Surname	Centre Number	Candidate Number
First name(s)		0

GCSE

3430U50-1

S25-3430U50-1

MONDAY, 19 MAY 2025 – MORNING

SCIENCE (Double Award)

Unit 5 – CHEMISTRY 2
FOUNDATION TIER

1 hour 15 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**7**	
2.	**5**	
3.	**7**	
4.	**9**	
5.	**11**	
6.	**6**	
7.	**8**	
8.	**7**	
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 or correction fluid.

You may use a pencil for graphs and diagrams only.

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 **6** 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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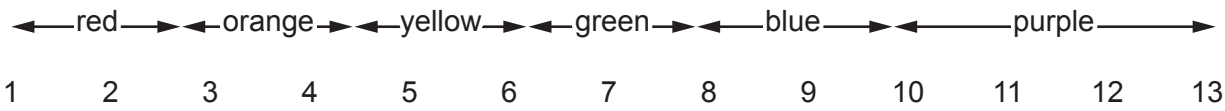
Answer **all** questions.

1. This question is about acids and alkalis.

(a) The following diagram shows the colour of universal indicator at different pH values.



(i) Sulfuric acid turns universal indicator red.

Give the pH of sulfuric acid. [1]

Tick (✓) **one** box.

2 ☐ 6 ☐ 7 ☐ 13 ☐

(ii) Sodium hydrogencarbonate solution has a pH value of 9.

Choose the statement that best describes the solution. [1]

Tick (✓) **one** box.

sodium hydrogencarbonate is a strong acid ☐

sodium hydrogencarbonate is a weak acid ☐

sodium hydrogencarbonate is a strong alkali ☐

sodium hydrogencarbonate is a weak alkali ☐

(iii) Water is neutral. Give the **colour** universal indicator would turn in water. [1]

.....

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(b) Acids react with alkalis to form a salt and water.

(i) The reaction between hydrochloric acid and calcium hydroxide solution produces a solution of calcium chloride and water.

I. Give the name for this type of reaction. [1]

Tick (✓) **one** box.

decomposition ☐

electrolysis ☐

addition ☐

neutralisation ☐

II. Give the formula of hydrochloric acid. [1]

Tick (✓) **one** box.

HNO_3 ☐

HCl ☐

H_2SO_4 ☐

H_2O ☐

III. Calcium chloride contains the ions Ca^{2+} and Cl^-.

Choose the correct formula of calcium chloride. [1]

Tick (✓) **one** box.

CaCl ☐ $CaCl_2$ ☐ Ca_2Cl ☐ Ca_2Cl_2 ☐

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(ii) Sodium hydroxide solution is an alkali.

Choose the statement that describes a possible change in pH when 25 cm^3 of hydrochloric acid is added to 25 cm^3 of sodium hydroxide solution. [1]

Tick (✓) **one** box.

pH changes from 12 to 7 ☐

pH changes from 4 to 10 ☐

pH changes from 2 to 7 ☐

7

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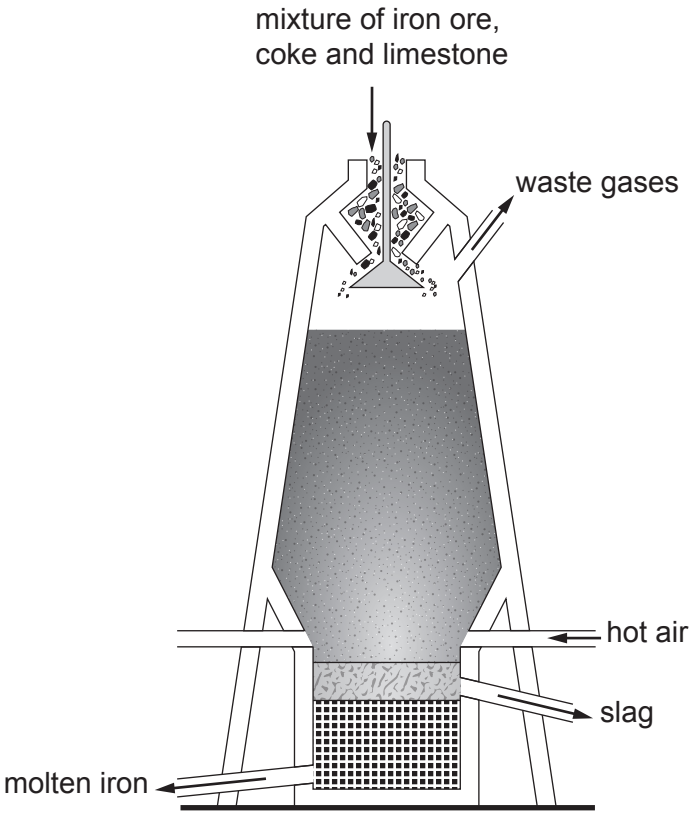
2. This question is about metal extraction.

(a) Iron is extracted from its ore in the blast furnace.



(i) The equation shows one of the reactions that takes place inside the furnace.

iron oxide + carbon ⟶ iron + carbon dioxide

Underline the substance that is reduced during this reaction. [1]

iron oxide **carbon** **iron** **carbon dioxide**

(ii) Give the reason why limestone is added to the furnace during the extraction of iron. [1]

.....

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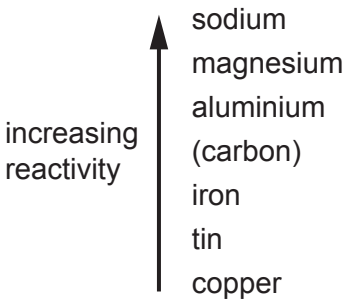
(b) Part of the reactivity series is shown below.



The method used to extract a metal from its ore depends upon its position within the reactivity series.

Give the letter, **A**, **B**, **C** or **D**, of the statement that describes the methods of extraction of magnesium and tin. [1]

A magnesium and tin are both extracted by electrolysis

B magnesium is extracted by electrolysis; tin is extracted by heating with carbon

C magnesium and tin are both extracted by heating with carbon

D magnesium is extracted by heating with carbon; tin is extracted by electrolysis

Letter .....

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(c) The photograph shows the reaction that takes place when magnesium and copper(II) oxide are heated together.

During the reaction magnesium oxide and copper are formed.

Complete the **symbol** equation for this reaction. [2]

Mg + CuO ⟶ ..... + ...

magnesium copper(II) oxide magnesium oxide copper

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3. This question is about energy changes.

(a) Exothermic and endothermic reactions are used in many everyday items.

Circle the item that makes use of an endothermic reaction. [1]

hand warming gel pack	**self-heating can**	**instant cold pack**

(b) Underline the correct word(s) in the brackets to complete each sentence. [2]

In an exothermic reaction, the energy released when the bonds in the products are formed is **(less than / the same as / more than)** the energy needed to break all the bonds in the reactants.

The energy needed to start a reaction is called the **(ignition / activation / bond)** energy.

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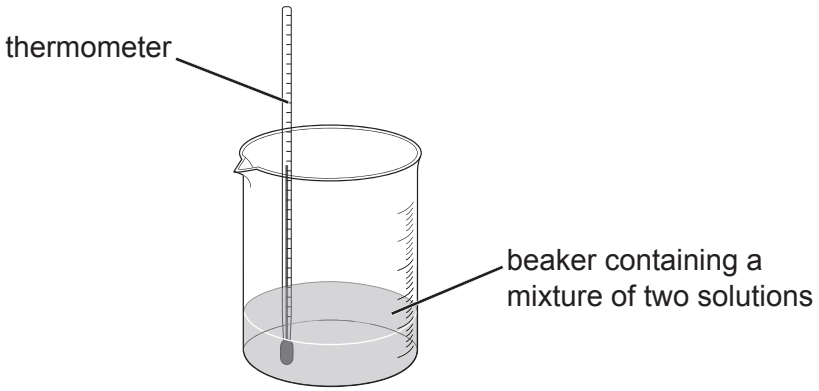
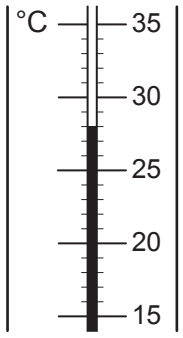
(c) A student was investigating the reaction between two solutions to see if it was exothermic or endothermic.

They used the following apparatus to carry out the investigation.



They used a thermometer to measure the temperature of the mixture at the start and end of the reaction.

The diagram shows the temperature reading on the thermometer at the end of the reaction.



(i) Use the information in the diagram to complete the table. [2]

Temperature at the start (°C)	21
Temperature at the end (°C)	.....
Change in temperature (°C)	.....

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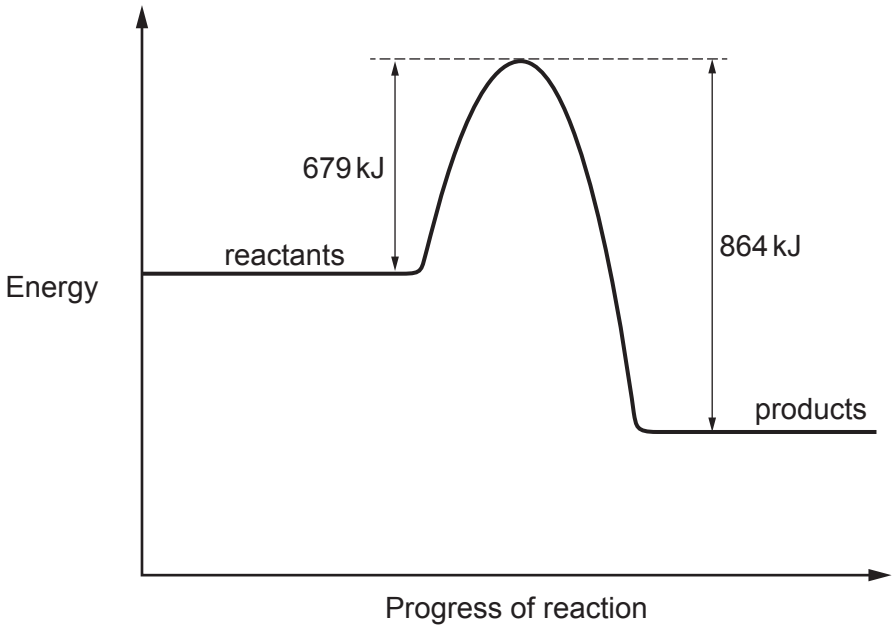
(ii) The temperature change shows that the reaction is exothermic.

The energy profile diagram for the reaction is given below.



Put a tick (✓) in the box next to the calculation used to find the overall energy change for the reaction. [1]

679 kJ + 864 kJ ☐

679 kJ × 864 kJ ☐

679 kJ − 864 kJ ☐

679 kJ ÷ 864 kJ ☐

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(iii) The temperature change recorded by the student was lower than expected, due to heat loss to the surroundings.

Choose the change that **would not** reduce heat loss during the investigation. [1]

Tick (✓) **one** box.

put a lid on the beaker ☐

cover the beaker with aluminium foil ☐

use a digital thermometer ☐

use a polystyrene cup instead of the beaker ☐

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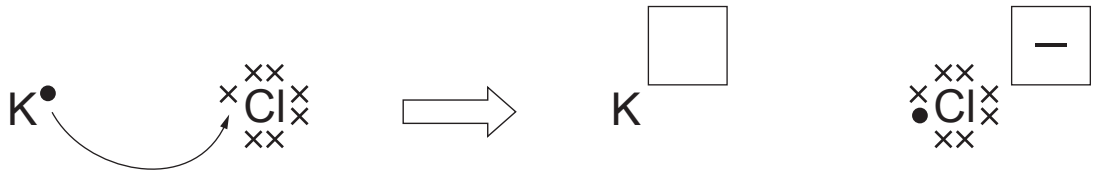
4. This question is about bonding and structures.

(a) The diagram shows the electronic changes that occur when potassium reacts with chlorine to form potassium chloride. The ● and × symbols represent outer shell electrons.

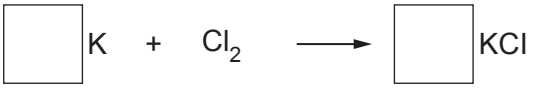


potassium atom	chlorine atom	potassium ion	chloride ion
(2,8,8,1)	(2,8,7)	(2,8,8)	(.....)

(i) **Complete the diagram** above by adding [2]

- the charge of the potassium ion
- the electronic structure of the chloride ion

(ii) Balance the symbol equation that represents the reaction between potassium and chlorine. [1]



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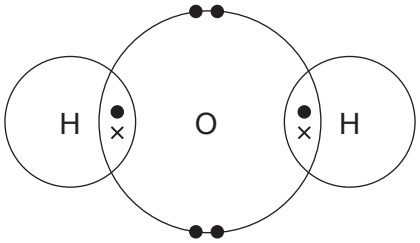
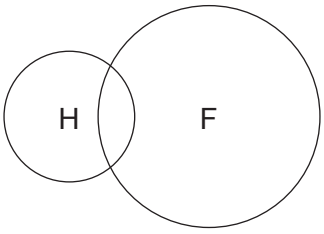
(b) The table shows the electronic structures of the elements present in water and hydrogen fluoride.

Element	Electronic structure
hydrogen	1
oxygen	2,6
fluorine	2,7

The diagram shows the bonding in a water molecule.



Complete the dot and cross diagram to show the bonding in a hydrogen fluoride molecule. [1]



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(c) Nano-particles are extremely small particles, ranging from 1-100 nm in size.

Their everyday uses are linked to the properties these materials display.

The box lists some properties.

antibacterial	**break down dirt**	**reflect UV rays**
low melting point	**lightweight**	

(i) Choose from the box the property that explains why

I. nano-sized silver particles are used in plasters and refrigerators. [1]

.....

II. nano-sized titanium dioxide particles are used in sunscreens. [1]

.....

(ii) Give **one** possible health concern scientists have about the widespread use of nano-particles. [1]

.....

.....

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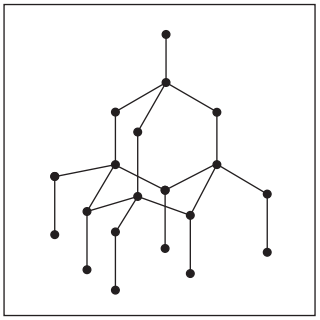
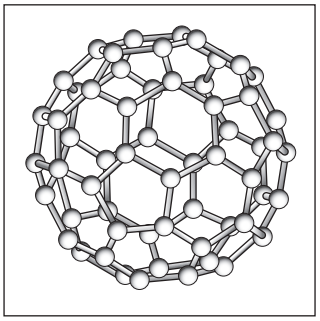
(d) The diagrams show the structures that represent two different forms of carbon.

Draw **one** line from each structure to the form of carbon. [2]

Structure	Form of carbon
	fullerene
	diamond
	graphite
	nanotube

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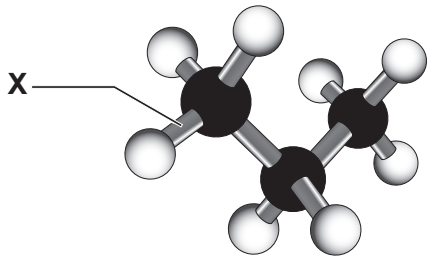
5. This question is about alkanes and alkenes.

(a) Alkanes are the simplest group of hydrocarbon compounds.

(i) The diagram shows a model used to represent an alkane.



I. Complete the chemical formula of the alkane shown in the diagram. [1]

C ..... H .....

II. The bond labelled **X** represents a bond between a carbon atom and a hydrogen atom.

Name this type of bond. [1]

.....

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(ii) Give the general formula of alkanes. [1]

Tick (✓) **one** box.

C_nH_{2n} ☐

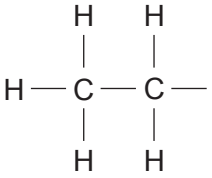
C_nH_{2n+2} ☐

C_nH_{2n-2} ☐

C_nH_{3n} ☐

(iii) Pentane is an alkane with the chemical formula C_5H_{12}.

Complete the diagram to show the structure of pentane. Show all the bonds. [1]



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(b) Alkenes are another group of hydrocarbon compounds. One of their main uses is in the production of plastics through the process of polymerisation.

(i) Polythene is a plastic made from ethene.

monomers	**two**	**four**	**polymers**
many	**hydrocarbons**	**alkanes**	

Choose **only** words from the box to complete the following sentences. [3]

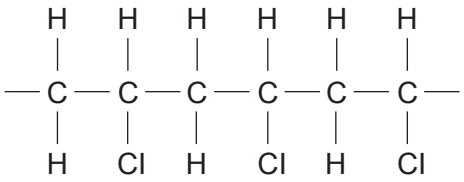
Polythene is produced from small reactive molecules called

..... .

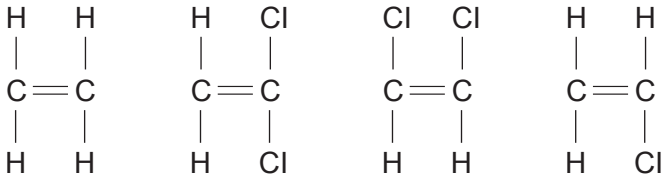
When polythene is made, ... ethene molecules are joined together using heat and a catalyst.

Large molecules, such as polythene, are called ..... .

(ii) Polyvinylchloride (PVC) is another plastic. The diagram shows part of the structure of PVC.



Which small molecule is used to produce PVC? Tick (✓) **one** box. [1]



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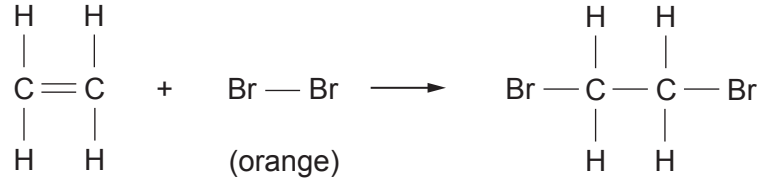
(c) The equation shows the reaction taking place when testing for a C = C bond in ethene.



(i) Describe the change seen in the bromine water when it reacts with ethene. [1]

Tick (✓) **one** box.

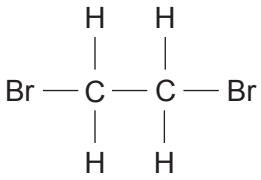
orange to colourless ☐

colourless to orange ☐

orange to cloudy ☐

cloudy to orange ☐

(ii) Calculate the relative molecular mass, M_r, of the product of the reaction. [2]



$A_r(C) = 12$ $A_r(H) = 1$ $A_r(Br) = 80$

M_r = ...

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6. The photographs show three methods that are used to tackle fires.

Method 1

Method 2

Method 3

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Use your knowledge and the information in the photographs to answer this question.

- Explain what is meant by the fire triangle.
- Give an example of a fire which could be put out using each of the methods shown. Explain how each method works. [6 QER]

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7. This question is about metals and their reactivity.

(a) A group of students was investigating the reaction between zinc powder and excess copper(II) nitrate solution.

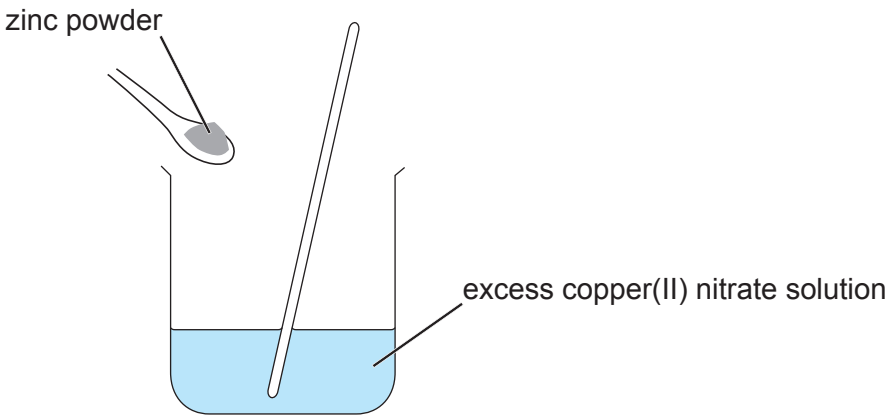
zinc + copper(II) nitrate ⟶ zinc nitrate + copper

(i) During the reaction, the more reactive zinc takes the place of the copper in the copper(II) nitrate solution.

Give the name for this type of reaction. [1]

.....

(ii) The students added different masses of zinc powder to 50 cm^3 samples of copper(II) nitrate solution and recorded the mass of copper formed each time.



The table shows their results.

Mass of zinc added (g)	Mass of copper formed (g)
0	0
1.0	2.4
2.0	4.8
3.0	7.2
4.0	9.6
5.0	12.0
6.0	14.4

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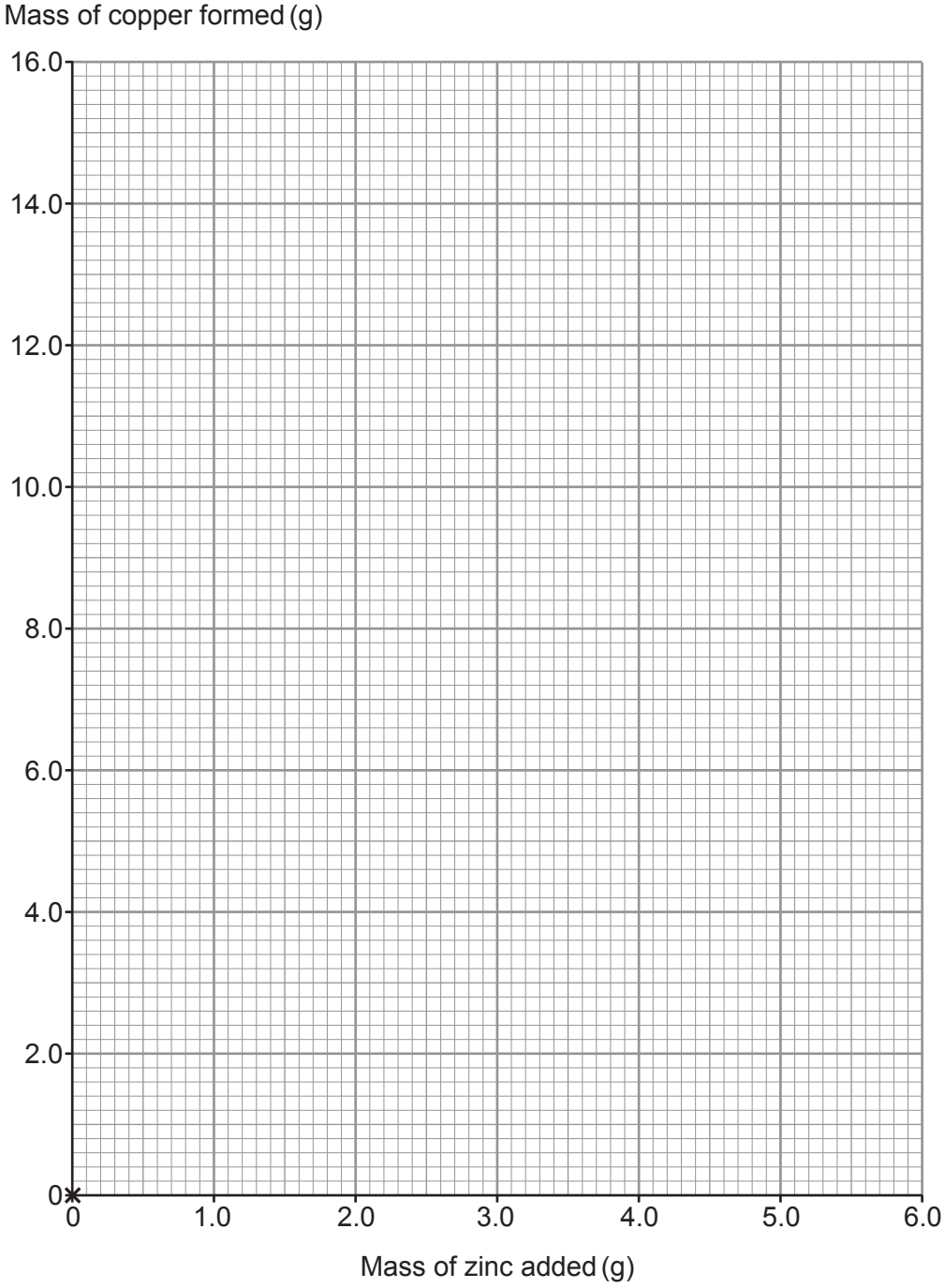
I. Plot the results on the grid below and draw a suitable line.

The point at (0,0) has been plotted for you. [3]



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II. Use the graph to find the mass of zinc needed to form 10.0 g of copper. [1]

Mass = ... g

III. Use the information to predict the mass of copper that would be produced from 7.5 g of zinc. [1]

Mass = ... g

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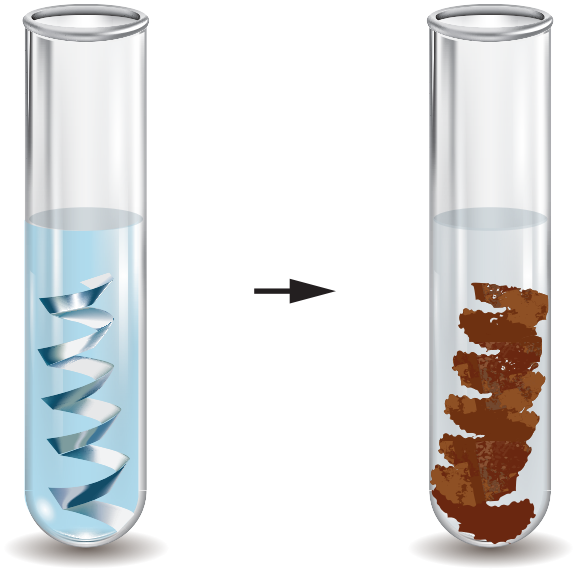
(b) The diagrams show what happens when a coil of aluminium is placed into a blue copper(II) sulfate solution.

During the reaction, the solution turns colourless and the coil becomes coated in a layer of copper.



Complete the symbol equation for the reaction by [2]

- writing the formula of copper(II) sulfate on the dotted line
- putting a number into the box to balance the equation.

$$\square\,Al + 3\,\ldots\ldots\ldots\ldots\ldots\ldots \longrightarrow Al_2(SO_4)_3 + 3Cu$$

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8. Electric or Petrol Cars: Which are the better option?

A key question when choosing a new car is whether to opt for petrol or electric. With advances in technology, concerns about the environmental impact of car pollution and confusion over which option is more cost-effective in the long run, it's no surprise that many consumers are uncertain about which to choose.

Are electric cars better than petrol cars?

The answer to this depends on how the car is used. For daily driving and commuting around crowded city centres, electric cars are better, providing you have somewhere to charge them. Although they are more expensive to buy than similar petrol equivalents, there are government grants available to contribute towards the price and they have lower running costs per mile. There is also an increasing choice of range and models. Electric cars are also exempt from charges in clean-air zones due to having zero exhaust emissions.

If the car is regularly used to travel long distances or to visit areas where there are few charging points, then petrol cars are the better choice. Not only are petrol cars quicker and more convenient to fill, but their engines deliver better fuel economy on long motorway journeys. Drivers of petrol cars are also less likely to experience range anxiety (fear of running out of power) than drivers of electric cars. There is the added benefit of there being a very large choice of range and models. However, petrol cars need more extensive servicing than their electric equivalents.

Comparing the cost of running an electric car and a petrol car

To many, the decision whether to buy a petrol or electric car comes down to the simple matter of cost. An electric car is cheaper to run, and servicing and maintenance costs tend to be lower than for petrol cars. But does this outweigh the higher initial price?

Table 1 provides a comparison of the buying and running costs of similar petrol and electric cars over a **3-year period**.

	Petrol Car	Electric Car
Cost to buy car	£26 835	£28 195 (after the government grant has been applied)
Typical running cost (based on 30 000 miles over a 3-year period)	£4500	£1200
Road tax charges (over a 3-year period)	£495	£0
Clean-air zone charges (over a 3-year period)	£450	£0
Service and maintenance costs (over a 3-year period)	£555	£216
Total	**£32 835**	**£29 611**

Table 1

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(a) Tick (✓) to show whether each of the following statements is true or false. [3]

Statement	True	False
Electric cars are the better choice for **all** drivers that commute around busy city centres		
The availability of government grants means the buying cost of electric cars is less than the cost of similar petrol cars		
Drivers of petrol cars can also suffer range anxiety		
Petrol cars cost less to run per mile on motorways when compared to electric cars		
There is an equal choice of range and models of both electric and petrol cars		
Electric cars require service and maintenance		

(b) 'Electric cars do not contribute to global warming.'

Explain to what extent this statement is correct. [2]

.....

.....

.....

.....

(c) The information in **Table 1** suggests that over a 3-year period, the typical running cost for a petrol car is 15 p per mile.

Use the information in **Table 1** to calculate the typical running cost per mile for an electric car over the same 3-year period. [2]

Running cost = ... p per mile

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END OF PAPER

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Question number	Additional page, if required. Write the question number(s) in the left-hand margin.

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Question number	Additional page, if required. Write the question number(s) in the left-hand margin.

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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+}		

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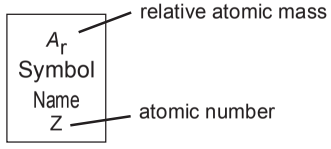
THE PERIODIC TABLE

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



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