Surname	Centre Number	Candidate Number
Other Names		0

GCSE

3430U50-1

S19-3430U50-1

SCIENCE (Double Award)

Unit 5 – CHEMISTRY 2
FOUNDATION TIER

THURSDAY, 16 MAY 2019 – MORNING

1 hour 15 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**6**	
2.	**14**	
3.	**6**	
4.	**6**	
5.	**13**	
6.	**15**	
Total	**60**	

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01

ADDITIONAL MATERIALS

In addition to this examination paper you will need a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet. If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

Question **5***(c)* is a quality of extended response (QER) question where your writing skills will be assessed.

The Periodic Table is printed on the back cover of this paper and the formulae for some common ions on the inside of the back cover.

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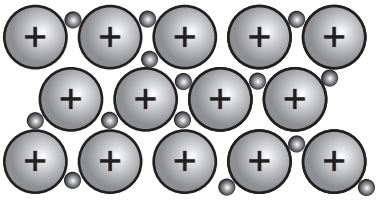
Answer **all** *questions.*

1. The following diagram can be used to represent the structure of silver.



(a) Select the correct words from the box to complete the sentences that follow. [3]

electrons	**tightly**	**protons**
malleable	**neutrons**	**brittle**
ductile	**irregularly**	**loosely**

Silver is a solid because the metal ions are ..... packed.

Silver is a good conductor of electricity because the ..... are delocalised and free to move.

Silver dents when hammered because it is ..... .

(b) Silver can also exist as nano-sized particles. These are used in plasters, socks and deodorant sprays.

(i) **<u>Underline</u>** the correct word in the brackets to complete each sentence. [2]

Nano-sized silver particles range from (**1-100 mm** / **1-100 nm** / **1-100 cm**) in size.

Nano-sized silver particles have (**the same** / **different** / **stronger**) properties compared to bulk silver.

(ii) Give the property of nano-sized silver particles that allows them to be used in plasters, socks and deodorants. [1]

.....

6

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2. A teacher was marking the exercise book of a student who had completed a topic of work on acids and alkalis.

(a) The table below shows the results the student had recorded from an experiment to investigate the pH values of some common laboratory chemicals.

The teacher has circled three errors for the student to correct.

Chemical name	Chemical formula	Colour with universal indicator	pH	Acid, alkali or neutral
sulfuric acid	H_2SO_4	green	1	acid
ethanoic acid	CH_3COOH	orange	4	alkali
calcium hydroxide	$Ca(OH)_2$	purple	12	alkali
water	H_2O	green	5	neutral
sodium carbonate	$NaCO_3$	blue	10	alkali

error 1

error 3

error 2

(i) Correct the errors the teacher has circled. [3]

Correction to **error 1** .....

Correction to **error 2** .....

Correction to **error 3** .....

(ii) There is another error in the table that the teacher has not spotted.
Circle this error **in the table**. [1]

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(b) Another piece of work in the exercise book showed the results of some tests that the student had carried out to identify some of the ions in the chemicals being investigated. However the table had not been fully completed by the student.

Ion being identified	Test	Result
carbonate CO_3^{2-}	add hydrochloric acid	bubbles formed as ..... gas is produced
sulfate SO_4^{2-}	add ..... solution	white precipitate is formed

(i) Use the names of chemicals from the box below to complete the table. [2]

silver nitrate	**hydrogen**	**sodium hydroxide**
barium chloride	**oxygen**	
universal indicator	**carbon dioxide**	**chlorine**

(ii) Describe the test that can be used to identify the gas produced when hydrochloric acid is added to a compound containing carbonate ions. [1]

.....

.....

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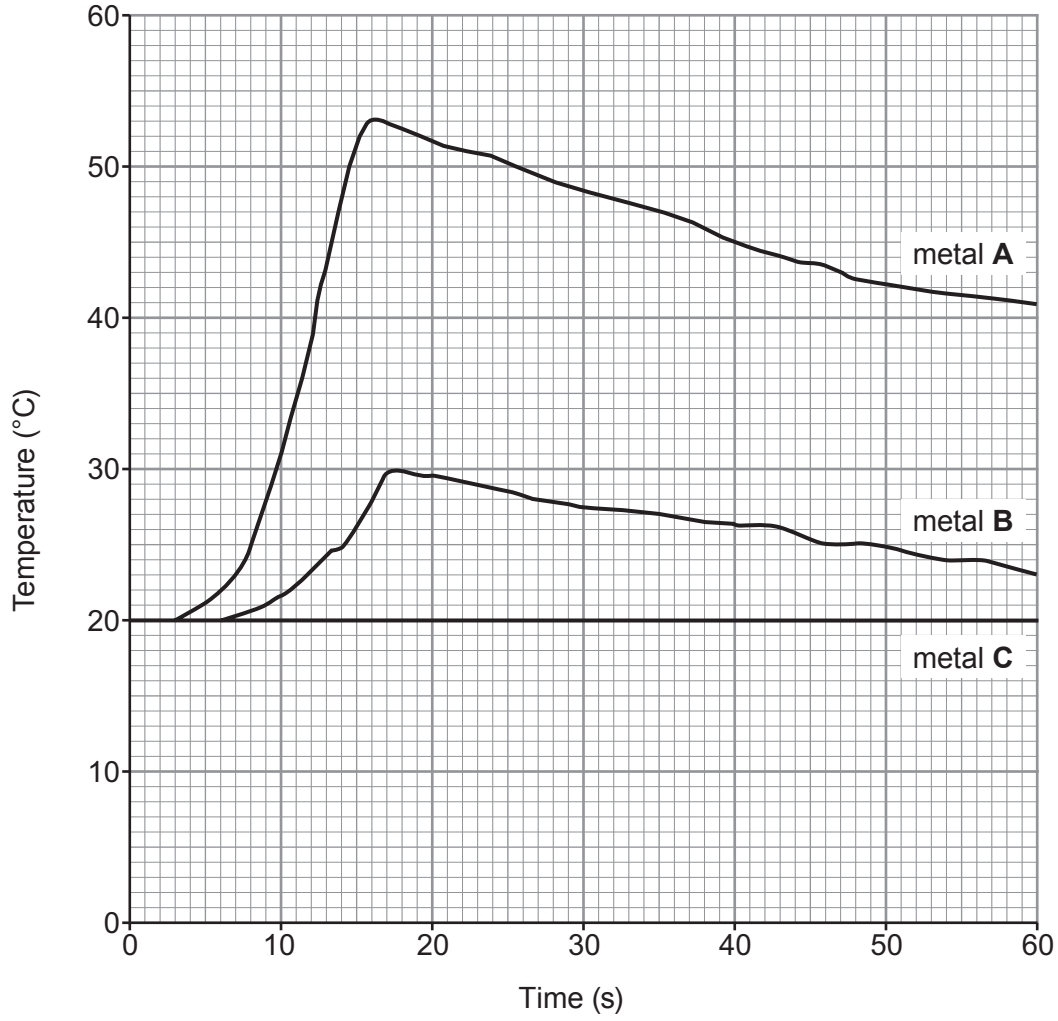
(c) The final piece of work marked by the teacher was an experiment that had been completed to investigate the temperature change when different metals react with hydrochloric acid.

The graphs of the results obtained by the student are shown below.



(i) Use the graphs to give

I. the **letter** of the metal that did not react with hydrochloric acid. [1]

.....

II. the maximum temperature **rise** for metal **A**. [1]

..... °C

(ii) State the term used to describe a reaction that gives out heat. [1]

.....

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(d) When metals react with acids they form a salt and hydrogen gas.

(i) Complete the word equation for the reaction between magnesium and sulfuric acid. [1]

magnesium + sulfuric acid ⟶ ..... + hydrogen

(ii) Give the test that can be used to identify hydrogen gas. Include the expected observation. [1]

.....

.....

(iii) The salt formed when zinc reacts with hydrochloric acid is zinc chloride.

I. Give the formulae of the ions present in zinc chloride. [1]

..... and .....

II. Give the formula of zinc chloride. [1]

.....

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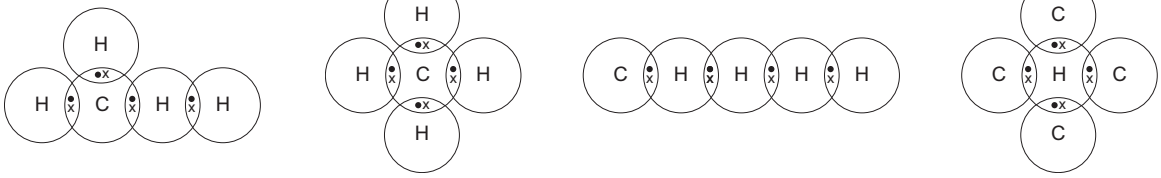
3. *(a)* Methane gas, CH_4, contains the elements carbon and hydrogen.

Element	Electronic structure
carbon	2,4
hydrogen	1

(i) I. Put a **tick** (✓) in the box below the diagram which shows how the atoms are bonded in one molecule of methane. [1]



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II. **Circle** the name given to the type of bonding found in methane. [1]

covalent **ionic** **giant covalent** **metallic**

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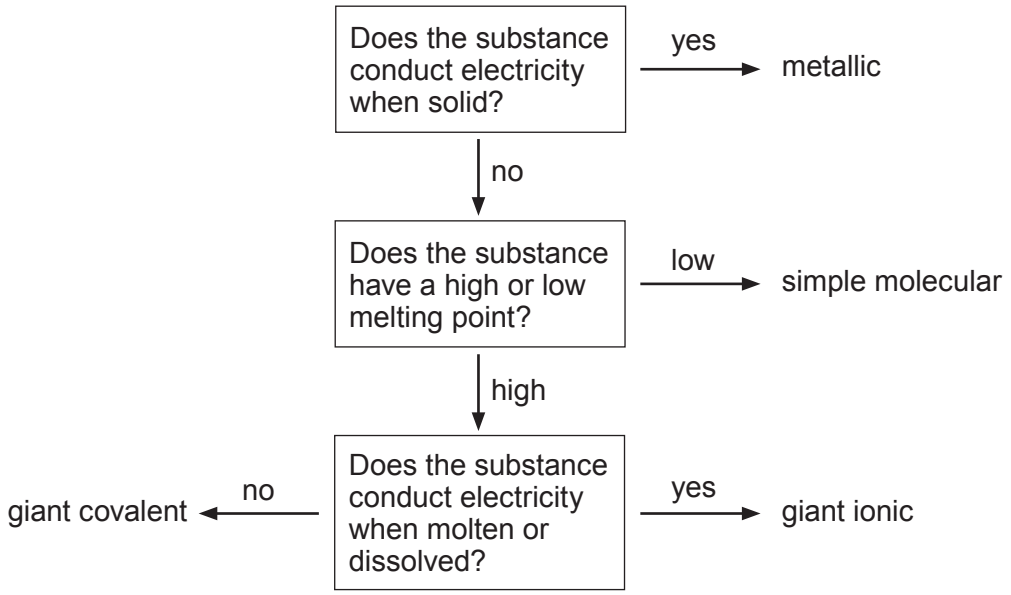
(ii) The flow chart below can be used to identify the type of structure found in different substances.



I. Use the flow chart to complete the table. [1]

Substance	Melting point (°C)	Electrical conductivity	Type of structure
A	2072	conducts only when molten	.....
B	–182	does not conduct electricity	.....
C	1610	does not conduct electricity	.....

II. Give the **letter** of the substance, **A**, **B** or **C**, that is most likely to be methane. [1]

Substance .....

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(b) Butene, C_4H_8, also contains the elements carbon and hydrogen. Calculate the percentage by mass of hydrogen in butene. [2]

$A_r(H) = 1$ $A_r(C) = 12$

Percentage = ... %

6

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4. An alloy is a material composed of a mixture of elements, at least one of which is a metal. The table lists the composition and common uses of different alloys containing silver and gold.

Name of alloy	Composition of alloy by mass (%)	Uses of alloy
amalgam	mercury 48 %, silver 25 %, tin 15 %, copper 12 %	dental fillings, mining
green gold	gold 75 %, silver 6-24 %, copper ..... %	Nobel Prize medals, decoration
nordic gold	gold 89 %, aluminium 5 %, zinc 5 %, tin 1 %	coins, decoration
solder	tin 90 %, silver 5 %, copper 5 %	joining electrical components
sterling silver	silver 92.5 %, platinum 4 %, germanium 1.5-3 %, zinc 0.5-2 %	decoration, plumbing, instruments, jewellery
white gold	gold 75 %, palladium 10 %, nickel 10 %, zinc 5 %	decoration, jewellery

(a) **Circle** the number of alloys that contain an element from Group 4 of the Periodic Table. [1]

0 **1** **2** **3** **4** **5** **6**

(b) **Circle** the correct percentage range for the mass of copper that can be found in green gold. [1]

0-25 % **1-19 %** **19-25 %** **6-24 %**

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(c) Tick (✓) the statement that **best** describes the composition of the alloys listed. [1]

the alloys all contain at least one metal ☐

the alloys all contain at least two metals ☐

the alloys all contain at least three metals ☐

the alloys all contain at least four metals ☐

(d) Tick (✓) the statement that **best** describes the decorative uses of the alloys listed. [1]

all of the alloys are used for decorative purposes ☐

all of the alloys containing gold are used for decorative purposes ☐

all of the alloys containing silver are used for decorative purposes ☐

none of the alloys containing silver are used for decorative purposes ☐

(e) A solder joint in an electrical circuit contains 0.00011 kg of silver.

Use this information and the composition of solder given in the table to calculate the mass of tin in the solder joint. [2]

Mass = ... kg

6

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5. *(a)* Metal ores are the materials found in the Earth's crust from which metals can be extracted. The following table gives information about some common metal ores.

Name of metal ore	Metal extracted from ore	Formula of ore
anglesite	lead	$PbCl_2$
copper pyrite	copper	$CuFeS_2$
cryolite	aluminium	Na_3AlF_6
salt petre	potassium	KNO_3
syberite	gold	$AgAuTe_2$
tin pyrite	tin	Cu_2FeSnS_4

Use the information in the table to give

(i) the **total** number of atoms shown in the formula of cryolite, [1]

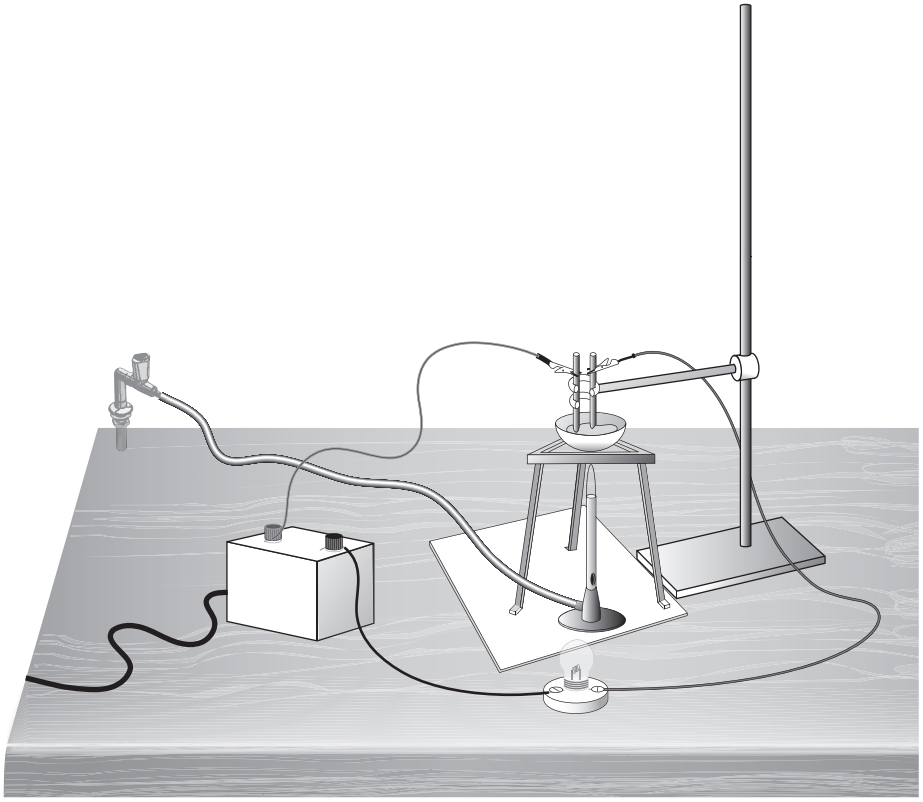
.....

(ii) the name of the ore that contains a ratio of 1:4 metal to non-metal atoms. [1]

.....

Examiner only

(b) The following diagram shows how the electrolysis of anglesite (lead chloride) can be carried out in the laboratory.



(i) Give the reason why lead chloride needs to be melted for electrolysis to take place. [1]

.....

(ii) Explain why the chloride ions move towards the positive electrode. [2]

.....

.....

(iii) The process occurring at the negative electrode is shown by the following equation.

$$Pb^{2+} + 2e^{-} \longrightarrow Pb$$

Use this **equation** to state what is meant by reduction. [1]

.....

.....

Examiner only

(iv) Tick (✓) the equation that shows the reaction taking place at the positive electrode. [1]

$2Cl^- + 2e^- \longrightarrow 2Cl$ ☐

$Cl^- + e^- \longrightarrow Cl^{2-}$ ☐

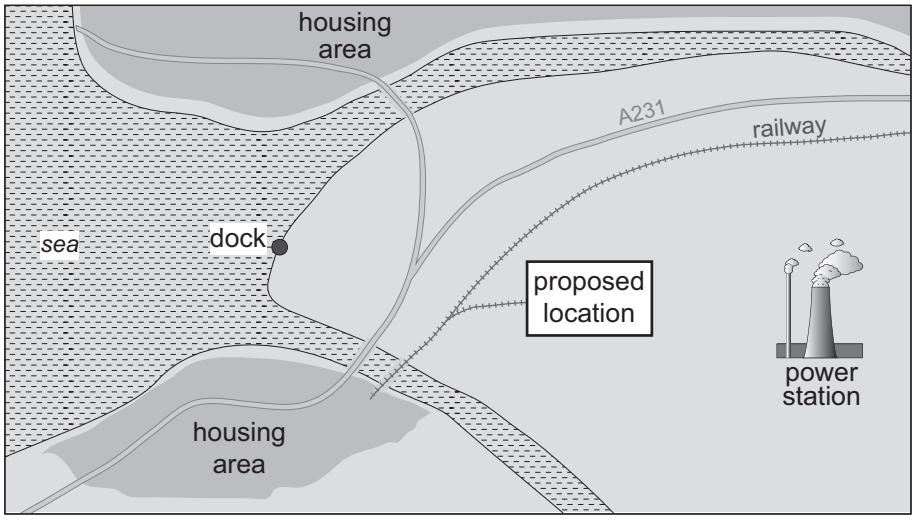
$2Cl^- \longrightarrow Cl_2 + 2e^-$ ☐

$Cl^- + e^- \longrightarrow Cl$ ☐

$Cl^- \longrightarrow Cl_2 + 2e^-$ ☐

Examiner only

(c) The following diagram shows a proposed location for a new aluminium works in Wales.



Use the information in the diagram to explain why this would make a suitable location for an aluminium works. [6 QER]

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6. Crude oil can be separated into simpler mixtures, called fractions, which contain hydrocarbon compounds with boiling points in a similar range.

(a) The table lists the properties of some fractions obtained from crude oil.

Fraction	Number of carbon atoms in fraction	Boiling point range (°C)	Colour of fraction	Flame when burning	Ease of burning
fuel oil	1-4	–170 to 20	colourless	clean	very easy
petrol	5-10	20 to 70	pale yellow	clean	easy
naphtha	8-12	70 to 120	yellow	some soot	quite easy
kerosene	10-16	120 to 240	dark yellow	smoky	quite difficult
diesel oil	15-30	240 to 350	brown	smoky	difficult

Use the information in the table to describe how the burning of the fractions depends upon the size of the molecules. [2]

.....

.....

.....

(b) The boiling points of hydrocarbons containing 1 to 12 carbon atoms are shown in the table below. The boiling point for the hydrocarbon with 7 carbon atoms is missing.

Number of carbon atoms	Boiling point (°C)
1	–165
2	–90
3	–40
4	10
5	35
6	70
7	
8	125
9	150
10	175
11	195
12	215

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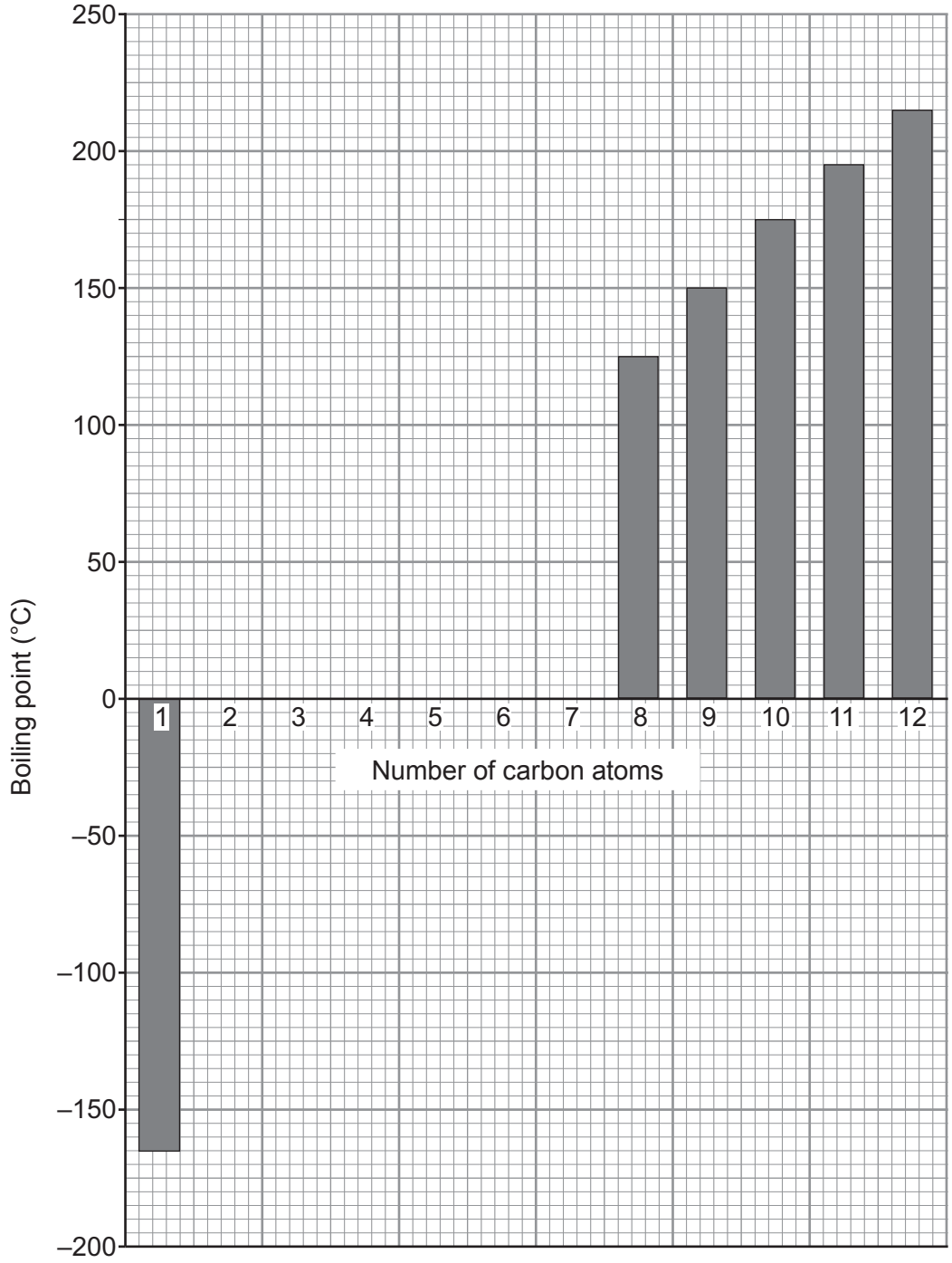
(i) Complete the bar chart below. Some of the bars have already been drawn. [2]



(ii) Use a ruler to draw a trend line **on the chart** and use this to estimate the boiling point of the hydrocarbon with 7 carbon atoms. [2]

Boiling point ..... °C

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(c) Many of the fractions obtained from crude oil are used as fuels.

(i) The fire triangle shows the factors necessary to start and maintain a fire.

State **one** method that could be used to safely put out a small amount of spilled petrol burning on the floor. Give the reason why your chosen method would work. [1]

Method .....

Reason .....

.....

(ii) One of the hydrocarbons in petrol is pentane, C_5H_{12}.

Complete and balance the symbol equation for the complete combustion of pentane. [2]

$C_5H_{12} + 8O_2 \longrightarrow$ ☐ ..... + ☐ .....

(iii) Hydrogen fuel cells are now used in many cars instead of petrol. The overall change inside a hydrogen fuel cell is the same as when hydrogen burns.

Explain why using hydrogen fuel cells in cars is better for the environment than petrol. [2]

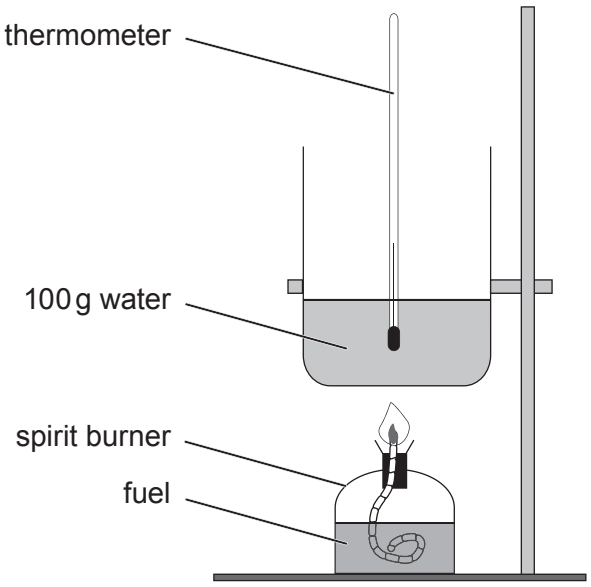
.....

.....

.....

Examiner only

(d) It is possible to compare the energy released when different fuels are burned using the following apparatus.



To calculate the energy released per gram of fuel burned, the following equation is used.

$$\text{energy released per gram of fuel (J/g)} = \frac{\text{mass of water} \times 4.2 \times \text{temperature rise (°C)}}{\text{mass of fuel used (g)}}$$

(i) Apart from measuring the mass of water, describe **all** the measurements that would need to be taken to be able to calculate the energy released per gram of fuel burned. [2]

.....

.....

.....

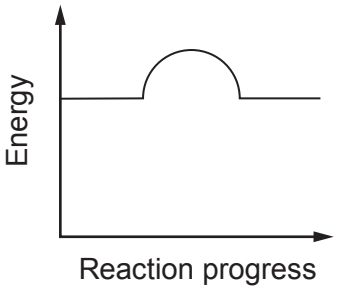
(ii) When comparing the energy released from different fuels, 100 g of water should be used each time. State **one** other variable that should be controlled. [1]

.....

.....

Examiner only

(iii) Tick (✓) the energy profile diagram that represents the combustion of fuels. [1]



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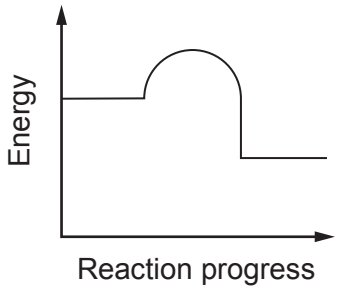

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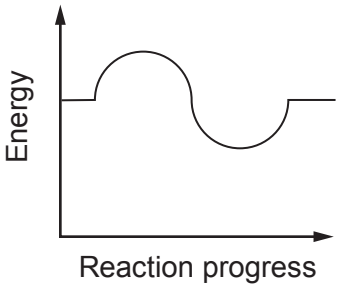

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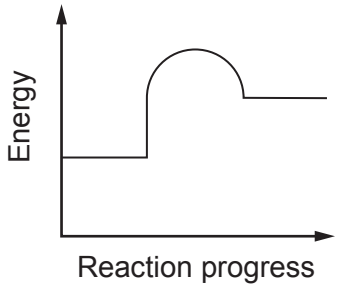

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FORMULAE FOR SOME COMMON IONS

POSITIVE IONS		NEGATIVE IONS	
Name	**Formula**	**Name**	**Formula**
aluminium	Al^{3+}	bromide	Br^{-}
ammonium	NH_4^{+}	carbonate	CO_3^{2-}
barium	Ba^{2+}	chloride	Cl^{-}
calcium	Ca^{2+}	fluoride	F^{-}
copper(II)	Cu^{2+}	hydroxide	OH^{-}
hydrogen	H^{+}	iodide	I^{-}
iron(II)	Fe^{2+}	nitrate	NO_3^{-}
iron(III)	Fe^{3+}	oxide	O^{2-}
lithium	Li^{+}	sulfate	SO_4^{2-}
magnesium	Mg^{2+}		
nickel	Ni^{2+}		
potassium	K^{+}		
silver	Ag^{+}		
sodium	Na^{+}		
zinc	Zn^{2+}		

THE PERIODIC TABLE

Group 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
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
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
223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89															

Key