Surname	Centre Number	Candidate Number
First name(s)		0

GCSE

S24-3430U20-1

3430U20-1

THURSDAY, 13 JUNE 2024 – MORNING

SCIENCE (Double Award)

Unit 2: CHEMISTRY 1
FOUNDATION TIER

1 hour 15 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**6**	
2.	**5**	
3.	**4**	
4.	**6**	
5.	**6**	
6.	**10**	
7.	**8**	
8.	**7**	
9.	**4**	
10.	**4**	
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 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 **7**(a) 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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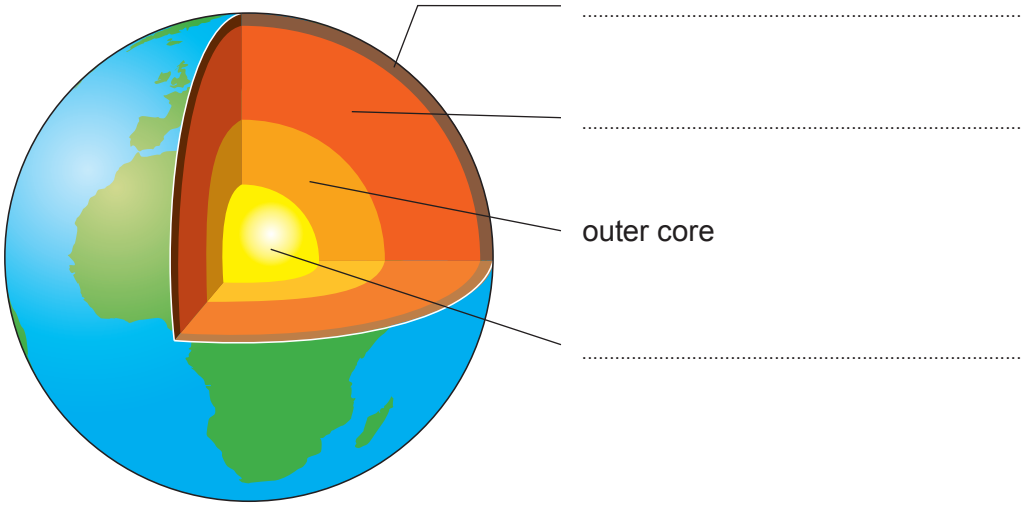
Answer **all** questions.

1. (a) The diagram shows the structure of the Earth.



mantle	**inner core**	**crust**

Use words from the box to label the layers of the Earth's structure **on the diagram**.

One has been done for you. [2]

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(b) Alfred Wegener's theory of continental drift describes how the Earth's continents have moved to their current positions.

Underline the correct words in the brackets to complete the sentences which describe the evidence on which Wegener based his theory. [3]

Wegener found that there are similar (**trees** / **animals** / **rocks**) on different continents and that some continents have (**mountains** / **coastlines** / **oceans**) which fit together. Most people did not believe Wegener's theory at the time because he could not explain how the continents (**moved** / **formed** / **melted**).

(c) **Circle** the name given to the large pieces which make up the Earth's crust. [1]

plates **fractions** **segments**

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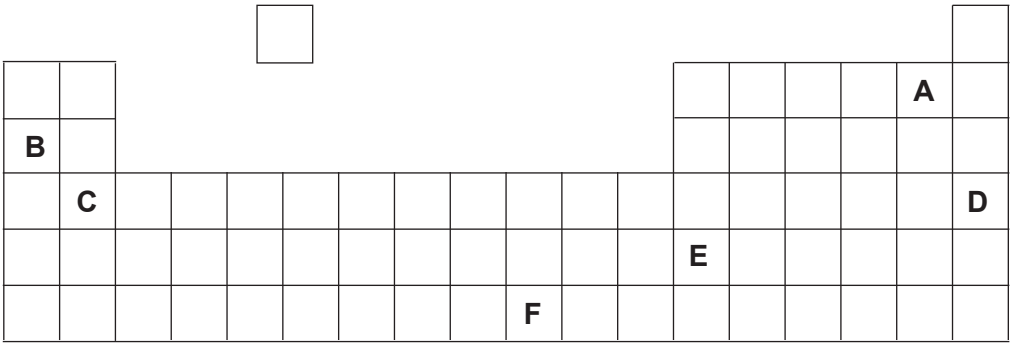
2. (a) The diagram shows part of the Periodic Table. The letters **A**–**F** are **not** the chemical symbols of the elements.



Use letters **A**–**F** to answer parts (i)–(iii).

(i) Give the **letter** of an element in Period 3. [1]

.....

(ii) Give the **letter** of an element in Group 2. [1]

.....

(iii) Give the **letter** of an element which is a non-metal. [1]

.....

Examiner only

(b) Draw a line to link each of the following metallic properties to its meaning.

One has been done for you. [2]

Property	Meaning
malleable	can be hammered into shape
	can be melted
ductile	can be pulled into wires
	can transfer electricity
thermal conductor	can be burned
	can transfer heat

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3. Some areas of the UK have hard water.

(a) The box contains some advantages of hard water and some advantages of soft water.

uses less soap		**reduces risk of heart disease**
	does not fur up kettles	
strengthens teeth and bones		**does not cause limescale**

From the box, state **two** advantages of **hard** water. [2]

1. .....

2. .....

(b) **Circle** the method that can be used to soften temporary hard water. [1]

freezing **dissolving** **boiling** **filtering**

Examiner only

(c) The table shows the concentrations of some common ions in water samples from three areas, **X**, **Y** and **Z**.

Area	Concentration of **sodium** ions (mg/dm^3)	Concentration of **calcium** ions (mg/dm^3)	Concentration of **potassium** ions (mg/dm^3)
X	41	81	0.5
Y	35	68	1.2
Z	13	102	0.8

Give the **letter** of the area with the hardest water. [1]

.....

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4. (a) Compounds are formed when atoms of different elements combine.

Draw **one** line from each compound to its formula. [2]

Compound	**Formula**
	CO
carbon dioxide	CO_2
	Ca_2O
	NaOH
sodium hydroxide	$NaNO_3$
	Na_2CO_3

(b) Magnesium oxide contains the ions Mg^{2+} and O^{2-}.

Give the formula of magnesium oxide. [1]

.....

Examiner only

(c) Calcium sulfate has the formula $CaSO_4$.

Calculate the relative formula mass (M_r) of calcium sulfate. [2]

$A_r(Ca) = 40$ $A_r(S) = 32$ $A_r(O) = 16$

M_r = ...

(d) Aluminium chloride, $AlCl_3$, is formed by the reaction of aluminium with chlorine.

Write a number in the box to balance the equation for this reaction. [1]

$$2\,Al + \square\ Cl_2 \longrightarrow 2\,AlCl_3$$

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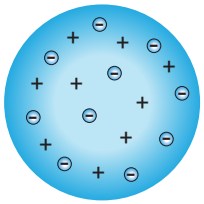
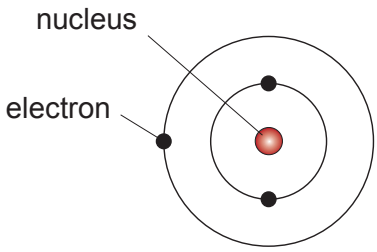
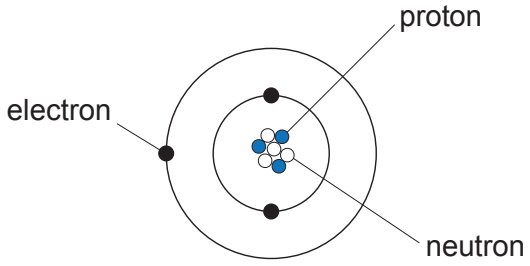
6

5. (a) For over two centuries, scientists have created different models of the atom. Our understanding of the atom has developed hugely over that time.

In the early 1800s, scientists already knew that:

- atoms are invisible
- atoms of one element are all the same
- atoms of different elements are different
- atoms combine to form compounds

The table shows some of the ideas that led to what we now know.

J.J. Thomson (1897) • Atoms are made of positive matter • Negative particles are spread out throughout the positive matter	
Ernest Rutherford (1911) • Protons are in a nucleus in the centre of the atom • Atoms are mostly empty space	
James Chadwick (1932) • Atoms have positive and negative particles, and they also have particles with no charge	

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(i) Tick (✓) the statement which describes a **difference** between J.J. Thomson's model and Rutherford's model. [1]

neither model has any neutrons ☐

Thomson had electron shells in his model ☐

Thomson did not think atoms are mostly empty space ☐

(ii) Tick (✓) the statement that does **not** describe Chadwick's model of the atom. [1]

electrons are in shells outside the nucleus ☐

atoms have equal numbers of protons and electrons ☐

atoms have equal numbers of protons and neutrons ☐

(iii) Tick (✓) the **three** statements which correctly describe how our knowledge about atoms today is different to J.J. Thomson's model. [2]

electrons are outside the nucleus ☐

electrons are inside the nucleus ☐

there are more protons than electrons in an atom ☐

protons are in a nucleus in the centre of an atom ☐

atoms have particles with no charge ☐

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(b) An atom of aluminium can be shown as $^{27}_{13}Al$.

State the number of protons and neutrons in this atom. [2]

Number of protons .....

Number of neutrons .....

6

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6. A class investigated the rate of the reaction between magnesium and hydrochloric acid by measuring the volume of gas produced in 10 seconds using different concentrations of acid.

(a) Tick (✓) the name of the piece of apparatus they used to measure the volume of gas produced. [1]

beaker ☐

thermometer ☐

gas syringe ☐

conical flask ☐

(b) The table shows the results of their experiment.

Concentration of acid (M)	Volume of gas produced (cm^3)			
	Test 1	Test 2	Test 3	Mean
0.2	16	14	15	15
0.4	31	33	30	32
0.6	47	49	29	48
0.8	63	64	65	64
1.0	82	83	79	81

(i) **Circle** the result in the table which was **not** used to calculate a mean.

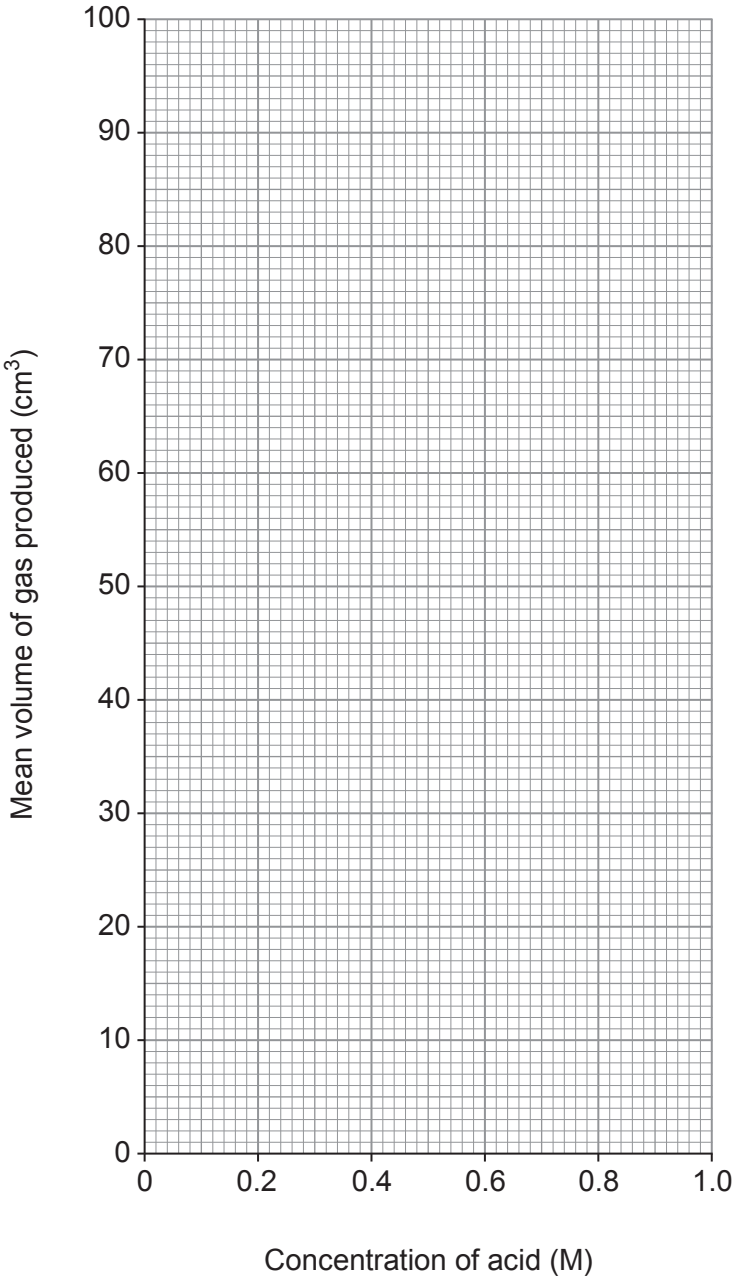
Give the reason why this result was not used. [2]

Reason .....

.....

Examiner only

(ii) Plot the mean volume of gas produced against the concentration of acid. Draw a suitable line. [3]



(iii) Use the information to find the volume of gas produced in 10 seconds using acid of concentration 0.5 M. [1]

..... cm^3

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(c) In another investigation the class found that as the temperature of the acid increases the reaction is faster.

Tick (✓) the **two** statements which explain why the reaction is faster at a higher temperature. [2]

there are more particles of acid	☐
the acid particles are moving faster	☐
there is a higher surface area	☐
there are more collisions per second	☐
the acid particles have less energy	☐

(d) The class wanted to identify the gas produced. They tested it as shown in the table.

Test	bubble the gas through limewater	place a burning splint in the gas
Observation	limewater did not change	a squeaky pop and the splint went out

State the name of the gas. [1]

.....

10

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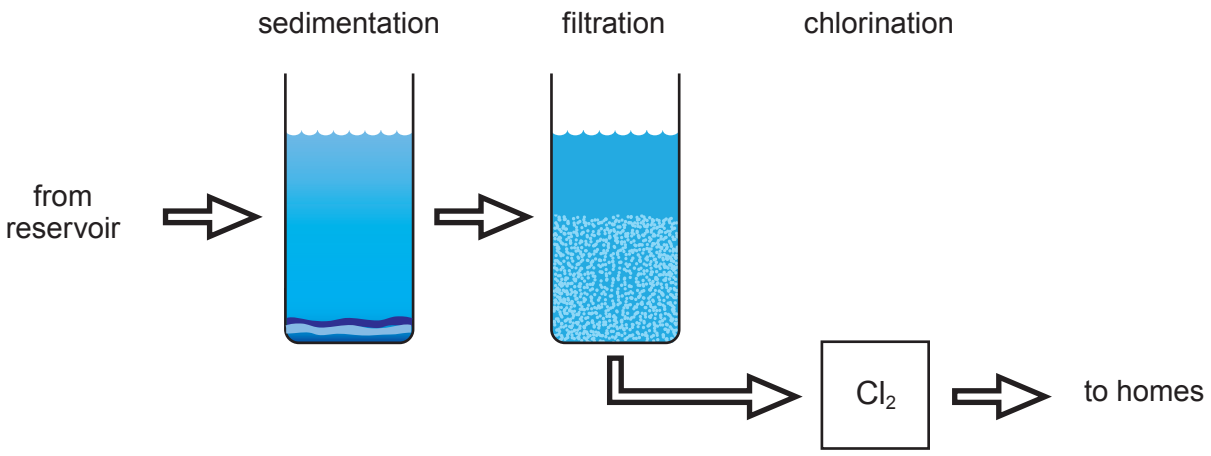
7. (a) The diagram shows the stages of a typical water treatment process.



Describe the sedimentation, filtration and chlorination stages of this process and the purpose of each stage in making the water clean and safe to drink. [6 QER]

Examiner only

(b) Fluoride is added to drinking water in some areas.

(i) Give the reason why fluoride is added. [1]

.....

(ii) Give **one** reason why some people think fluoride should not be added. [1]

.....

.....

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8. (a) The table shows information about some Group 1 elements. The melting point of rubidium is missing.

Element	Melting point (°C)	Boiling point (°C)	Density (g/cm^3)
lithium	181	1330	0.53
sodium	98	883	0.99
potassium	64	759	0.86
rubidium		688	1.53
caesium	29	671	1.93

(i) State which of the elements **lithium**, **sodium** or **potassium**, is a liquid over the greatest temperature range. [1]

.....

(ii) Estimate a value for the melting point of rubidium. [1]

.....

(iii) Group 1 elements are stored in paraffin oil to prevent reactions with oxygen.

The density of paraffin oil is $0.80\,g/cm^3$.

State which of the Group 1 elements would float on paraffin oil. [1]

.....

Examiner only

(b) When a small piece of **sodium** is added to water, it fizzes, melts and moves around on the surface of the water.

Give **another** observation that you would expect to make when **potassium** is added to water. State the reason for the difference. [2]

Observation .....

Reason .....

.....

(c) Lithium reacts with oxygen to give lithium oxide.

Complete the equation for the reaction by

- giving the formula for lithium oxide
- putting numbers in the boxes to balance the equation [2]

$$\square\ Li + O_2 \longrightarrow \square$$ .....

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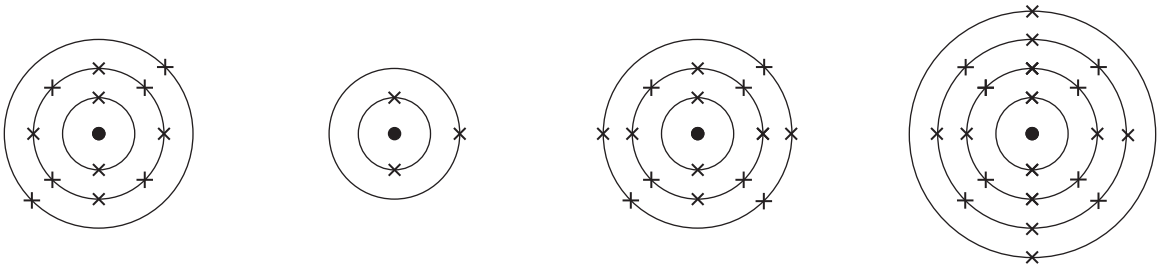
9. The diagrams below show the electronic structures of four elements, **A**, **B**, **C** and **D**.

The letters are **not** the chemical symbols of the elements.



A **B** **C** **D**

(a) Give the **letters** of **two** elements which are in the same period in the Periodic Table. [1]

..... and .....

(b) Give the atomic number and the name of element **D**. [2]

Atomic number .....

Name .....

(c) Draw the electronic structure of the element directly **above** element **C** in the Periodic Table. [1]

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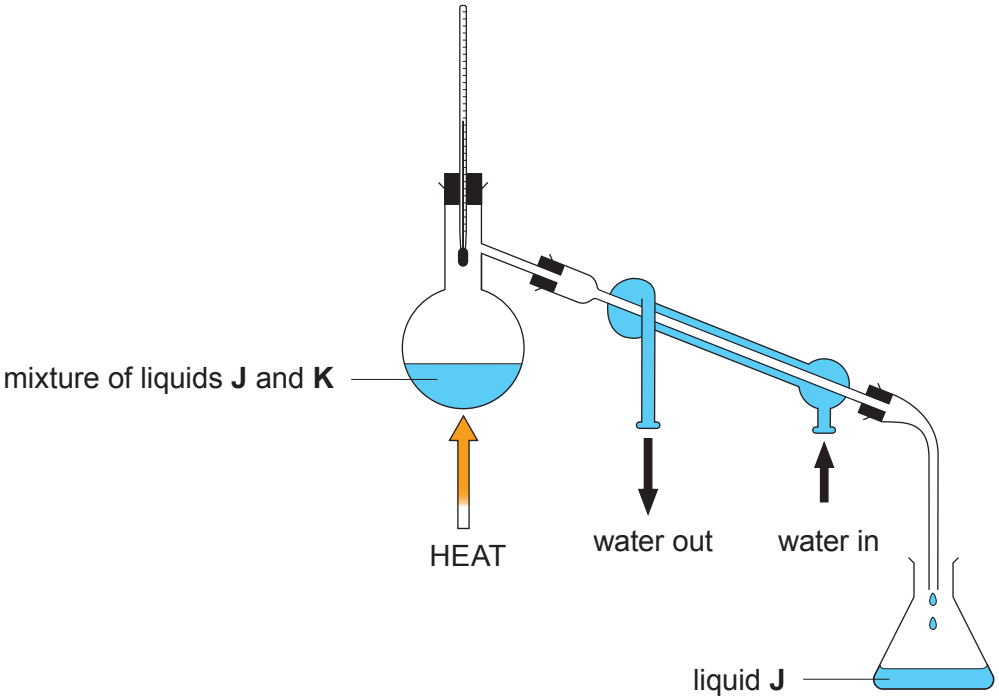
10. The diagram shows the separation of a mixture of liquids **J** and **K**.



- The temperature on the thermometer stays at 56 °C even though the mixture is still being heated
- Drops of liquid **J** fall steadily into the flask

(a) Use the information given above and in the diagram.

State the conclusions that you can draw about the boiling points of liquids **J** and **K**. [2]

.....

.....

.....

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(b) **K** is a compound with the formula C_4H_8O. The relative formula mass (M_r) of compound **K** is 72.

Calculate the percentage by mass of carbon in compound **K**. [2]

$A_r(C) = 12$

Percentage = ... %

4

END OF PAPER

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

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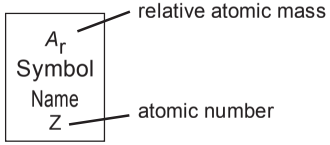
FORMULAE FOR SOME COMMON IONS

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	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
Group	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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