OCR
RECOGNISING ACHIEVEMENT

SPECIMEN F

GENERAL CERTIFICATE OF SECONDARY EDUCATION

GATEWAY SCIENCE

B742/01

CHEMISTRY B

Unit B742: Chemistry modules C4, C5, C6 (Foundation Tier)

Candidates answer on the question paper
A calculator may be used for this paper

OCR Supplied Materials:
None

Other Materials Required:
- Pencil
- Ruler (cm/mm)

Duration: 1 hour 30 minutes

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

INFORMATION FOR CANDIDATES

- Your quality of written communication is assessed in questions marked with a pencil (✎).
- The Periodic Table can be found on the back page.
- The number of marks for each question is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **85**.
- This document consists of **32** pages. Any blank pages are indicated.

Examiner's Use Only:			
1		11	
2		12	
3		13	
4		14	
5		15	
6		16	
7		17	
8		18	
9			
10			
Total			

Answer **all** the questions

Section A – Module C4

1 This question is about the elements in the Periodic Table.

Look at the list of elements.

argon	**calcium**
hydrogen	**iodine**
magnesium	**neon**
nitrogen	**oxygen**
potassium	**sodium**

Answer the questions.

Choose your answers from the list.

Each element can be used **once**, **more than once** or **not at all**.

(a) Write down the **name** of the element which has the **atomic number** of **12**.

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

(b) Write down the **name** of the element which is a **grey solid** non-metal at room temperature.

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

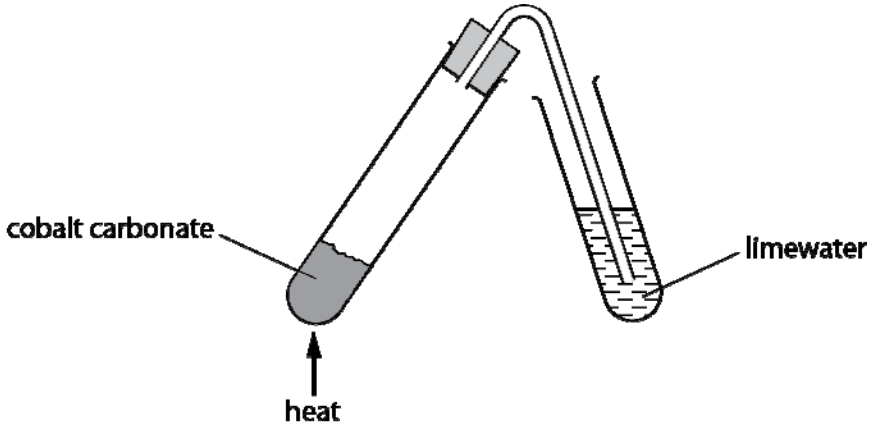
(c) Which element has an atom with only **five** electrons in its outer shell?

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

[Total: 3]

2 Beth investigates the thermal decomposition of cobalt carbonate.

Look at the diagram. It shows the apparatus she uses.



She measures the mass of the solid cobalt carbonate before heating.

She also measures the mass of the solid left after heating.

Look at her results.

	mass in grams
solid cobalt carbonate before heating	2.21
solid left after heating	1.39

During the heating the limewater turns milky.

(a) Explain why there is a change in mass of the solid cobalt carbonate during the heating.

.....

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

(b) Explain why the heating of cobalt carbonate is an example of thermal decomposition

.....

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

(c) Construct the **word** equation for the thermal decomposition of cobalt carbonate.

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

(d) Beth uses the internet to find out about other metal carbonates.

She finds out the temperature needed to decompose different carbonates.

Look at the table. It shows these temperatures.

carbonate	temperature needed to decompose carbonate in °C
copper carbonate	375
iron(III) carbonate	–25
manganese carbonate	500
zinc carbonate	400

Most carbonates need to be heated before they will decompose.

Explain which carbonate will decompose **without** being heated by a Bunsen burner.

Choose from the carbonates in the table.

.....

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

[Total: 4]

3 Many scientists helped to develop the theory of atomic structure in the early 1900s.

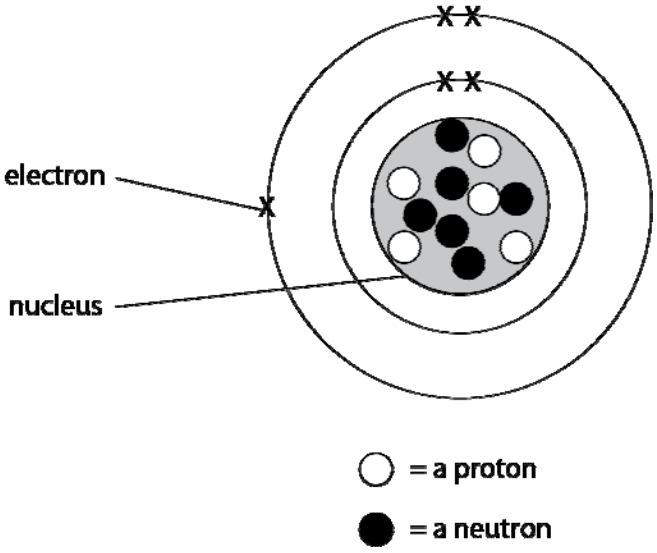
A scientist called Thomson discovered the electron.

Another scientist called Rutherford had the idea of atoms having a nucleus.

A third scientist called Bohr had the idea of electron shells.

Look at the diagram.

It shows the structure of an atom with a nucleus, electrons and electron shells.



(a) What is the electrical charge on an electron?

Choose from:

negative **neutral** **positive**

answer ..... **[1]**

(b) Explain why the nucleus of an atom has a positive charge.

.....

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

(c) Explain why the **atomic** number of this atom is 5 and the **mass** number is 11.

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

(d) The scientists Thomson, Rutherford and Bohr told other scientists about their ideas about atoms.

Suggest how and explain why they told other scientists.

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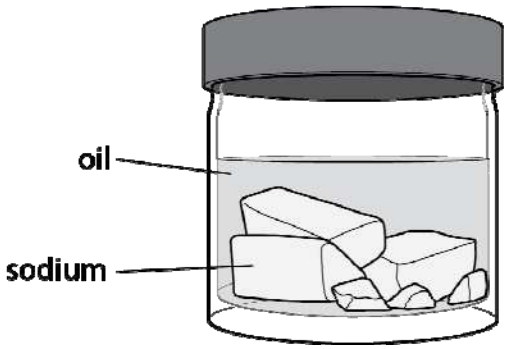
..... **[2]**

[Total: 6]

4 This question is about Group 1 elements such as sodium and rubidium.

(a) Look at the diagram.

It shows how sodium is stored.



The sodium is covered with oil.

Write down **two** reasons why sodium must be stored under oil.

.....

.....

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

(b) Group 1 elements, such as sodium, react with water.

Sodium hydroxide, NaOH, and hydrogen are made.

Construct the **balanced symbol** equation for the reaction between sodium and water.

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

(c) Look at the table. It shows some information about the elements in Group 1.

element	atomic symbol	atomic number	melting point in ^{o}C	density in g/cm^3	atomic radius in pm
lithium	Li	3	181	0.53	152
sodium	Na	11	98	0.97	182
potassium	K	19	64	0.86	227
rubidium	Rb	37			

The atomic number increases down the group.

It is difficult to predict the density of rubidium.

It is easier to predict the melting point and atomic radius of rubidium.

Explain why rubidium's melting point and atomic radius are easier to predict than its density.

.....

.....

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

[Total: 6]

5 Titanium, Ti, atomic number 22, is used to make the wings of some aeroplanes.

Predict four physical properties of titanium.

Explain why you make your predictions and relate the properties to the use of titanium in making aeroplane wings.

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

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..... **[6]**

[Total: 6]

Section B – Module C5

6 Steve looks at the label on his bottle of concentrated pineapple cordial (pineapple drink).

It shows some information about **100 cm^3** of concentrated pineapple cordial.

nutrient	Mass in milligrams	percentage of guideline daily amount (GDA)
vitamin C	20.8	25

Preparation guidelines
Shake well and dilute (1 part concentrated cordial to 4 parts water)

(a) Steve makes 1000 cm^3 of diluted pineapple cordial using the preparation guidelines.

What mass of vitamin C will be in 1000 cm^3 of diluted cordial?

.....

.....

mass of vitamin C = ... mg **[1]**

(b) Steve suggests he could get all the vitamin C he needs by drinking pineapple cordial.

What volume of **diluted** cordial would Steve need to drink each day?

.....

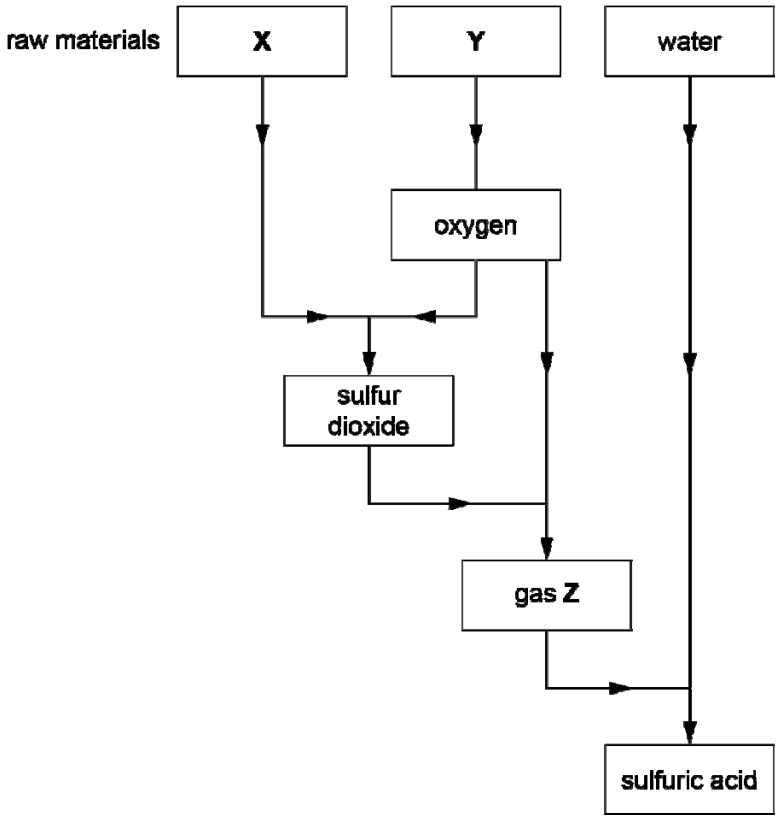
.....

volume of diluted cordial = ... cm^3 **[1]**

[Total: 2]

7 Sulfuric acid is made in the Contact Process.

Look at the flow chart. It shows all the stages in the Contact Process.



(a) The three raw materials used in the Contact Process are at the top of the chart.

Water is shown.

Write down the **names** of the other two raw materials (**X** and **Y**) and suggest why water is a good raw material.

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..... **[3]**

(b) Sulfur dioxide and oxygen react to give gas **Z**.

$$\text{sulfur dioxide} + \text{oxygen} \rightleftharpoons \text{gas } \mathbf{Z}$$

What is the name of gas **Z**?

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

[Total: 4]

8 This question is about acid-base titrations.

Issy decides to find out the volume of dilute nitric acid needed to neutralise 25.0 cm^3 of an alkali.

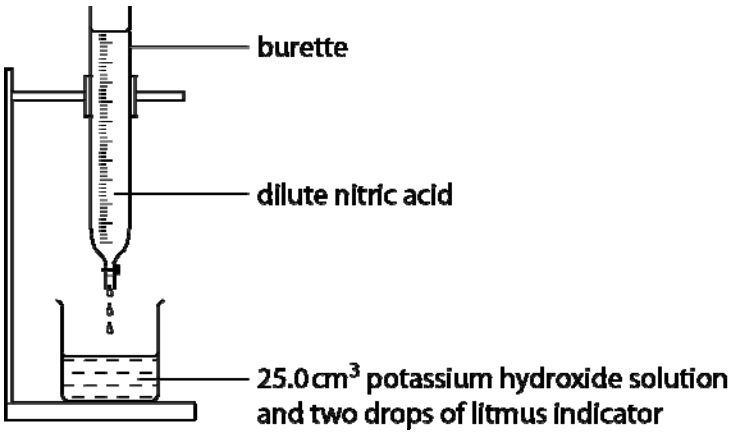
She uses 0.100 mol/dm^3 potassium hydroxide solution.

(a) Issy measures 25.0 cm^3 of potassium hydroxide solution.

Write down the name of a piece of apparatus she can use.

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

(b) Look at the apparatus Issy uses to do her titrations.



She adds dilute nitric acid slowly until the end point is reached.

Describe what Issy sees when the end point of the titration has been reached.

.....

.....

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

(c) She repeats the experiment two more times.

Look at Issy's results table.

titration number	**1**	**2**	**3**
final burette reading in cm^3	29.7	27.0	34.8
initial burette reading in cm^3	8.5	6.9	24.9
volume of acid used (titre) in cm^3	21.2		

Calculate the **mean** titre for titration numbers 2 and 3.

Give your answer to **one** decimal place.

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mean titre =..... cm^3 **[2]**

(d) Issy repeats the titration experiment with three more acids.

Look at the results.

acid	**mean titre in cm^3**
A	24.2
B	18.7
C	22.0

Which is the most concentrated acid?

Choose from **nitric acid**, acid **A**, acid **B** or acid **C**.

Explain your answer.

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

[Total: 6]

9 Silicon dioxide and sodium ferrate have been discovered on the planet Mars.

(a) Silicon dioxide, SiO_2, has a molar mass of 60 g/mol.

Calculate the molar mass of sodium ferrate, Na_2FeO_4.

The relative atomic mass of O is 16, of Na is 23, of Si is 28 and of Fe is 56.

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molar mass = ... g/mol **[1]**

(b) Compound **X** has been discovered on the planet Mars.

Compound **X** has the empirical formula CH.

Which **two** formulas could be the formula of compound **X**?

CH_4	**C_2H_2**
C_2H_6	**C_4H_8**
C_6H_6	**$C_{10}H_{22}$**

answer ..... and ..... **[1]**

[Total: 2]

10 Sulfamic acid solution is used to remove limescale in kettles.

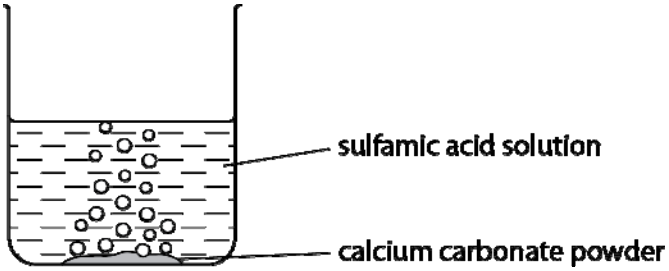
Limescale is mostly calcium carbonate.

Sulfamic acid reacts with calcium carbonate as shown in the equation.

sulfamic acid + calcium carbonate → calcium sulfamate + carbon dioxide + water

Hayley investigates 1.0 mol/dm^3 sulfamic acid solution and 1.0 mol/dm^3 nitric acid.

Look at the diagram.



Sulfamic acid is a weak acid. Nitric acid is a strong acid.

Hayley adds 1.0 g of calcium carbonate powder to 100 cm^3 of the sulfamic acid solution.

There is a lot of fizzing but after a minute the reaction stops.

Hayley repeats the experiment. This time she uses 100 cm^3 of the nitric acid.

Describe and explain, using the particle model, one **similarity** and one **difference** between the reactions of the two acids with calcium carbonate.

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

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..... **[6]**

[Total: 6]

11 Emma wants to prepare a pure dry sample of lead iodide by a precipitation reaction.

$$2KI(aq) + Pb(NO_3)_2(aq) \rightarrow PbI_2(s) + 2KNO_3(aq)$$

She starts with potassium iodide solution and lead nitrate solution.

(a) Describe the steps Emma must do to get a **pure dry** sample of lead iodide.

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..... **[3]**

(b) Look at the equation.

It shows the masses of the reactants used and products made in this reaction.

$2KI(aq)$	+	$Pb(NO_3)_2(aq)$	→	$PbI_2(s)$	+	$2KNO_3(aq)$
3.3g		3.3g		4.5g		1.9g

What conclusions can be drawn about the principle of conservation of mass from this reaction?

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

[Total: 5]

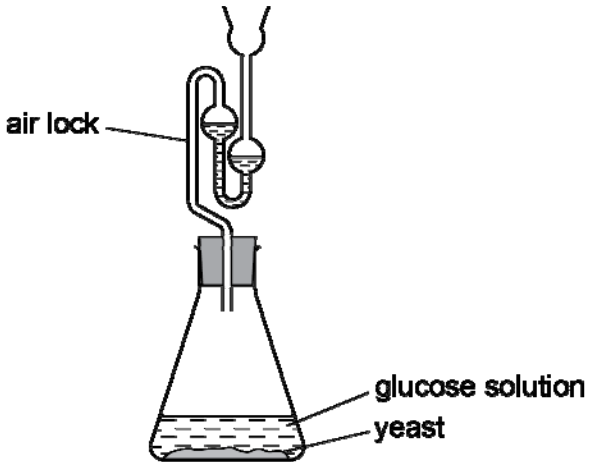
Section C – Module C6

12 Fermentation is used to make ethanol.

Ali and Saeed investigate fermentation.

Look at the diagram.

It shows the apparatus they use.



(a) What are the optimum conditions for fermentation?

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

(b) Fermentation is one way to make ethanol.

Write down one **other** way to make ethanol.

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

[Total: 3]

13 Look at the picture of a car.

(a) Some of the car body is made of iron.

One disadvantage of using iron is that it rusts.

Two substances react with iron to make rust.

Write down the names of these **two** substances.

Choose from

chlorine

hydrogen

nitrogen

oxygen

water

trichlorofluoromethane

answer ..... and..... **[1]**

(b) Write down **two** methods of preventing rusting.

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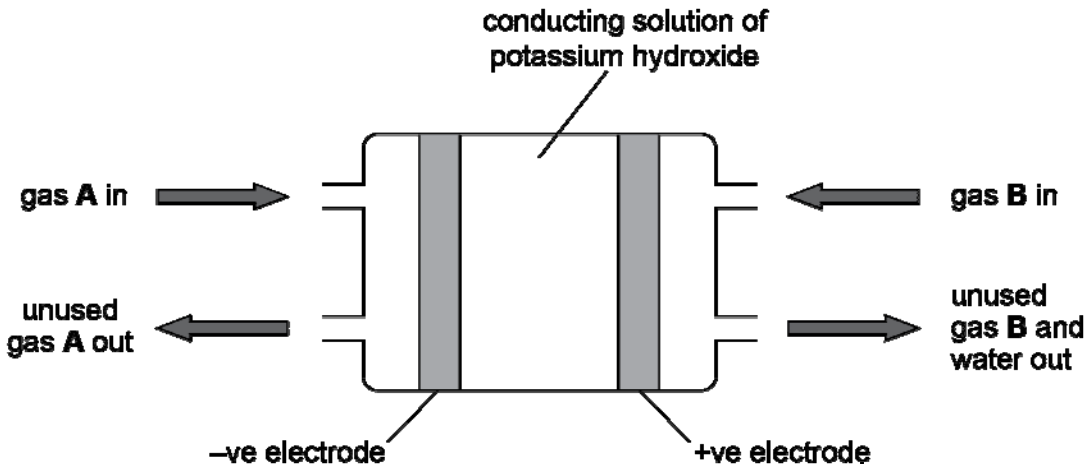
..... **[2]**

[Total: 3]

14 Look at the diagram of a fuel cell.



A fuel cell produces electrical energy.

(a) This fuel cell uses two gases to produce an electric current.

What is the fuel in this fuel cell?

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

(b) Most cars are powered by an engine that burns petrol.

Using a fuel cell to power a car instead of a petrol engine means the car's emissions are less polluting.

Explain why.

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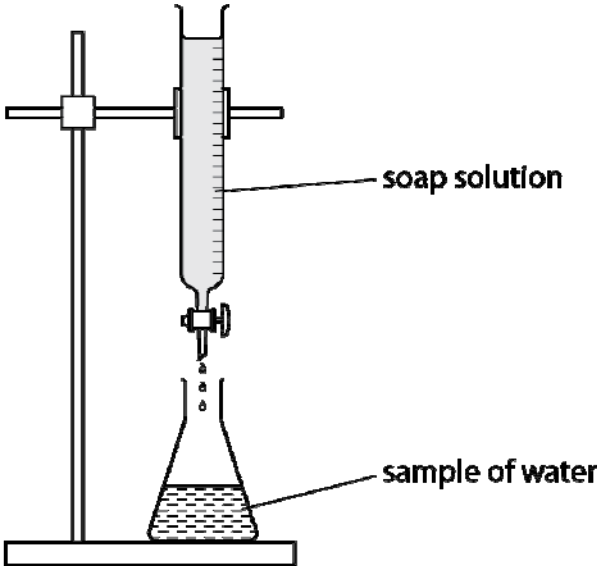
..... **[2]**

[Total: 3]

15 This question is about hardness in water.

Luke and Henry investigate the hardness of three different samples of water.



They do this by adding drops of soap solution to each 50 cm^3 sample of water.

They add soap solution until a lather remains on the surface after shaking.

Look at their table of results.

sample of water	volume of soap solution added in cm^3
boiled tap water	15
spring water	18
river water	28
tap water	30
distilled water	5

(a) Luke and Henry tested distilled water as well as the four other water samples.

Suggest why.

.....

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

(b) Which sample of water is the softest?

Choose from

boiled tap water

river water

spring water

tap water

answer ..... **[1]**

(c) Tap water contains **both** temporary hardness and permanent hardness.

Explain how you can tell from the results.

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

(d) Hardness is caused by dissolved ions in the water.

Put a (ring) around the name of **one** ion which causes hardness.

calcium

carbonate

chloride

hydrogen

magnesium

[1]

[Total: 5]

16 In 1950 research scientists thought that CFCs were very useful compounds.

CFCs have been used as aerosol propellants and refrigerants.

This is because they have useful properties such as being non-poisonous.

(a) Explain, in terms of their properties, why CFCs were used as propellants and refrigerants .

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.....

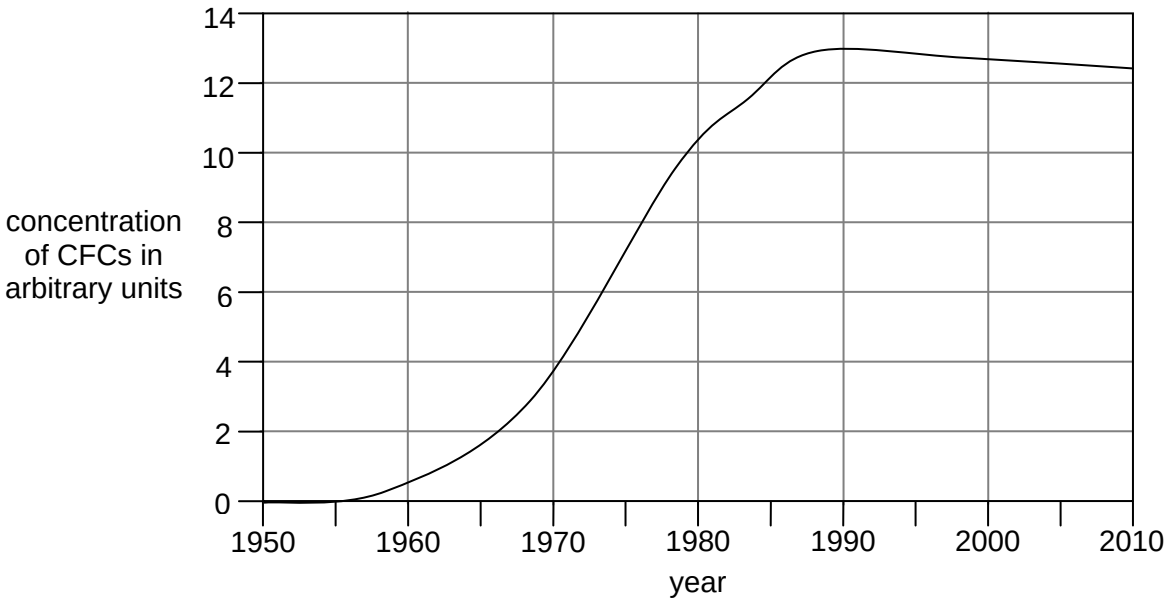
.....

..... **[3]**

(b) CFCs enter the air when aerosol cans are used or thrown away.

Look at the graph.

It shows how the concentration of CFCs in the air has changed since 1950.



(i) The UK government banned the use of CFCs.

Explain why.

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.....

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

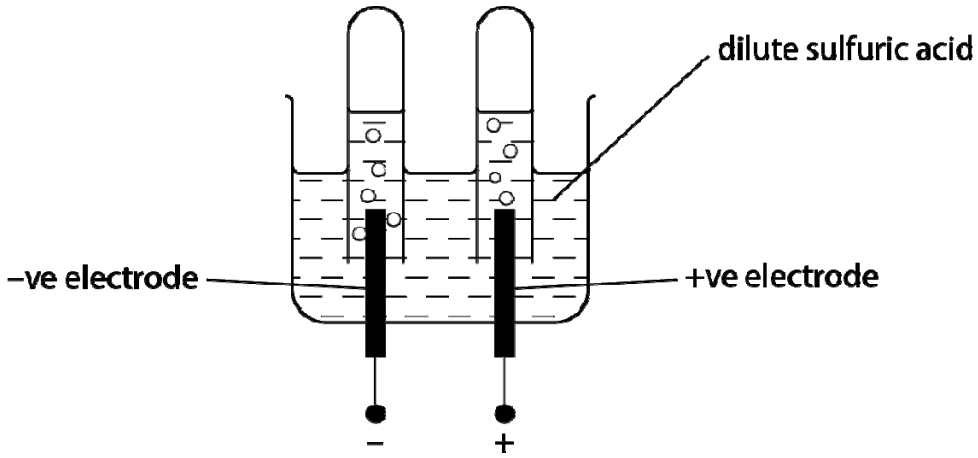
(ii) Use the graph to estimate in which year the UK ban on the use of CFCs started.

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

[Total: 5]

17 Harry investigates the electrolysis of dilute sulfuric acid.

Look at the apparatus he uses.



Hydrogen is made at the negative electrode.

Harry measures the time it takes to fill the test tube with hydrogen.

He does five experiments.

He investigates three factors

- the concentration of the dilute sulfuric acid
- the temperature of the dilute sulfuric acid
- the current used.

He keeps everything else the same.

Look at his table of results.

experiment number	concentration of acid in mol/dm^3	temperature of dilute sulfuric acid in ^{o}C	current used in amps	time taken to fill the test tube with hydrogen in seconds
1	1.0	10	1.0	60
2	1.0	15	1.0	60
3	1.0	15	2.0	30
4	1.0	15	4.0	15
5	2.0	15	4.0	15

What conclusions can be drawn from these results?

Explain how each conclusion is supported by the data.

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

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..... **[6]**

[Total: 6]

Section D

18 Elizabeth is a farmer.

She has to make some decisions about growing crops on her fields which will be used for bio-fuels.

If she does decide to grow crops for bio-fuels she will need to decide what crops to grow.

Look at the information about bio-fuels.

Bio-fuels

- are renewable fuels used in motor vehicles
- are made from plant materials.

Farmers have to use valuable land to grow crops for bio-fuels.

They cannot use the same land to grow food crops.

(a) Write down **two** factors Elizabeth needs to consider so that she can make a decision about growing crops for bio-fuels.

.....

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

(b) Elizabeth is considering growing crops which could be used for two bio-fuels:

1. bio-ethanol
2. bio-diesel.

Look at Table 1.

It gives some information about the production of bio-fuels in 2007.

Table 1

bio-fuel	units of energy used during growth and manufacture	total energy content of bio-fuel produced in units of energy
bio-ethanol	378	924
bio-diesel	1	64

Energy is used during the growth and manufacture of bio-fuels.

This has to be set against the total energy content of the fuel.

Suggest, with a reason, an advantage of producing bio-diesel rather than bio-ethanol.

.....

.....

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

(c) Elizabeth finds out more information about making bio-diesel.

Bio-diesel can be produced from a wide range of different plants.

Look at Table 2.

It shows the average volume of bio-diesel you can get from different plants.

Table 2

plant used to make bio-diesel	average volume of bio-diesel in dm^3 from a 1000 m^2 area
coconut	35
corn	7
hemp	150
palm	115
peanut	15
rape	16
soy	12
sunflower	13

Elizabeth has a field with an area of 10 000 m^2.

She wants to produce as much bio-diesel as possible from her field.

Which plant should she grow and how much bio-diesel would she produce?

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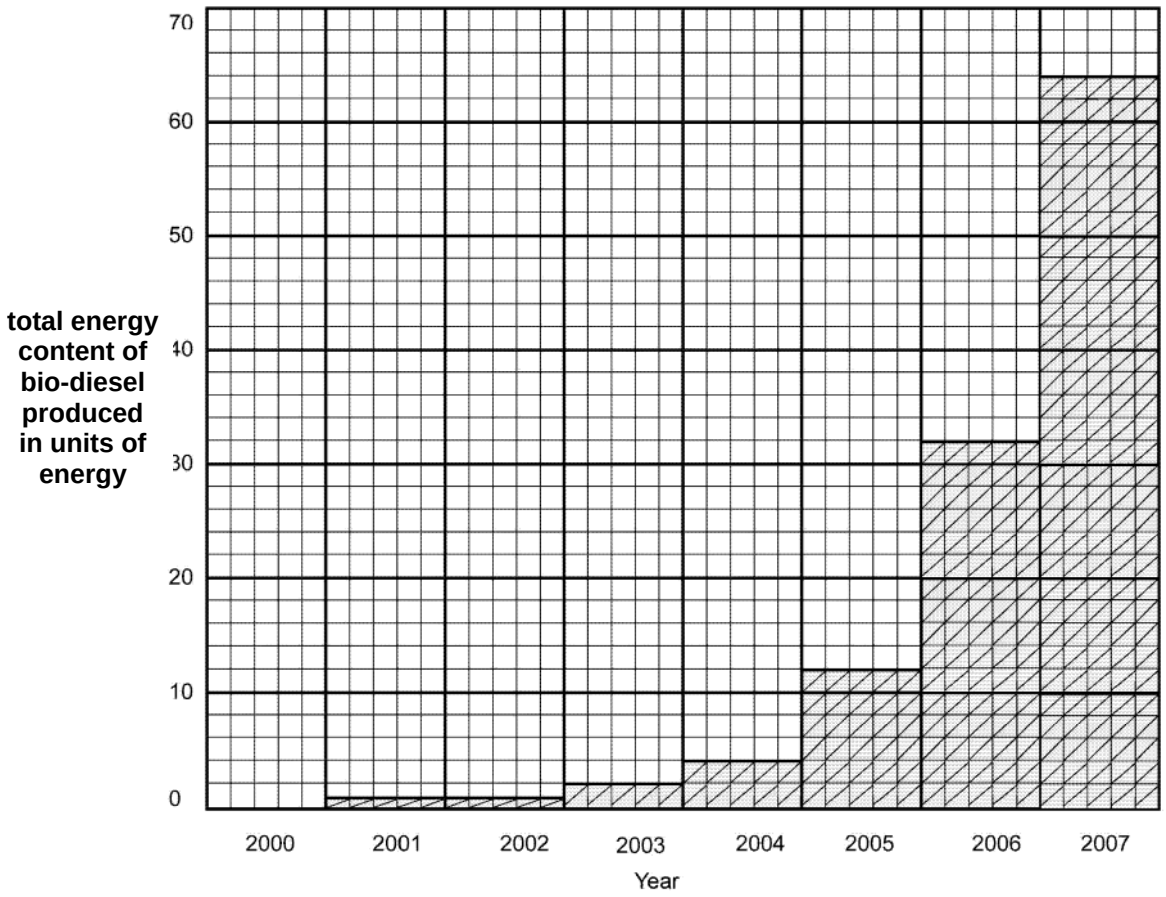
..... **[1]**

(d) Look at the bar chart.

It shows the total energy content of the bio-diesel produced each year since the year 2000.



(i) The amount of bio-diesel produced is likely to continue to increase.

Suggest **two** reasons why it is difficult to predict the total energy content of bio-diesel produced in 2011.

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.....

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

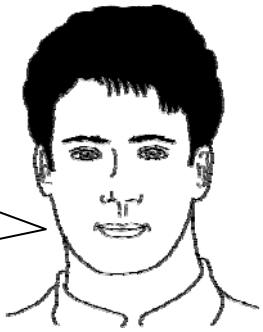
(ii) What are the possible consequences of this increase in bio-diesel production?

.....

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

(e) Elizabeth's friends are discussing her choices.

Sally
Using bio-fuels means that non-renewable fossil fuels will not be used up.



Guy
Because the plants take in carbon dioxide when they grow, there is no overall production of carbon dioxide when using bio-fuels.

Sharon
The technology needed to use bio-fuels is not very well developed.

Use the evidence in this section to recommend what decision Elizabeth should make.

Explain your reasoning.

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..... **[4]**

[Total: 10]

[Paper Total: 85]

END OF QUESTION PAPER

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PERIODIC TABLE

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **A***l* aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **C***l* chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **T***l* thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

* The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.