Surname	Centre Number	Candidate Number
Other Names		0

GCSE – NEW

3430UE0-1

S18-3430UE0-1

SCIENCE (Double Award)

Unit 5 – CHEMISTRY 2
HIGHER TIER

THURSDAY, 17 MAY 2018 – MORNING

1 hour 15 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**11**	
2.	**4**	
3.	**11**	
4.	**12**	
5.	**8**	
6.	**8**	
7.	**6**	
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 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 **7** is a quality of extended response (QER) question where your writing skills will be assessed.

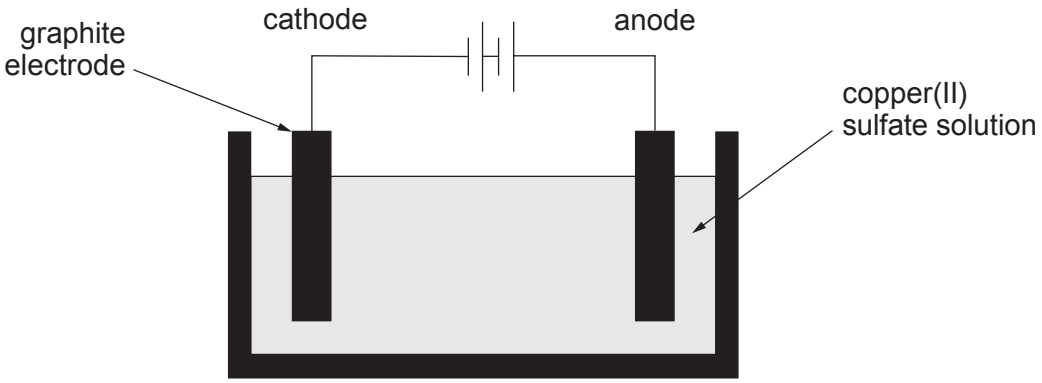
The Periodic Table is printed on the back cover of this paper and the formulae for some common ions on the inside of the back cover.

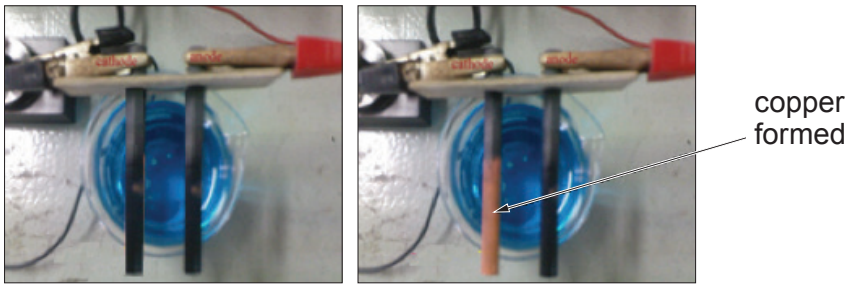
MAY183430UE0101

Answer **all** *questions.*

1. 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

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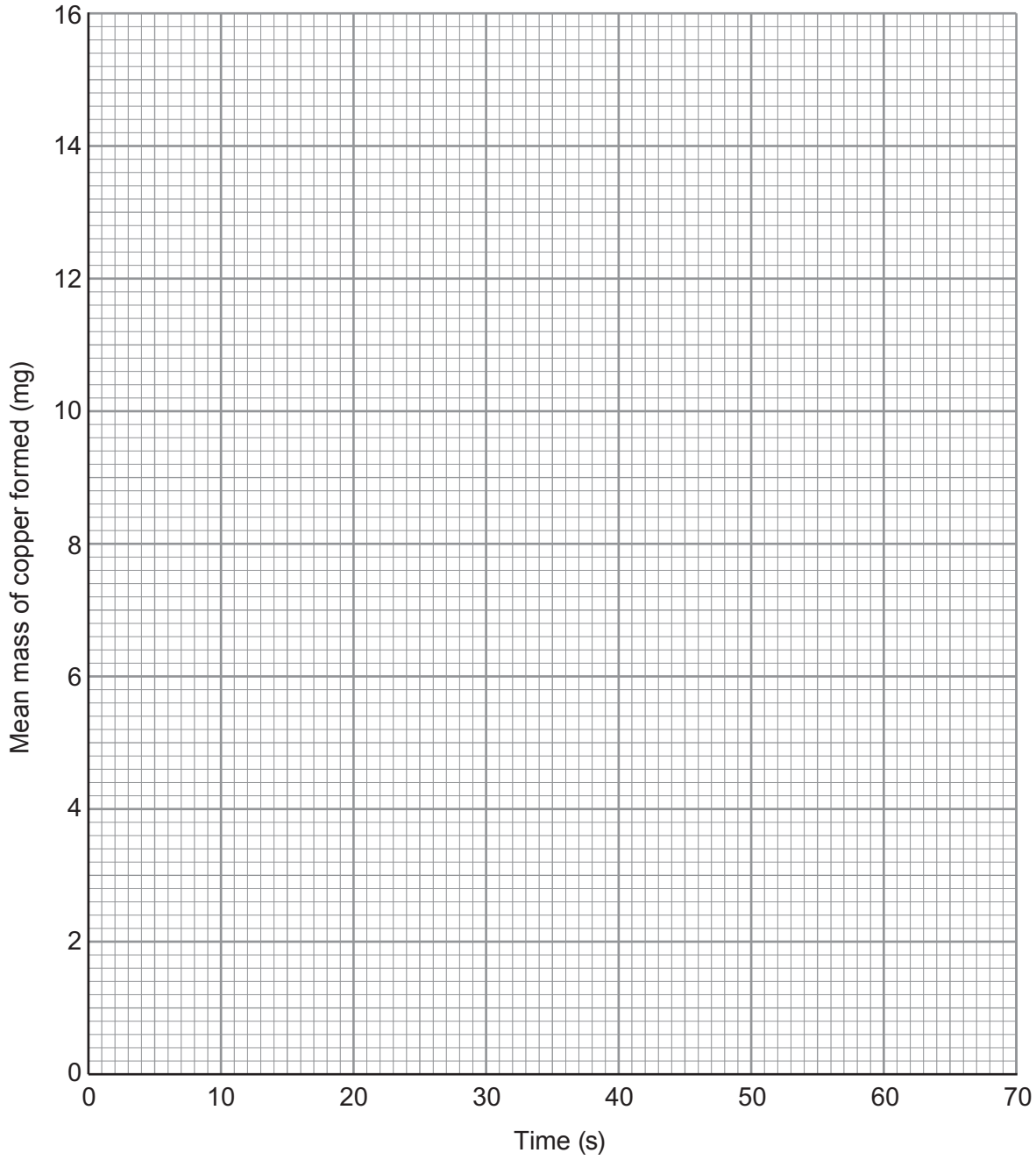
(a) On the grid below, plot the mean mass of copper formed against time. Draw a suitable line. [3]



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(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]

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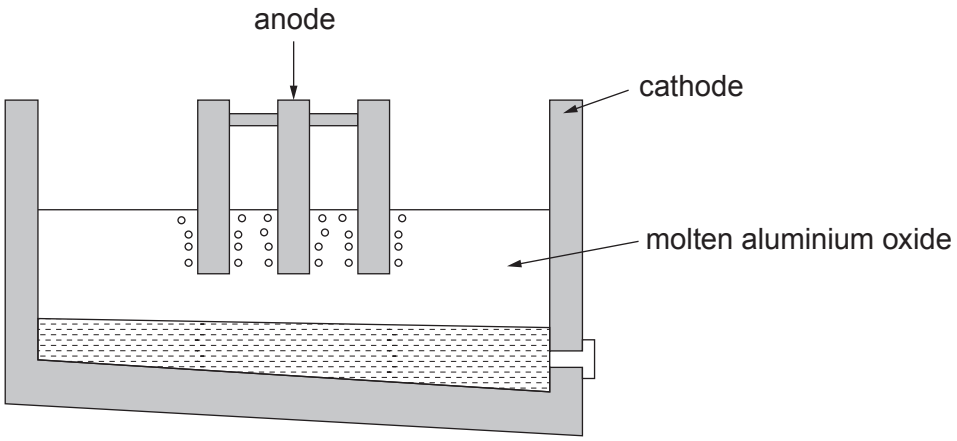
(c) (i) Aluminium is extracted from molten aluminium oxide by electrolysis.



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

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

$2Al_2O_3 \longrightarrow$ ☐ ..... + ☐ .....

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

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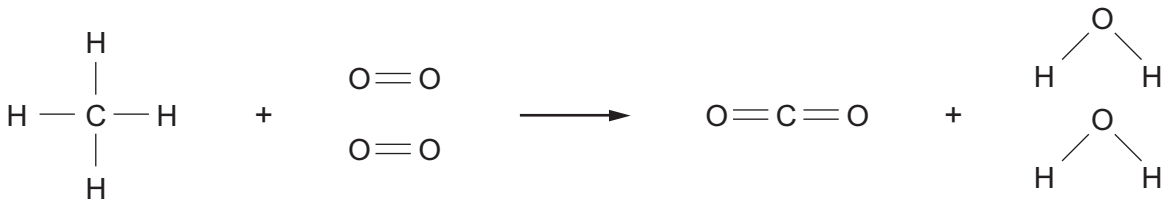
2. The burning of methane in air can be represented by the following equation.



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

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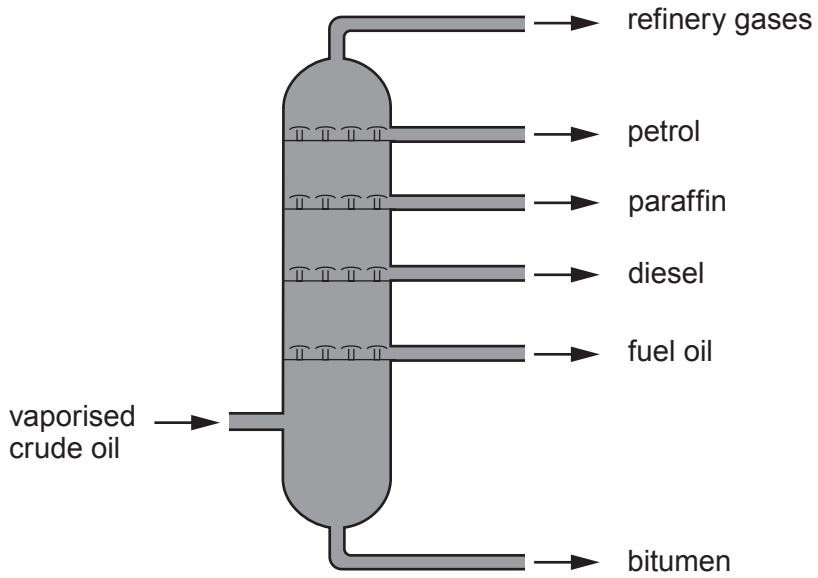
3. Crude oil is a mixture of hydrocarbon compounds. It is separated into different fractions inside a fractionating column. Each fraction has a different boiling point range.



(a) Explain how the length of the hydrocarbon chains within each fraction determines where each fraction collects in the column. [2]

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(b) Many of the hydrocarbons that are collected from crude oil go through a second process called cracking. The equation shows the cracking of the hydrocarbon with the formula $C_{15}H_{32}$.

$$C_{15}H_{32} \longrightarrow C_3H_8 + 2C_2H_4 + 2 \text{ .....}$$

(i) **Complete the equation** for this reaction by adding the **formula** of **one** other product. [1]

(ii) Give the reaction conditions used in the process. [1]

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(iii) Give **one** reason why it is important for oil companies to carry out cracking. [1]

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(c) Many hydrocarbons display isomerism.

(i) Give the meaning of the term *isomer*. [1]

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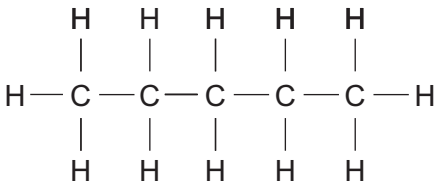
(ii) C_5H_{12} has three isomers. The diagram shows one of these isomers.



Draw the **two** other isomers of C_5H_{12}. [2]

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(d) 8.4 g of a hydrocarbon was found to contain 7.2 g of carbon. Use this information to determine whether the compound is an alkane or an alkene. You **must** show your working. [3]

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

Conclusion .....

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4. Potassium chloride and potassium sulfate are salts that can be made from the reactions of acids. Becky and David carried out experiments to prepare both salts.

(a) To make a sample of potassium chloride, they reacted potassium carbonate powder with dilute hydrochloric acid, HCl. They used the following method.

Stage 1 – add potassium carbonate powder to dilute hydrochloric acid

Stage 2 – filter the mixture

Stage 3 – leave the remaining mixture in a warm place overnight

(i) David said it was important to know the volume of acid in stage 1.

Circle whether you agree or disagree with his statement and explain your answer. [2]

Agree / Disagree

Explanation .....

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.....

(ii) Give the balanced **symbol** equation for the reaction taking place in stage 1. [3]

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Examiner only

(b) To make a sample of potassium sulfate, they reacted potassium hydroxide solution with dilute sulfuric acid, H_2SO_4. They used the following method.

Stage 1 – measure out 25.0 cm^3 of potassium hydroxide solution into a flask

Stage 2 – add 4-5 drops of indicator

Stage 3 – record the volume of sulfuric acid required to neutralise the solution

Stage 4 – repeat without the indicator, using the volume of acid used in stage 3

Stage 5 – leave the remaining mixture in a warm place overnight

(i) Becky was concerned that carrying out stages 1-3 only once would mean that the volume of sulfuric acid used in stage 4 would be larger than that actually needed to neutralise the potassium hydroxide solution. Suggest the reason for her concern. [1]

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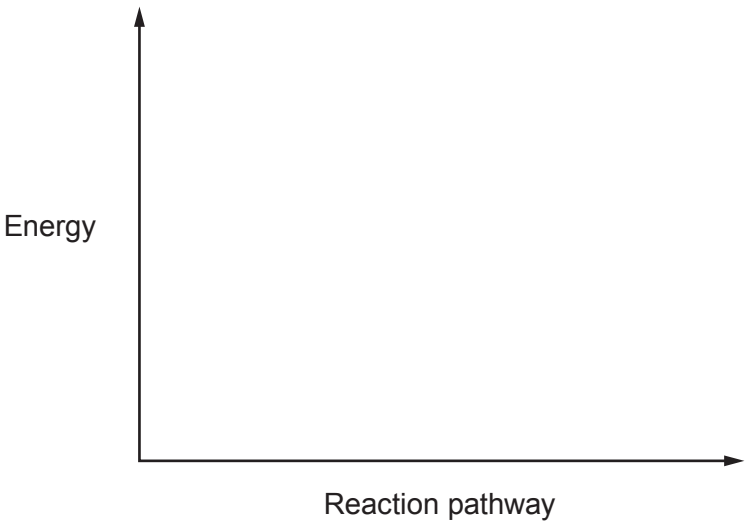
(ii) Write the **ionic** equation to show how water is formed during this reaction and state the source of each of the ions. [2]

Equation .....

Source of ions .....

.....

(iii) The reaction is exothermic. Sketch the energy profile diagram for this reaction. [1]



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(c) Becky and David carried out a series of tests to identify the ions present in their salts.

(i) They carried out a flame test on each of the salts. Give the reason why the results of this test could not be used to identify the salts. [1]

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(ii) Describe a test that enabled them to tell the salts apart. Give the results seen with both salts. [2]

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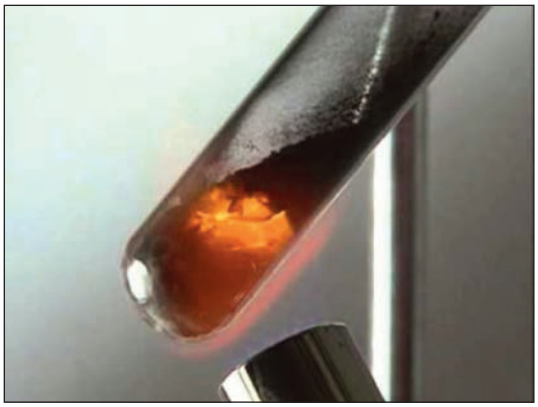
5. *(a)* A teacher showed her class how copper can be extracted from copper(II) oxide using charcoal.



$$2CuO(s) + C(s) \longrightarrow CO_2(g) + 2Cu(s)$$

In her experiment, the teacher heated 1.59 g of copper(II) oxide and 0.12 g of charcoal in a boiling tube. She continued to heat the mixture strongly until it had been glowing for 5 minutes.

She recorded the mass of the boiling tube and its contents before heating and then again after heating, once the carbon dioxide produced had been released from the tube.

Mass of boiling tube = 37.43 g
Mass of boiling tube and contents **before** heating = 39.14 g
Mass of boiling tube and contents **after** heating = 38.82 g

(i) The teacher had expected the reaction to produce 1.27 g of copper from the masses of copper(II) oxide and charcoal used. Use her results to show that the mass produced suggests a 109 % yield. [2]

(ii) Assuming the reactants had been heated at a high enough temperature for sufficient time, suggest **one** reason for the yield being larger than expected. [1]

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Examiner only

(b) Iron is extracted from iron(III) oxide, Fe_2O_3, inside the blast furnace using coke.

(i) Write a balanced **symbol** equation for **one** of the reactions that show the reduction of iron(III) oxide inside the furnace. [2]

.....

(ii) An iron ore contains 22 % by mass of iron(III) oxide. Calculate the maximum mass of iron that could be obtained from 5×10^5 tonnes of this ore. Give your answer in **standard form**. [3]

Mass = ... tonnes

8

Examiner only

6. Saturated and Unsaturated Fats

Saturated and unsaturated fats are found in different amounts in different foods.

Unsaturated fats are often described as 'good fats'. When used to replace saturated fats in the diet they help lower cholesterol, one of the risk factors linked to heart disease.

While full-fat dairy products and meat contain large amounts of saturated fats, sources of unsaturated fats include nuts, seeds and vegetable oils.

Saturated and unsaturated fats differ in their chemical structures. Unsaturated fats contain double bonds between the carbon atoms within their molecular structure, whereas saturated fats have no double bonds.

The label on the bottle of a new brand of cooking oil claims that it is better than other cooking oils available on the market because it contains only **15% saturated fat**.

Scientists decided to investigate this claim.

They used bromine water to compare the percentage unsaturation of this new brand of cooking oil with four other vegetable oils, **W**, **X**, **Y** and **Z**. They also tested a known alkane and alkene.

They measured the volume of bromine water that could be added to each oil sample before the bromine water colour remained. Their results are shown below.

Sample	Mean volume of bromine water added (cm^3)	Unsaturation (%)	Saturation (%)
oil **W**	20.4	50	50
oil **X**	12.0	30	70
oil **Y**	24.1	60	40
oil **Z**	16.3	40	60
new brand oil	30.1	?	?
alkane	0.1	-	-
alkene	40.0	-	-

Examiner only

(a) Which **one** of these statements best describes the oils tested? Tick (✓) the correct answer. [1]

the oils contain saturated fats only ☐

the oils contain unsaturated fats only ☐

the oils contain both saturated and unsaturated fats ☐

it is not possible to tell whether the oils contain saturated or unsaturated fats ☐

(b) Explain why the first drops of bromine water that are added to each of the oil samples are decolourised. [2]

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(c) The label states that the new oil contains only 15 % saturated fat. Use the results to show whether this statement is correct. [3]

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(d) Explain why these results might persuade many consumers to use this new brand of oil in preference to the other available brands. [2]

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Examiner only

7. Magnesium chloride is a solid with a high melting point. It conducts electricity only when molten or dissolved.

Describe the electronic changes that take place in the formation of magnesium chloride and explain its properties in terms of the bonding and structure. You may use diagrams as part of your answer. [6 QER]

END OF PAPER

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

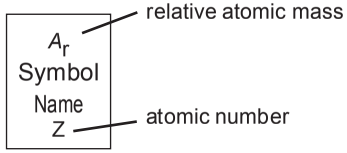
FORMULAE FOR SOME COMMON IONS

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	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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