Surname	Centre Number	Candidate Number
First name(s)		0

GCSE

3430UE0-1

S25-3430UE0-1

MONDAY, 19 MAY 2025 – MORNING

SCIENCE (Double Award)

Unit 5 – CHEMISTRY 2

HIGHER TIER

1 hour 15 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**8**	
2.	**7**	
3.	**12**	
4.	**15**	
5.	**12**	
6.	**6**	
Total	**60**	

3430UE01
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 metals and their reactivity.

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

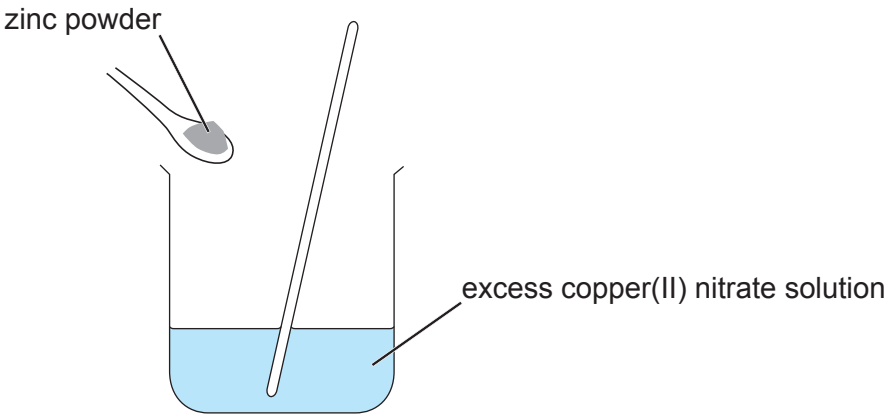
zinc + copper(II) nitrate ⟶ zinc nitrate + copper

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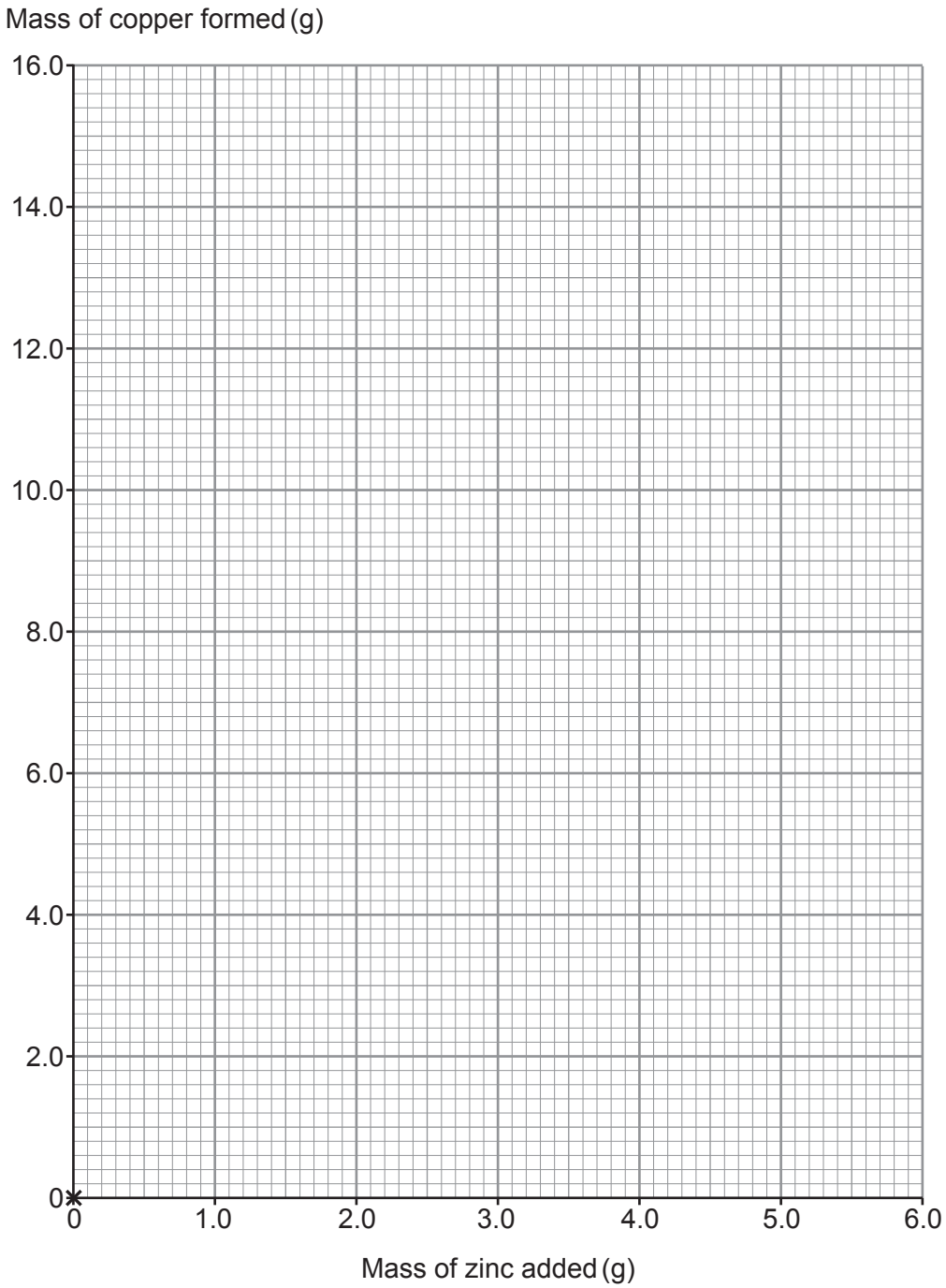
I. Plot the results on the grid below and draw a suitable line.

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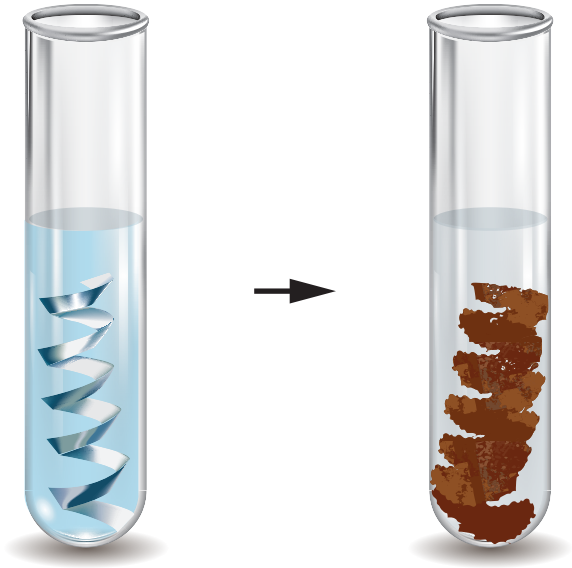
(b) The diagrams show what happens when a coil of aluminium is placed into a blue copper(II) sulfate solution.

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.

$$\boxed{}\,Al + 3\,\ldots\ldots\ldots\ldots \longrightarrow Al_2(SO_4)_3 + 3Cu$$

8

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2. 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]

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(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

7

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3. This question is about bonding and structure and nano-science.

(a) Magnesium fluoride is an ionic compound.

Complete the dot and cross diagram on the page opposite to show what happens when magnesium reacts with fluorine to form magnesium fluoride.

You should

- show the transfer of electrons between the magnesium and fluorine atoms
- complete the electronic structures of the magnesium and fluoride ions
- give the charges of the magnesium and fluoride ions. [3]

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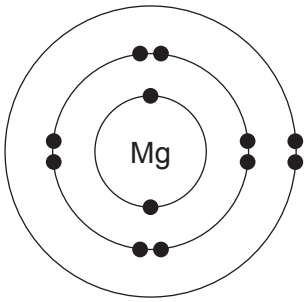
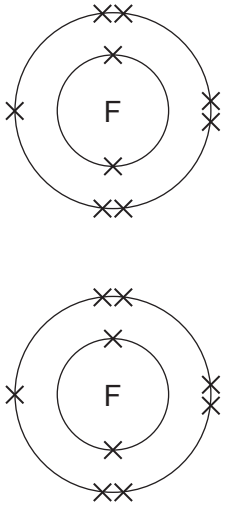
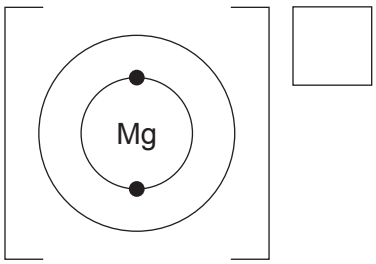


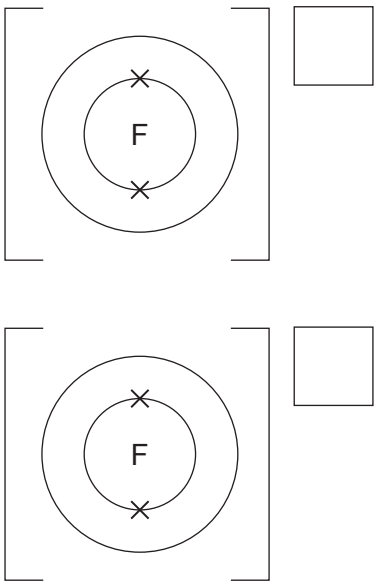
magnesium atom



fluorine atoms



magnesium ion



fluoride ions

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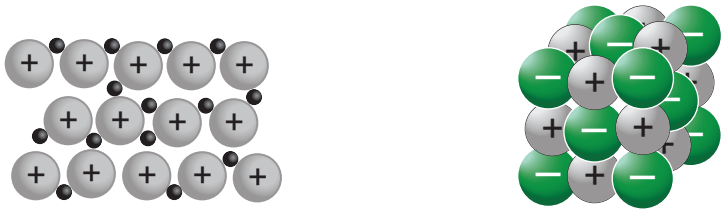
(b) This diagram shows models used to represent the structures of metallic and ionic substances.



metallic substance ionic substance

Explain why metallic substances are able to conduct electricity when solid, whereas ionic substances can only conduct when they are molten or dissolved. [2]

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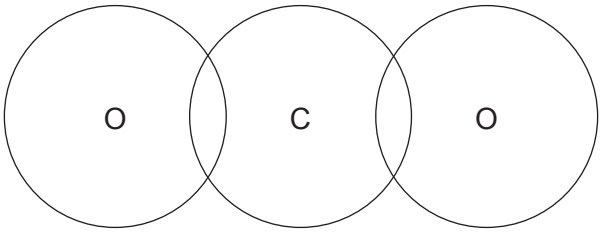
(c) Carbon dioxide has a simple covalent structure.

(i) The table lists the electronic structures of carbon and oxygen.

Element	Electronic structure
carbon	2,4
oxygen	2,6

Complete the dot and cross diagram to show the bonding in a carbon dioxide molecule. [2]

You should only show the outer shell electrons.



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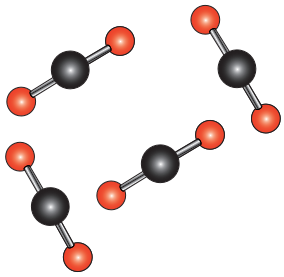
(ii) The diagram shows some molecules of carbon dioxide.



Explain why carbon dioxide has a low melting point. [2]

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(d) Nanoparticles are extremely small particles that have different properties to the same material at bulk size.

Nano-scale silver particles are commonly used in plasters, shower gels and deodorants.

(i) Give the property of nano-scale silver particles that make them effective in plasters, shower gels and deodorants. [1]

.....

(ii) Explain why some people are concerned about the use of nano-scale silver particles in these products. [2]

.....

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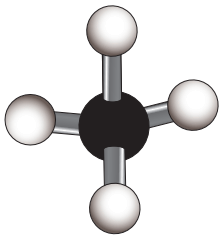
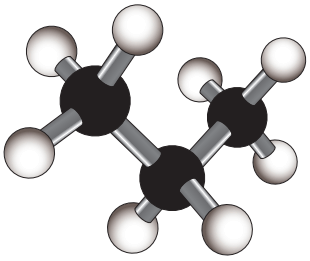
4. This question is about alkanes and alkenes.

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

(i) The diagrams show models used to represent methane and propane.



methane



propane

Use the information in the diagrams to answer parts I and II.

I. Give the general formula of alkanes. [1]

.....

II. Explain why alkanes are saturated compounds. [1]

.....

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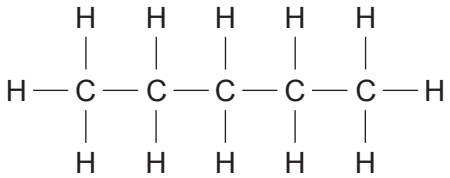
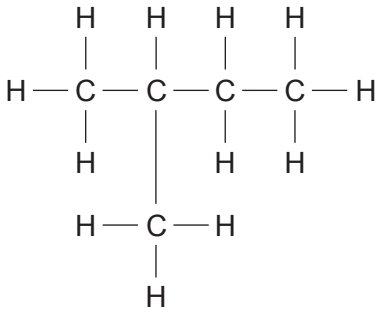
(ii) Pentane and methylbutane are two of the three isomers with the formula C_5H_{12}.

The diagrams show the structures of pentane and methylbutane.



pentane



methylbutane

I. Give the meaning of the term isomer. [1]

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.....

II. Draw the structure of the third isomer with the formula C_5H_{12}. [1]

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

(i) A teacher used bromine water to confirm that an unknown compound is an alkene.

I. Give the expected observation for a positive result. [1]

.....

II. Complete the equation to show the reaction that would take place when adding bromine water to ethene. [2]

ethene

III. Name the type of reaction taking place when bromine water reacts with ethene. [1]

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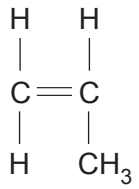
(ii) Polypropene is an example of a plastic made through the process of polymerisation.

The diagram shows a propene molecule.



Explain how polypropene forms. Draw its repeating unit as part of your answer. [3]

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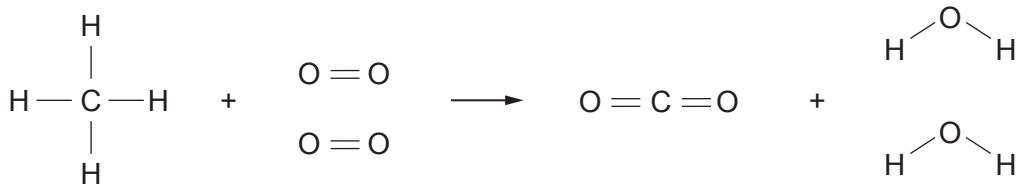
(c) Alkanes are commonly used as fuels.

The burning of methane in air can be represented by the following equation.



The bond energy of the C ═ O bond is 805 kJ.

(i) The total energy released in forming all of the bonds in the **products** is 3466 kJ.

Calculate the energy released when forming **one** O—H bond. [3]

Energy = ... kJ

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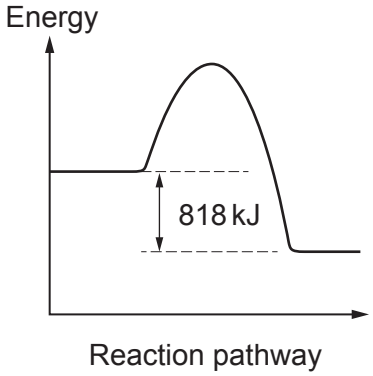
(ii) The energy profile for this reaction is shown below.



Use this information to calculate the energy needed to break all the bonds in the reactants. [1]

Energy = ... kJ

15

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5. This question is about salts.

(a) The reactions of acids with metals, bases and carbonates produce salts.

Complete the equations for the following **three** reactions. [3]

$2HCl + Zn \longrightarrow ZnCl_2 +$ .....

2 ..... $+ MgCO_3 \longrightarrow Mg(NO_3)_2 + H_2O + CO_2$

$H_2SO_4 + 2NaOH \longrightarrow$ ..... $+ 2H_2O$

(b) Zinc sulfate is a soluble salt.

(i) Describe the two-stage method that can be used to prepare a pure **solution** of zinc sulfate from insoluble zinc carbonate powder. [3]

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(ii) To collect a dry sample of zinc sulfate **crystals** from the pure zinc sulfate solution the water needs to be evaporated.

Describe how this stage would be carried out to produce **large** crystals. [1]

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(c) Iron forms many soluble salts.

(i) Two students were asked to find the simplest formula of a chloride of iron which contains 2.24 g of iron and 2.84 g of chlorine.

Student 1 found the formula of the iron chloride to be FeCl, whereas student 2 found the formula to be $FeCl_3$.

Use the information to determine the simplest formula of the iron chloride and hence decide which, if either, student is correct.

Put a tick (✓) in the box next to the correct conclusion. [3]

You must show your working.

A_r(Fe) = 56 A_r(Cl) = 35.5

Student 1 is correct ☐

Student 2 is correct ☐

Neither student is correct ☐

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(ii) When in solution, chloride ions can be identified by adding silver nitrate solution.

I. Give the expected observation. [1]

.....

II. Put a tick (✓) in the box next to the ionic equation for the reaction between chloride ions and silver ions. [1]

$Ag^+(aq) + Cl^-(s) \longrightarrow AgCl(s)$ ☐

$Ag^+(aq) + Cl^-(aq) \longrightarrow AgCl(s)$ ☐

$Ag^+(s) + Cl^-(s) \longrightarrow AgCl(s)$ ☐

$Ag^+(aq) + Cl^-(aq) \longrightarrow AgCl(aq)$ ☐

$Ag^+(s) + Cl^-(aq) \longrightarrow AgCl(s)$ ☐

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QUESTION 6 ON PAGE 22

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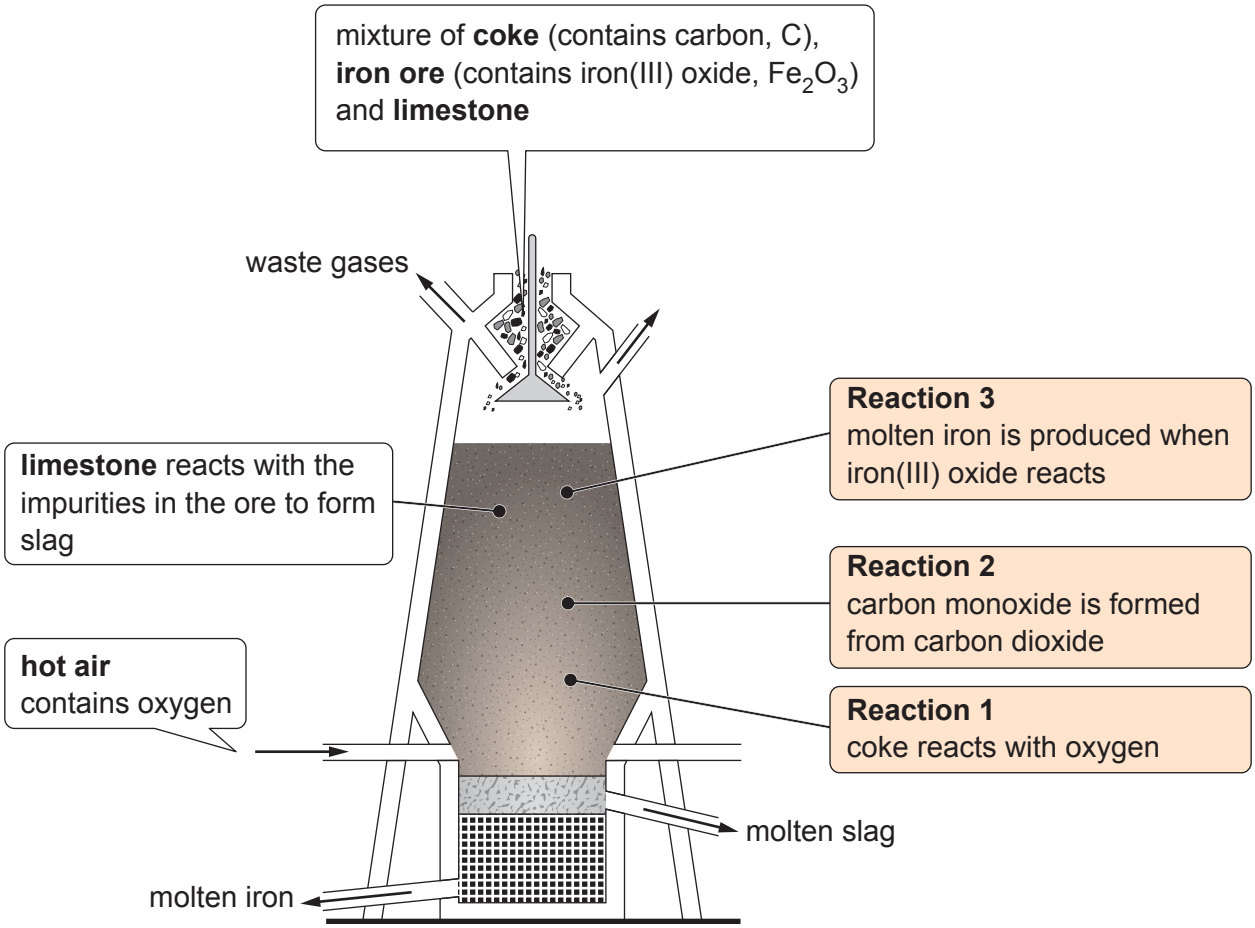
6. Iron is extracted from its ore inside the blast furnace.

The diagram gives information about the raw materials added to the furnace, the reactions taking place inside and the products formed.



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Use your knowledge and the information in the diagram to explain the role of **reactions 1**, **2** and **3** in the blast furnace.

Include equations in your answer. [6 QER]

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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.	Examiner only

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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

1	2											3	4	5	6	7	0
Group																	
						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

A_r — relative atomic mass
Symbol
Name
Z — atomic number

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