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Thursday 13 June 2013 – Morning

GCSE GATEWAY SCIENCE
CHEMISTRY B

B742/01 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, centre number and candidate number in the boxes above. 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. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

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 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.

Answer **all** the questions.

SECTION A – Module C4

1 The table shows the electronic structures of the atoms of some elements.

Element	Symbol	Electronic structure
helium	He	2
oxygen	O	2.6
neon	Ne	2.8
magnesium	Mg	2.8.2
chlorine	C*l*	2.8.7
calcium	Ca	2.8.8.2

(a) How many **electrons** are there in one atom of chlorine?

.... **[1]**

(b) What is the **atomic number** of magnesium?

.... **[1]**

(c) Write down the symbols for two elements in the same **group** of the periodic table.

Choose from the table above.

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

(d) Write down the symbols for two elements in the same **period** of the periodic table.

Choose from the table above.

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

[Total: 4]

2 In 1808, a scientist named Dalton published his atomic theory.

Dalton thought that:

- elements were made up of atoms
- atoms could **not** be split into simpler particles.

About a century later, a scientist called Rutherford published another atomic theory.

Rutherford thought that:

- atoms had a positively charged nucleus
- electrons orbited the nucleus.

(a) Why is it important that scientists publish their theories?

....

....

.... **[2]**

(b) Write about one **difference** between Dalton's atomic theory and Rutherford's atomic theory.

....

.... **[1]**

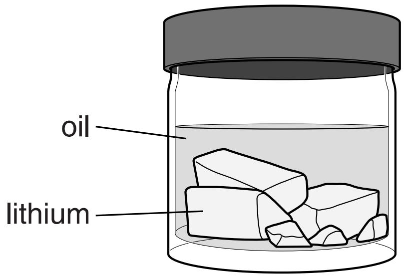
(c) What is the electrical charge on an electron?

.... **[1]**

[Total: 4]

3 Lithium, Li, is in Group 1 of the Periodic Table.

(a) Lithium is stored under oil in a sealed bottle.



Explain why lithium is stored under oil.

....

....

.... **[2]**

(b) Laura's teacher adds a small piece of lithium to a bowl of water.

The lithium reacts with the water.

The lithium moves about on the surface of the water.

Laura sees bubbles of hydrogen being made.

The piece of lithium gets smaller and smaller until it has completely reacted.

A solution of lithium hydroxide is made.

Caesium, Cs, is another element in Group 1.

Predict, including a word equation, how the reaction of **caesium** with water compares with the reaction of **lithium** with water.

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

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.... **[6]**

[Total: 8]

4 Oskar investigates the thermal decomposition of zinc carbonate.

zinc carbonate $\rightarrow$ zinc oxide + carbon dioxide

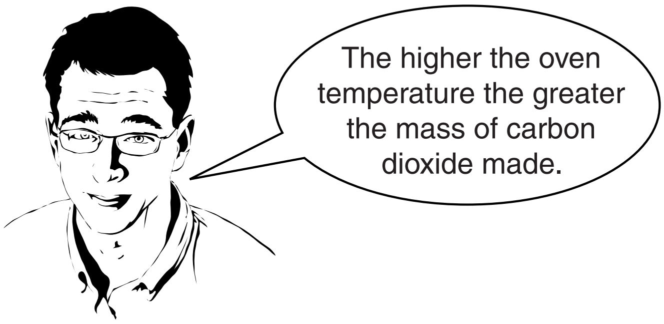
He heats 4.0 g of solid zinc carbonate for 30 minutes in a hot oven.

He lets the solid cool down and then measures its mass.

He repeats the experiment four more times.

Each time he uses a different oven temperature.

Oskar makes a prediction.



Look at Oskar's results.

Oven temperature in °C	**200**	**300**	**400**	**500**	**600**
Mass of zinc carbonate at start in g	4.00	4.00	4.00	4.00	4.00
Mass of solid after heating in g	4.00	3.42	2.65	2.59	2.59

(a) Do Oskar's results support his prediction?

Explain your answer.

....

....

.... **[2]**

(b) Oskar wants to check that carbon dioxide is made during the reaction.

What is the chemical test for carbon dioxide?

....

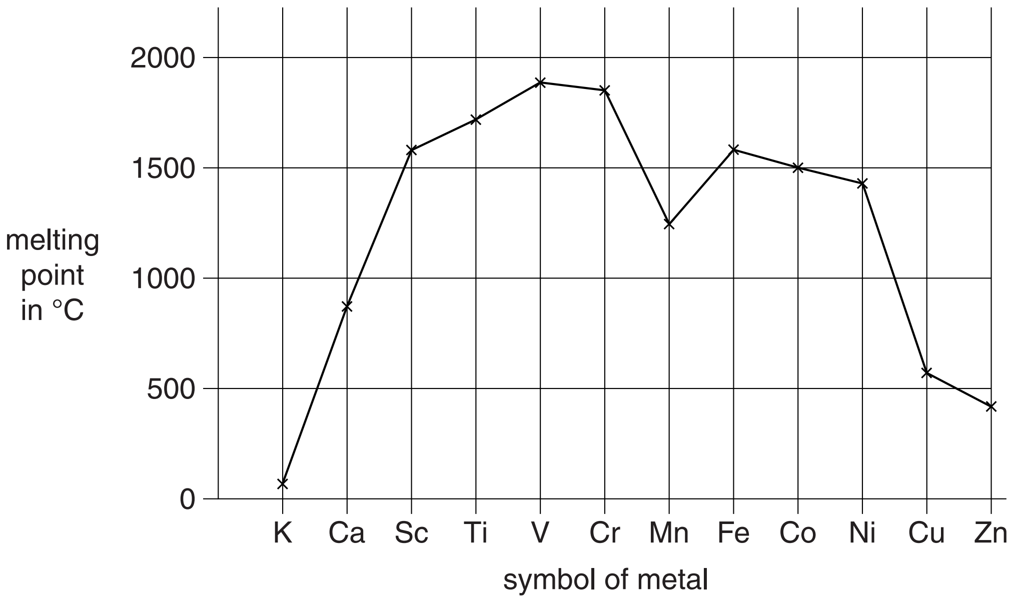
....

.... **[2]**

[Total: 4]

5 Most metals have high melting points.

Look at the graph. It shows the melting points of some metals.



(a) Write the **symbol** of a metal that can be used to make a container to melt iron.

Explain your answer.

....

....

.... **[2]**

(b) Write the **symbol** of the metal which has the **weakest** metallic bonds.

.... **[1]**

(c) One property of metals is that they often have high melting points.

Write about **other** properties of metals.

....

....

....

.... **[2]**

[Total: 5]

SECTION B – Module C5

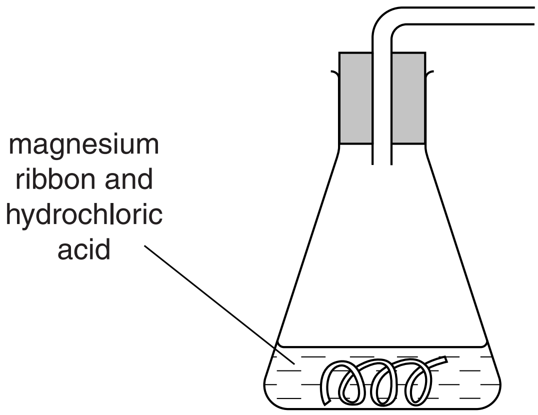
6 Trevor and Julie investigate the reaction between magnesium and hydrochloric acid at 20 °C.

magnesium + hydrochloric acid → magnesium chloride + hydrogen

(a) Hydrogen gas is given off in the reaction.

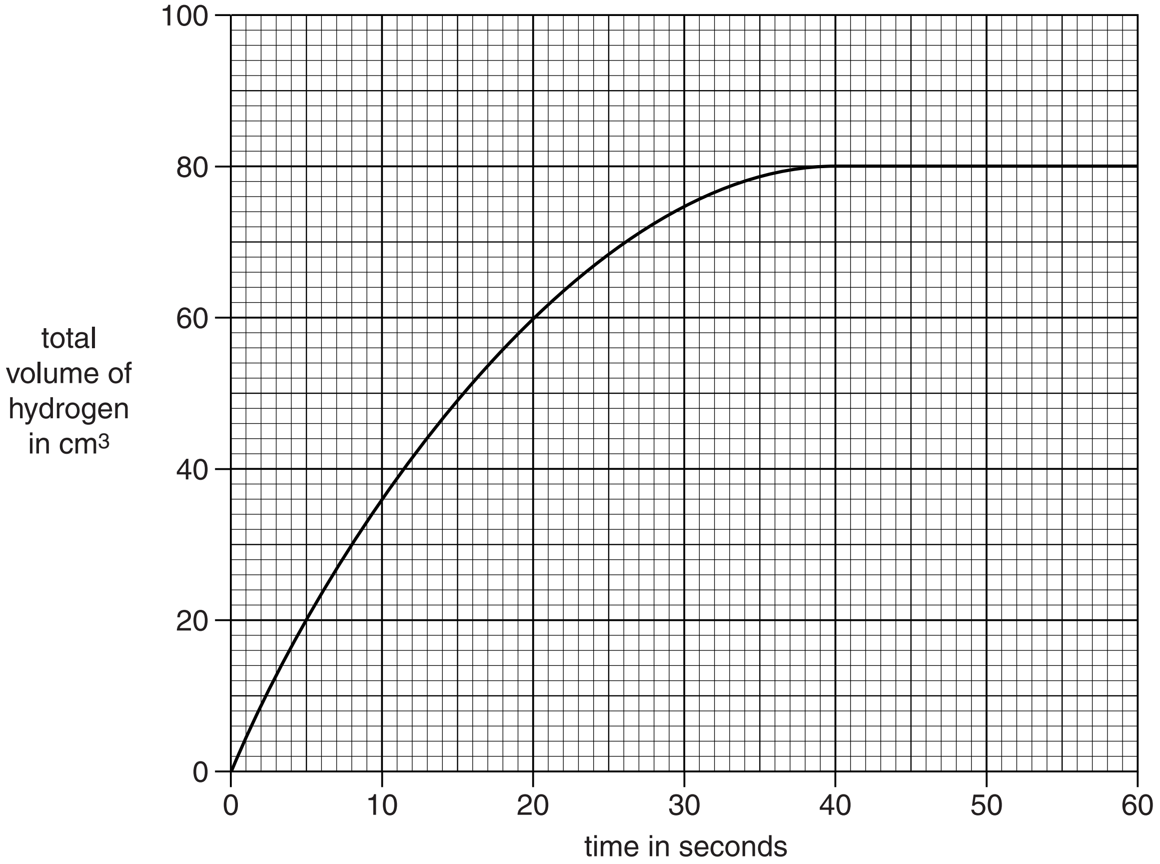
Look at the diagram. It shows **part** of the apparatus they use.

Complete the diagram to show how Trevor and Julie can **collect** and **measure** the volume of hydrogen made.



[2]

(b) Look at the graph. It shows their results.



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

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

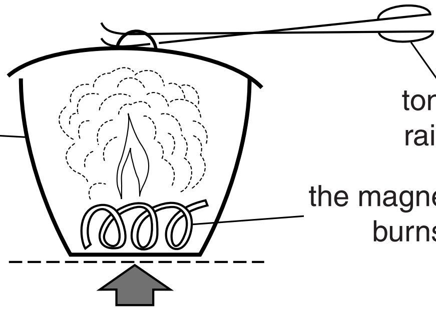
(ii) Why does the reaction stop?

.... **[1]**

[Total: 4]

7 Nick reacts magnesium with oxygen.

He heats the magnesium in a crucible.



The magnesium reacts with oxygen in the air.

Magnesium oxide is made.

magnesium + oxygen → magnesium oxide

Nick does the experiment four times with different masses of magnesium.

Look at the table of his results.

Mass of magnesium in g	Mass of oxygen used in g	Mass of magnesium oxide made in g
0.10	0.07	0.17
0.20	0.14	0.34
0.30	0.21	....
0.40	....	0.68

(a) Complete the table. **[2]**

(b) How much magnesium would Nick need to make 1.7 g of magnesium oxide?

Explain how you worked out your answer.

....

....

.... **[2]**

(c) Calculate the molar mass of magnesium oxide, MgO.

The relative atomic mass of Mg is 24 and of O is 16.

answer .... g/mol **[1]**

[Total: 5]

8 This question is about acid-base titrations.

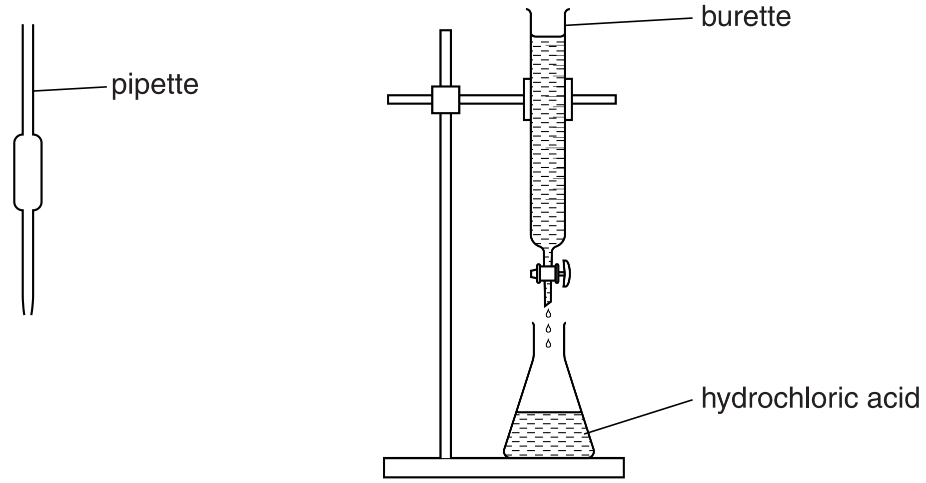
(a) Complete the table to show the colours of acid-base indicators.

	Colour in	
Indicator	**Acid**	**Alkali**
litmus	red	blue
phenolphthalein	colourless	....

[1]

(b) Brian neutralises dilute hydrochloric acid with sodium hydroxide solution.

Look at the apparatus he uses to do a titration.



He uses the pipette to measure 25.0 cm^3 of hydrochloric acid into the flask.

Describe how Brian completes the titration.

....

....

....

....

.... **[3]**

(c) Brian does three more titrations.

Look at his results.

Titration number	**1**	**2**	**3**	**4**
Volume of sodium hydroxide added in cm^3	22.9	22.1	22.3	22.2

(i) Calculate the mean (average) volume of sodium hydroxide solution added for titrations **2**, **3** and **4.**

mean volume of sodium hydroxide solution added = ... cm^3 **[1]**

(ii) Titration **1** was not included in the calculation of the mean volume of sodium hydroxide added.

Suggest why.

.... **[1]**

[Total: 6]

9 Ammonia is made from nitrogen and hydrogen in a **reversible** reaction, which reaches an **equilibrium**.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

Look at **Table 1**.

It shows the percentage of ammonia in the equilibrium mixture at 450 °C and different **pressures**.

Pressure in atmospheres	**Percentage (%) of ammonia at 450 °C**
1	0.2
50	9.5
100	16.2
200	25.3

Table 1

Look at **Table 2**.

It shows the percentage of ammonia in the equilibrium mixture at 300 atmospheres and different **temperatures**.

Temperature in °C	**Percentage (%) of ammonia at 300 atmospheres**
400	50
450	35
500	25
550	17

Table 2

The reaction between nitrogen and hydrogen is a **reversible** reaction, which reaches an **equilibrium**.

What is meant by a reversible reaction which reaches an equilibrium?

How does changing the pressure and temperature affect the position of equilibrium?

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

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.... **[6]**

[Total: 6]

10 Look at the table.

It shows information about the contents of some foods on food labels.

It also shows the Guideline Daily Amounts (GDA) for an adult.

Food contents	**Small pizza**	**Chicken curry**	**Fish in cheese sauce**	**GDA for an adult**
Energy in calories	396	384	200	2000
Protein in g	16.9	41.4	22.8	45
Carbohydrate in g	51.3	11.0	2.9	230
Fat in g	13.7	19.2	10.8	70
Sodium in g	0.7	0.9	0.4	2.3

(a) Look at the information for the chicken curry.

What percentage of the GDA for **fat** is in the chicken curry?

answer .... % **[2]**

(b) A scientist writes a summary about the contents of food.

The contents of food

1 Too much energy content causes obesity.

2 Proteins are needed for growth and repair.

3 Carbohydrates provide energy but eating too much causes obesity.

4 Fats can be stored as body fat and can cause heart disease.

5 Too much sodium can cause heart disease.

Using this summary, together with the information in the table about food contents, which of the three foods in the table is the most healthy?

Explain your answer.

....

....

....

.... **[2]**

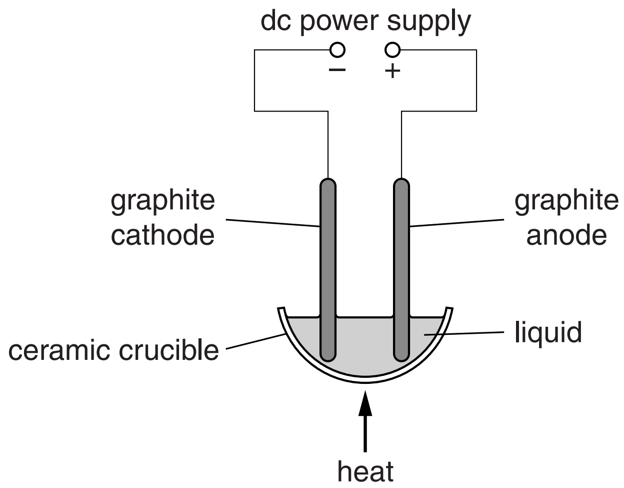
[Total: 4]

SECTION C – Module C6

11 (a) Joel's teacher investigates the electrolysis of four liquids.

The first liquid he uses is melted sodium chloride.

Look at the apparatus he uses.



The table shows the products made.

Liquid	Product at cathode	Product at anode
lead bromide	lead	bromine
lead iodide	lead	iodine
sodium chloride	sodium	....
potassium iodide	....	iodine

(i) Complete the table. **[2]**

(ii) Sodium chloride contains sodium ions, Na^+, and chloride ions, Cl^-.

Solid sodium chloride does **not** conduct electricity, but **melted** sodium chloride **does** conduct electricity.

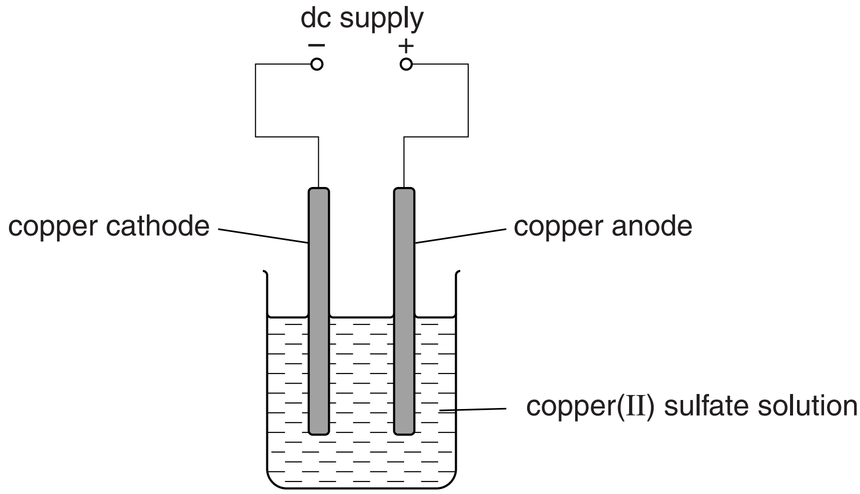
Explain why.

....

....

.... **[2]**

(b) Joel passes an electric current through **copper(II) sulfate solution**.



Joel does four experiments.

Joel changes either the **time** or the **current**.

Copper is made at the cathode.

He measures how much copper is made in each experiment.

Experiment	Current in amps	Time in minutes	Mass of copper made in g
1	0.15	5	0.20
2	0.30	5	0.40
3	0.15	10	0.40
4	0.60	10	1.60

Joel concludes that the amount of copper made is **proportional** to both the current and to the time.

Show how the results support this conclusion.

....

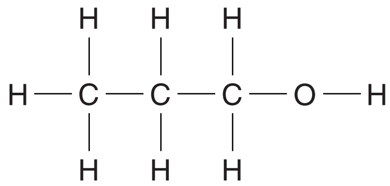
....

.... **[2]**

[Total: 6]

12 Propanol and ethanol are alcohols.

(a) Look at the displayed formula of propanol.



Propanol is **not** a hydrocarbon.

Explain why.

....

.... **[1]**

(b) Ethanol can be made from ethene.

Look at the word equation.

ethene + water → ethanol

Write down the name of this type of reaction.

Choose from the list.

displacement

electrolysis

hydration

galvanising

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

(c) Ethanol can also be made by fermentation from glucose.

Write about how fermentation can be used to make ethanol. Include the conditions needed for fermentation and how to get **pure** ethanol from the reaction mixture.

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

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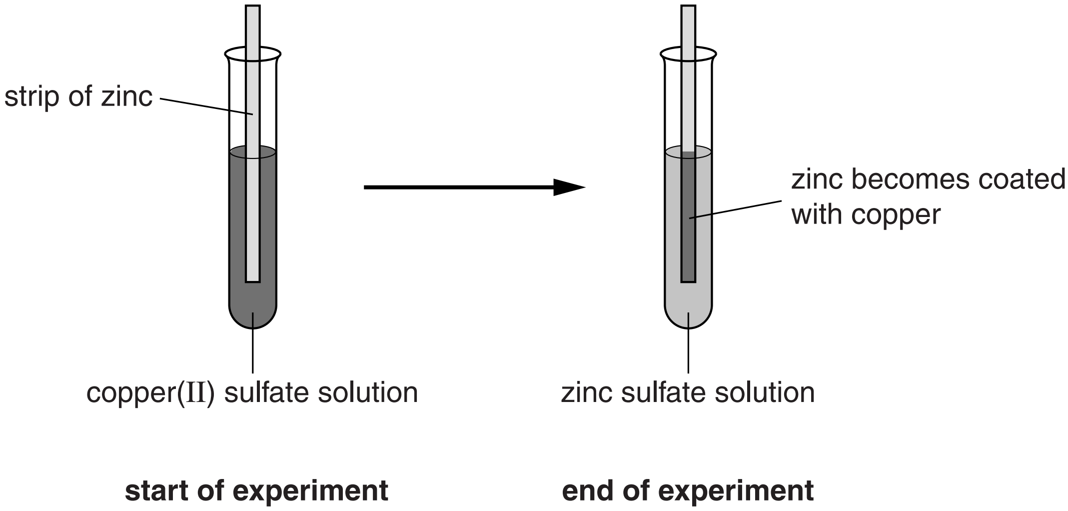
.... **[6]**

[Total: 8]

13 Jill investigates the reactivity of some metals.

Look at the diagram. It shows what happens when she puts a strip of zinc into copper(II) sulfate solution.



(a) Write the **word** equation for the reaction between zinc and copper(II) sulfate solution.

....	+	....	→	....	+	....

[1]

(b) Jill repeats the experiment with other metals and solutions.

Look at her table of results.

Solution used	Metal being added			
	Iron	**Copper**	**Magnesium**	**Zinc**
Iron(II) sulfate		✗	✓	✓
Copper(II) sulfate	✓		✓	✓
Magnesium sulfate	✗	✗		✗
Zinc sulfate	✗	✗	✓	

✗ = no reaction

✓ = metal reacts

Write down the **four** metals, copper, iron, magnesium and zinc, in order of reactivity.

Use the table of results to help you. The first metal has been completed for you.

most reactive metal ....magnesium........

....

....

least reactive metal .... **[1]**

(c) Jill finds out that copper reacts with silver nitrate solution.

Predict what will happen if Jill puts a strip of **copper** into a solution of **silver nitrate**.

Explain your answer.

....

....

.... **[2]**

[Total: 4]

14 This question is about hard and soft water.

(a) Jean investigates which ions cause hardness in water.

She has four different water samples, **A**, **B**, **C** and **D**.

She shakes 10 cm^3 of each water sample with 0.5 cm^3 of soap solution.

Water sample	Ions present in water sample	Reaction with soap solution
A	Na^+ and Cl^-	no scum, lots of lather
B	Ca^{2+} and Cl^-	lots of scum, no lather
C	K^+ and NO_3^-	no scum, lots of lather
D	Mg^{2+} and NO_3^-	some scum, little lather

(i) Which sample of water is the **hardest**?

Choose from **A**, **B**, **C** or **D**.

.... **[1]**

(ii) The results show that $\mathbf{Cl^-}$ does **not** cause water to be hard.

Explain why.

....

.... **[1]**

(b) Jean investigates different types of water softeners.

Write about different ways hard water can be softened.

....

....

.... **[2]**

[Total: 4]

15 Chlorofluorocarbons, CFCs, were used in the 1970s.

Scientists found evidence that CFCs cause holes in the ozone layer.

This allows more ultraviolet light to reach the surface of the Earth.

(a) Describe some of the medical problems caused by the increasing levels of ultraviolet light.

....

....

.... **[2]**

(b) The use of chlorofluorocarbons such as CCl_3F has now been banned in the UK.

Hydrofluorocarbons such as C_2HF_5 are now being used instead.

Explain which formula, $\mathbf{CCl_3F}$ or $\mathbf{C_2HF_5}$, contains the **most** atoms.

....

.... **[1]**

[Total: 3]

SECTION D

16 Scientists are concerned about the pollution of both the air and water.

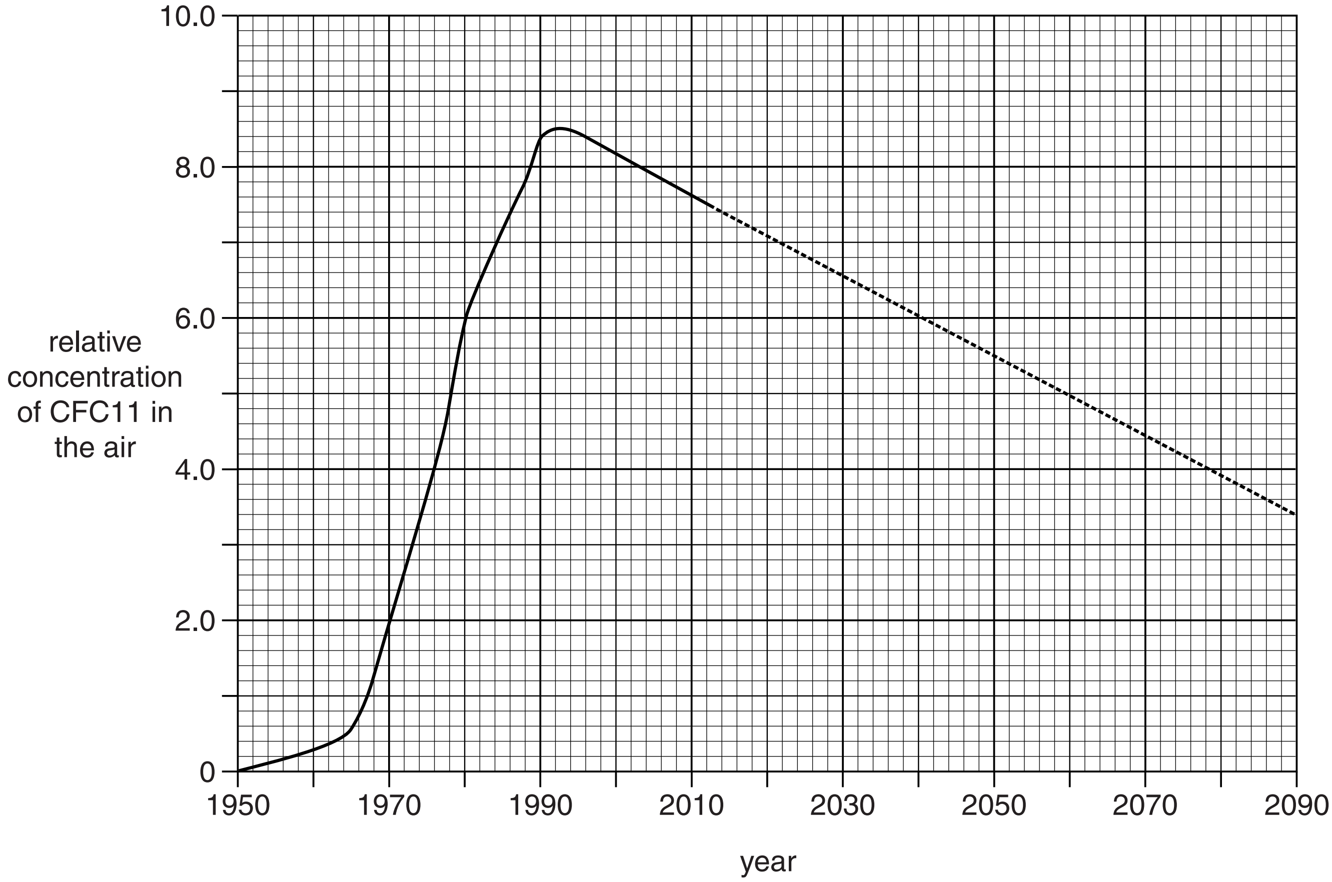
Chlorofluorocarbons, CFCs, are pollutants found in the air.

CFC11 is a chlorofluorocarbon.

Look at the graph.

It shows how the concentration of CFC11 in the air has changed between 1950 and 2013.

The dotted line shows how it may change up to 2090.



(a) Describe how the concentration of CFC11 has changed from 1950 until 2013.

....

....

.... **[2]**

(b) Many countries signed an international agreement to ban the use of CFCs.

Use the graph to suggest in which year the ban first started.

Explain your answer.

....

....

.... **[2]**

(c) CFC11 dissolves in rainwater.

Some rainwater collects underground.

Once underground, the concentration of CFC11 in the water does not change.

In 2013, a scientist analyses some underground rainwater.

She finds that the CFC11 concentration in the air, when the rain fell, was 2.0 units.

Use the graph to decide how many years this rainwater has been underground.

....

.... **[2]**

(d) Look at the graph.

Estimate the year when the concentration of CFC11 will drop to 50% of the 2003 value.

....

.... **[2]**

Turn over for the remainder of question 16

(e) CFC12 is another chlorofluorocarbon.

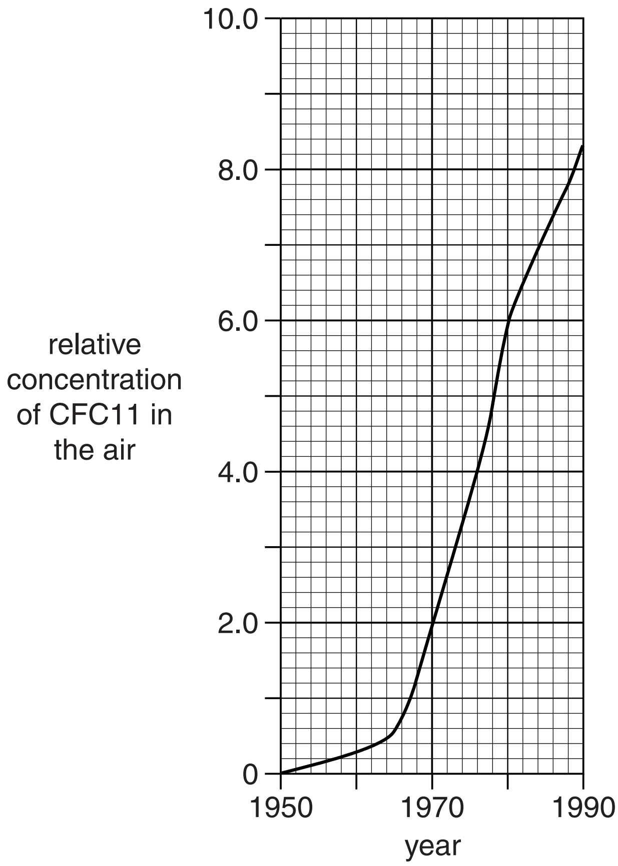
Look at the table.

It shows how the concentration of **CFC12** in the air has changed between 1950 and 1990.

Year	Relative concentration of CFC12 in the air
1950	0
1960	0.1
1970	1.2
1980	4.0
1990	4.3

Look at this graph.

It shows how the concentration of **CFC11** in the air has changed between 1950 and 1990.



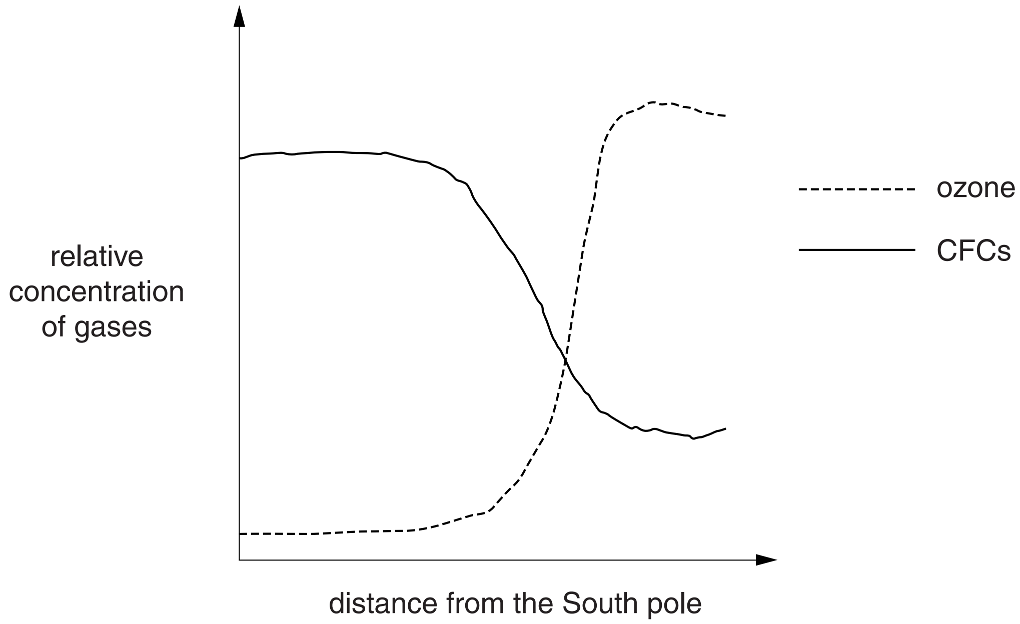
How does the concentration of CFC12 compare with that of CFC11?

.... **[1]**

(f) Scientists think that CFCs cause ozone depletion.

Look at the graph.

It shows how the ozone concentration and CFCs concentration change with increasing distance from the South Pole.



How does the information in the graph support the idea that CFCs cause ozone depletion?

....

.... **[1]**

[Total: 10]

END OF QUESTION PAPER

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The Periodic Table of the Elements

Key

relative atomic mass **atomic symbol** name atomic (proton) number

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						

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

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.