Write your name here

Surname	Other names

Edexcel Certificate
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Centre Number | | | | | |

Candidate Number | | | | |

Chemistry

Unit: KCH0/4CH0
Science (Double Award) KSC0/4SC0
Paper: 1C

Monday 14 January 2013 – Morning
Time: 2 hours

Paper Reference
KCH0/1C 4CH0/1C
KSC0/1C 4SC0/1C

You must have:
Calculator
Ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*
- Show all the steps in any calculations and state the units.

Information

- The total mark for this paper is 120.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Write your answers neatly and in good English.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

P41538A

1/1/1/1/1/

P 4 1 5 3 8 A 0 1 2 8

PEARSON

THE PERIODIC TABLE

Period	Group 1	2											3	4	5	6	7	0
1	1 H Hydrogen 1																	4 He Helium 2
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
3	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
4	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
5	86 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	99 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
6	133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57	179 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	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86
7	223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89															

Key

Relative atomic mass
Symbol
Name
Atomic number

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Answer ALL questions.

1 This question is about the element beryllium.

(a) Use words from the box to complete the sentences about beryllium.

Each word may be used once, more than once or not at all.

(7)

electrons	**negative**	**neutral**	**neutrons**
nucleus	**positive**	**protons**	**shells**

An atom of beryllium has a central ..... that contains particles called ..... and ..... . Around these particles there are ..... orbiting in ..... .

An atom of beryllium has no charge because it contains equal numbers of ..... and ..... .

The particles with the lowest mass in an atom of beryllium are called ..... .

(b) Beryllium forms a compound with the formula $Be(OH)_2$

(i) How many different elements are there in $Be(OH)_2$?

(1)

.....

(ii) What is the total number of atoms in the formula $Be(OH)_2$?

(1)

.....

(Total for Question 1 = 9 marks)

2 The halogens are elements in Group 7 of the Periodic Table.

(a) Put a cross ☒ in the box to indicate your answer.

(i) Chlorine gas is

(1)

☒ **A** brown

☒ **B** colourless

☒ **C** green

☒ **D** violet

(ii) At room temperature, the physical state of bromine is

(1)

☒ **A** solid

☒ **B** liquid

☒ **C** gas

☒ **D** aqueous solution

(b) Which is the most reactive element in Group 7?

(1)

.....

(c) Chlorine reacts with hydrogen to form a colourless gas that dissolves in water to form an acid.

(i) What is the name of the colourless gas?

(1)

.....

(ii) What is the name of the acid?

(1)

.....

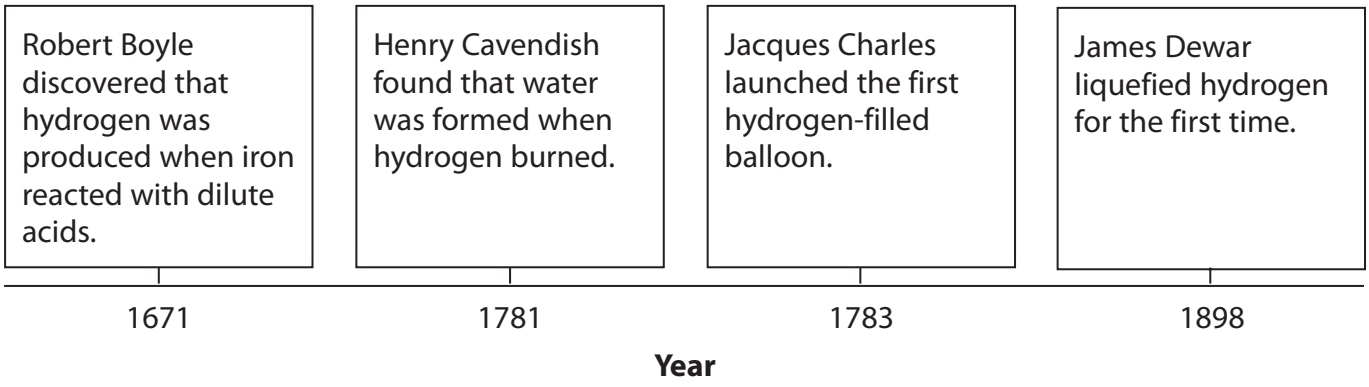
(iii) What is the formula that is used to represent both the colourless gas and the acid?

(1)

.....

(Total for Question 2 = 6 marks)

3 A student found this information about hydrogen.



(a) (i) The student repeated Boyle's experiment using iron and dilute sulfuric acid.

State **two** observations that he could have made.

(2)

1 .....

.....

2 .....

.....

(ii) Complete the word equation for this reaction.

(1)

iron + sulfuric acid → ..... + ...

(b) Balance the equation for the complete combustion of hydrogen.

(1)

..... H_2 + ... O_2 → ..... H_2O

(c) To show that the liquid produced by burning hydrogen was pure water, a student carried out a chemical test and a physical test.

(i) The chemical test involved adding a few drops of the liquid to a sample of anhydrous copper(II) sulfate.

State the colour change observed.

(2)

Initial colour .....

Final colour .....

(ii) Place a cross ☒ in one box to show the formula of the compound formed in this chemical test.

(1)

☒ **A** $Cu(OH)_2$

☒ **B** $CuSO_4$

☒ **C** $CuSO_4.H_2O$

☒ **D** $CuSO_4.5H_2O$

(iii) The physical test involved measuring a property of the liquid.

State a suitable physical property and give the value for pure water.

(2)

Physical property .....

Value .....

(d) (i) Suggest what property of hydrogen makes it suitable for filling balloons.

(1)

.....

(ii) Helium is now used instead of hydrogen to fill balloons.

State the property of helium that makes it more suitable than hydrogen for filling balloons.

(1)

.....

(e) Write an equation, including state symbols, to show the process that occurs when hydrogen is liquefied.

(1)

.....

(Total for Question 3 = 12 marks)

4 Water is needed for iron to rust.

(a) (i) State **one** other substance needed for iron to rust.

(1)

.....

(ii) When iron rusts, a brown compound forms that can be represented by the formula Fe_2O_3

State the name of this compound.

(1)

.....

(b) Three students decided to investigate the rusting of some iron nails. They measured the mass of each nail before placing it in some water. After rusting had occurred, the nails were removed and their masses were measured.

The table shows their results.

Student	Mass of nail before rusting in g	Mass of nail after rusting in g
A	3.0	3.3
B	1.5	1.7
C	1.8	1.7

(i) Suggest **one** problem in measuring the mass of a nail after rusting.

(1)

.....

.....

(ii) Student **A** thought that the results showed that his nail had rusted most.

Suggest why he thought this.

(1)

.....

(iii) Student **B** thought that her nail had rusted most.

Suggest why she thought this.

(1)

.....

(iv) How do the results of Student **C** show that he must have made an error in his experiment?

(1)

.....

.....

(c) Most methods used to prevent iron objects from rusting use a physical barrier. This involves covering the iron object with another substance to keep out the water.

Complete the table by choosing words from the box to suggest the substance that should be used to prevent each named iron object from rusting.

(2)

aluminium	**grease**	**oil**	**paint**	**plastic**

Iron object	Substance used to prevent rusting
bicycle chain	
railway bridge	

(d) Some iron objects are coated with zinc to prevent rusting. The zinc initially acts as a physical barrier, but an extra advantage of using zinc is that it continues to prevent rusting even if the layer of zinc is damaged.

State the name of this type of rust prevention and explain how it works.

(3)

.....

.....

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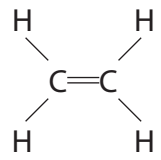
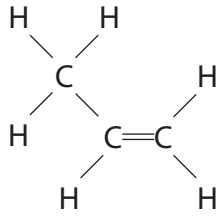
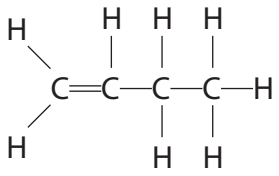
.....

.....

(Total for Question 4 = 11 marks)

5 The table shows the displayed formulae of three unsaturated hydrocarbons.

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

(a) Explain the meaning of the term **hydrocarbon**.

(2)

.....

.....

.....

(b) Explain the meaning of the term **unsaturated**.

(1)

.....

.....

(c) Compounds **A**, **B** and **C** belong to the same homologous series. One characteristic of the compounds in a homologous series is that they have the same general formula.

(i) State the name of this homologous series.

(1)

.....

(ii) State the general formula of this homologous series.

(1)

.....

(iii) State **two** other characteristics of the compounds in a homologous series.

(2)

1 .....

.....

2 .....

.....

(d) Compound **C** has several isomers.

(i) What is the name of compound **C**?

(1)

.....

(ii) What is the molecular formula of compound **C**?

(1)

.....

(iii) Explain the meaning of the term **isomers**.

(2)

.....

.....

.....

.....

(iv) Draw the displayed formula of an isomer of compound **C**.

(1)

(e) Bromine water can be used to distinguish compound **A** from ethane.

(i) Complete the sentence to show the colour change when compound **A** is bubbled through bromine water.

(1)

Bromine water changes from orange to ..... .

(ii) Complete the chemical equation for the reaction between compound **A** and bromine water.

(1)

$C_2H_4 + Br_2 \rightarrow$ .....

(Total for Question 5 = 14 marks)

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6 The reactivity of metals can be studied using displacement reactions. In these reactions, one metal is added to a solution of a salt of a different metal.

If a displacement reaction occurs, there is a temperature rise.

A student used the following method in a series of experiments.

- Pour some metal salt solution into a polystyrene cup supported in a glass beaker and record the temperature of the solution.
- Add a known mass of a metal and stir.
- Record the maximum temperature of the mixture.

(a) Suggest **three** variables that should be kept the same for the student's experiments to be a fair test.

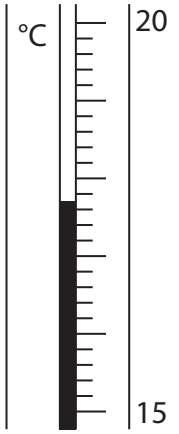
(3)

1 .....

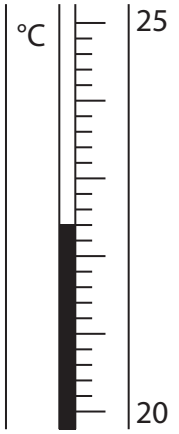
2 .....

3 .....

(b) The student used a thermometer to measure the temperature rise. The diagrams show the thermometer readings before and after adding the metal.



before adding metal



after adding metal

Use the diagrams to complete the table.

(3)

Temperature after adding the metal in °C	
Temperature before adding the metal in °C	
Temperature change in °C	

(c) The student used copper(II) sulfate solution in all her experiments. She used five different metals. She did not know the identity of the metal labelled **X**.

The student did each experiment twice. The table shows her results.

Metal	Temperature rise in °C		Average temperature rise in °C
	Run 1	Run 2	
magnesium	10.5	15.5	13.0
silver	0.0	0.0	0.0
iron	3.5	4.5	4.0
X	0.0	0.0	0.0
zinc	8.0	9.0	8.5

(i) Which of the metals gave the least reliable temperature rise?

Explain your choice.

(2)

Metal .....

Explanation .....

.....

.....

(ii) Identify the most reactive of the metals used.

Explain how the results show that it is the most reactive.

(2)

Metal .....

Explanation .....

.....

.....

(iii) Why is there no temperature rise when silver is added to copper(II) sulfate solution?

(1)

.....

.....

.....

(iv) Why do the results make it impossible to decide which of the metals is the least reactive?

(1)

.....

.....

.....

(d) A word equation for one of the reactions is

zinc + copper(II) sulfate → copper + zinc sulfate

Write a chemical equation for this reaction.

(1)

.....

(Total for Question 6 = 13 marks)

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7 Most metals are extracted in a blast furnace or by electrolysis.

(a) (i) The chemical equations for two reactions that occur during the extraction of aluminium are

A $\underline{Al^{3+}} + 3e^- \rightarrow Al$

B $\underline{C} + O_2 \rightarrow CO_2$

For each of these reactions, complete the table to show whether the underlined species is being oxidised or reduced. In each case, explain your choice.

(3)

Reaction	Species oxidised or reduced	Explanation of choice
A		
B		

(ii) Reaction **A** takes place at the negative electrode during the extraction of aluminium.

Write an ionic half-equation for the reaction at the positive electrode.

(2)

.....

(iii) Reaction **B** gives a waste product during the extraction of aluminium.

What effect does this reaction have on the positive electrodes?

(1)

.....

.....

(iv) Reaction **B** is also important in the extraction of iron in a blast furnace.

Name the raw material that reacts with oxygen and state why the reaction is important.

(2)

Raw material .....

Importance of reaction .....

.....

(b) Galena (PbS) and cerussite ($PbCO_3$) are two ores of lead. A mining company is considering which of these two ores to use for the extraction of lead.

The equations for the reactions occurring are

Process using galena:

$$2PbS + 3O_2 \rightarrow 2PbO + 2SO_2$$

$$2PbO + C \rightarrow 2Pb + CO_2$$

Process using cerussite:

$$PbCO_3 \rightarrow PbO + CO_2$$

$$2PbO + C \rightarrow 2Pb + CO_2$$

(i) Both processes form carbon dioxide, which the mining company hopes to sell.

Complete the table to show **two** uses of carbon dioxide and a property on which each use depends.

(4)

Use	Property

(ii) One disadvantage of using galena is that the sulfur dioxide produced can cause acid rain.

Write a chemical equation to show the formation of an acidic solution from sulfur dioxide and state one effect of acid rain.

(2)

Equation .....

Effect .....

.....

(c) The company uses a sample of cerussite containing 500 g of $PbCO_3$

Calculate the maximum mass of lead that can be obtained from this sample of cerussite.

(3)

Mass of lead = ... g

(Total for Question 7 = 17 marks)

8 The equation for a reaction that occurs in the manufacture of nitric acid is

$$4NH_3(g) + 5O_2(g) \rightleftharpoons 4NO(g) + 6H_2O(g) \qquad \Delta H = -900 \text{ kJ/mol}$$

(a) (i) State the meanings of the symbols $\rightleftharpoons$ and ΔH.

(2)

$\rightleftharpoons$ .....

ΔH .....

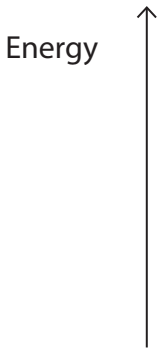
(ii) What does the negative sign of ΔH indicate about the reaction?

(1)

.....

(b) Complete the energy level diagram for this reaction.

(2)



(c) Typical conditions used for this reaction are a temperature of 900 °C and a pressure of 10 atmospheres.

Deduce the effects of changing the conditions as shown in the table. Choose from the words **increased**, **decreased** or **unchanged** to complete the table.

(4)

Change	Effect on rate of reaction	Effect on yield of products
increase in temperature		
addition of catalyst		

(d) A manufacturer considers using a pressure of 5 atm instead of 10 atm.

(i) Predict and explain the effect on the rate of reaction of changing the pressure to 5 atm.

(3)

Effect on rate of reaction .....

.....

Explanation .....

.....

.....

.....

.....

(ii) Predict and explain the effect on the position of equilibrium of changing the pressure to 5 atm.

(2)

Effect on position of equilibrium .....

.....

Explanation .....

.....

.....

(e) Balance the equation that represents the last stage in the manufacture of nitric acid.

$$\text{.....}NO_2 + \text{.....}O_2 + \text{.....}H_2O \rightarrow \text{.....}HNO_3$$

(1)

(Total for Question 8 = 15 marks)

9 This question is about bromine and some of its compounds.

(a) Atoms of bromine can be represented as ^{79}Br and ^{81}Br

(i) State the number of protons, neutrons and electrons in an atom of ^{79}Br

(2)

Protons .....

Neutrons .....

Electrons .....

(ii) What name is used for atoms of bromine that have different numbers of neutrons?

(1)

.....

(iii) Why do all atoms of bromine have the same chemical properties?

(1)

.....

.....

(iv) The relative atomic mass of bromine is given in the Periodic Table as 80, but a more accurate value is 79.9

Suggest, with a reason, which of the atoms ^{79}Br and ^{81}Br exists in greater numbers in a sample of bromine.

(2)

.....

.....

.....

.....

(b) Hydrogen bromide (HBr) and sodium bromide (NaBr) are compounds of bromine.

(i) Draw a dot and cross diagram to represent a hydrogen bromide molecule.

Show only the outer electrons in each atom.

(2)

(ii) Explain how the atoms are held together in a hydrogen bromide molecule.

(2)

.....

.....

.....

(iii) Explain why sodium bromide has a higher melting point than hydrogen bromide.

(3)

.....

.....

.....

.....

.....

.....

(c) A compound has the percentage composition 13.8% sodium, 47.9% bromine and 38.3% oxygen by mass.

Calculate its empirical formula.

(3)

Empirical formula = ...

(Total for Question 9 = 16 marks)

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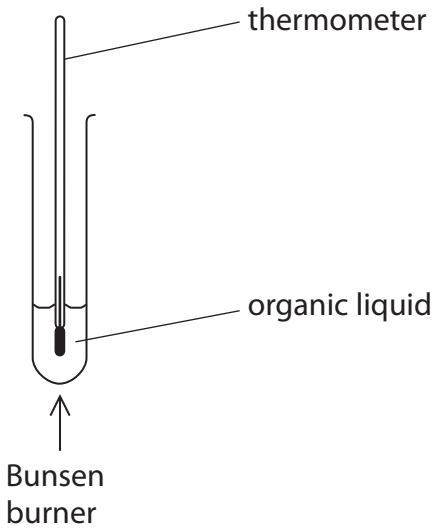
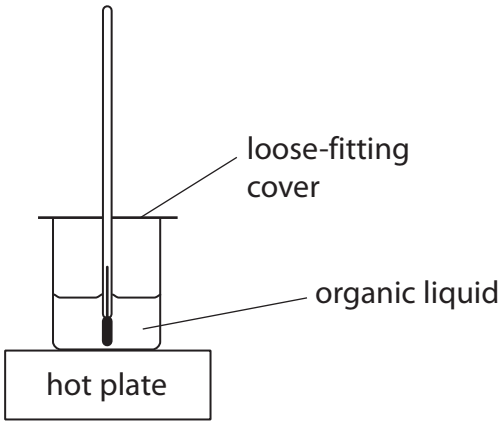
10 A teacher discussed with her students whether the boiling points of organic compounds are related to the size of their molecules.

The students suggested measuring the boiling points of some organic compounds using this apparatus.



(a) The teacher said that their suggested method was too dangerous.

She recommended using the apparatus shown below instead.



Suggest **one** reason why this apparatus is better than the students' suggestion.

(1)

.....

.....

(b) The students used the apparatus recommended by the teacher to measure the boiling points of five alcohols.

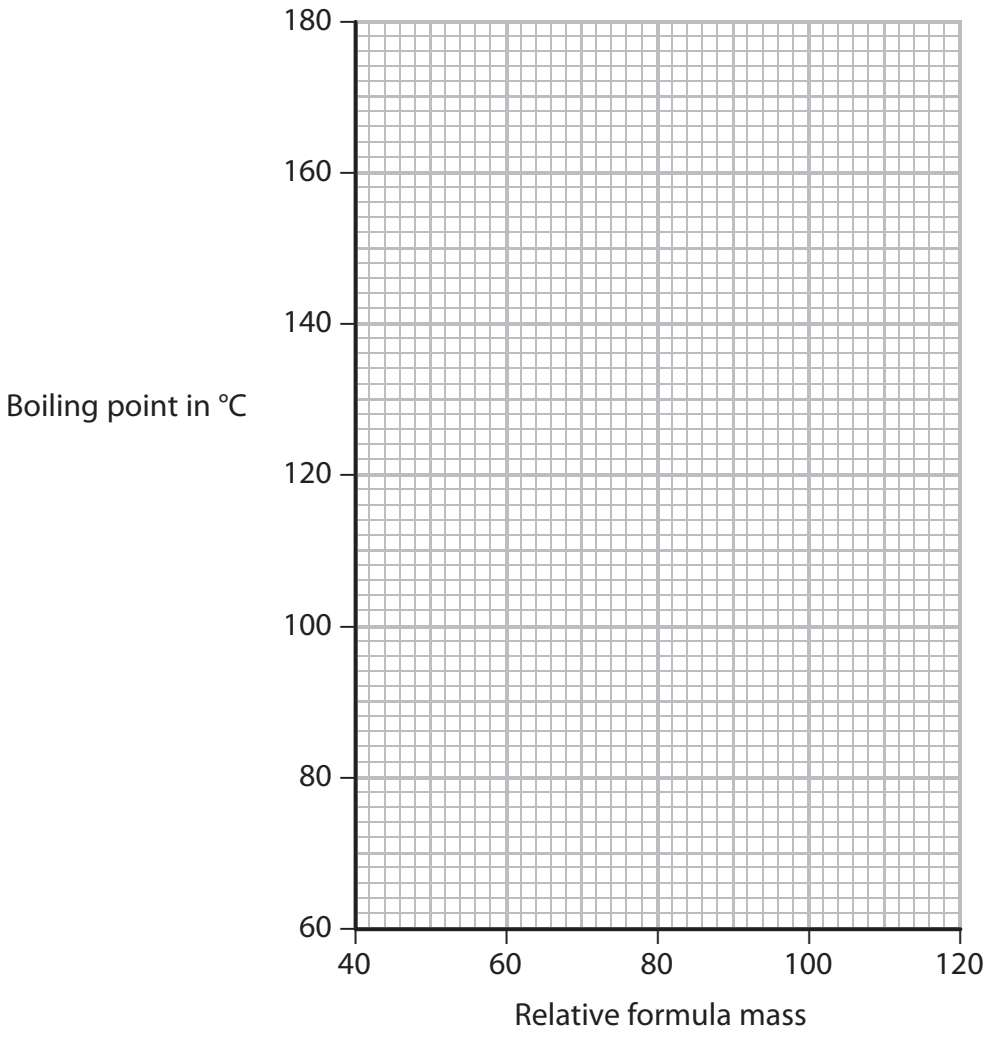
Their results are shown in the table.

	Alcohol				
	A	**B**	**C**	**D**	**E**
Boiling point in °C	78	96	138	157	176
Relative formula mass	46	60	88	102	116

(i) Plot a graph of the data in the table on the grid.

Draw a straight line of best fit through the points.

(3)



(ii) Describe the relationship shown by your graph.

(1)

.....

.....

(iii) Use your graph to predict the boiling point of the alcohol that has a relative formula mass of 74.

(1)

.....

(iv) Which of the alcohols **A**, **B**, **C**, **D** or **E** is the least volatile?

(1)

.....

(Total for Question 10 = 7 marks)

(TOTAL FOR PAPER = 120 MARKS)

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