OCR
Oxford Cambridge and RSA

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Monday 15 June 2015 – 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 **28** pages. Any blank pages are indicated.

Answer **all** the questions.

SECTION A – Module C4

1 Lindsay is heating some copper carbonate, $CuCO_3$.

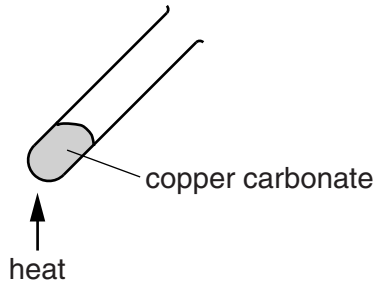
(a) **(i)** How many different **elements** are there in copper carbonate?

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

(ii) What is the total number of **atoms** in the formula, $CuCO_3$?

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

(b) Look at the diagram. It shows the apparatus Lindsay uses to heat the copper carbonate.



Copper carbonate changes into carbon dioxide and a solid. This is called **thermal decomposition**.

(i) Write a **word** equation for this reaction.

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

(ii) What is meant by thermal decomposition?

.....

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

(c) Copper is a metal.

One property of metals is that they are good conductors of heat.

Write down **two** other properties of metals.

.....

.....

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

2 Look at these symbols and formulas.

Na^+ H_2O Mg N

(a) (i) Which formula is a **molecule**?

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

(ii) Which formula is an **ion**?

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

(b) Find magnesium, Mg, on the periodic table.

What is the **atomic number** of magnesium?

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

(c) The **mass number** of nitrogen, N, is 14.

What is meant by the mass number?

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

(d) Magnesium, Mg, is an element.

Use its formula to explain how you can tell.

.....

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

(e) Several scientists helped to develop the periodic table.

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

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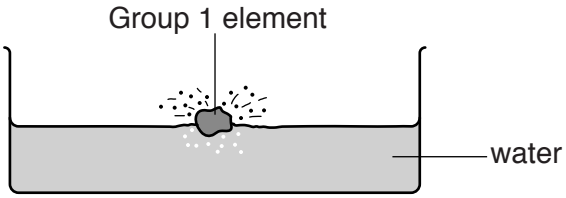
..... **[2]**

3 This question is about the reaction of Group 1 elements with water.

Lithium, sodium and potassium are Group 1 elements.

They react with water.



Look at the table.

Group 1 element	Time for 0.5 g of metal to react completely in seconds	Observations
sodium	15	melts moves across surface of water makes a gas which burns with a 'pop' makes an alkaline solution
potassium	7	melts and catches fire moves quickly across surface of water makes a gas which burns with a 'pop' makes an alkaline solution
lithium	25	moves slowly across surface of water makes a gas which burns with a 'pop' makes an alkaline solution

Rubidium is another Group 1 element.

It is below potassium in Group 1 of the periodic table.

When the same mass of rubidium reacts with water, **predict**

- what you will see
- the names of the products
- how long rubidium will take to react.

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

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

4 These substances are found in water before it is purified for drinking

- insoluble solids
- microbes.

(a) How are **insoluble solids** and **microbes** removed from water to make it safe to drink?

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

(b) Pete analyses two samples.

Look at Pete's results.

Sample	Addition of sodium hydroxide solution	Addition of barium chloride solution
A	blue solid made	white solid made
B	brown solid made	no reaction

Pete thinks that sample **A** is copper sulfate.

He thinks that sample **B** is iron(III) sulfate.

Is Pete right about **each** sample?

Explain your answer.

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

SECTION B – Module C5

5 Space probes have been sent to Mars to analyse the soil.

One compound analysed has the formula, K_2FeO_4.

(a) Calculate the molar mass of K_2FeO_4.

The relative atomic mass, A_r, of O = 16, of K = 39 and of Fe = 56.

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

(b) A sample of K_2FeO_4 is analysed.

The 1.00 g sample contains 0.39 g of potassium and 0.28 g of iron.

(i) Calculate the mass of oxygen in this sample.

mass of oxygen = ... g **[1]**

(ii) Calculate the percentage by mass of oxygen in this sample of K_2FeO_4.

percentage by mass = ... % **[1]**

(c) Another compound found on Mars has the molecular formula C_4H_{10}.

What is the **empirical** formula for this compound?

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

6 This question is about acids.

Nitric acid is a strong acid and propanoic acid is a weak acid.

David investigates the reaction of both of these acids with calcium carbonate.

(a) Both acids react with calcium carbonate to make a gas.

What is the name of this gas?

Choose from

carbon dioxide

carbon monoxide

hydrogen

nitrogen

propane

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

(b) David does two experiments

- the first with nitric acid
- the second with propanoic acid.

Each time he puts 50 cm^3 of 1.0 mol/dm^3 acid into a conical flask.

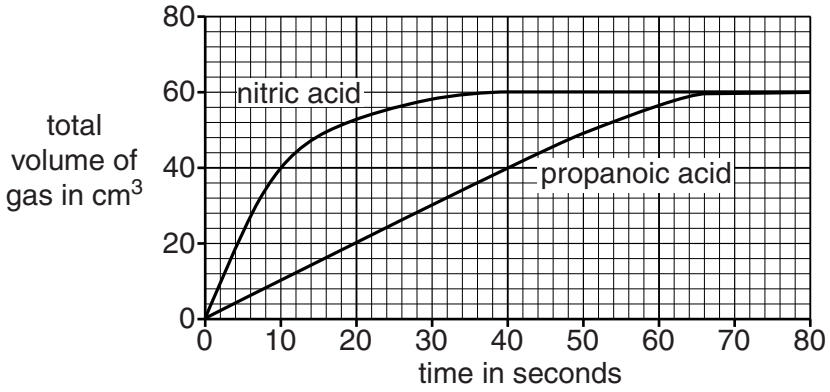
He then adds 0.25 g of calcium carbonate to the acid.

David measures the total volume of gas made every 10 seconds.

(i) Draw a **labelled** diagram of the apparatus David can use in these experiments.

[2]

(ii) Look at the graph of David's results.



Explain why the two lines are different but the final volume of gas at the end of the reaction is the same.

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

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

7 Methane is a fuel that can be made by the reaction between carbon dioxide and hydrogen.

$$CO_2(g) + 4H_2(g) \rightleftharpoons CH_4(g) + 2H_2O(g)$$

(a) What is the meaning of (g) in the equation?

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

(b) What is the meaning of the symbol $\rightleftharpoons$?

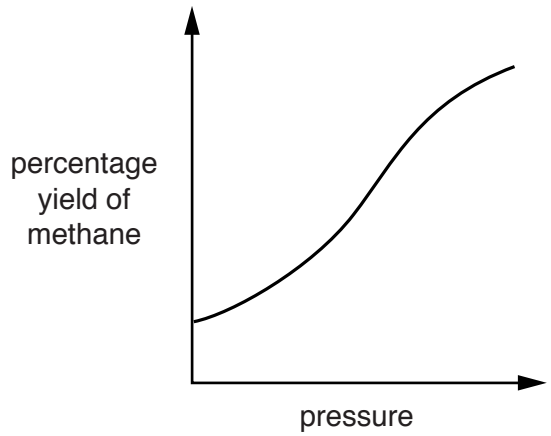
.....

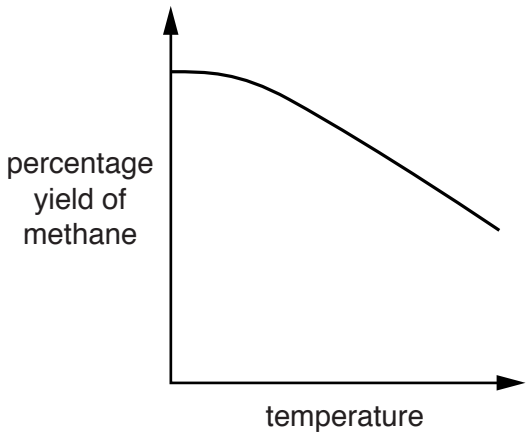
..... **[1]**

(c) Paul predicts that

- the percentage yield of methane increases when the temperature increases
- the percentage yield of methane increases when the pressure increases.

Look at the two graphs.





Do the graphs support Paul's predictions?

Explain your answer.

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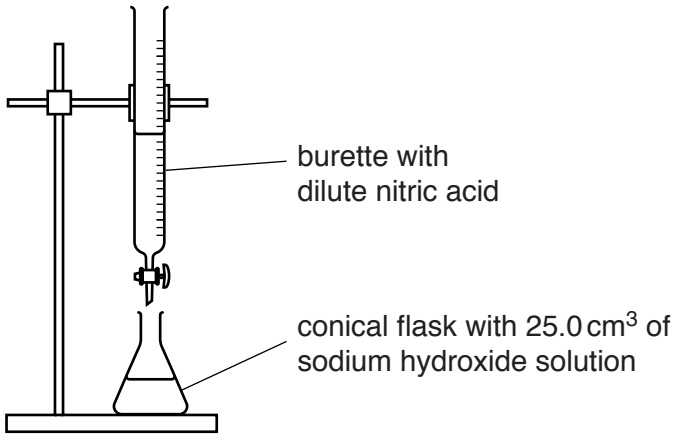
..... **[2]**

8 Sam does some titrations.

She uses sodium hydroxide solution and dilute nitric acid.

Look at the apparatus she uses.



Sam adds five drops of litmus indicator to the conical flask.

She records the burette reading at the start and slowly adds the acid to the flask.

She records the burette reading at the end-point of the titration.

(a) Describe the colour change of the litmus at the end-point of the titration.

.....

.....

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

(b) Sam does three titrations.

Look at a page from her exercise book. It shows her results.

second titration

first reading 5.2
second burette reading
24.1 cm^3

rough titration

burette reading goes from 0.0 to 20.1 cm^3

third titration

first burette reading 24.2
second reading 43.1 cm^3

(i) Present Sam's results in a table.

Include in the table the titres (the volume of acid added).

[2]

(ii) Which titrations should Sam use to work out the average (mean) titre?

What is the average (mean) titre for these titrations?

Give your answer to one decimal place.

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Average (mean) titre = ... cm^3 **[2]**

9 It is necessary to dilute a concentrated solution in medicines and in some food preparation.

Write about **one** example of the need for dilution in medicine and **one** example in food preparation.

In each example explain why it is important to dilute the solution.

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

SECTION C – Module C6

10 Mark is washing his clothes.

Look at the contents of Mark's washing powder.

active detergent
water softener
bleach
optical brightener
enzymes

The **enzyme** is needed in low temperature washes.

(a) What is the job of the enzyme?

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

(b) What are the advantages of using **low temperature** washes?

.....

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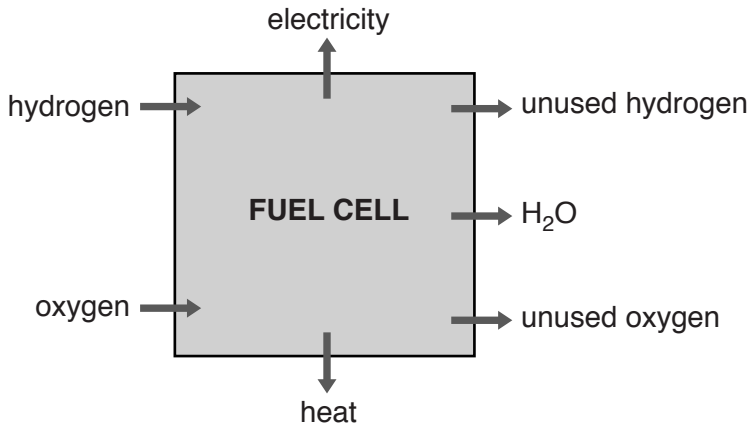
..... **[2]**

11 Fuel cells are used to make electricity.

Look at the diagram. It shows what happens in a fuel cell.



(a) What is the name of the fuel used in this fuel cell?

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

(b) In this fuel cell, hydrogen, H_2, reacts with oxygen, O_2.

Water, H_2O, is made.

Write a **balanced symbol** equation for this reaction.

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

(c) The burning of fossil fuels makes waste products that cause pollution.

This fuel cell does **not** make waste products that cause pollution.

Explain why.

.....

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

(d) Fuel cells are used to provide electrical energy in spacecraft.

Write down one **other advantage** of using fuel cells in spacecraft.

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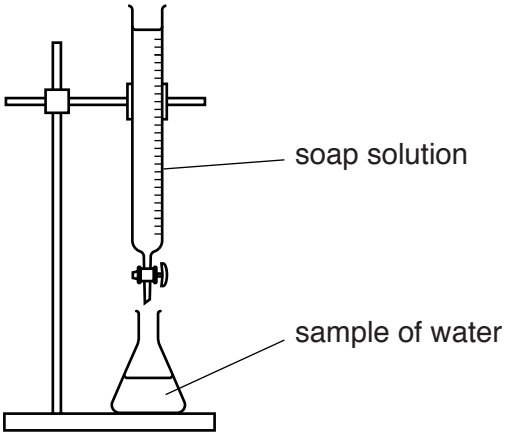
..... **[1]**

12 Kate is testing some samples of water with soap solution.

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



Kate adds soap solution to each sample of water and shakes it.

She keeps adding soap solution until a lather remains.

Look at the table. It shows her results.

Sample		Volume of soap solution added in cm^3
distilled water		5.0
X	before boiling	15.0
	after boiling	5.0
Y	before boiling	20.0
	after boiling	20.0
Z	before boiling	14.0
	after boiling	10.0

(a) Which sample of water is the **hardest before boiling**?

Explain your answer.

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

(b) Which sample contains **only permanent hardness**?

Explain your answer.

.....

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

(c) Kate has used soap solution.

She could have used a soapless detergent such as washing-up liquid.

There is a difference in the way that hard water reacts with a soap and with soapless detergent.

What is the difference?

.....

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

(d) Write down one way that **permanent** hardness can be removed from water.

.....

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

13 Nick is investigating the rusting of iron.

He wants to find out the best way of stopping iron from rusting.

He treats iron in different ways.

He leaves them in a damp place and sees how long it takes for the first signs of rust to appear.

Look at Nick's results.

Type of treatment	Time for rust to appear in days
untreated iron (no treatment)	1
painted iron	10
iron mixed with chromium (alloying)	120
iron coated in zinc (galvanised)	50
iron covered in oil	5

(a) Nick included the results for a piece of untreated iron.

Suggest why.

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

(b) Put the methods of preventing rusting in order of their effectiveness, with the most effective first.

Explain how you decided the order and describe how painting iron protects it from rusting.

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

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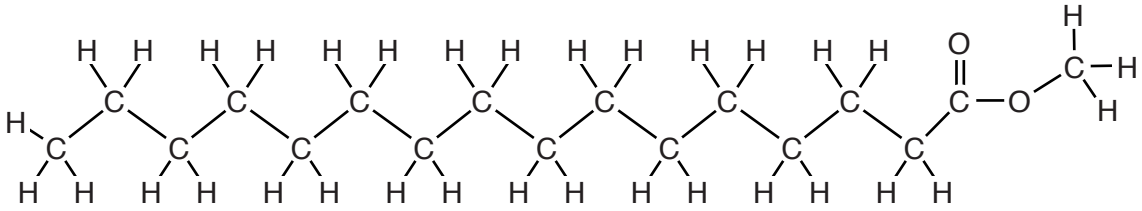
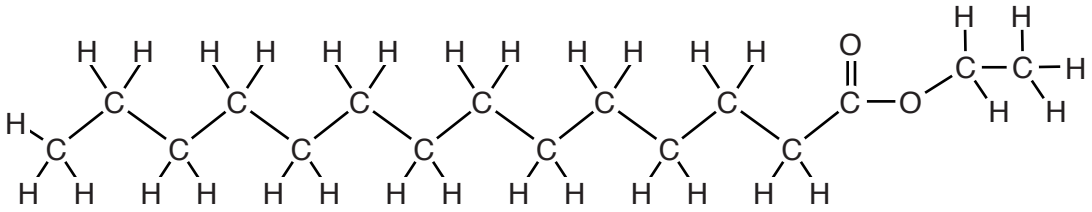
..... **[6]**

14 Look at the diagrams. They show the displayed formulas of some fats and oils.

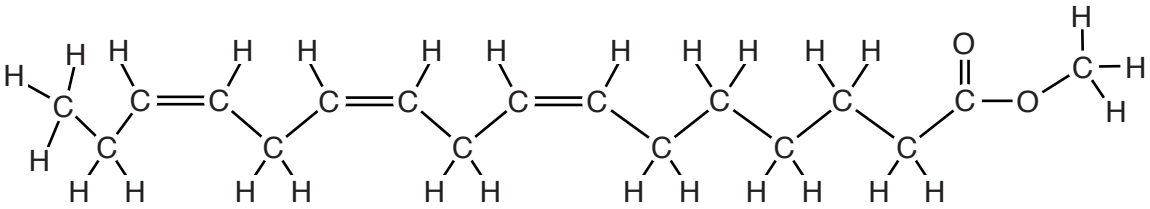
Formula **A**



Formula **B**



Formula **C**



(a) Which formula is **unsaturated**?

Explain your answer.

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

(b) Oils can be used to make an **emulsion**.

What is meant by an emulsion?

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

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Section D starts on the next page

SECTION D

15 This question is about air pollution.

Three atmospheric pollutants are:

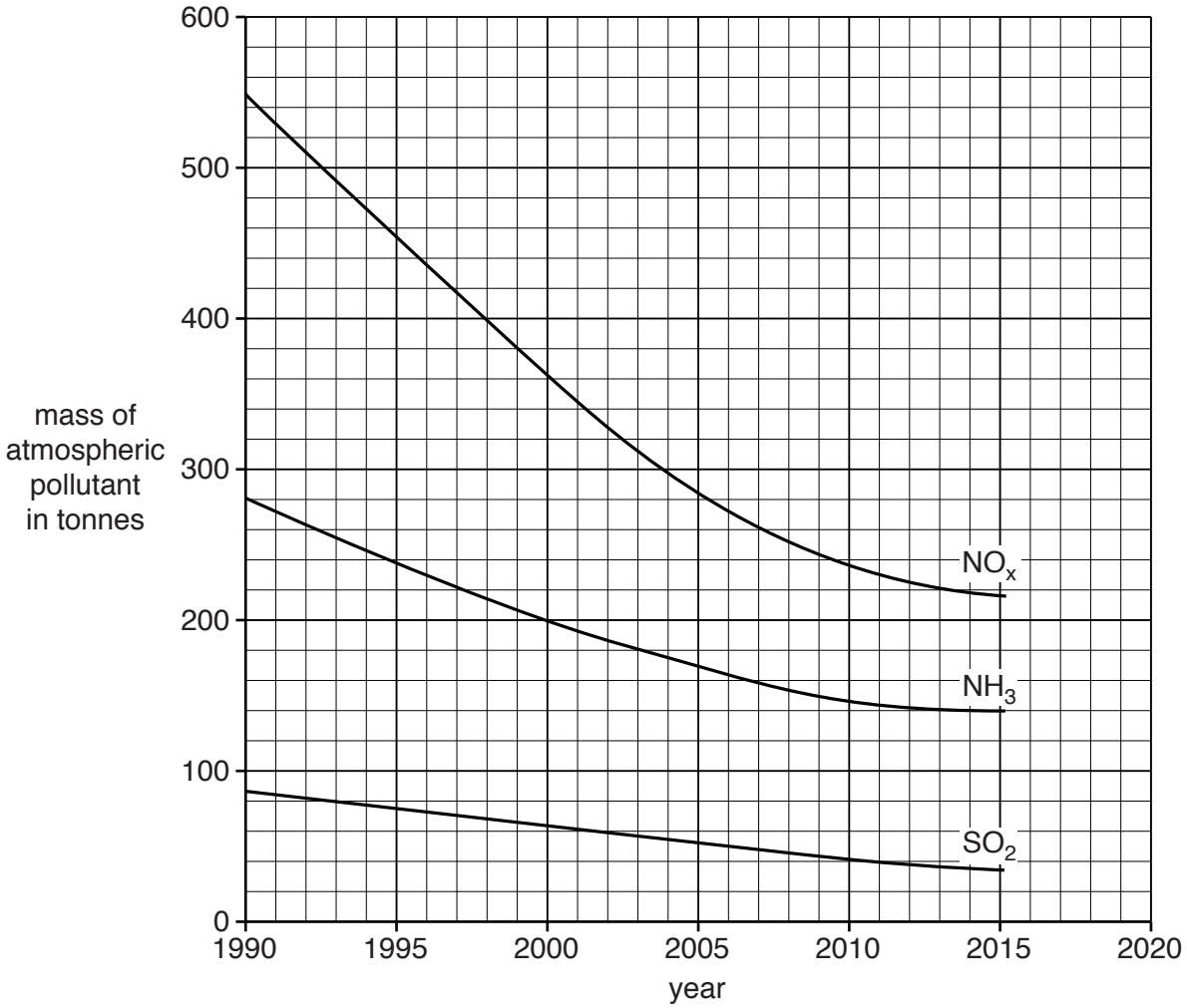
ammonia, NH_3

oxides of nitrogen, NO_x

sulfur dioxide, SO_2.

(a) Look at the graph.

It shows how the masses of atmospheric pollutants have changed in a city since 1990.



(i) In what year was 200 tonnes of ammonia present in the atmosphere?

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

(ii) Describe the general trend in the amount of atmospheric pollutants present in the atmosphere since 1990.

Suggest a reason for this trend.

.....

.....

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

(b) The table shows information about atmospheric pollutants in some countries of the European Union.

Country	Population in millions	Mass of pollutant made in kilotonnes		
		NO_x	SO_2	NH_3
Estonia	1.3	38	83	10
Germany	80	1323	449	548
Poland	39	867	974	271
Slovakia	5.4	89	69	24
Sweden	9.6	161	34	52
United Kingdom	64	1106	406	284
Whole of European Union	508	9200	4600	3600

(i) Look at the table. Which of these countries makes the **greatest** mass of atmospheric pollutants?

Explain your answer.

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.....

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

(ii) In the European Union the order from **greatest** mass to **least** mass of pollutant made is

greatest mass	**NO_x**
↓	**SO_2**
least mass	**NH_3**

Is this trend shown by all the countries in the table?

Explain your answer. Use information from the table.

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

(iii) What percentage of the total mass of NH_3 made by the European Union comes from Sweden?

percentage = ... % **[2]**

(iv) The population of Sweden is 1.9% of the population of the European Union.

Compare this percentage with your answer in part **(iii)**.

What conclusion can you make from these results?

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

END OF QUESTION PAPER

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The Periodic Table of the Elements

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 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** 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 **Tl** 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.***

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