Write your name here

Surname	Other names

Pearson Edexcel
Level 1/Level 2 GCSE (9-1)

Centre Number	Candidate Number

Chemistry

Paper 2

Foundation Tier

Sample Assessment Materials for first teaching September 2016
Time: 1 hour 45 minutes

Paper Reference
1CH0/2F

You must have:
a calculator
a 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.*
- Calculators may be used.
- Any diagrams may NOT be accurately drawn, unless otherwise indicated.
- You must **show all your working out** with **your answer clearly identified** at the **end of your solution**.

Information

- The total mark for this paper is 100.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- In questions marked with an asterisk (*), marks will be awarded for your ability to structure your answer logically showing how the points that you make are related or follow on from each other where appropriate.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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S 5 0 0 4 7 A 0 1 3 2

PEARSON

Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒.
If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 The Earth's early atmosphere was different from that of the Earth's atmosphere today.

(a) The Earth's early atmosphere was formed by

(1)

☒ **A** animals breathing.

☒ **B** global warming.

☒ **C** plants growing.

☒ **D** volcanic activity.

(b) Figure 1 shows some data about the composition of gases present in the Earth's early atmosphere and today's atmosphere.

	composition (%)	
gas	**Earth's early atmosphere**	**today's atmosphere**
nitrogen	4	78
oxygen	<0.01	21
argon	<0.01	0.9
gas X	95	0.04
ammonia	0.5	<0.001
sulfur dioxide	0.5	<0.001

Figure 1

Explain, using the data, the identity of gas X.

(2)

.....

.....

.....

.....

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(c) Figure 2 shows the concentration of carbon dioxide in the atmosphere above Hawaii from 1960 to 2010.

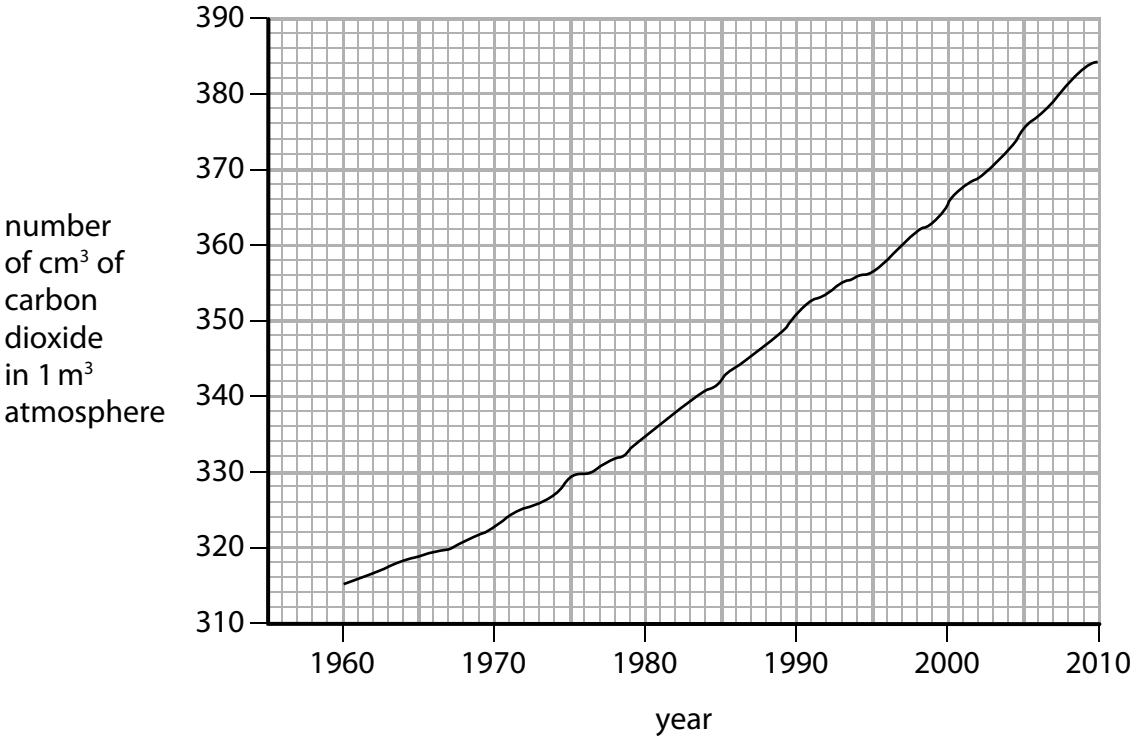


Figure 2

(i) Use the graph to calculate the increase in the volume of carbon dioxide in 1 m^3 of atmosphere from 1960 to 2010.

(2)

increase in volume of carbon dioxide = ... cm^3

(ii) Describe how carbon dioxide is released into today's atmosphere.

(2)

.....

.....

.....

.....

(Total for Question 1 = 7 marks)

2 (a) The atomic symbols of the first twenty elements in the periodic table are shown in Figure 3.

						H											He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca																

Figure 3

(i) From the position of beryllium, Be, in the periodic table, beryllium is most likely to be a

(1)

☒ **A** metal

☒ **B** halogen

☒ **C** compound

☒ **D** gas at room temperature

(ii) Give the symbol of the element that is in period 2 and in group 3.

(1)

.....

(iii) State the number of electron shells in an atom of potassium, K.

(1)

.....

(b) Figure 4 shows information about some of the elements in group 7 of the periodic table.

element	melting point / °C	boiling point / °C
fluorine	–220	–188
chlorine	–101	–35
bromine	7	59
iodine	114	184

Figure 4

Astatine is below iodine in group 7 of the periodic table.

Estimate the boiling point of astatine.

(1)

boiling point of astatine = ... °C

(c) Chlorine reacts with potassium iodide to form iodine and potassium chloride.

Complete the word equation for the reaction between bromine and potassium astatide.

(2)

bromine + potassium astatide → +

(d) Hydrogen reacts with chlorine to form hydrogen chloride.

$$H—H + Cl—Cl \rightarrow 2H—Cl$$

The symbol — is used to show a covalent bond.

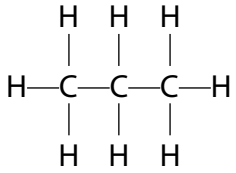
The electronic configuration of hydrogen is 1.
The electronic configuration of chlorine is 2.8.7.

Draw the dot-and-cross diagram for the molecule of hydrogen chloride.
Show outer electrons only.

(2)

(Total for Question 2 = 8 marks)

3 The structure of a molecule of propane is shown as



(a) Give the names of the elements combined together in propane.

(2)

.....

(b) Propane can burn completely in oxygen to form carbon dioxide and water.

(i) Write the word equation for this reaction.

(2)

.....

(ii) Propane is a fuel.

Give the reason why fuels are burned.

(1)

.....

.....

(c) Which product is formed when there is incomplete combustion of propane?

(1)

☒ **A** sulfur dioxide

☒ **B** oxygen

☒ **C** hydrogen

☒ **D** carbon monoxide

(d) Which of the following is the formula of a hydrocarbon?

(1)

☒ **A** C_6H_5OH

☒ **B** CH_2OHCH_2OH

☒ **C** $H_2C{=}CHCH_2CH_3$

☒ **D** $C_6H_{12}Cl_2$

(Total for Question 3 = 7 marks)

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4 (a) When solid ammonium chloride is shaken with water, a colourless solution forms and the temperature changes from 20 °C to 16 °C.

Give the name of the type of heat change occurring.

(1)

.....

(b) A student carries out an experiment to measure accurately the temperature changes when different metals are added to iron(II) sulfate solution.

The method for the experiment is:

- measure 25 cm^3 of iron(II) sulfate solution and pour into a container
- record the initial temperature of the solution
- add excess magnesium ribbon
- record the highest temperature of the mixture
- repeat the experiment using excess copper turnings, then using excess zinc foil.

(i) State a suitable container for the iron(II) sulfate solution in this experiment.

(1)

.....

(ii) State what the student should do to the mixtures during the experiment.

(1)

.....

(iii) Figure 5 shows the results obtained by the student.

metal added to iron(II) sulfate solution	temperature rise / °C
magnesium	6.0
copper	0.0
zinc	2.8

Figure 5

Explain the order of reactivity of the metals magnesium, copper and zinc using the results.

(2)

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.....

.....

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(iv) Explain how the student could improve the method to make a fairer comparison of the temperature change produced by the different metals.

(2)

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.....

.....

.....

(v) The iron(II) sulfate solution contained 6.2 g of iron(II) sulfate in 50 cm^3 of solution.

Calculate the concentration of the iron(II) sulfate solution in g dm^{-3}.

(2)

concentration = ... g dm^{-3}

(Total for Question 4 = 9 marks)

5 A student used the equipment in Figure 6 to investigate the rate of reaction between zinc and excess dilute hydrochloric acid.

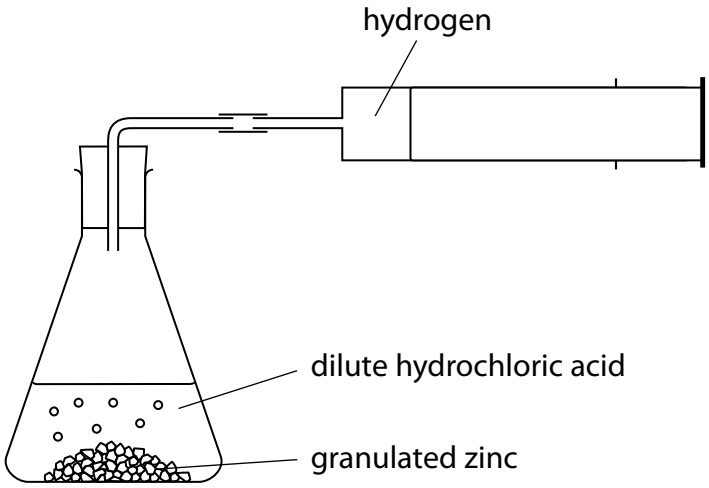


Figure 6

The student uses the following method:

- place a known mass of granulated zinc into the conical flask
- pour 25 cm^3 of dilute hydrochloric acid (an excess) into the conical flask and fit the bung quickly into the neck of the flask
- measure the volume of gas produced every 20 seconds until after the reaction finishes.

Figure 7 shows the results.

time / s	volume of hydrogen / cm^3
0	0
20	42
40	66
60	75
80	80
100	82
120	82
140	82

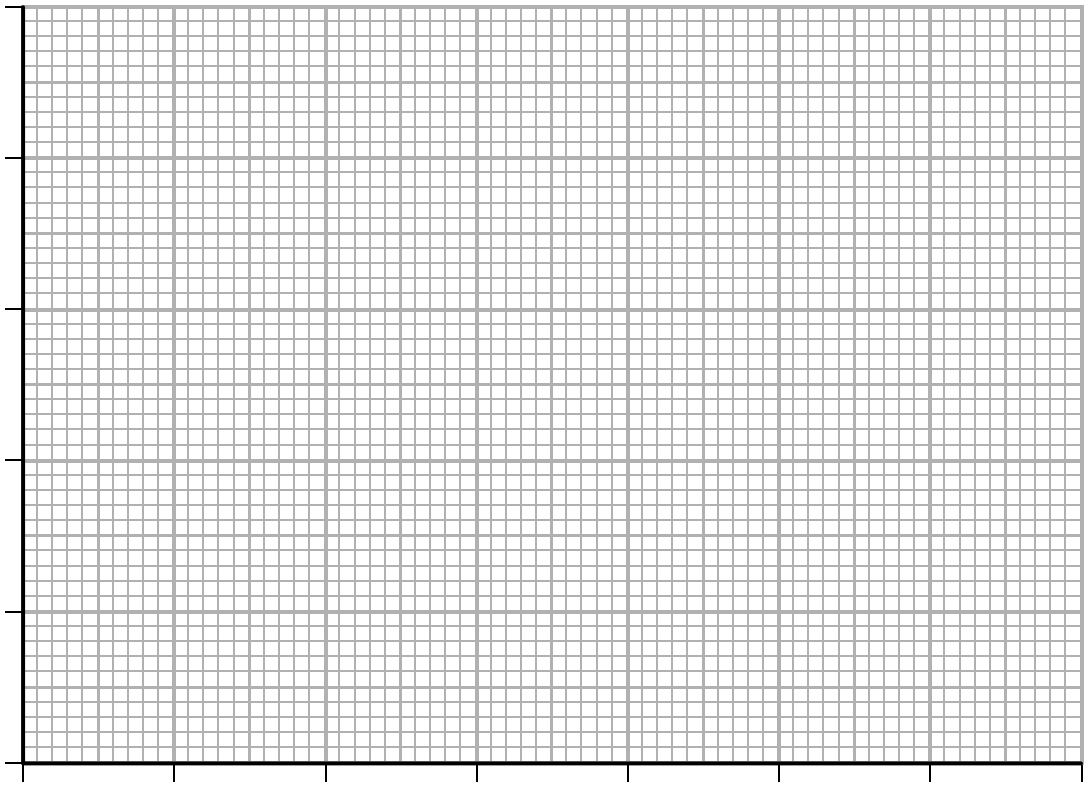
Figure 7

(a) Give the name of a piece of equipment that can be used to measure 25 cm^3 of dilute hydrochloric acid accurately.

(1)

(b) Draw a graph of the volume of hydrogen gas produced against time using the grid.

(3)



(c) The average rate of reaction in the first 20 seconds in cm^3 of hydrogen produced per second is

(1)

☒ **A** 2.1

☒ **B** 8.4

☒ **C** 21

☒ **D** 84

(d) The student repeated the experiment keeping all conditions the same but using the same mass of powdered zinc instead of granulated zinc.

On the grid above sketch the graph you would expect when the experiment is repeated using powdered zinc.
Label your line **A**.

(2)

(e) Sodium thiosulfate solution, $Na_2S_2O_3$, reacts with dilute hydrochloric acid as shown in the equation.

$$Na_2S_2O_3(aq) + 2HCl(aq) \rightarrow 2NaCl(s) + H_2O(l) + S(s) + SO_2(g)$$

The rate of this reaction can be investigated by mixing the reactants and finding the time taken for a precipitate of sulfur to become visible.

A student wants to investigate the effect of changing the temperature on the rate of this reaction.

Devise a method the student could use to find out how the time taken for the precipitate of sulfur to become visible changes with temperature.

(3)

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.....

(Total for Question 5 = 10 marks)

6 Alcohols and carboxylic acids are important organic compounds.

Figure 8 shows the names and formulae of three alcohols in a homologous series.

name	formula
methanol	CH_3OH
ethanol	C_2H_5OH
propanol	C_3H_7OH

Figure 8

(a) Predict the formula of the alcohol that has **five** carbon atoms in its molecule, using the information in Figure 8.

(1)

.....

(b) Calculate the relative formula mass of ethanol, C_2H_5OH.

(relative atomic masses: H = 1, C = 12, O = 16)

(2)

relative formula mass = ...

(c) Ethanol can be oxidised to form ethanoic acid.

Draw the structure of a molecule of ethanoic acid, showing all the covalent bonds.

(2)

(d) The temperature rise in water when liquid fuels burn can be found using the equipment shown in Figure 9.

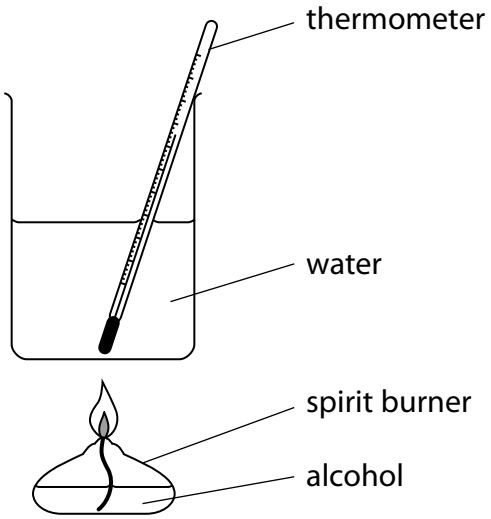

Figure 9

(i) A student compares the temperature rise produced in the water when propanol burns with the temperature rise produced when ethanol burns.

State **two** factors that the student must keep the same in both experiments in order to have a fair comparison.

(2)

1 .....

.....

2 .....

.....

(ii) The results for the two alcohols are shown in Figure 10.

alcohol	mass of alcohol burned / g	temperature rise / °C
ethanol	0.33	20
propanol	0.28	20

Figure 10

Explain, using only the information in Figure 10, why propanol might be the better fuel.

(2)

.....

.....

.....

.....

(Total for Question 6 = 9 marks)

7 This question is about some of the elements in groups 1 and 2 of the periodic table.

(a) The atomic number of lithium is 3.
The mass number of a lithium atom is 7.

Which row of the table shows the number of protons, neutrons and electrons in an atom of lithium-7?

(1)

	number of protons	number of neutrons	number of electrons
☒ **A**	3	3	4
☒ **B**	3	4	3
☒ **C**	4	3	7
☒ **D**	7	4	3

(b) Lithium, sodium and potassium are in group 1 of the periodic table.

State, in terms of the electrons in their atoms, what the atoms of lithium, sodium and potassium have in common.

(1)

.....

(c) Magnesium has atomic number 12.
Magnesium exists as magnesium-24, magnesium-25 and magnesium-26 atoms.

Explain, in terms of protons and neutrons, why these atoms are isotopes of magnesium.

(2)

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(d) Magnesium and calcium are in group 2 of the periodic table. They are less reactive than the metals in group 1.

Calcium reacts with water to form calcium hydroxide, $Ca(OH)_2$, and hydrogen, H_2.

$$Ca(s) + 2H_2O(l) \rightarrow Ca(OH)_2(s) + H_2(g)$$

Describe what would be **seen** when a piece of calcium is dropped into a container of water.

(2)

(e) Magnesium reacts very slowly with cold water but it reacts faster with steam, H_2O, to form magnesium oxide, MgO, and hydrogen.

Write the balanced equation for the reaction between magnesium and steam.

(2)

(f) The electronic configurations of magnesium and calcium are

magnesium 2.8.2
calcium 2.8.8.2

When magnesium and calcium react with water they form positive ions.

Suggest an explanation, in terms of their electronic configurations, why calcium is more reactive than magnesium.

(2)

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(g) A sample of calcium bromide contains 0.2 g calcium and 0.8 g bromine by mass.

Calculate the empirical formula of calcium bromide.

(relative atomic masses: Ca = 40, Br = 80)

(3)

empirical formula = ...

(Total for Question 7 = 13 marks)

8 Crude oil is a mixture of hydrocarbons.

It can be separated into fractions.

(a) Which of these mixtures shows formulae of substances that could be in the gaseous fraction of crude oil?

(1)

☒ **A** C_2H_4, C_3H_8, $C_4H_{10}O$

☒ **B** C_2H_4, C_3H_7Br, C_4H_{10}

☒ **C** C_2H_6, C_3H_8, C_4H_{10}

☒ **D** C_2H_6, C_3H_7Br, $C_4H_{10}O$

(b) Figure 11 shows the percentages of the fractions in crude oil from three different oil wells.

	percentage of fraction in crude oil from		
fraction	**oil well A**	**oil well B**	**oil well C**
gases	1	6	9
petrol	2	15	24
kerosene	6	14	20
diesel oil	7	10	16
fuel oil	26	28	30
bitumen	58	27	1

Figure 11

(i) State which oil well produces a crude oil containing the highest percentage of the high boiling point fractions.

(1)

.....

(ii) A barrel of crude oil from oil well B weighs 130 kg.

Calculate the mass of kerosene in this barrel.

(1)

..... kg

*(c) Diesel is the fuel used in most bus engines.

Research is being carried out into the use of hydrogen, instead of diesel, as a fuel for buses.

Discuss the advantages and disadvantages of using hydrogen, rather than diesel, as a fuel for buses.

(6)

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(d) Fractions of crude oil contain alkanes.

A sample of decane, $C_{10}H_{22}$, was cracked using the apparatus in Figure 12.

This produced a mixture of products, including ethene.

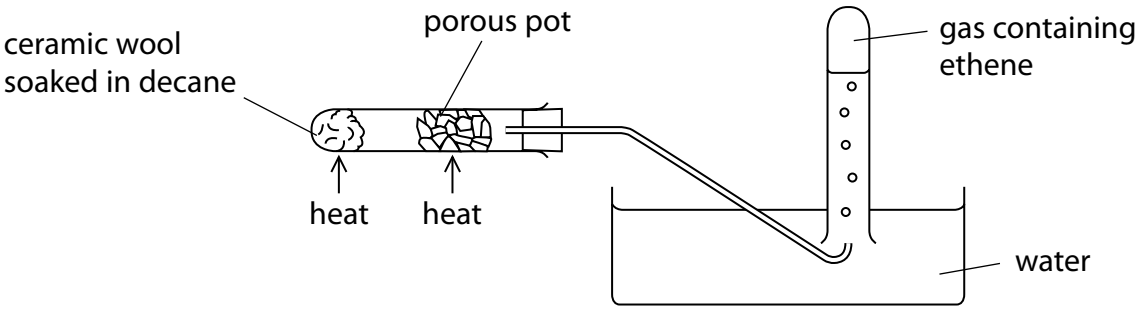

Figure 12

(i) Explain how ethene is produced using the apparatus in Figure 12.

(3)

(ii) One molecule of decane produced two molecules of propene, C_3H_6, and one molecule of product **Z**.

$C_{10}H_{22} \rightarrow 2C_3H_6$ + product **Z**

What is the formula of product **Z**?

(1)

- ☒ **A** C_4H_8
- ☒ **B** C_4H_{10}
- ☒ **C** C_7H_{14}
- ☒ **D** C_7H_{16}

(Total for Question 8 = 13 marks)

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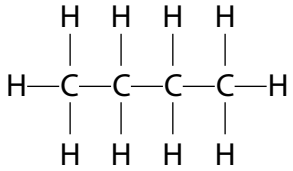
9 Alkanes and alkenes are hydrocarbons.

The structure of a molecule of butane is shown.



(a) Which of the following is the empirical formula for butane?

(1)

☒ **A** CH

☒ **B** CH_2

☒ **C** C_2H_5

☒ **D** C_4H_{10}

(b) The graph in Figure 13 shows the boiling points of some alkanes plotted against the number of carbon atoms in one molecule of each alkane.

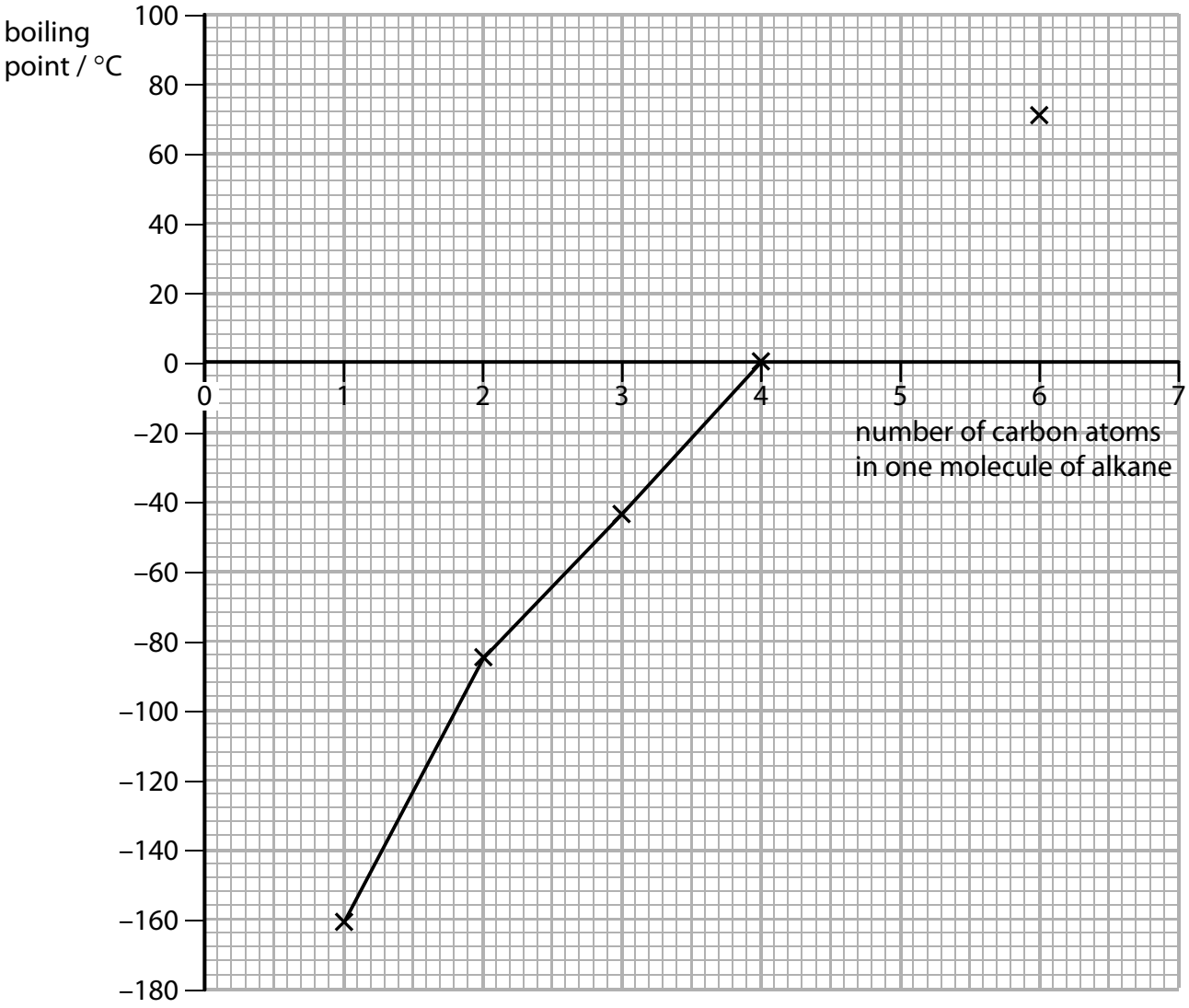


Figure 13

A molecule of pentane contains five carbon atoms.
Use the graph to estimate the boiling point of pentane.

(1)

boiling point of pentane = ... °C

(c) Figure 14 shows some information about the alkenes, ethene and propene.

Complete the table. The structure of propene must show all covalent bonds.

(2)

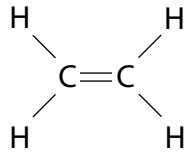
name of alkene	molecular formula	structure
ethene		
propene	C_3H_6	

Figure 14

(d) Alkenes burn completely to produce carbon dioxide and water.

Balance the equation for the complete combustion of butene gas, C_4H_8.

(1)

$$C_4H_8 + \ldots\ldots O_2 \rightarrow \ldots\ldots CO_2 + \ldots\ldots H_2O$$

(e) Butene reacts with steam to produce butanol.

$$C_4H_8 + H_2O \rightarrow C_4H_9OH$$

(i) Calculate the maximum mass of butanol, C_4H_9OH, that can be produced when 1.4 kg of butene, C_4H_8, reacts with excess steam.

(relative atomic masses: H = 1, C = 12, O = 16
relative molecular mass of butene, C_4H_8 = 56)

(3)

mass of butanol = ... kg

(ii) What type of reaction takes place between butene and steam?

(1)

- ☒ **A** addition
- ☒ **B** dehydration
- ☒ **C** neutralisation
- ☒ **D** substitution

(f) A sample of each of three hydrocarbons, **X**, **Y** and **Z**, was shaken with bromine water. Bromine water is orange coloured.

The results are:

X orange mixture becomes colourless

Y orange mixture becomes colourless

Z mixture remains orange

Using the results, comment on the structures of the hydrocarbons **X**, **Y** and **Z**.

(2)

.....

.....

.....

.....

(g) Alkenes are used to make polymers.

Figure 15 shows the repeating unit of a polymer.

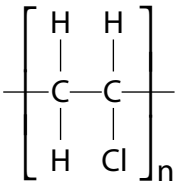


Figure 15

Draw the structure of a molecule of the monomer that was used to produce this polymer.

(1)

(h) Bottles can be made of polymers, such as poly(ethene), and of glass.

Give **one** advantage of a bottle made of a polymer rather than a bottle made of glass.

(1)

.....

.....

(Total for Question 9 = 13 marks)

10 Qualitative tests can be used to identify ions in substances.

(a) Sodium hydroxide solution is warmed with a solution of ammonium ions.
Ammonia gas is given off.

Describe the test to show the gas is ammonia.

(2)

.....

.....

.....

.....

(b) Two tests were carried out on copper sulfate solution.

(i) Sodium hydroxide solution was added to a small amount of copper sulfate solution.
A blue precipitate of copper hydroxide formed.

Complete the word equation for the reaction.
Include state symbols.

(2)

copper sulfate (aq) + sodium hydroxide (aq) → ..... (.....) + ... (.....)

(ii) Dilute hydrochloric acid was added to a different sample of copper sulfate solution. Barium chloride solution was then added.

State what would be **seen**.

(1)

.....

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*(c) A technician found some colourless crystals in an unlabelled beaker in a laboratory.

The technician knew that the substance was potassium chloride, potassium carbonate, sodium chloride or sodium iodide.

Plan a series of tests the technician could carry out to identify the colourless crystals.

(6)

(Total for Question 10 = 11 marks)

TOTAL FOR PAPER = 100 MARKS

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.

Paper 2 Foundation

Question number	Answer	Mark
1(a)	D	**(1)**

Question number	Answer	Mark
1(b)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 mark): • gas X is carbon dioxide (1) • because the percentage of gas has fallen markedly (1)	**(2)**

Question number	Answer	Additional guidance	Mark
1(c)(i)	• 384 and 315 used from graph (1) • 384 − 315 = 69 (cm^3) (1)	Allow 384 to 385 in 2010 and 314 to 316 in 1960. Second mark consequential on values read from graph. Award full marks for correct numerical answer without working.	**(2)**

Question number	Answer	Additional guidance	Mark
1(c)(ii)	An answer that provides a description by making reference to one of the following linked pairs: • burning/(complete) combustion (1) • of carbon compounds/(fossil) fuels/wood/rubbish/plastic (1) OR • respiration/gas exhaled/breathing/ decaying (1) • from plants/animals/organisms (1) OR • eruption (releases gas) (1) • from volcanic activity/volcanoes (1)	Allow any type of fuel except hydrogen. Allow heating limestone.	**(2)**

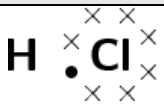
Question number	Answer	Mark
2(a)(i)	A	**(1)**

Question number	Answer	Additional guidance	Mark
2(a)(ii)	B	Allow boron.	**(1)**

Question number	Answer	Mark
2(a)(iii)	4	(1)

Question number	Answer	Additional guidance	Mark
2(b)	Any temperature > 184 (°C).	Ignore units.	(1)

Question number	Answer	Additional guidance	Mark
2(c)	astatine (1) + potassium bromide (1)	Allow products in either order.	(2)

Question number	Answer	Additional guidance	Mark
2(d)	 • One shared pair of electrons in molecule (1) • Rest of molecule correct, conditional on shared pair (1)	Allow any combination of dots and crosses.	(2)

Question number	Answer	Mark
3(a)	• carbon (1) • hydrogen (1)	(2)

Question number	Answer	Mark
3(b)(i)	propane + oxygen → carbon dioxide + water • LHS (1) • RHS (1)	(2)

Question number	Answer	Mark
3(b)(ii)	to {release/produce} {heat/energy}	(1)

Question number	Answer	Mark
3(c)	D	(1)

Question number	Answer	Mark
3(d)	C	(1)

Question number	Answer	Mark
4(a)	endothermic	**(1)**

Question number	Answer	Mark
4(b)(i)	Any one from: • beaker (1) • polystyrene cup (1) • conical flask (1)	**(1)**

Question number	Answer	Mark
4(b)(ii)	Stir the mixtures with the thermometer	**(1)**

Question number	Answer	Mark
4(b)(iii)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 mark): • order of reactivity from most reactive to least reactive magnesium, zinc, (iron), copper (1) • because the most reactive shows biggest temperature rise/least reactive shows lowest temperature rise (1)	**(2)**

Question number	Answer	Additional guidance	Mark
4(b)(iv)	An explanation that combines identification – improvement of the experimental procedure (1 mark) and justification/reasoning which must be linked to the improvement (1 mark): • use magnesium, zinc and copper as powders (1) • so they have the same/similar size particles/surface area/shape (1)	allow other acceptable answers, e.g. use same mass / no moles of each	**(2)**

Question number	Answer	Additional guidance	Mark
4(b)(v)	1000 cm^3 contain $\frac{6.2 \times 1000}{50}$ (1) 1 dm^3 contains 124 ($g\,dm^{-3}$) (1)	Award full marks for correct numerical answer without working.	**(2)**

Question number	Answer	Mark
5(a)	Measuring cylinder/burette/pipette	**(1)**

Question number	Answer	Additional guidance	Mark
5(b)	• axes with linear scale that use more than half of each edge of the grid and labelled with units from the table (1). • all points correctly plotted to ± half a square (1). • single straight line passing through all points and the origin (1).	7 points plotted correctly (i.e. one error) (1) allow ecf from plotting error.	**(3)**

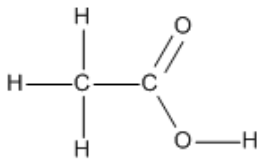
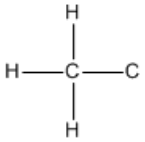
Question number	Answer	Mark
5(c)	A	**(1)**

Question number	Answer	Mark
5(d)	Line A on graph: • steeper curve/curve drawn to left of original (1) • levelling off at 82 cm^3 (1)	**(2)**

Question number	Answer	Mark
5(e)	An answer that combines the following points to provide a method: • suitable method of warming the solutions, e.g. water bath, Bunsen burner with tripod and gauze and measure the temperature of each solution using a thermometer (1) • use the same volumes of the solutions in each experiment (1) • measure the time for the precipitate to form (and obscure a cross placed under the reaction vessel) using a stop watch/clock (1)	**(3)**

Question number	Answer	Mark
6(a)	$C_5H_{11}OH$	**(1)**

Question number	Answer	Additional guidance	Mark
6(b)	(2 × 12) + (5 × 1) + 16 + 1 (1) = 46 (1)	Award full marks for correct numerical answer without working.	**(2)**

Question number	Answer	Additional guidance	Mark
6(c)	 Structure to show 2 carbon atoms with 3 hydrogens joined to one of them (1)  Rest of structure correct (1)	Allow OH	**(2)**

Question number	Answer	Mark
6(d)(i)	Any two from: • mass/volume of water (1) • height of container above wick (1) • length of wick/height of flame (1) • the container needs to be the same {shape/size/material} (1) • same number of moles of alcohol (1)	**(2)**

Question number	Answer	Mark
6(d)(ii)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 mark): • the same temperature rise is achieved (1) • using a lower mass of alcohol/propanol (1)	**(2)**

Question number	Answer	Mark
7(a)	B	**(1)**

Question number	Answer	Mark
7(b)	They (contain) same number of outer shell electrons/all have 1 electron in outer shell.	**(1)**

Question number	Answer	Additional guidance	Mark
7(c)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (1 mark): • all magnesium atoms have 12 protons (1) • however Mg-24 has 12 neutrons, Mg-25 has 13 neutrons, Mg-26 has 14 neutrons (1)	Ignore references to atomic number and to mass number/relative atomic mass. Allow magnesium atoms contain same number of protons but different numbers of neutrons (1)	**(2)**

Question number	Answer	Additional guidance	Mark
7(d)	An answer that combines the following points of understanding to provide a logical description: • (hydrogen produced as a gas so) there would be {effervescence/fizzing/ bubbles} (1) • calcium hydroxide produced as a solid so the water would {go cloudy/a white precipitate would form} (1)	Allow: • calcium would move (around) (1) • calcium would decrease in size/disappears/ dissolves (1)	**(2)**

Question number	Answer	Mark
7(e)	$Mg + H_2O \rightarrow MgO + H_2$ • LHS (1) • RHS (1)	**(2)**

Question number	Answer	Additional guidance	Mark
7(f)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • in calcium the outermost electron(s) {are further away from nucleus/experience(s) greater shielding} (from the nucleus) (as shown by the electronic configuration) (1) • therefore less attraction between nucleus and electron(s)/the electron(s) is/are easier to remove (1)	Allow answers in terms of why reactivity of magnesium is less than that of calcium.	**(2)**

Question number	Answer	Additional guidance	Mark
7(g)	• divides mass by relative atomic mass (1) • calculates simplest ratio (1) • expresses ratio correctly as empirical formula (1)	Example of calculation Ca : Br $\frac{0.2}{40}$: $\frac{0.8}{80}$ 0.005 : 0.01 1 : 2 empirical formula $CaBr^2$ formula alone scores max	**(3)**

Question number	Answer	Mark
8(a)	C	**(1)**

Question number	Answer	Mark
8(b)(i)	(oil well) C	**(1)**

Question number	Answer	Mark
8(b)(ii)	(oil well) A	**(1)**

Question number	Indicative content
***8(c)**	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO1 (6 marks)** Answers must compare advantages of using hydrogen instead of diesel • plenty of water/raw material • limited supplies of crude oil • hydrogen produces only water as waste • diesel also produces carbon dioxide • carbon dioxide emissions may cause global warming • diesel undergoes incomplete combustion • diesel also produces carbon and/or carbon monoxide • carbon is formed as soot and makes objects dirty • carbon monoxide is a toxic gas • hydrogen can be obtained from the water produced. with disadvantages of using hydrogen instead of diesel • hydrogen gas has to be manufactured • energy/electricity is needed to produce hydrogen • producing electricity from non-renewable resources produces carbon dioxide • hydrogen is expensive to produce • problems of storage of large volumes of flammable gas • stronger/heavier/bigger fuel tanks needed • hydrogen is a gas and leaks easily if the fuel system is damaged • there are limited outlets for buying hydrogen.

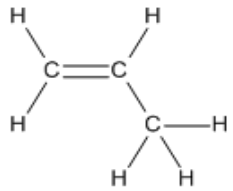
Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	• Demonstrates elements of chemical understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • Presents a discussion with some structure and coherence. (AO1)
Level 2	3–4	• Demonstrates chemical understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • Presents a discussion that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5–6	• Demonstrates accurate and relevant chemical understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Presents a discussion that has a well-developed structure which is clear, coherent and logical. (AO1)

Question number	Answer	Additional guidance	Mark
8(d)(i)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (2 marks): • when the decane is heated it vaporises/turns to a gas (1) • decane vapour/gas breaks down as it comes in contact with hot porous pot (1) • large molecules of decane produce smaller molecules, including ethene (1)	Do not allow this point if ethene passes over hot porous pot.	**(3)**

Question number	Answer	Mark
8(d)(ii)	B	**(1)**

Question number	Answer	Mark
9(a)	C	**(1)**

Question number	Answer	Mark
9(b)	36 °C (±2)	**(1)**

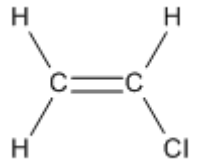
Question number	Answer	Mark
9(c)	• Molecular formula – C_2H_4 (1) • Structure (1) 	**(2)**

Question number	Answer	Mark
9(d)	$C_4H_8 + 6O_2 \rightarrow 4CO_2 + 4H_2O$	**(1)**

Question number	Answer	Additional guidance	Mark
9(e)(i)	• Calculates relative molecular mass of C_4H_9OH (1) • Calculates mass of C_4H_9OH produced (1) • Final answer = 1.9 (kg) (1)	Example of calculation: relative molecular mass of C_4H_9OH = (4 × 12) + (9 × 1) + 16 + 1 = 74 mass of C_4H_9OH produced = (74 ÷ 56) × 1.4 Accept 1.85 (kg) Award full marks for use of moles/correct numerical answer without working.	**(3)**

Question number	Answer	Mark
9(e)(ii)	A	**(1)**

Question number	Answer	Mark
9(f)	• X and Y are both unsaturated/contain {multiple/double} bonds/alkenes (1) • Z is saturated/contains no {multiple/double} bonds/alkane (1)	**(2)**

Question number	Answer	Additional guidance	Mark
9(g)		Ignore bond angles.	**(1)**

Question number	Answer	Additional guidance	Mark
9(h)	Any **one** from the following points: polymer • is lighter/has a lower density (1) • is more resistant to shattering (1)	Ignore any reference to cost.	**(1)**

Question number	Answer	Additional guidance	Mark
10(a)	An answer that provides a description by making reference to: • test gas with moist (red) litmus paper (1) • turns blue (1)	Allow universal indicator paper/pH paper (1) and yellow to blue/purple (1).	**(2)**

Question number	Answer	Additional guidance	Mark
10(b)(i)	(copper sulfate(aq) + sodium hydroxide(aq) →) copper hydroxide(s) + sodium sulfate(aq) • sodium sulfate identified as a product (1) • (sodium sulfate)(aq) **and** copper hydroxide(s) both state symbols matched to the correct product (1)	allow Na_2SO_4 allow copper(II) hydroxide/ $Cu(OH)_2$	**(2)**

Question number	Answer	Mark
10(b)(ii)	white precipitate/ppt/solid	**(1)**

Question number	Indicative content
***10(c)**	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO3 (6 marks)** Any logical description of tests which result in identification of all four substances. Plans may include: • flame test • description of carrying out a flame test • if the flame is yellow/not lilac, sodium ions present • if the flame is lilac/not yellow, potassium ions present • add dilute {hydrochloric/nitric} acid to the solid • if bubbles of gas form then carbonate ions present • bubble gas through limewater • if limewater turns milky/cloudy, carbon dioxide present • make a solution of the crystals in water • add dilute nitric acid • (if no reaction with acid) add silver nitrate solution • if there is a white precipitate, chloride ions present • if there is a yellow precipitate, iodide ions present. Alternative test for halide ions: • make a solution of the crystals in water • add chlorine water • then cyclohexane • if the cyclohexane/top layer turns purple, iodide ions present.

Level	Mark	Descriptor
	0	No awardable content.
Level 1	1–2	• Analyses the scientific information but understanding and connections are flawed. (AO3) • An incomplete plan that provides limited synthesis of understanding. (AO3)
Level 2	3–4	• Analyses the scientific information and provides some logical connections between scientific enquiry, techniques and procedures. (AO3) • A partially completed plan that synthesises mostly relevant understanding, but not entirely coherently. (AO3)
Level 3	5–6	• Analyses the scientific information and provide logical connections between scientific concepts throughout. (AO3) • A well-developed plan that synthesises relevant understanding coherently. (AO3)