Surname	Centre Number	Candidate Number
Other Names		0

GCSE – NEW

3430UB0-1

S17-3430UB0-1

SCIENCE (Double Award)

Unit 2: CHEMISTRY 1
HIGHER TIER

FRIDAY, 16 JUNE 2017 – MORNING

1 hour 15 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**9**	
2.	**6**	
3.	**8**	
4.	**11**	
5.	**15**	
6.	**5**	
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 continuation 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.

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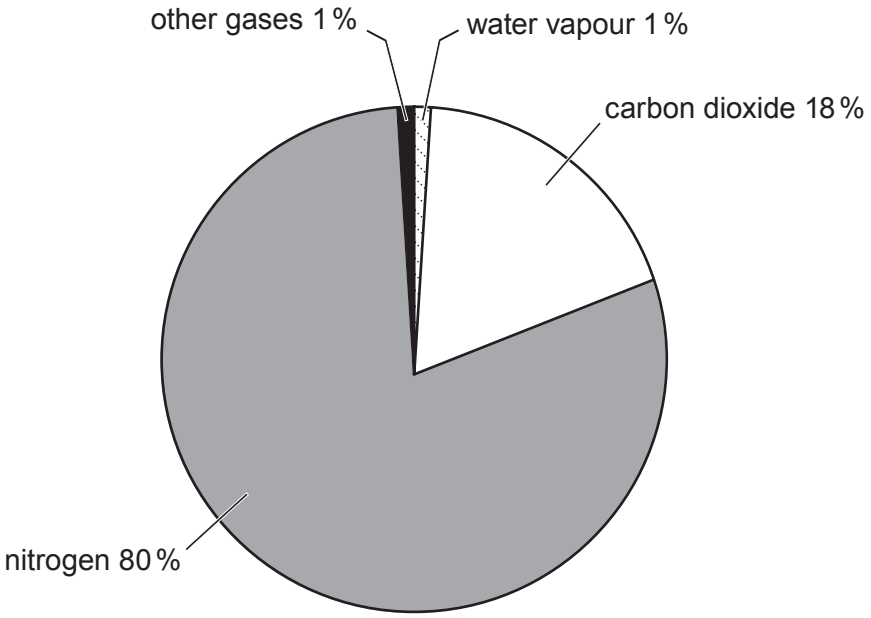
Answer **all** *questions.*

1. *(a)* The Earth's atmosphere has evolved over millions of years to its present composition.

The pie chart shows the composition of the atmosphere at one stage of its evolution.



(i) Describe the **main** differences in the composition of the atmosphere shown in the pie chart and that present on the Earth today. [3]

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(ii) **Complete the table** to describe simple chemical tests that can be used in the laboratory to identify hydrogen and carbon dioxide. [2]

Gas	Test carried out	Expected observation
hydrogen		
carbon dioxide		

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(b) During the last 250 years the level of carbon dioxide in the atmosphere has increased. Most scientists believe that the increase in the level of carbon dioxide in the atmosphere has resulted in global warming.

The table below shows some data about the atmosphere between 1750 and 2000.

Year	Concentration of carbon dioxide in the atmosphere (parts per million)	Average global temperature (°C)
1750	278	13.3
1800	282	13.4
1850	288	13.5
1900	297	13.7
1950	310	14.0
2000	368	14.6

Use the data in the table to answer parts (i) and (ii).

(i) Describe the trend in average global temperature between 1750 and 2000. [2]

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(ii) Calculate the percentage increase in the concentration of carbon dioxide in the atmosphere from 1750 to 1850. [2]

percentage increase = ... %

9

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2. *(a)* The following table gives information about some atoms, **A**-**E**.

A-**E are not the chemical symbols of the elements.**

Atom	Number of protons	Number of neutrons
A	12	12
B	10	10
C	6	8
D	11	12
E	6	6

(i) Give the letter, **A**-**E**, of the atom with a mass number of 12. [1]

.....

(ii) Give the letter, **A**-**E**, of the atom found in Group 1 of the Periodic Table. [1]

.....

(iii) Choose the letters, **A**-**E**, of the atoms that are isotopes. Give the reason for your choice. [2]

Letters ..... and .....

Reason .....

.....

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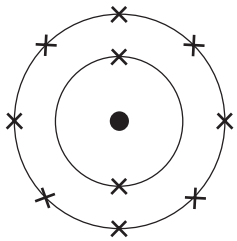
(b) The diagram below shows the electronic structure of an element in the Periodic Table.



(i) Using × to represent an electron, draw a diagram to show the electronic structure of the element which lies directly **below** this one in the Periodic Table. [1]

(ii) Explain why both of these elements are chemically unreactive. [1]

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3. The following information is about hardness in water.

Hardness in water is caused by the presence of dissolved calcium (Ca^{2+}) and magnesium (Mg^{2+}) ions. These ions come from compounds that are dissolved by the water as it passes through rocks. Because they are dissolved, these ions are not removed during the water treatment processes.

Hardness in water can be identified using soap solution. The relative hardness in different water samples can be determined by measuring the volume of soap solution required to produce a given lather.

Temporary hardness in water can be removed simply by boiling. Permanent hardness can be removed by passing the sample through an ion exchange column.

Three samples of water, **A**, **B** and **C**, were tested for hardness using soap solution. Distilled water was also tested.

Sample **A** required 8 cm^3 of soap solution to form lather before boiling.
It still required 8 cm^3 of soap solution to form lather after boiling.

Sample **B** required 12 cm^3 of soap solution to form lather before boiling.
It only required 6 cm^3 of soap solution to form lather after boiling.

Sample **C** required 15 cm^3 of soap solution to form lather before boiling.
It only required 2 cm^3 of soap solution to form lather after boiling.

Distilled water required 2 cm^3 of soap solution to form lather both before and after boiling.

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(a) Which **one** of these statements best describes the water samples before boiling? Tick (✓) the correct answer. [1]

samples **A**, **B** and **C** contain magnesium or calcium ions ☐

only samples **A** and **B** contain magnesium or calcium ions ☐

only samples **B** and **C** contain magnesium or calcium ions ☐

none of the samples contain magnesium or calcium ions ☐

(b) What is the purpose of testing the distilled water? Tick (✓) the correct answer. [1]

to show the expected result for permanent hard water ☐

to show the expected result for temporary hard water ☐

to act as a control for the experiment ☐

to make sure the investigation is a fair test ☐

(c) In carrying out the tests on the samples, which variables need to be kept the same each time? Tick (✓) the correct answer. [1]

volume of soap solution and number of times shaken ☐

volume of water sample and volume of soap solution used ☐

volume of water sample and number of times shaken ☐

volume of water sample, volume of soap solution and number of times shaken ☐

(d) Which **one** of these statements best describes water sample **B**? Tick (✓) the correct answer and explain your choice. [3]

sample **B** contains temporary hardness only ☐

sample **B** contains permanent hardness only ☐

sample **B** contains a mixture of temporary and permanent hardness ☐

sample **B** does not contain hardness ☐

Explanation .....

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(e) In your opinion, do the advantages of living in a hard water area outweigh the disadvantages? Give **two** reasons to support your answer. [2]

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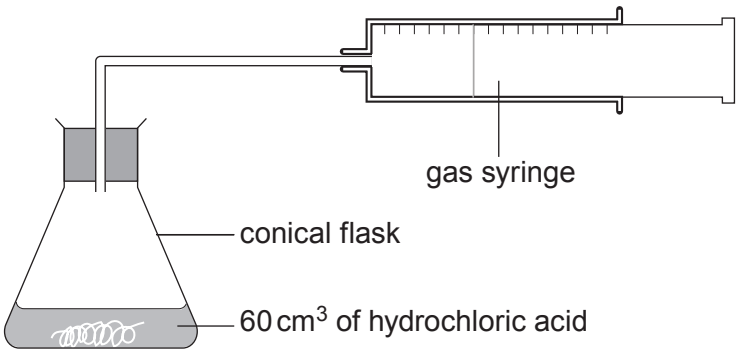
4. Magnesium ribbon was reacted with excess dilute hydrochloric acid. The volume of hydrogen produced during the reaction was measured over time using a gas syringe. The experiment was carried out at a temperature of 20 °C.



The table shows the results obtained in the experiment.

Time (s)	Volume of gas (cm^3)
0	0
10	34
20	64
30	78
40	94
50	98
60	100
70	100

(a) Plot the data **on the grid opposite** and draw a suitable line. Label the graph **A**. [3]

(b) **On the same grid**, sketch the graph that would be obtained if a piece of magnesium ribbon of half the length were reacted with another 60 cm^3 of the same hydrochloric acid. Label this graph **B**. [2]

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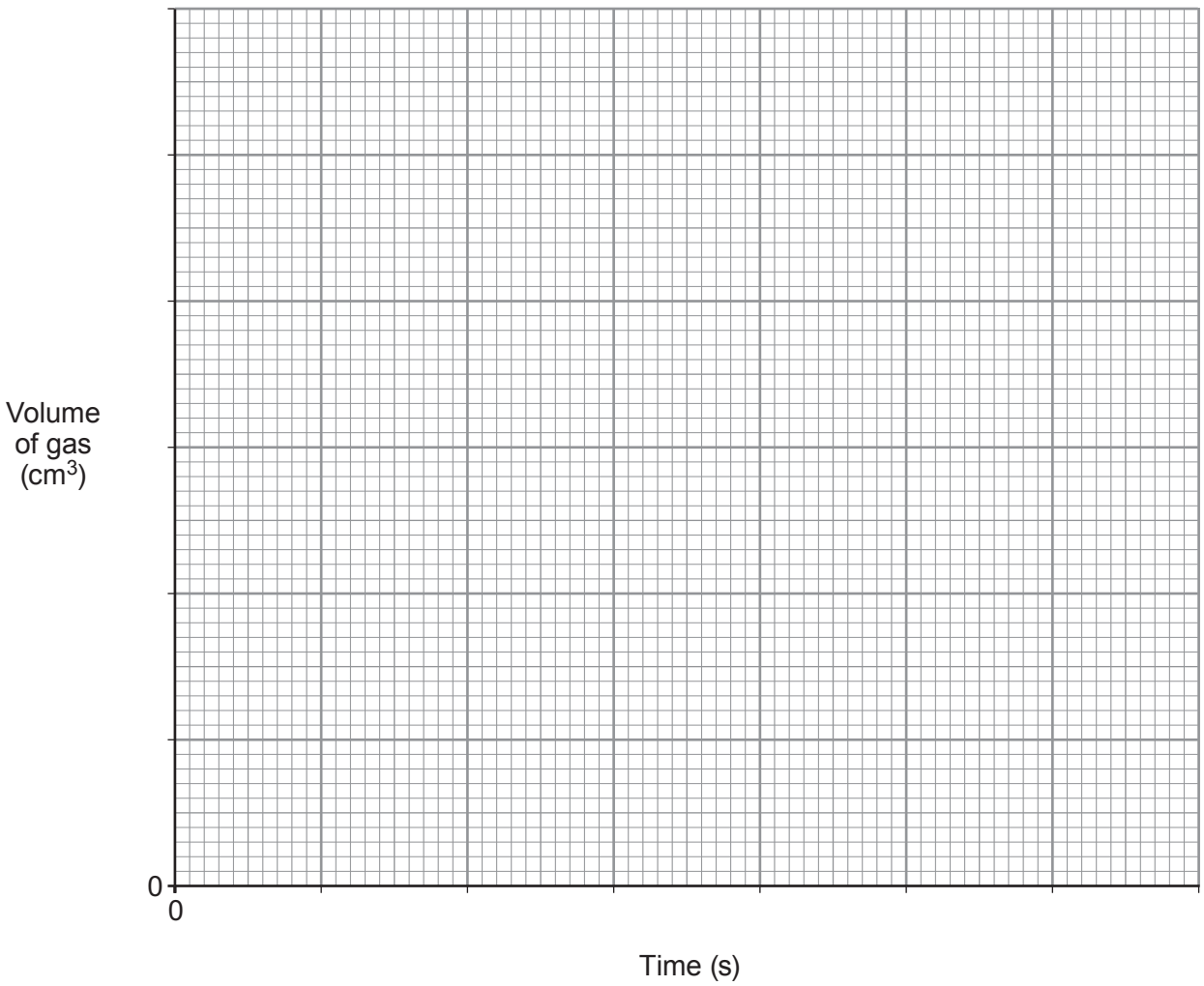

(c) If the original experiment were repeated at a higher temperature, the reaction would occur at a higher rate. Explain this using particle theory. [2]

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(d) This method can be used to investigate the rate of this reaction. Without changing the method or apparatus used, state what should be done to improve the overall strength of the evidence collected. [2]

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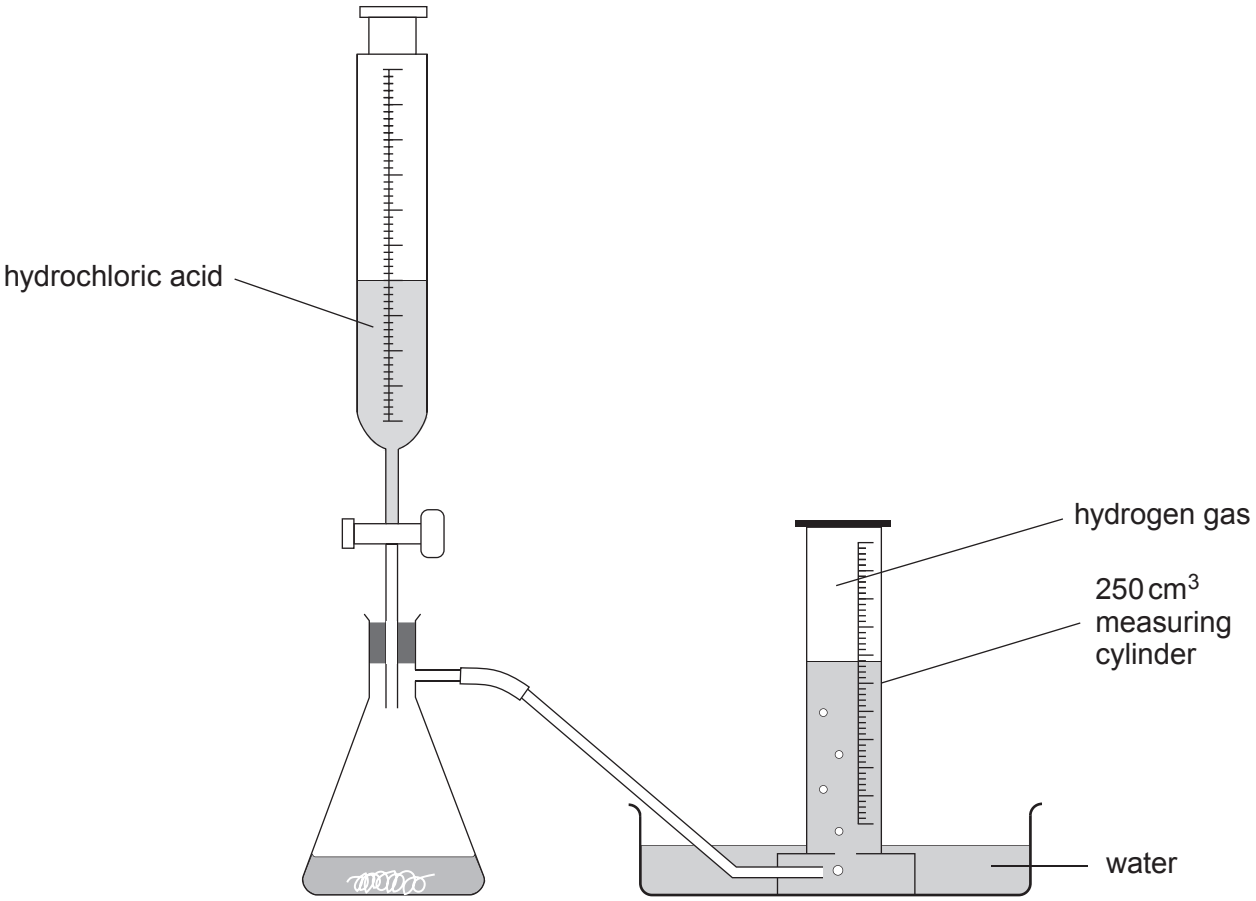
(e) Give an advantage and a disadvantage of using the following alternative apparatus to collect the hydrogen gas. [2]



Advantage .....

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Disadvantage .....

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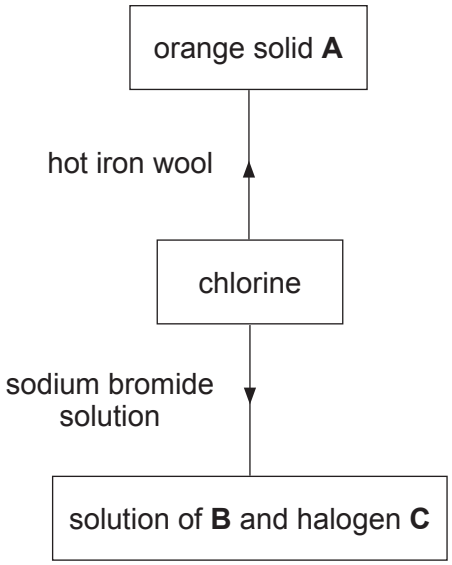
5. *(a)* The diagram shows some reactions of chlorine.



(i) Give the chemical **formulae** for substances **A**, **B** and **C**. [3]

A .....

B .....

C .....

(ii) State, giving a reason, the **main** safety precaution that must be taken when carrying out these reactions. [1]

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(iii) State and explain how the observations for the reaction with sodium bromide would be different if the chlorine were replaced with iodine. [3]

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(b) Chlorine can form a number of compounds by reacting with oxygen gas. One of these is used in water treatment.

A sample of this compound contains 0.71 g of chlorine and 0.64 g of oxygen. Calculate its simplest formula. [3]

Simplest formula .....

(c) Silver nitrate solution is used to detect the presence of halide ions in solution.

(i) The equation below represents the reaction between silver nitrate solution and potassium bromide solution.

$$AgNO_3 + KBr \longrightarrow AgBr + KNO_3$$

Write the **ionic** equation for the reaction. **Include state symbols**. [2]

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(ii) Write the balanced **symbol** equation for the reaction between calcium iodide solution and silver nitrate solution. [3]

.....

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6. The balanced symbol equation for the reaction between sodium and oxygen is given below.

$$4Na + O_2 \longrightarrow 2Na_2O$$

(a) Calculate the mass of sodium oxide that should be produced when 0.736 g of sodium is burned in air. [3]

mass = ... g

(b) When the reaction was carried out using 0.736 g of sodium, it was found that the mass of sodium oxide formed was 0.338 g.

(i) Use your answer to part *(a)* to calculate the percentage yield of the reaction. [1]

percentage yield = ... %

(ii) If no product was lost, suggest **one** possible explanation for the percentage yield not being 100 %. [1]

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7. Describe how the reactions of lithium, sodium and potassium with water can be used to show the trend in reactivity in Group 1. Explain this trend in terms of the electronic structures of the elements. [6 QER]

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END OF PAPER

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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+}		

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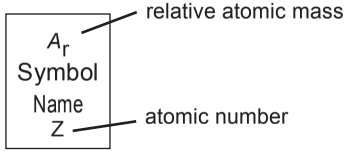
THE PERIODIC TABLE

	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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