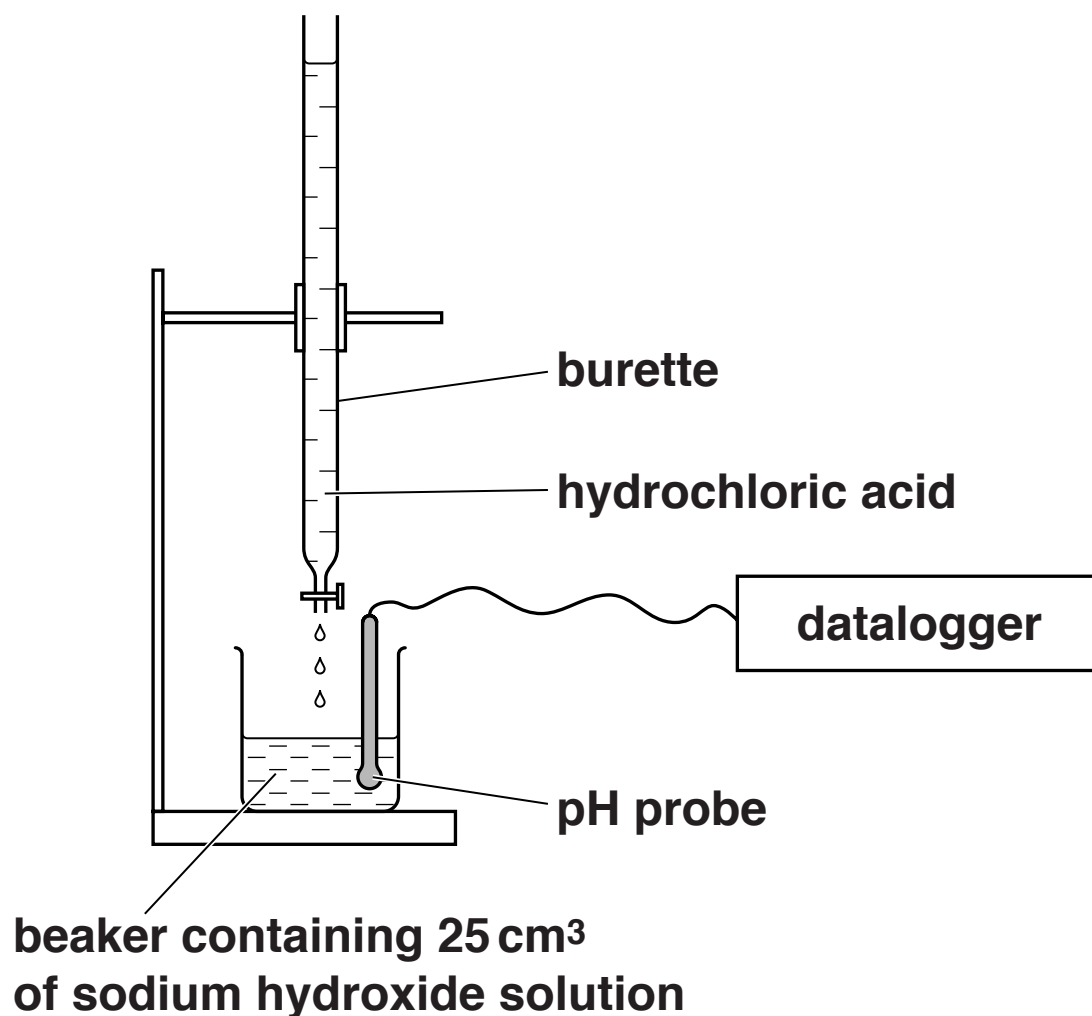
volume = \_\_\_\_\_  $\text{cm}^3$  [1]

[TOTAL: 8]

## 10 Stewart and Claire want to do a titration.

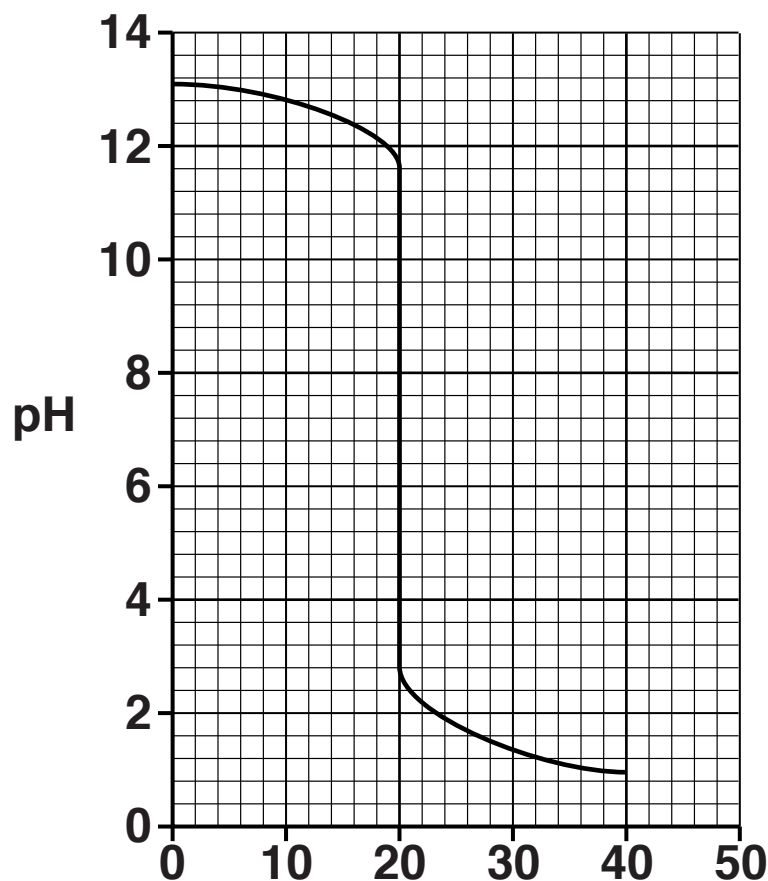
They use a solution of hydrochloric acid with a concentration of  $0.10 \text{ mol/dm}^3$ .

They titrate  $25 \text{ cm}^3$  of a solution of sodium hydroxide with the hydrochloric acid.



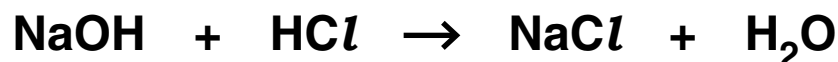
They measure the pH of the mixture during the titration.

Look at the graph of their results.



volume of hydrochloric acid added in cm<sup>3</sup>

The equation for the reaction is



What can you deduce from the graph? Include the volume of hydrochloric acid added at the end-point.

Use the graph to calculate the concentration of the sodium hydroxide solution.

[6]



The quality of written communication will be assessed in your answer to this question.

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[illegible]

**[TOTAL: 6]**



## SECTION C – Module C6

**11 Fats are made by the reaction between an alcohol called glycerol and carboxylic acids.**

**(a) What TYPE of compound is a fat?**

**Choose from**

**alkene**

**emulsion**

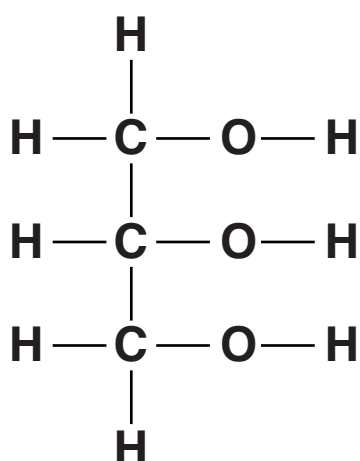
**ester**

**soap**

**solvent**

**answer** \_\_\_\_\_ **[1]**

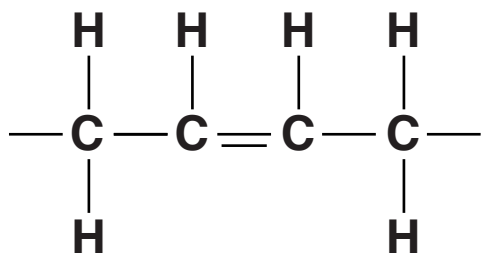
**(b) Look at the displayed formula of a molecule of glycerol.**



**What is the MOLECULAR FORMULA of glycerol?**

\_\_\_\_\_ **[1]**

**(c) Look at part of the displayed formula of a fat.**



**The fat is UNSATURATED.**

**(i) How can you tell from its formula?**

\_\_\_\_\_

\_\_\_\_\_ [1]

**(ii) Dave does a chemical test to show that the fat is unsaturated.**

**Write about the chemical test and the result Dave gets.**

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ [2]

**(d) Vegetable oils are also fats.**

**Vegetable oils can be used to make margarine.**

**Write about how margarine is manufactured.**

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[2]

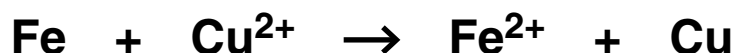
**[TOTAL: 7]**

## 12 Colin investigates displacement reactions.

He adds some iron powder to copper(II) sulfate solution,  $\text{CuSO}_4$ .

A displacement reaction happens.

Look at the ionic equation for this reaction.



This displacement reaction is a REDOX reaction.

Write the WORD equation and the BALANCED SYMBOL equation for the reaction between iron and copper(II) sulfate.

Explain why this displacement reaction involves both oxidation and reduction. [6]



The quality of written communication will be assessed in your answer to this question.

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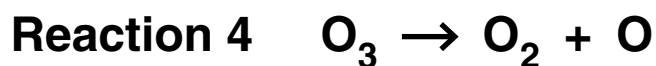
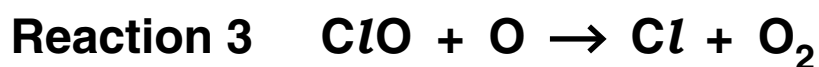
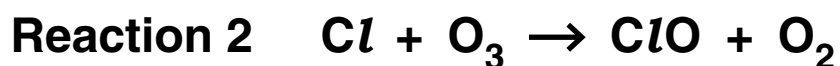
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**[TOTAL: 6]**

**13 The compound  $\text{C}_2\text{F}_2\text{Cl}_4$  is a CFC.**

**CFCs have been linked with the depletion of the ozone layer.**

**Look at the equations for five reactions that occur in the stratosphere.**

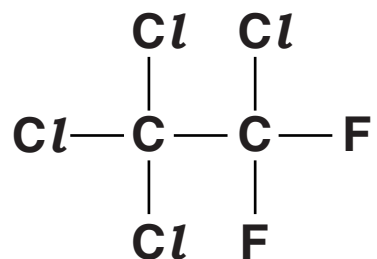


**(a) Ozone absorbs harmful ultraviolet radiation.**

**Which reaction happens when ozone absorbs ultraviolet radiation?**

\_\_\_\_\_ **[1]**

(b) Look at the displayed formula for  $\text{C}_2\text{F}_2\text{Cl}_4$ .



Explain, in terms of electrons and bonds, how the chlorine atoms are made in reaction 1.

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[2]

(c) One chlorine atom can destroy many ozone molecules.

Use reactions from the list to explain why.

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[2]

**(d) When CFCs were first discovered scientists thought they were extremely useful compounds.**

**Scientists' attitudes to CFCs have changed over the last 70 years.**

**The use of CFCs in the UK has now been banned.**

**It took a long time between the first use of CFCs and the ban by the UK government.**

**Suggest why.**

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[2]

**[TOTAL: 7]**



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**14 Magda and Sam investigate soap solution and washing-up liquid.**

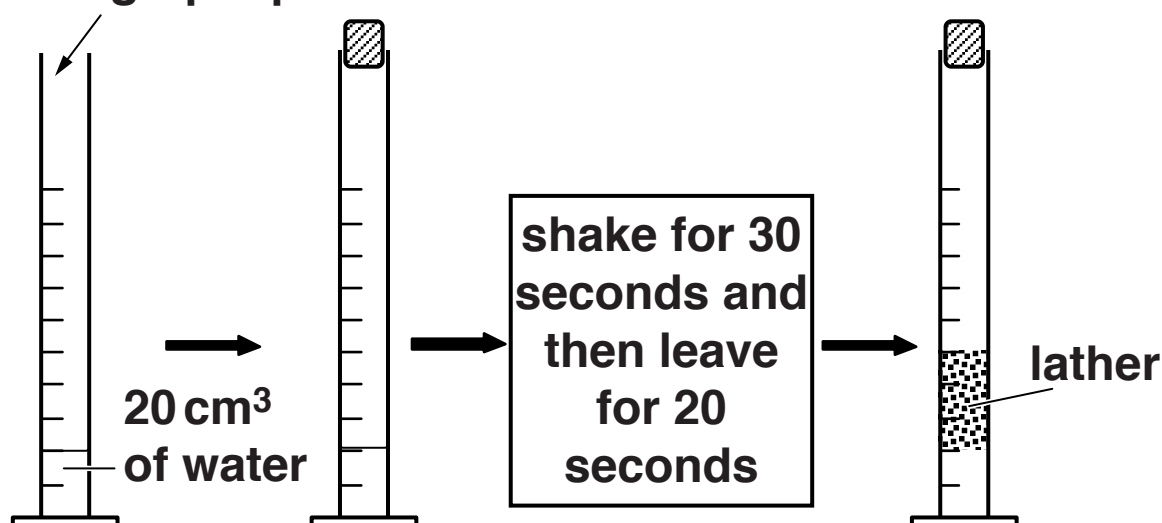
**In their first experiment they measure out  $20\text{ cm}^3$  of a water sample in a measuring cylinder.**

**They then add  $1\text{ cm}^3$  of soap solution to the water sample.**

**Magda shakes the measuring cylinder for 30 seconds.**

**Sam waits 20 seconds and then measures the volume of lather in the measuring cylinder.**

**$1\text{ cm}^3$  of either  
soap solution or  
washing-up liquid**



**Magda and Sam repeat this experiment using different water samples and soap solution.**

**They then repeat the experiments using washing-up liquid instead of soap solution.**

Look at Magda and Sam's results.

WATER SAMPLE	Volume of lather with soap solution in cm <sup>3</sup>	Volume of lather with washing-up liquid in cm <sup>3</sup>
distilled water	30	60
magnesium sulfate solution	5	40
calcium hydrogencarbonate solution	10	60
sodium chloride solution	25	60

Before she did the experiment, Magda predicted that temporary water hardness affects the action of BOTH soap AND of washing-up liquid.

Is this prediction supported by the results?

Explain your answer quoting data from the results table.

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[2]

[TOTAL: 2]

**15 Molten (liquid) potassium chloride can be electrolysed.**

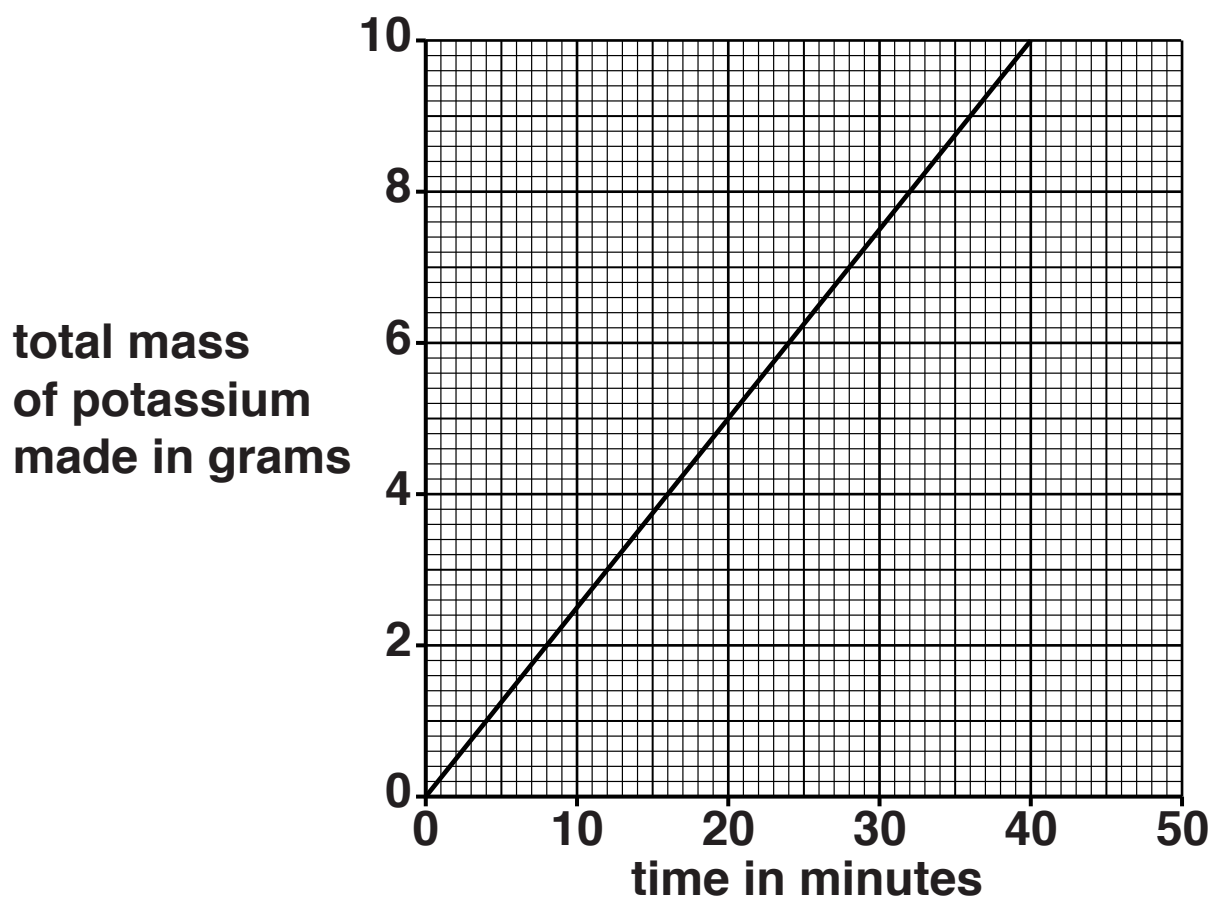
**Potassium is made.**

**Manjit investigates the mass of potassium made when molten potassium chloride is electrolysed.**

**She always uses a current of 10.3 amps.**

**She does the electrolysis for different lengths of time.**

**Look at the graph of her results.**



**(a) What is the total mass of potassium made in 30 minutes?**

\_\_\_\_\_ g [1]

**(b) Manjit electrolyses molten potassium chloride for 120 minutes.**

**She uses a current of 20.6 rather than 10.3 amps.**

**Predict the mass of potassium made.**

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ [2]

**[TOTAL: 3]**

## **SECTION D**

### **16 Farmers use fertilisers to improve crop yield.**

**Fertilisers contain one or more of the three essential elements.**

**These essential elements are nitrogen, phosphorus and potassium.**

**Fertilisers made in factories are called SYNTHETIC fertilisers.**

**(a) Look at GRAPH 1.**

**It shows the world use of synthetic fertilisers containing nitrogen between the years 1950 and 2010.**

Vaclav Smil, Feeding the world, 2000 and Food and Agriculture Organization FAO.  
Removed due to third party restrictions.

**(i) What mass of fertilisers containing nitrogen was used in 1970?**

**mass = \_\_\_\_\_ millions of tonnes [1]**

**(ii) Look at GRAPH 2.**

**It shows the concentration of nitrate ions,  $\text{NO}_3^-$ , from fertilisers in the River Rhine between the years 1950 and 2010.**

Vaclav Smil, Feeding the world, 2000 and Food and Agriculture Organization FAO.  
Removed due to third party restrictions.

**Pollution controls were introduced for the River Rhine in 1977 to reduce nitrate,  $\text{NO}_3^-$ , concentrations.**

**What evidence is there from GRAPH 2 that these controls have been effective?**

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**[1]**



**(b) Farmers also use PESTICIDES to increase crop yield.**

**Pesticides kill pests such as insects which eat the crops.**

**Look at the table. It shows the use of synthetic fertilisers and pesticides in some countries.**

<b>Country</b>	<b>Mass of synthetic fertilisers used in 1 km<sup>2</sup> of agricultural land in kg</b>	<b>Mass of pesticides used in 1 km<sup>2</sup> of agricultural land in kg</b>	<b>Percentage of land area available for agriculture (%)</b>
<b>A</b>	<b>26 000</b>	<b>66</b>	<b>61</b>
<b>B</b>	<b>963 000</b>	<b>128 000</b>	<b>4</b>
<b>C</b>	<b>62 000</b>	<b>1400</b>	<b>34</b>
<b>D</b>	<b>67 000</b>	<b>740</b>	<b>34</b>
<b>E</b>	<b>330 000</b>	<b>1000</b>	<b>18</b>

**(i) The agricultural land area of country E is 1 260 000 km<sup>2</sup>.**

**Calculate the mass of PESTICIDES used in country E.**

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**mass of pesticides = \_\_\_\_\_ kg [1]**

- (ii) Country B uses much more synthetic fertiliser and pesticides per km<sup>2</sup> than country A.

**Suggest why. Use information from the table.**

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**[2]**

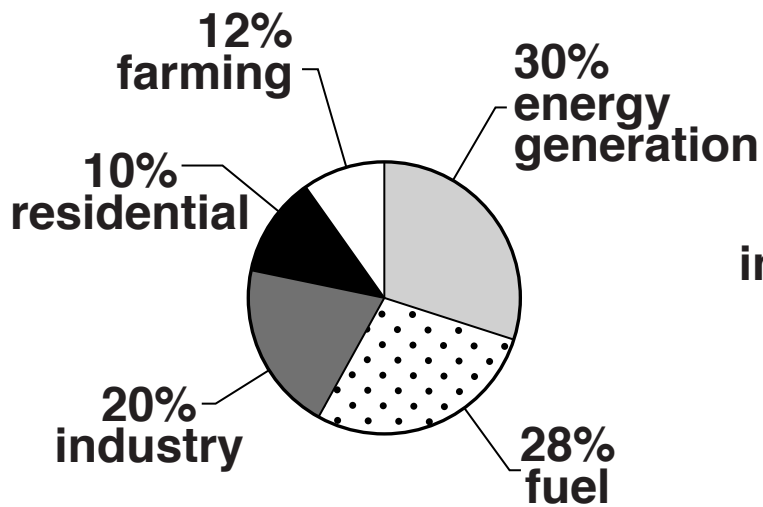
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- (c) The use of synthetic fertilisers also contributes towards the greenhouse effect.

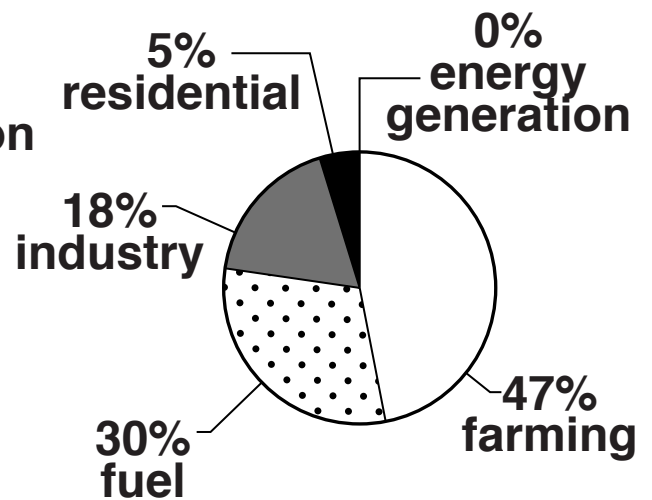
Look at the pie charts about three greenhouse gases.

They show where these greenhouse gases come from.

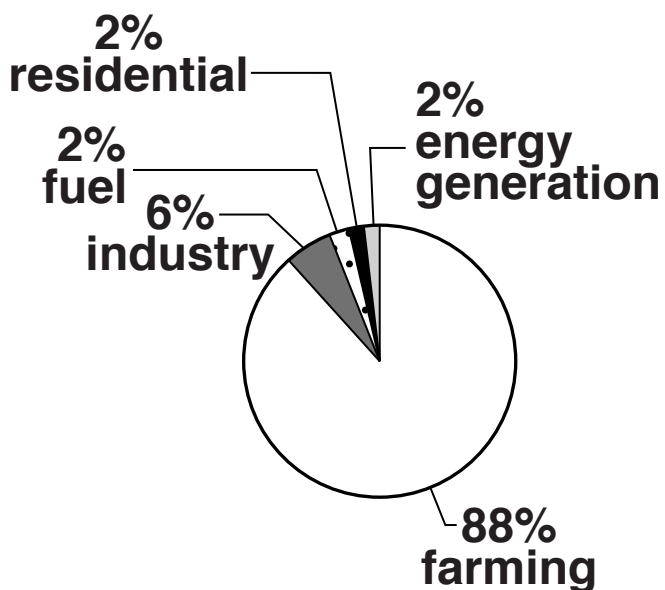
### CARBON DIOXIDE



### METHANE



### NITROUS OXIDE



- (i) Suggest which gas is most likely to be made from the use of synthetic fertilisers.

Choose from carbon dioxide, methane or nitrous oxide.

How can you tell?

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[2]

- (ii) Farming has a bigger contribution towards the greenhouse effect than residential use.

Use the information in the pie charts to support this statement.

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[3]

[TOTAL: 10]

**END OF QUESTION PAPER**

**ADDITIONAL ANSWER SPACE**

**If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margins.**










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