Surname	Centre Number	Candidate Number
Other Names		0

GCSE – NEW

3430U50-1

S18-3430U50-1

SCIENCE (Double Award)

Unit 5 – CHEMISTRY 2
FOUNDATION TIER

THURSDAY, 17 MAY 2018 – MORNING

1 hour 15 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**5**	
2.	**8**	
3.	**5**	
4.	**13**	
5.	**8**	
6.	**6**	
7.	**11**	
8.	**4**	
Total	**60**	

3430U501
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 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. *(a)* Salts can be produced by reacting acids with alkalis.

(i) Complete the following equation for the reaction between an acid and alkali. [1]

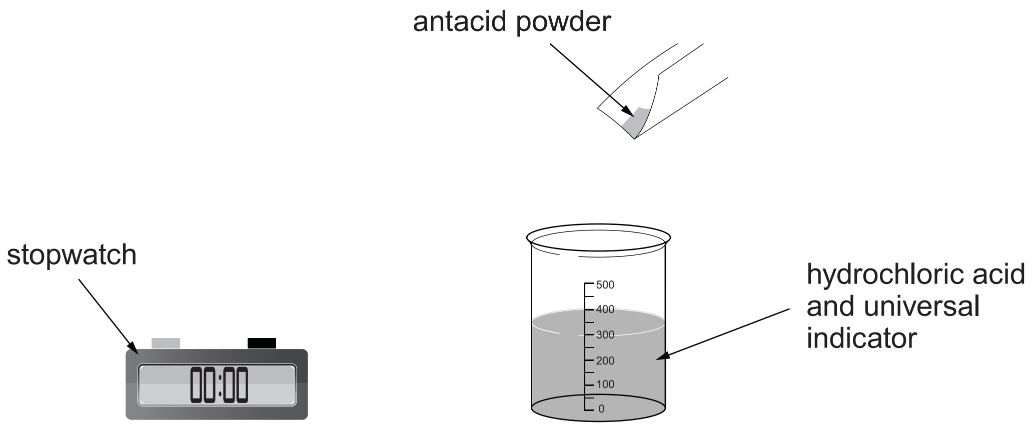
acid + alkali ⟶ salt + ……………………………………

(ii) **Circle** the word which best describes the reaction between an acid and an alkali. [1]

displacement **neutralisation** **oxidation** **reduction**

(b) Indigestion can be caused by excess hydrochloric acid in the stomach. To treat indigestion, antacid powders are commonly used.

A group of pupils used the following apparatus to compare three brands of antacid powder, to see which was the most effective at treating acid indigestion.



They added an equal mass of each of the antacid powders to separate beakers, containing equal amounts of hydrochloric acid and universal indicator.

They stirred the mixture and recorded the time taken for the universal indicator to turn green in each beaker. They carried out the test three times for each antacid powder. Their results are shown in the table.

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Antacid powder	Time taken for the universal indicator to turn green (min : s)			
	Result 1	Result 2	Result 3	Mean
Brand 1	5 : 25	5 : 36	5 : 14	5 : 25
Brand 2	4 : 28	3 : 20	4 : 32	4 : 30
Brand 3	2 : 28	2 : 30	2 : 44	2 : 34

(i) State which **two** results were used to calculate the mean value for brand 2. [1]

.... and ....

(ii) Convert the mean time for brand 2 into **seconds**. [1]

Mean time = ... s

(iii) Give the reason why the results suggest that brand 3 is the best powder for treating acid indigestion. [1]

....

....

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5

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2. *(a)* Chromium is one of the metals found in stainless steel. The equation shows how chromium is produced industrially by reacting chromium oxide with aluminium.

chromium oxide + aluminium $\longrightarrow$ chromium + aluminium oxide

(i) The reaction is highly exothermic.

Give the meaning of the term *exothermic*. [1]

....

(ii) During the reaction, oxidation and reduction happens.

I. Name the substance which is oxidised. [1]

....

II. State what is meant by *reduction*. [1]

....

....

(iii) State what the equation tells you about the relative reactivities of chromium and aluminium. [1]

....

....

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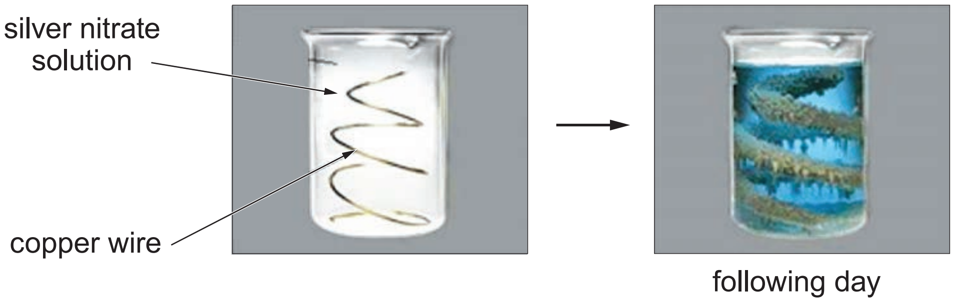
(b) Copper is able to displace silver from a solution of silver nitrate. The equation for this reaction is given below.

silver nitrate + copper ⟶ copper(II) nitrate + silver

A teacher demonstrated this reaction to her class. The photographs show the beaker before and after the reaction had taken place.



(i) Explain how the changes show that this chemical reaction has taken place. [2]

....

....

....

(ii) Complete the symbol equation for the reaction by

- giving the formula for silver nitrate
- balancing the overall equation [2]

$\square$ .... + Cu ⟶ $Cu(NO_3)_2$ + $\square$ Ag

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8

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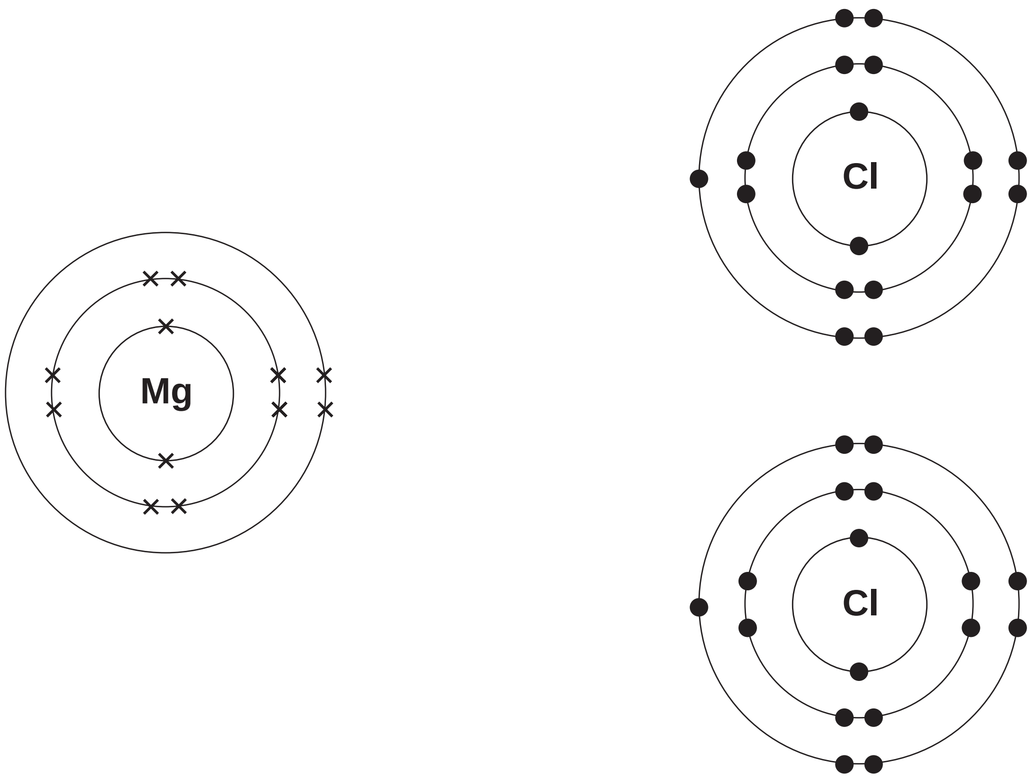
3. *(a)* Magnesium reacts with chlorine to form magnesium chloride.

The following diagram shows the electronic structures of magnesium and chlorine atoms.



(i) **Draw arrows on the diagram** to show how electrons are transferred between the magnesium and chlorine atoms during the formation of magnesium chloride. [1]

(ii) **Complete the table** giving information about the charge and electronic structure of the magnesium and chloride **ions** that are formed. [2]

Ion	Charge	Electronic structure
magnesium	+2	....
chloride	....	2,8,8

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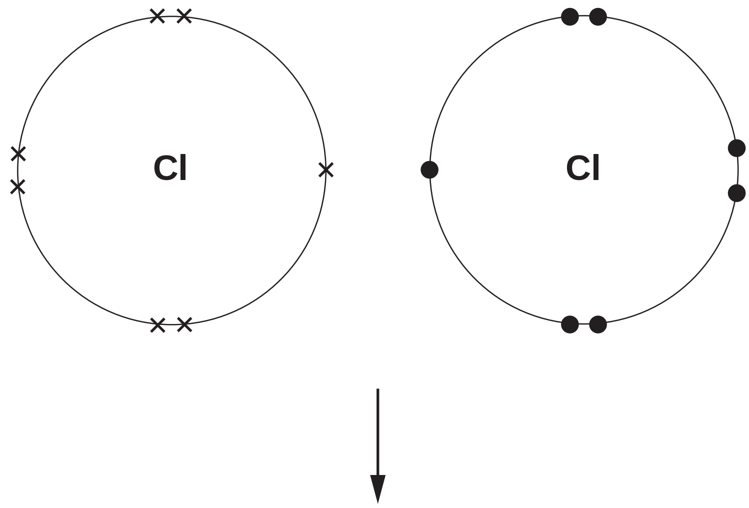
(b) Chlorine gas, Cl_2, consists of two chlorine atoms bonded together.

(i) Draw a diagram in the box to show how the atoms bond to form a chlorine molecule. [1]



(ii) Give the name of this type of bonding.

.... [1]

5

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07

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4. *(a)* Crude oil is a fossil fuel and is described as a non-renewable resource.

(i) Describe how crude oil was formed. [2]

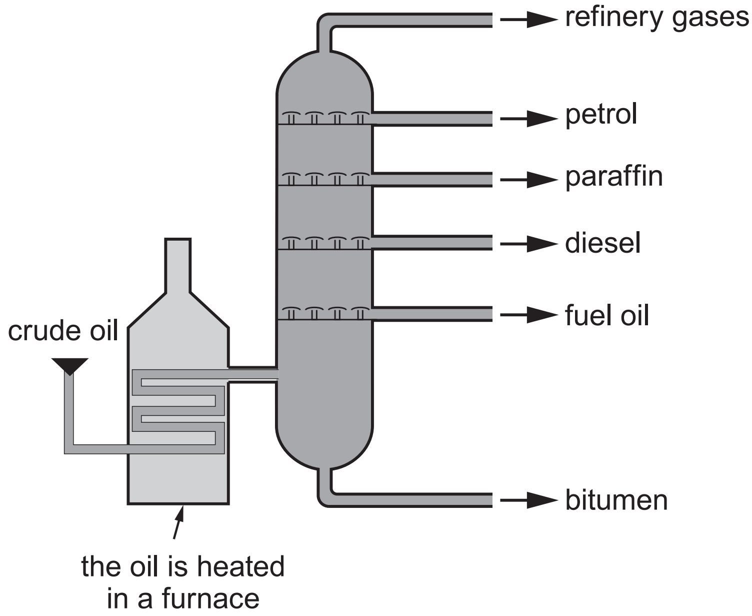
....

....

(ii) Give the meaning of the term *non-renewable*. [1]

....

(b) To make crude oil more useful, it is separated into fractions.



(i) Complete the following sentences. [2]

Crude oil is separated into different fractions by a process called fractional

....

The fractions can be separated because they have different

....

(ii) **Circle** the word which best describes crude oil. [1]

mixture **element** **compound**

Examiner only

(c) One of the fractions obtained from crude oil contains hexane, C_6H_{14}.

Calculate the percentage by mass of carbon in hexane. [2]

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

Percentage = ... %

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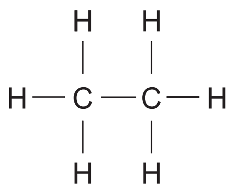
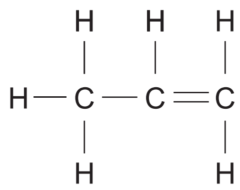
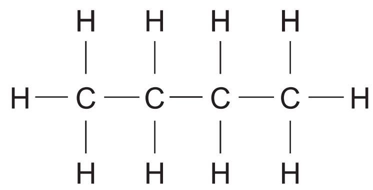
(d) The diagram shows the structures of five different hydrocarbons, **A**-**E**.



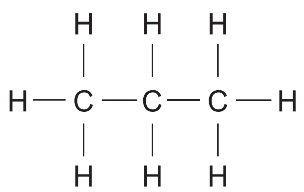
A



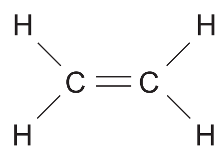
B



C



D



E

Use letters **A**-**E** in your answers to parts (i) and (ii).

(i) Give the structure that represents propene. .... [1]

(ii) Identify the structures that fit the following descriptions. [2]

Hydrocarbons with the general formula C_nH_{2n+2} ....

Unsaturated molecules ....

Examiner only

(e) Plastics are made from chemicals that are obtained from crude oil. Supermarkets in Wales were the first in the UK to charge their customers for plastic bags. This was to reduce the amount of plastic waste generated.

Give **two** methods of plastic waste disposal that lead to environmental problems. Explain the problem linked to each method. [2]

Method 1 ....

Problem ....

....

Method 2 ....

Problem ....

....

13

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5. There are a number of factors that should be taken into consideration when deciding what makes the 'best fuel'.

Information was collected about various factors for three fuels, **A**, **B** and **C**.

Fuel A
- Existing supplies will last around 50 years
- Releases 2.8 kJ of energy per gram of fuel burned
- Costs 0.03p per gram of fuel burned
- Burns very easily and no storage issues
- Releases carbon dioxide and water vapour when it burns

Fuel B
- There are infinite supplies of this fuel
- Releases 44.1 kJ of energy per gram of fuel burned
- Costs 0.18p per gram of fuel burned
- Burns very easily but can be difficult to store
- Releases water vapour when it burns

Fuel C
- Existing supplies will last around 250 years
- Releases 1.2 kJ of energy per gram of fuel burned
- Costs 0.04p per gram of fuel burned
- Burns very easily and fairly easy to store
- Releases carbon dioxide, sulfur dioxide and water vapour when it burns

This information was analysed by a group of students to decide what they considered to be the 'best fuel'.

(a) Give the reason why the information about how easily each fuel burns was not useful to the students when reaching their decision. [1]

....

....

(b) One of the students based his decision purely on a judgement of the available supply of each fuel. Choose the order that shows his conclusion. Place a tick (✓) in the appropriate box. [1]

best fuel ↑						
	A	**A**	**B**	**B**	**C**	**C**
	B	**C**	**A**	**C**	**A**	**B**
	C	**B**	**C**	**A**	**B**	**A**
	☐	☐	☐	☐	☐	☐

(c) Which of the following statements best describes how the fuels affect the environment when they burn? Tick (✓) the correct answer and give the reason for your choice. [2]

all of the fuels contribute to acid rain and global warming when they burn ☐

fuels **A** and **C** contribute to acid rain and global warming when they burn ☐

only fuel **C** contributes to acid rain and global warming when it burns ☐

none of the fuels contribute to acid rain and global warming when they burn ☐

Reason ....

....

Examiner only

(d) The cost efficiency of fuel **A** can be calculated as follows:

$$\text{cost efficiency} = \frac{2.8}{0.03} = 93.3\,\text{kJ/p}$$

Use the information given for fuel **B** and this example to calculate the cost efficiency of fuel **B**. [2]

Cost efficiency = ... kJ/p

(e) The students eventually agreed on the following rank order for the fuels.

best fuel

↑

B
A
C

In the table below, tick (✓) **all** the statements that are **correct** and could therefore have been used in deciding upon this order. [2]

	(✓)
fuel **C** will run out after fuels **A** and **B**	
fuel **C** is easier to store than fuel **A**	
fuel **A** burns more easily than fuel **C**	
fuel **B** is the cleanest fuel	
fuel **B** is easier to store than fuel **C**	
fuel **B** will never run out	
fuel **A** is less harmful to the environment than fuel **C**	
fuel **A** is less cost efficient than fuel **B**	

8

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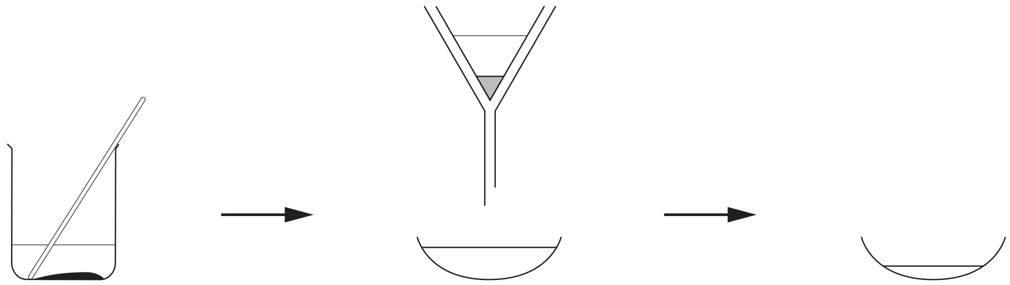
6. The diagram shows the three stages used in the preparation of copper(II) sulfate crystals from copper(II) carbonate and sulfuric acid.



Stage **1** Stage **2** Stage **3**

Describe and explain each stage of the preparation. Include an equation in your answer.

[6 QER]

....

....

....

....

....

....

....

....

....

....

....

....

....

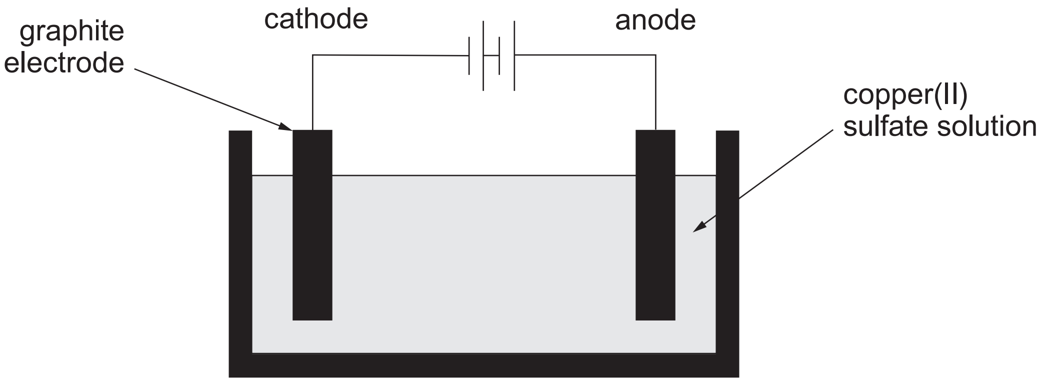
....

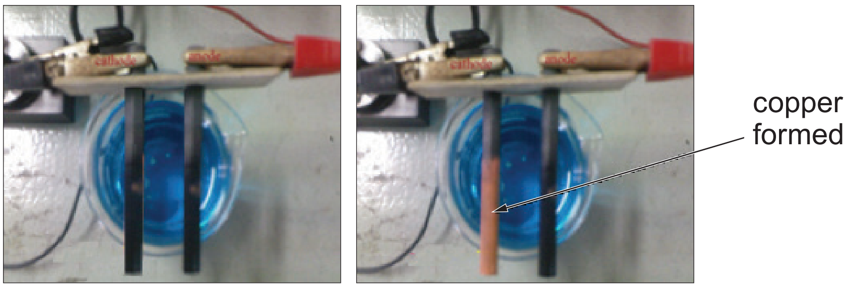
....

6

7. A group of students carried out an investigation into the electrolysis of copper(II) sulfate solution. They used the apparatus shown to test the hypothesis:

"the mass of copper that forms on the cathode increases as the time increases"





before   after

To test the hypothesis, they weighed the cathode before placing it into the copper(II) sulfate solution and then again after allowing electrolysis to take place for varying times.

Their results are shown below.

Time (s)	Mass of copper formed (mg)		
	1	2	Mean
0	0	0	0
10	2.8	3.2	3.0
20	4.8	5.0	4.9
30	8.2	7.8	8.0
40	10.8	11.2	11.0
50	12.9	13.1	13.0
60	15.8	16.0	15.9

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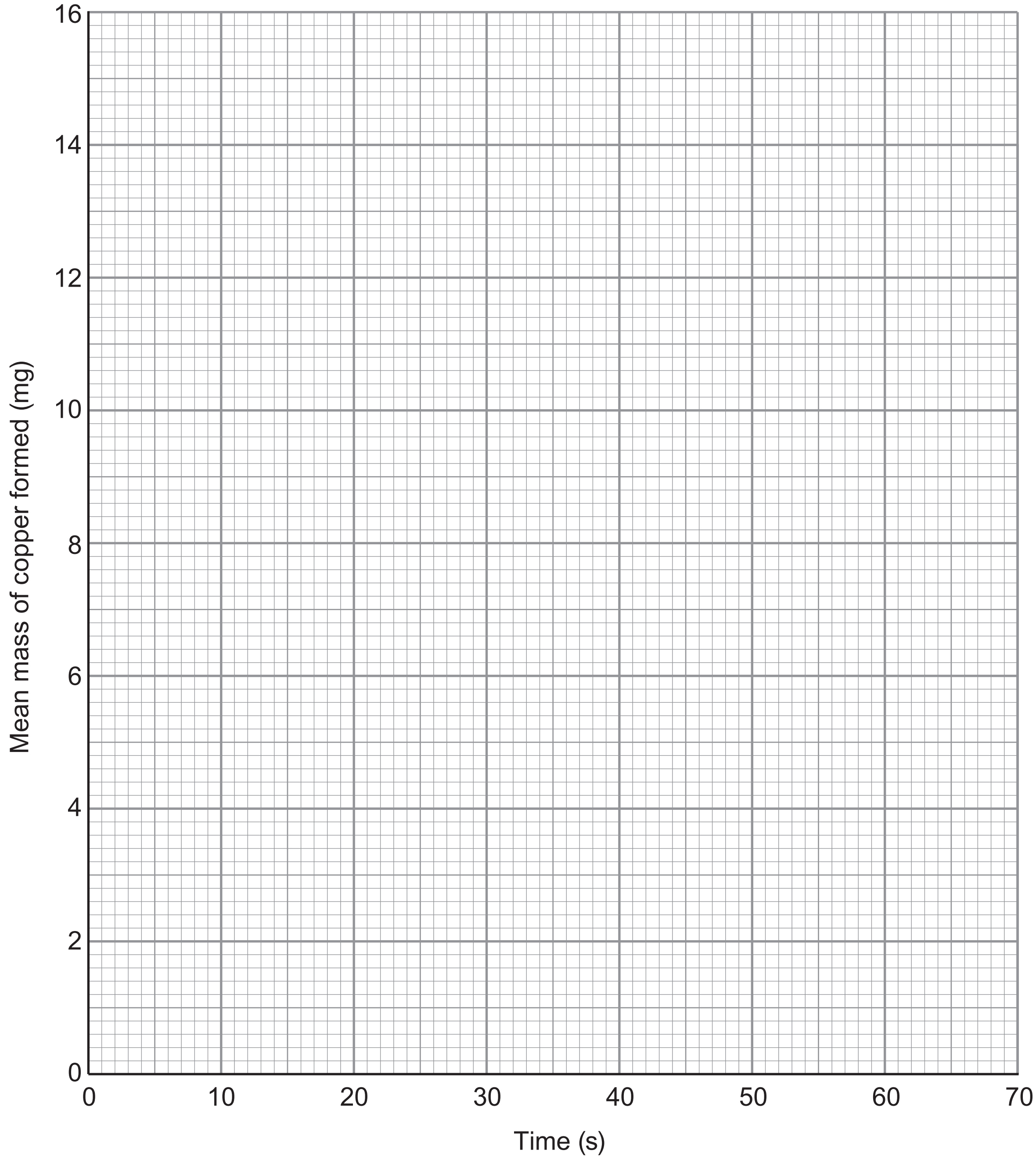
(a) On the grid below, plot the mean mass of copper formed against time. Draw a suitable line. [3]



Examiner only

(b) (i) Use the results collected at 30 s and the following equation to calculate the percentage variation in these measurements. [2]

$$\text{percentage variation} = \frac{\text{furthest mass from the mean} - \text{mean mass}}{\text{mean mass}} \times 100$$

Percentage variation = ... %

(ii) The mass of copper formed is lower than expected. Give the most likely reason for this difference. [1]

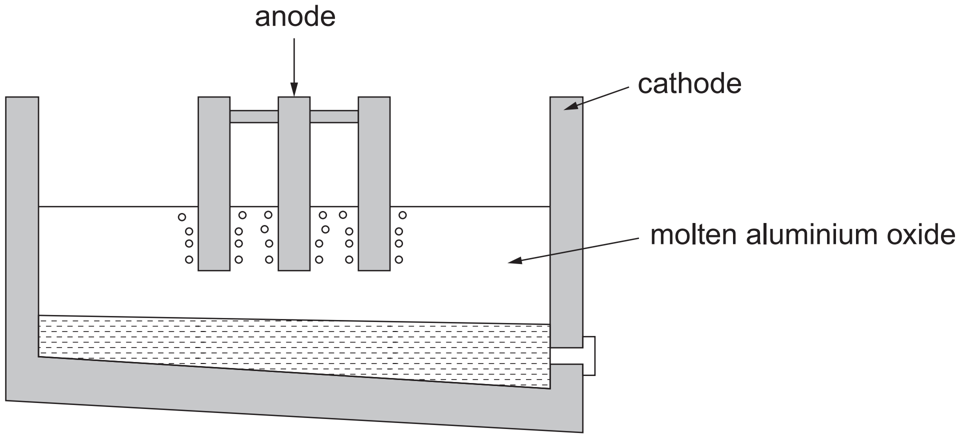
....

....

....

Examiner only

(c) (i) Aluminium is extracted from molten aluminium oxide by electrolysis.



I. Explain why aluminium forms at the cathode. [2]

....

....

....

II. Complete and balance the equation for the overall reaction that takes place. [2]

$2Al_2O_3 \longrightarrow \square$ .... + $\square$ ....

(ii) Potassium can also be extracted through electrolysis of potassium carbonate.

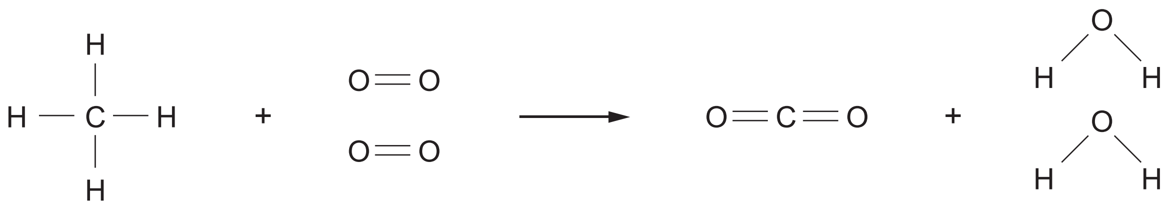
Write the **formula** of potassium carbonate to complete the equation for the overall reaction. [1]

2 .... $\longrightarrow$ $4K + 2CO_2 + O_2$

11

Turn over.

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



The bond energies are given in the table below.

Bond	Bond energy (kJ)
C — H	413
O ═ O	498
O — H	464
C ═ O	805

(a) Use the bond energy values to calculate the energy released when **all** the bonds in the carbon dioxide and water molecules are formed. [2]

Energy released = ... kJ

Examiner only

(b) The energy needed to break **all** the bonds in the methane and oxygen molecules is 2648 kJ.

Calculate the overall energy change for this reaction and use this value to explain why the reaction is exothermic. [2]

Overall energy change = ... kJ

....

....

4

END OF PAPER

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+}		

THE PERIODIC TABLE

1
H
Hydrogen
1

1	2					Group						3	4	5	6	7	0
																	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