

Surname	Centre Number	Candidate Number
Other Names		0



GCSE – NEW

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	

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. 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.

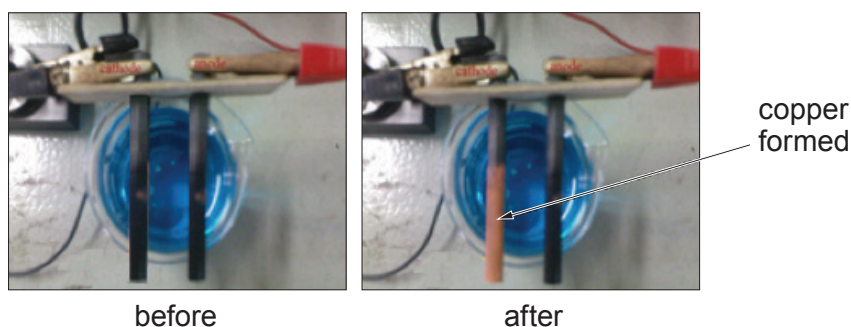
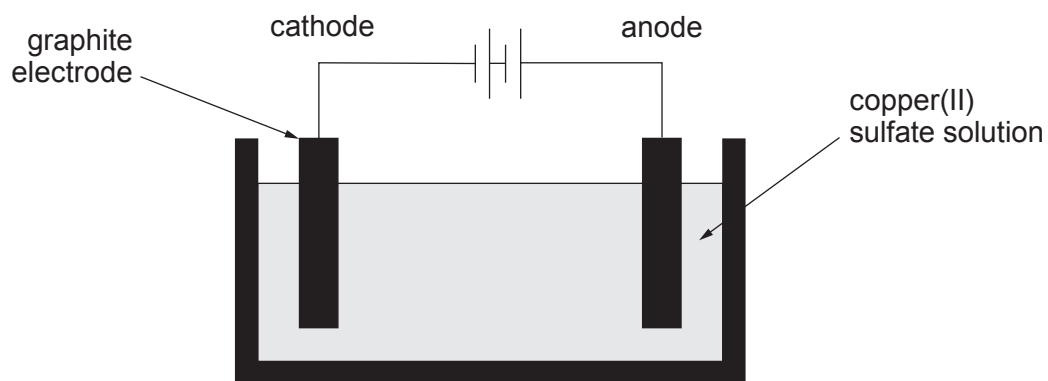


MAY183430UE0101

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”



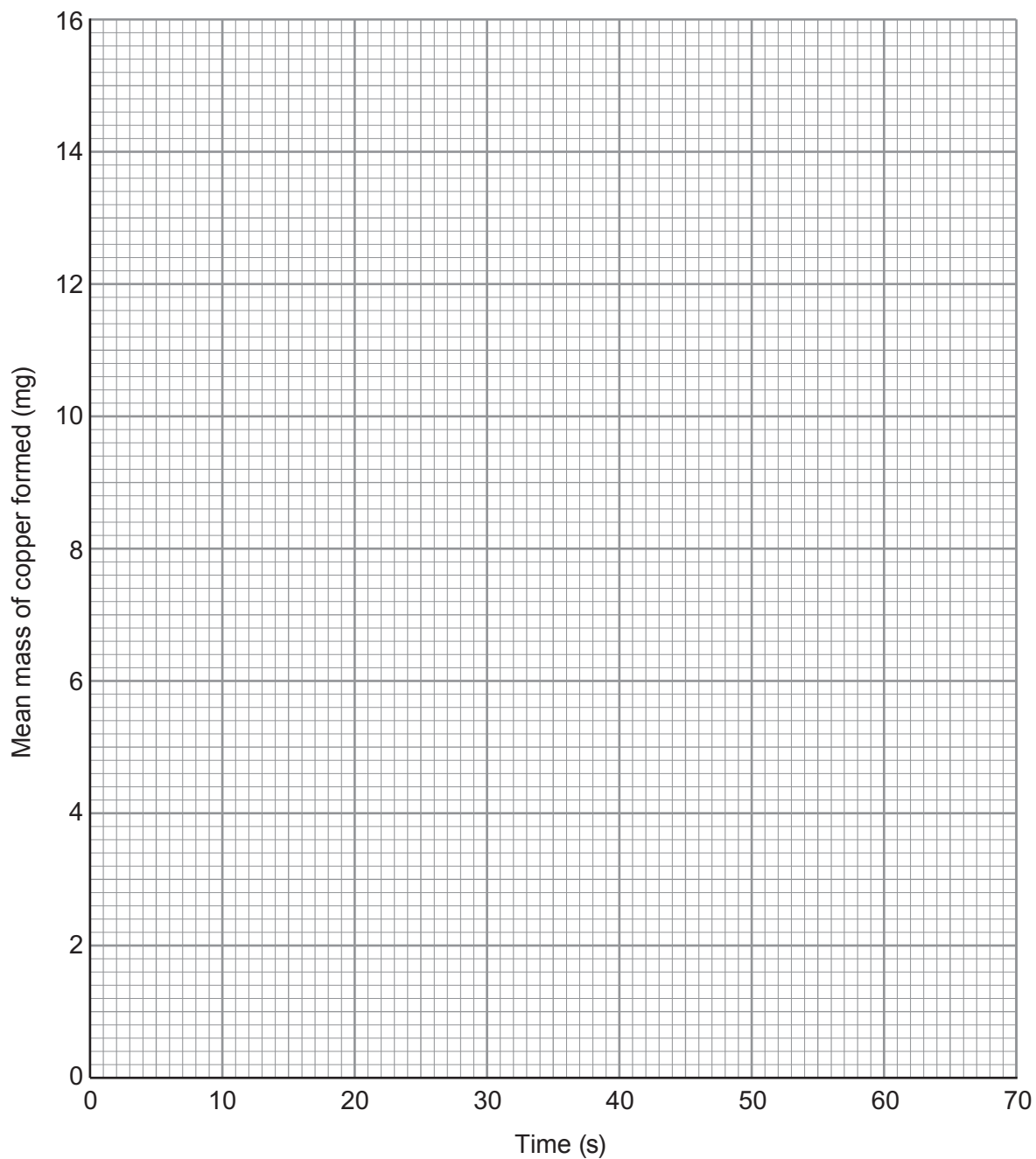
To test the hypothesis, they weighed the cathode before placing it into the copper(II) sulfate solution and then again after allowing electrolysis to take place for varying times.

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



- (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]

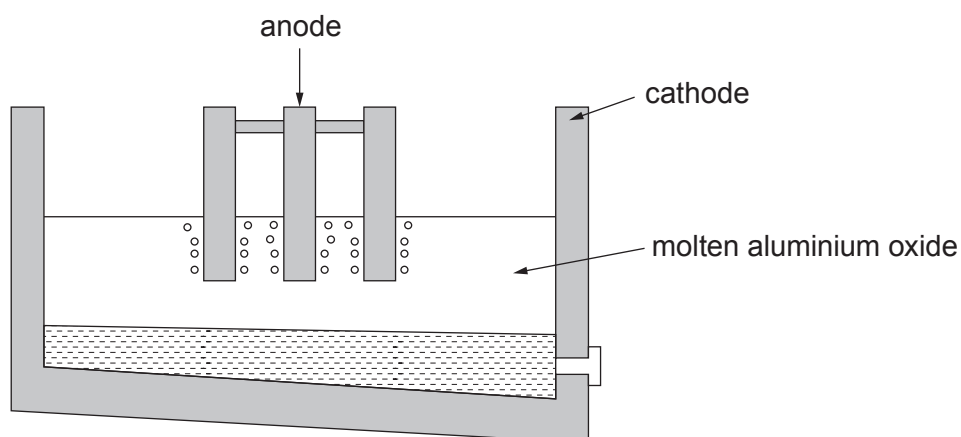
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- (c) (i) Aluminium is extracted from molten aluminium oxide by electrolysis.



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

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

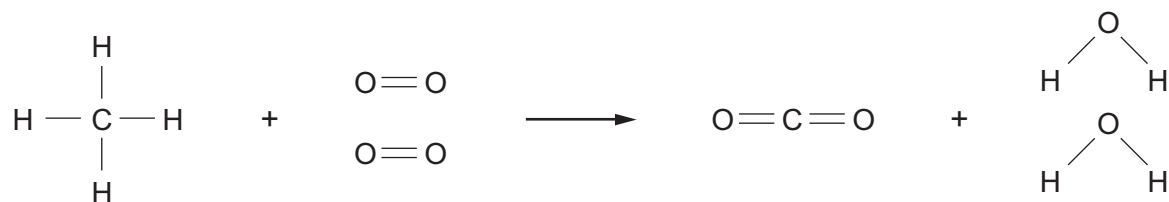


- (ii) Potassium can also be extracted through electrolysis of potassium carbonate.

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



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



- (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

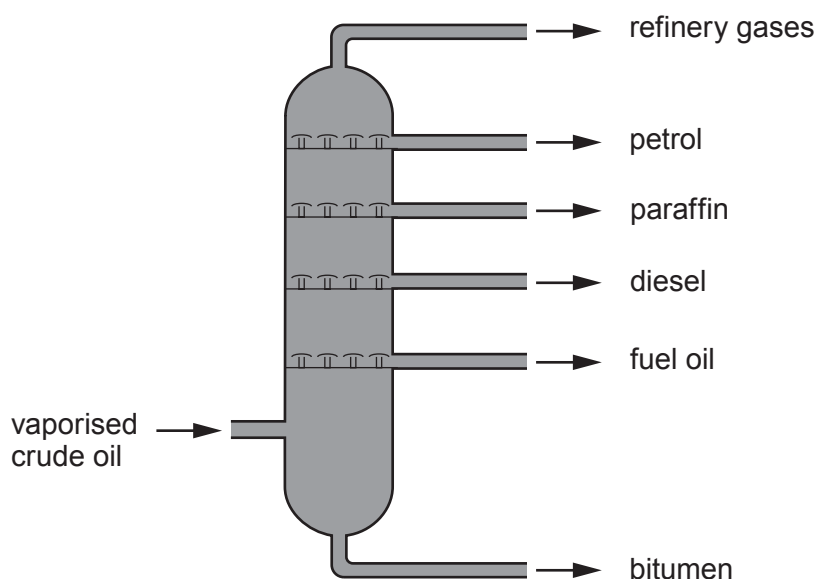
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3. Crude oil is a mixture of hydrocarbon compounds. It is separated into different fractions inside a fractionating column. Each fraction has a different boiling point range.



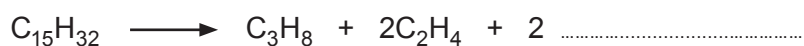
- (a) Explain how the length of the hydrocarbon chains within each fraction determines where each fraction collects in the column. [2]

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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 $C_{15}H_{32}$.



- (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]

- (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.

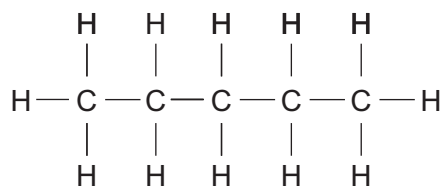
(i) Give the meaning of the term *isomer*.

[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]



- (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]

$$A_r(\text{H}) = 1 \quad A_r(\text{C}) = 12$$

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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- (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.

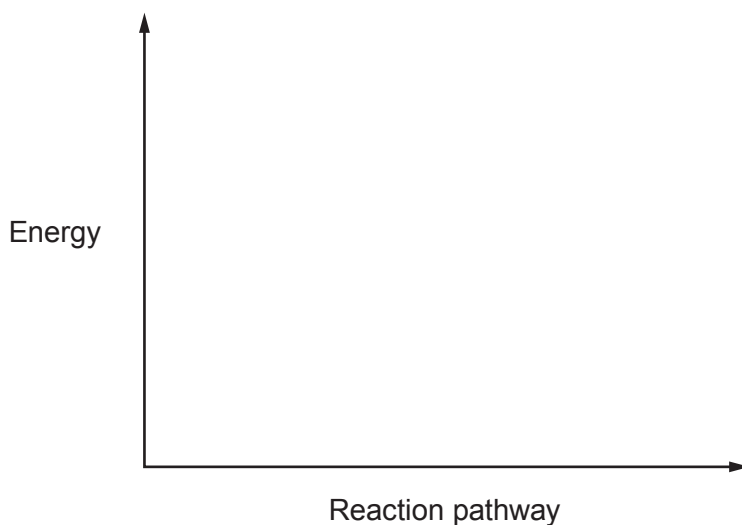
[2]

Equation

Source of ions

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



(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.



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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(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]

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- (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

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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	-	-



(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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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

<div style="border: 1px solid black; padding: 5px; display: inline-block;"> ¹ H Hydrogen 1 </div>																		<div style="border: 1px solid black; padding: 5px; display: inline-block;"> ⁴ He Helium 2 </div>																																			
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			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			¹¹² Cd Cadmium 48			¹¹⁵ In Indium 49			¹¹⁹ Sn Tin 50			¹²² Sb Antimony 51			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

