

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.



MAY183430U50101

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]



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

displacement

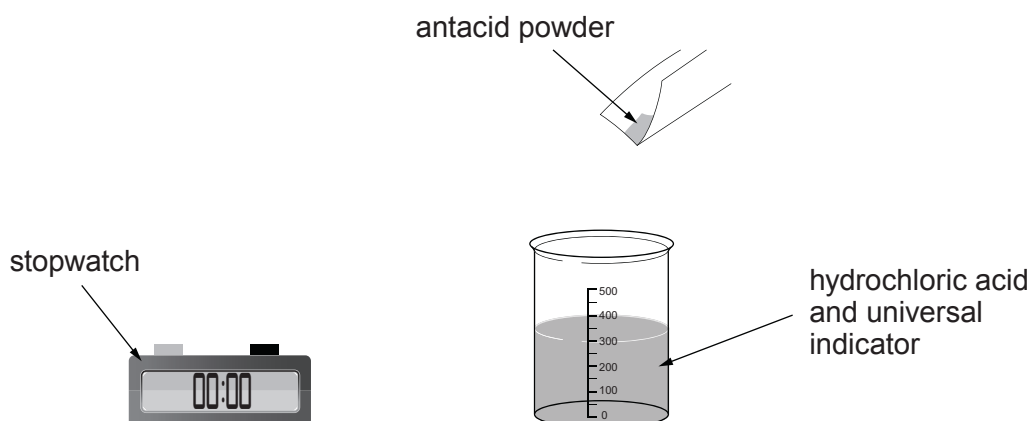
neutralisation

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.



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]

.....
.....



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.



- (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]

.....

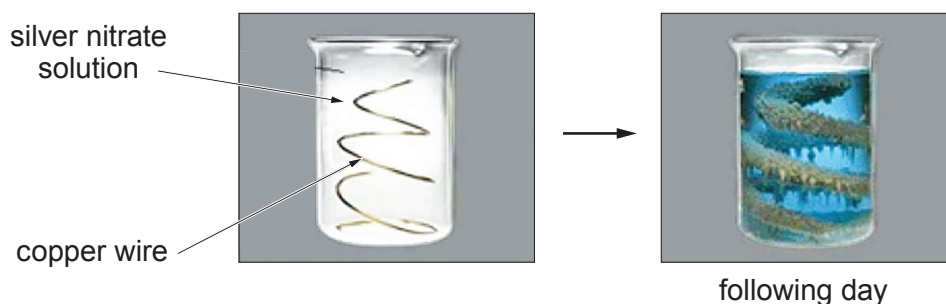
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- (b) Copper is able to displace silver from a solution of silver nitrate. The equation for this reaction is given below.



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]

.....

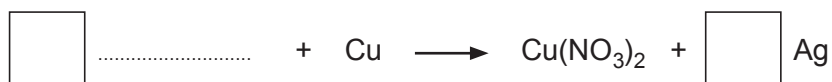
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- (ii) Complete the symbol equation for the reaction by

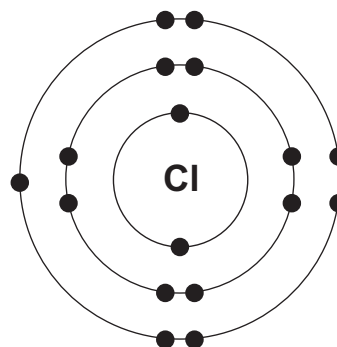
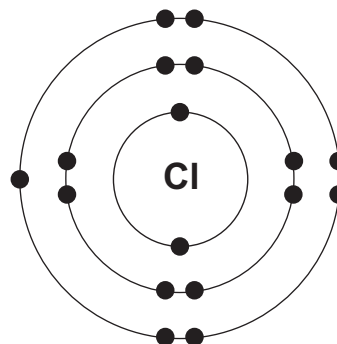
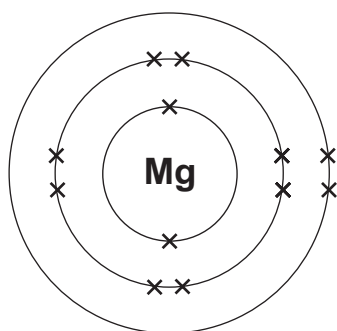
- giving the formula for silver nitrate
- balancing the overall equation

[2]



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

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



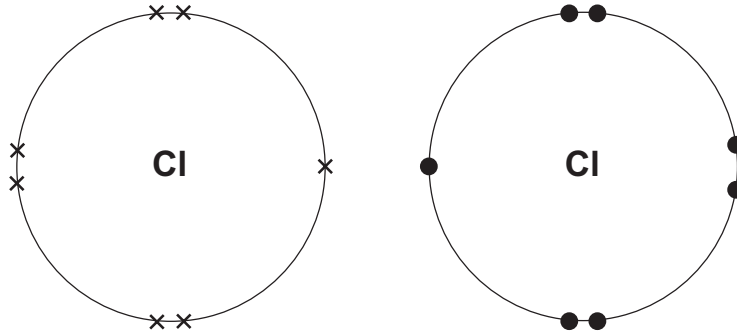
- (i) **Draw arrows on the diagram** to show how electrons are transferred between the magnesium and chlorine atoms during the formation of magnesium chloride. [1]
- (ii) **Complete the table** giving information about the charge and electronic structure of the magnesium and chloride **ions** that are formed. [2]

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



(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]



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

(i) Describe how crude oil was formed.

[2]

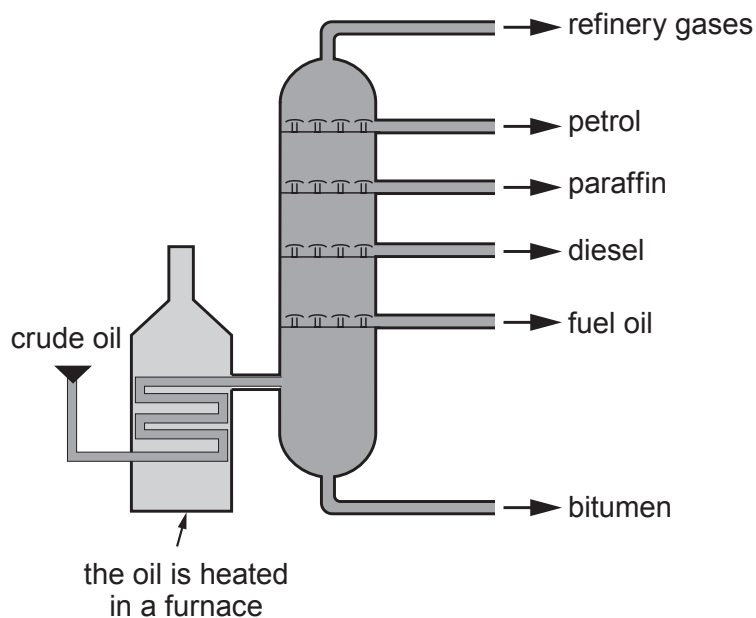
.....

(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



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

Calculate the percentage by mass of carbon in hexane.

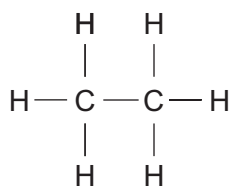
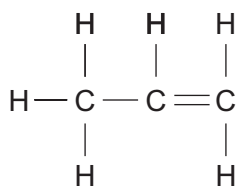
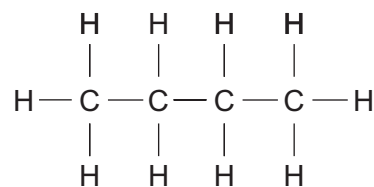
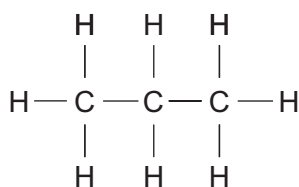
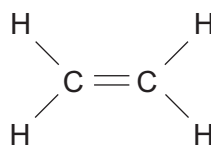
[2]

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

Percentage = %



(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 $\text{C}_n\text{H}_{2n+2}$

Unsaturated molecules



(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



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
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

- (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

.....



- (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



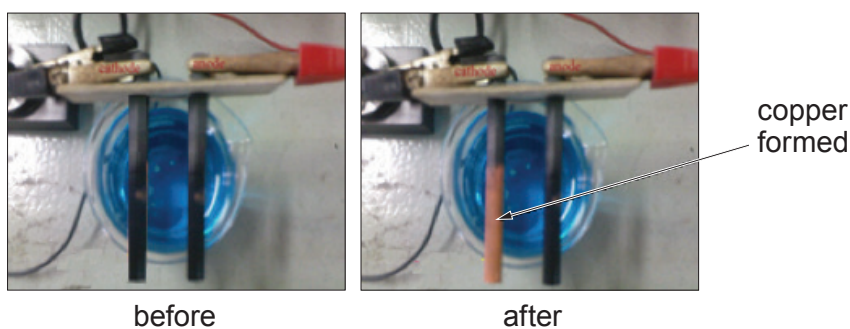
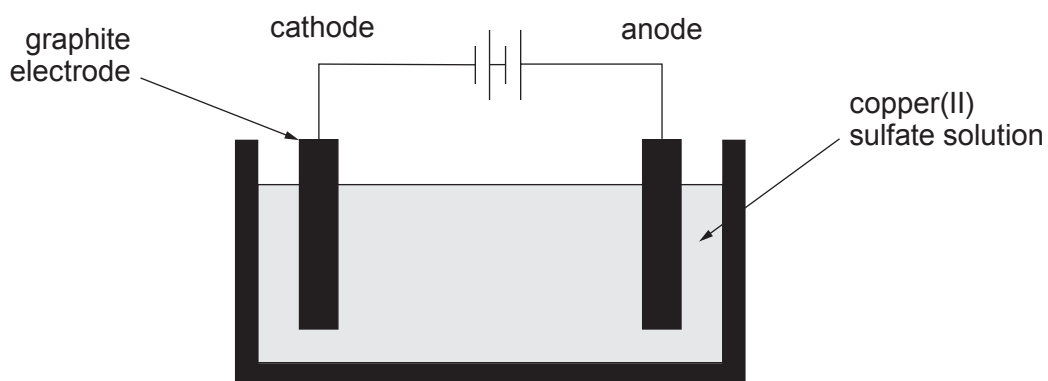
In the table below, tick (✓) **all** the statements that are **correct** and could therefore have been used in deciding upon this order. [2]

	(✓)
fuel C will run out after fuels A and B	<input type="checkbox"/>
fuel C is easier to store than fuel A	<input type="checkbox"/>
fuel A burns more easily than fuel C	<input type="checkbox"/>
fuel B is the cleanest fuel	<input type="checkbox"/>
fuel B is easier to store than fuel C	<input type="checkbox"/>
fuel B will never run out	<input type="checkbox"/>
fuel A is less harmful to the environment than fuel C	<input type="checkbox"/>
fuel A is less cost efficient than fuel B	<input type="checkbox"/>



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”



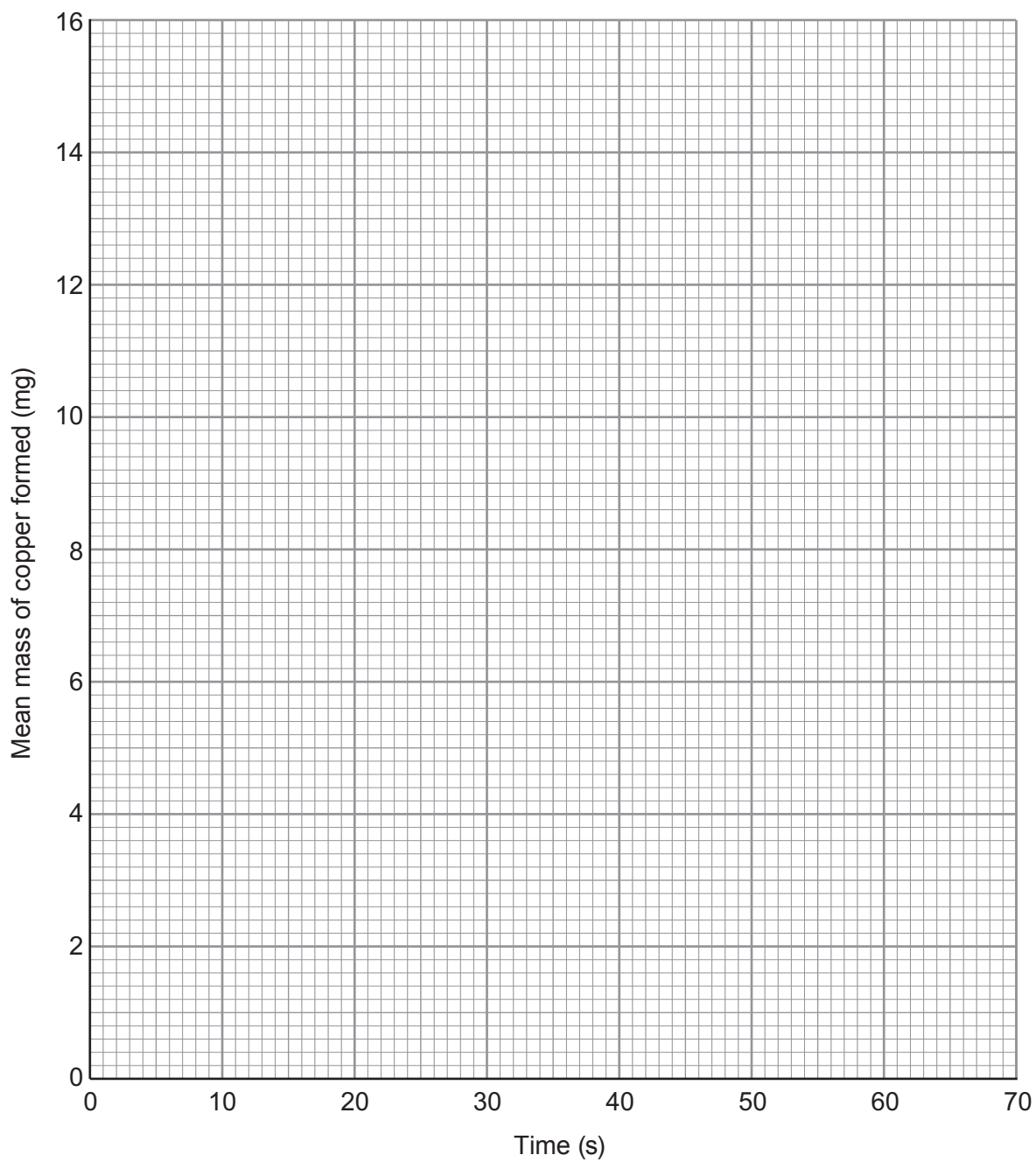
To test the hypothesis, they weighed the cathode before placing it into the copper(II) sulfate solution and then again after allowing electrolysis to take place for varying times.

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



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



- (b) (i) Use the results collected at 30s 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]

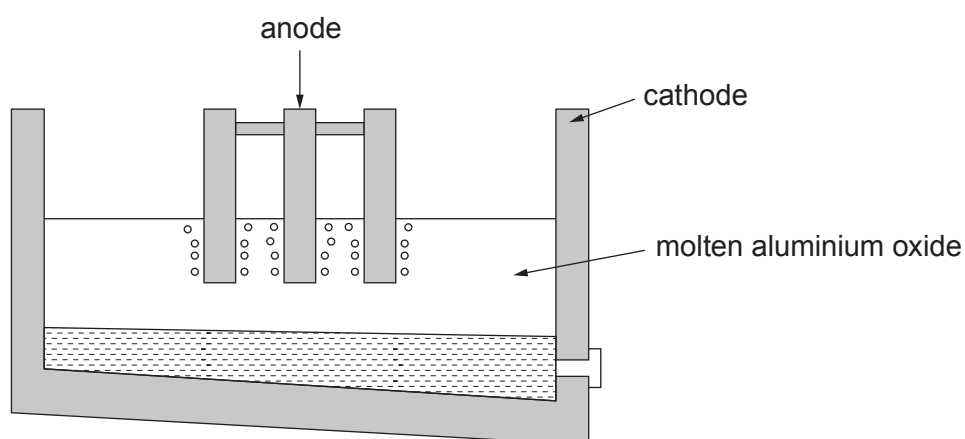
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- (c) (i) Aluminium is extracted from molten aluminium oxide by electrolysis.



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

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.....

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

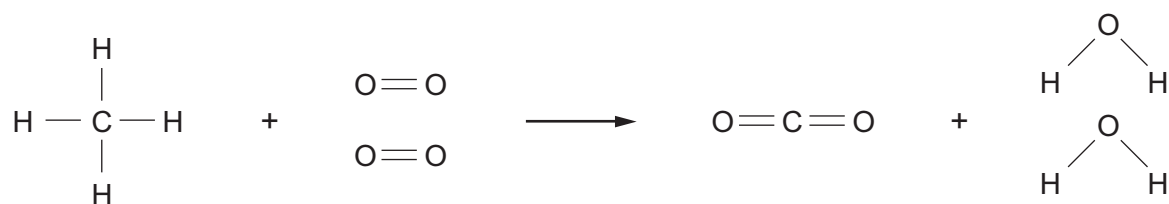


- (ii) Potassium can also be extracted through electrolysis of potassium carbonate.

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



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



- (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



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

0

7

6

5

4

3

2

1

Group

2

1

24

7 Li Lithium 3	9 Be Beryllium 4	11 Na Sodium 11	12 C Carbon 6	13 Al Aluminium 13	14 N Nitrogen 7	15 P Phosphorus 15	16 O Oxygen 8	17 F Fluorine 9	18 Ne Neon 10
19 K Potassium 19	20 Ca Calcium 20	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
37 Rb Rubidium 37	38 Sr Strontium 38	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
55 Cs Caesium 55	56 Ba Barium 56	57 La Lanthanum 57	58 Ce Cerium 58	59 Pr Praseodymium 59	60 Nd Neodymium 60	61 Pm Promethium 61	62 Sm Samarium 62	63 Eu Europium 63	64 Gd Gadolinium 64
87 Fr Francium 87	88 Ra Radium 88	89 Ac Actinium 89	90 Th Thorium 90	91 Pa Protactinium 91	92 U Uranium 92	93 Np Neptunium 93	94 Pu Plutonium 94	95 Am Americium 95	96 Cm Curium 96
133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57	140 Ce Cerium 58	141 Pr Praseodymium 59	142 Nd Neodymium 60	143 Pm Promethium 61	144 Sm Samarium 62	145 Eu Europium 63	146 Gd Gadolinium 64
223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89	228 Th Thorium 90	231 Pa Protactinium 91	232 U Uranium 92	235 Np Neptunium 93	238 Pu Plutonium 94	241 Am Americium 95	244 Cm Curium 96
101 B Boron 5	102 C Carbon 6	103 N Nitrogen 7	104 O Oxygen 8	105 F Fluorine 9	106 Ne Neon 10	107 Na Sodium 11	108 Mg Magnesium 12	109 Al Aluminium 13	110 Si Silicon 14
111 B Boron 5	112 C Carbon 6	113 N Nitrogen 7	114 O Oxygen 8	115 F Fluorine 9	116 Ne Neon 10	117 Na Sodium 11	118 Mg Magnesium 12	119 Al Aluminium 13	120 Si Silicon 14
119 In Indium 49	120 Tl Thallium 81	121 Pb Lead 82	122 Bi Bismuth 83	123 Po Polonium 84	124 At Astatine 85	125 Rn Radon 86	126 Fr Francium 87	127 Ra Radium 88	128 Ac Actinium 89
127 I Iodine 53	128 Xe Xenon 54	129 Ba Barium 56	130 La Lanthanum 57	131 Ce Cerium 58	132 Pr Praseodymium 59	133 Nd Neodymium 60	134 Pm Promethium 61	135 Sm Samarium 62	136 Eu Europium 63
131 Xe Xenon 54	132 Rn Radon 86	133 Cs Caesium 55	134 Ba Barium 56	135 La Lanthanum 57	136 Ce Cerium 58	137 Pr Praseodymium 59	138 Nd Neodymium 60	139 Pm Promethium 61	140 Sm Samarium 62
135 Br Bromine 35	136 Kr Krypton 36	137 Ba Barium 56	138 La Lanthanum 57	139 Ce Cerium 58	140 Pr Praseodymium 59	141 Nd Neodymium 60	142 Pm Promethium 61	143 Sm Samarium 62	144 Eu Europium 63
151 Sb Antimony 51	152 Te Tellurium 52	153 Pb Lead 82	154 Bi Bismuth 83	155 Po Polonium 84	156 At Astatine 85	157 Rn Radon 86	158 Fr Francium 87	159 Ra Radium 88	160 Ac Actinium 89
155 As Arsenic 33	156 Se Selenium 34	157 Ge Germanium 32	158 Sn Tin 50	159 Pb Lead 82	160 Bi Bismuth 83	161 Po Polonium 84	162 At Astatine 85	163 Rn Radon 86	164 Fr Francium 87
163 Cd Cadmium 48	164 Hg Mercury 80	165 Zn Zinc 30	166 Cu Copper 29	167 Ag Silver 47	168 Au Gold 79	169 Pt Platinum 78	170 Ir Iridium 77	171 Rh Rhodium 45	172 Co Cobalt 27
171 Rh Rhodium 45	172 Co Cobalt 27	173 Ni Nickel 28	174 Cu Copper 29	175 Zn Zinc 30	176 Ga Gallium 31	177 Ge Germanium 32	178 As Arsenic 33	179 Se Selenium 34	180 Br Bromine 35
181 Ta Tantalum 73	182 Hf Hafnium 72	183 W Tungsten 74	184 Re Rhenium 75	185 Os Osmium 76	186 Ir Iridium 77	187 Pt Platinum 78	188 Au Gold 79	189 Hg Mercury 80	190 Tl Thallium 81
191 Zr Zirconium 40	192 Nb Niobium 41	193 Mo Molybdenum 42	194 Tc Technetium 43	195 Ru Ruthenium 44	196 Rh Rhodium 45	197 Pd Palladium 46	198 Ag Silver 47	199 Cd Cadmium 48	200 In Indium 49
201 Hg Mercury 80	202 Tl Thallium 81	203 Pb Lead 82	204 Bi Bismuth 83	205 Po Polonium 84	206 At Astatine 85	207 Rn Radon 86	208 Fr Francium 87	209 Ra Radium 88	210 Ac Actinium 89
209 Bi Bismuth 83	210 Po Polonium 84	211 At Astatine 85	212 Rn Radon 86	213 Fr Francium 87	214 Ra Radium 88	215 Ac Actinium 89	216 Th Thorium 90	217 Pa Protactinium 91	218 U Uranium 92
215 At Astatine 85	216 Rn Radon 86	217 Fr Francium 87	218 Ra Radium 88	219 Ac Actinium 89	220 Th Thorium 90	221 Pa Protactinium 91	222 U Uranium 92	223 Np Neptunium 93	224 Pu Plutonium 94
221 Pa Protactinium 91	222 U Uranium 92	223 Np Neptunium 93	224 Pu Plutonium 94	225 Am Americium 95	226 Cm Curium 96	227 Bk Berkelium 97	228 Cf Californium 98	229 Es Einsteinium 99	230 Fm Fermium 100
225 Am Americium 95	226 Cm Curium 96	227 Bk Berkelium 97	228 Cf Californium 98	229 Es Einsteinium 99	230 Fm Fermium 100	231 Mn Mendelevium 101	232 Nv Nobelium 102	233 Lr Lawrencium 103	234 Rf Rutherfordium 104
231 Mn Mendelevium 101	232 Nv Nobelium 102	233 Lr Lawrencium 103	234 Rf Rutherfordium 104	235 Db Dubnium 105	236 Sg Seaborgium 106	237 Bh Bohrium 107	238 Hs Hassium 108	239 Mt Meitnerium 109	240 Ds Darmstadtium 110
235 Am Americium 95	236 Cm Curium 96	237 Bk Berkelium 97	238 Cf Californium 98	239 Es Einsteinium 99	240 Fm Fermium 100	241 Mn Mendelevium 101	242 Nv Nobelium 102	243 Lr Lawrencium 103	244 Rf Rutherfordium 104
241 Mn Mendelevium 101	242 Nv Nobelium 102	243 Lr Lawrencium 103	244 Rf Rutherfordium 104	245 Db Dubnium 105	246 Sg Seaborgium 106	247 Bh Bohrium 107	248 Hs Hassium 108	249 Mt Meitnerium 109	250 Ds Darmstadtium 110
245 Am Americium 95	246 Cm Curium 96	247 Bk Berkelium 97	248 Cf Californium 98	249 Es Einsteinium 99	250 Fm Fermium 100	251 Mn Mendelevium 101	252 Nv Nobelium 102	253 Lr Lawrencium 103	254 Rf Rutherfordium 104
249 Am Americium 95	250 Cm Curium 96	251 Bk Berkelium 97	252 Cf Californium 98	253 Es Einsteinium 99	254 Fm Fermium 100	255 Mn Mendelevium 101	256 Nv Nobelium 102	257 Lr Lawrencium 103	258 Rf Rutherfordium 104
253 Lr Lawrencium 103	254 Rf Rutherfordium 104	255 Db Dubnium 105	256 Sg Seaborgium 106	257 Bh Bohrium 107	258 Hs Hassium 108	259 Mt Meitnerium 109	260 Ds Darmstadtium 110	261 Uu Ununennium 111	262 Uub Unubium 112
257 Bk Berkelium 97	258 Cf Californium 98	259 Es Einsteinium 99	260 Fm Fermium 100	261 Mn Mendelevium 101	262 Nv Nobelium 102	263 Lr Lawrencium 103	264 Rf Rutherfordium 104	265 Db Dubnium 105	266 Sg Seaborgium 106
261 Mn Mendelevium 101	262 Nv Nobelium 102	263 Lr Lawrencium 103	264 Rf Rutherfordium 104	265 Db Dubnium 105	266 Sg Seaborgium 106	267 Bh Bohrium 107	268 Hs Hassium 108	269 Mt Meitnerium 109	270 Ds Darmstadtium 110
265 Am Americium 95	266 Cm Curium 96	267 Bk Berkelium 97	268 Cf Californium 98	269 Es Einsteinium 99	270 Fm Fermium 100	271 Mn Mendelevium 101	272 Nv Nobelium 102	273 Lr Lawrencium 103	274 Rf Rutherfordium 104
269 Am Americium 95	270 Cm Curium 96	271 Bk Berkelium 97	272 Cf Californium 98	273 Es Einsteinium 99	274 Fm Fermium 100	275 Mn Mendelevium 101	276 Nv Nobelium 102	277 Lr Lawrencium 103	278 Rf Rutherfordium 104
273 Lr Lawrencium 103	274 Rf Rutherfordium 104	275 Db Dubnium 105	276 Sg Seaborgium 106	277 Bh Bohrium 107	278 Hs Hassium 108	279 Mt Meitnerium 109	280 Ds Darmstadtium 110	281 Uu Ununennium 111	282 Uub Unubium 112
277 Bk Berkelium 97	278 Cf Californium 98	279 Es Einsteinium 99	280 Fm Fermium 100	281 Mn Mendelevium 101	282 Nv Nobelium 102	283 Lr Lawrencium 103	284 Rf Rutherfordium 104	285 Db Dubnium 105	286 Sg Seaborgium 106
281 Mn Mendelevium 101	282 Nv Nobelium 102	283 Lr Lawrencium 103	284 Rf Rutherfordium 104	285 Db Dubnium 105	286 Sg Seaborgium 106	287 Bh Bohrium 107	288 Hs Hassium 108	289 Mt Meitnerium 109	290 Ds Darmstadtium 110
285 Am Americium 95	286 Cm Curium 96	287 Bk Berkelium 97	288 Cf Californium 98	289 Es Einsteinium 99	290 Fm Fermium 100	291 Mn Mendelevium 101	292 Nv Nobelium 102	293 Lr Lawrencium 103	294 Rf Rutherfordium 104
289 Am Americium 95	290 Cm Curium 96	291 Bk Berkelium 97	292 Cf Californium 98	293 Es Einsteinium 99	294 Fm Fermium 100	295 Mn Mendelevium 101	296 Nv Nobelium 102	297 Lr Lawrencium 103	298 Rf Rutherfordium 104
293 Lr Lawrencium 103	294 Rf Rutherfordium 104	295 Db Dubnium 105	296 Sg Seaborgium 106	297 Bh Bohrium 107	298 Hs Hassium 108	299 Mt Meitnerium 109	300 Ds Darmstadtium 110	301 Uu Ununennium 111	302 Uub Unubium 112
297 Bk Berkelium 97	298 Cf Californium 98	299 Es Einsteinium 99	300 Fm Fermium 100	301 Mn Mendelevium 101	302 Nv Nobelium 102	303 Lr Lawrencium 103	304 Rf Rutherfordium 104	305 Db Dubnium 105	306 Sg Seaborgium 106
301 Mn Mendelevium 101	302 Nv Nobelium 102	303 Lr Lawrencium 103	304 Rf Rutherfordium 104	305 Db Dubnium 105	306 Sg Seaborgium 106	307 Bh Bohrium 107	308 Hs Hassium 108	309 Mt Meitnerium 109	310 Ds Darmstadtium 110
305 Am Americium 95	306 Cm Curium 96	307 Bk Berkelium 97	308 Cf Californium 98	309 Es Einsteinium 99	310 Fm Fermium 100	311 Mn Mendelevium 101	312 Nv Nobelium 102	313 Lr Lawrencium 103	314 Rf Rutherfordium 104
309 Am Americium 95	310 Cm Curium 96	311 Bk Berkelium 97	312 Cf Californium 98	313 Es Einsteinium 99	314 Fm Fermium 100	315 Mn Mendelevium 101	316 Nv Nobelium 102	317 Lr Lawrencium 103	318 Rf Rutherfordium 104
313 Lr Lawrencium 103	314 Rf Rutherfordium 104	315 Db Dubnium 105	316 Sg Seaborgium 106						