

Surname	Centre Number	Candidate Number
Other Names		0



GCSE – **NEW**

3430U20-1



S18-3430U20-1

SCIENCE (Double Award)

**Unit 2: CHEMISTRY 1
FOUNDATION TIER**

WEDNESDAY, 13 JUNE 2018 – MORNING

1 hour 15 minutes

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	7	
2.	9	
3.	7	
4.	6	
5.	10	
6.	6	
7.	8	
8.	7	
Total	60	

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.

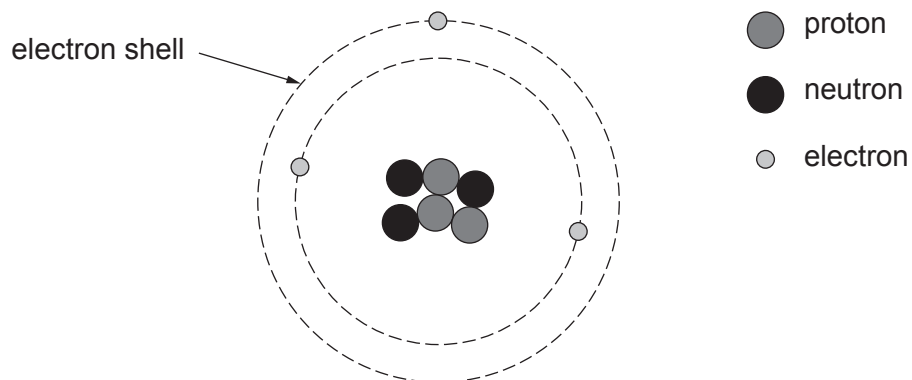
The Periodic Table is printed on the back cover of this paper and the formulae for some common ions on the inside of the back cover.



JUN183430U20101

Answer all questions.

1. (a) The diagram represents a lithium atom. Its nucleus contains protons and neutrons.



- (i) Complete the table of information about particles in the atom.

[2]

Name of particle	Charge	Mass
proton		1
neutron	0	
electron	-1	almost zero

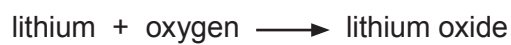
- (ii) Use the information in the diagram to give the mass number of this lithium atom.

[1]

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(b) Lithium reacts with oxygen. The word equation for this reaction is as follows.



(i) Name the **metal** in this equation. [1]

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(ii) Name the **compound** in this equation. [1]

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(iii) Name a **reactant** in this equation. [1]

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(iv) Lithium oxide contains the ions Li^+ and O^{2-} .

Underline the formula of lithium oxide. [1]



2. Peter, Claire and David compared the hardness of three samples of water, **A**, **B** and **C**. They added soap solution to each sample until it gave a lather on shaking. They carried out a fair test.

- (a) Give **two** ways they made it a fair test. [2]

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- (b) Their results are shown in the table.

Water sample	Volume of soap solution needed to give a lather (cm ³)			
	Peter	Claire	David	Mean
A	18	19	17
B	8	10	9	9
C	1	1	1	1

- (i) Calculate the mean volume of soap solution needed for sample **A** to give a lather. **Show your working.** [2]

Mean = cm³

- (ii) Which of the three water samples is the **hardest**? Give a reason for your answer. [2]

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(c) The box shows some advantages and some disadvantages of hard water.

strengthens bones and teeth	forms limescale when heated
wastes soap	reduces heart disease
forms a scum with soap	tastes better

Choose **all** the disadvantages of hard water from the box.

[2]

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(d) Choose from the box an ion that causes hardness in water.

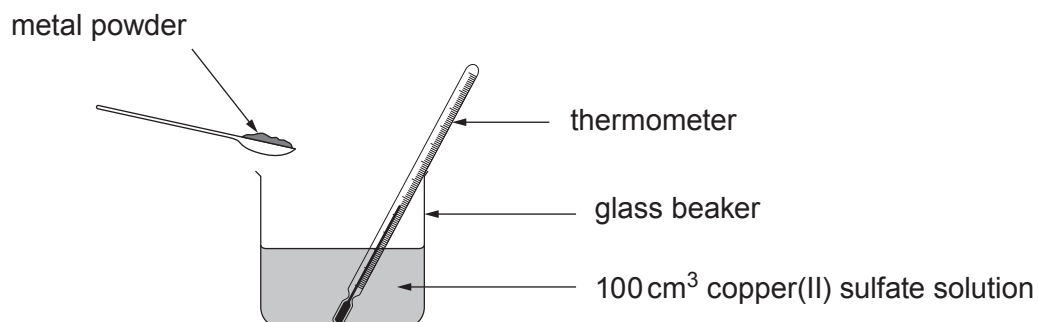
[1]

K⁺	Na⁺	Ca²⁺	Cu²⁺
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Ion



3. Magnesium, zinc and iron powders were each added separately to 100 cm^3 of copper(II) sulfate solution, to see which gave the greatest temperature change.



The temperature was recorded before and after each reaction. The results are shown in the table.

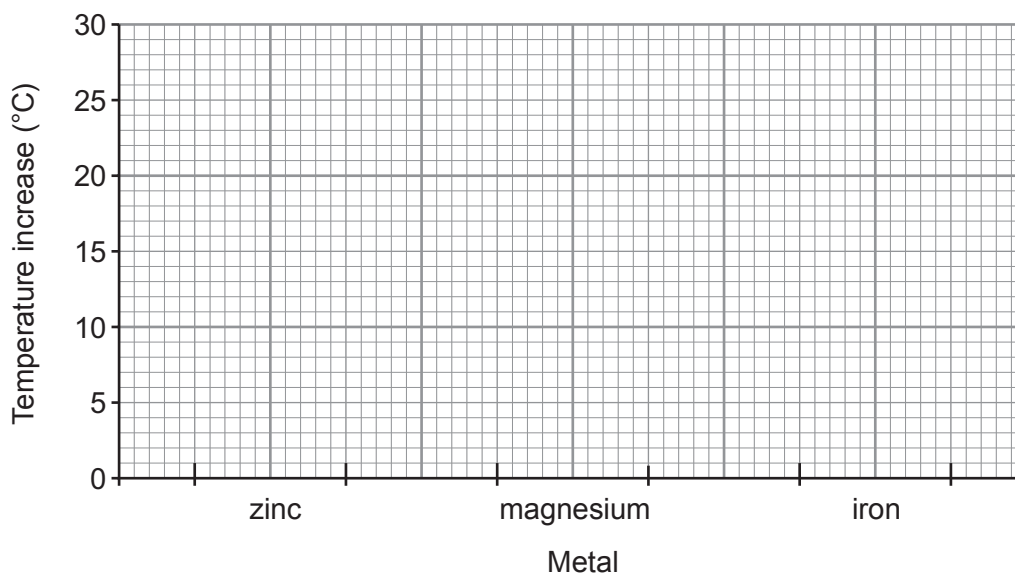
Metal	Temperature before the reaction ($^{\circ}\text{C}$)	Temperature after the reaction ($^{\circ}\text{C}$)	Temperature increase ($^{\circ}\text{C}$)
zinc	20	14
magnesium	19	39	20
iron	19	24	5

- (a) Calculate the temperature after the reaction with zinc. [1]

Temperature = $^{\circ}\text{C}$



- (b) Plot a **bar chart** to show the temperature increase for each metal. [2]



- (c) (i) Calculate the energy released in the reaction with magnesium. Use the following equation. [2]

$$\text{energy released (J)} = \text{volume of solution (cm}^3\text{)} \times 4.2 \times \text{temperature increase (}^\circ\text{C)}$$

Energy released = J

- (ii) In this reaction magnesium sulfate, MgSO_4 , is formed. What is the relative formula mass (M_r) of magnesium sulfate? [2]

$$A_r(\text{Mg}) = 24 \quad A_r(\text{S}) = 32 \quad A_r(\text{O}) = 16$$

$M_r =$



4. A student investigated changes that happened when pairs of colourless solutions were mixed. The table shows the observations made after mixing.

Pair of solutions	Appearance of the reactants	Appearance when mixed	Temperature change when mixed
A	two colourless solutions	no change	increase
B	two colourless solutions	bubbles form	increase
C	two colourless solutions	white precipitate forms	no change
D	two colourless solutions	no change	no change

- (a) Which pair of solutions do **not** react? Give a reason for your answer. [2]

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- (b) (i) The gas given off when pair **B** react is carbon dioxide. Describe the test for carbon dioxide gas. [1]

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- (ii) One of the solutions in pair **B** is sodium carbonate. Give the formula of sodium carbonate. [1]

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- (c) (i) Which pair of solutions is silver nitrate and sodium chloride? [1]

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- (ii) What colour would sodium chloride give in a flame test? [1]

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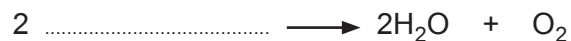
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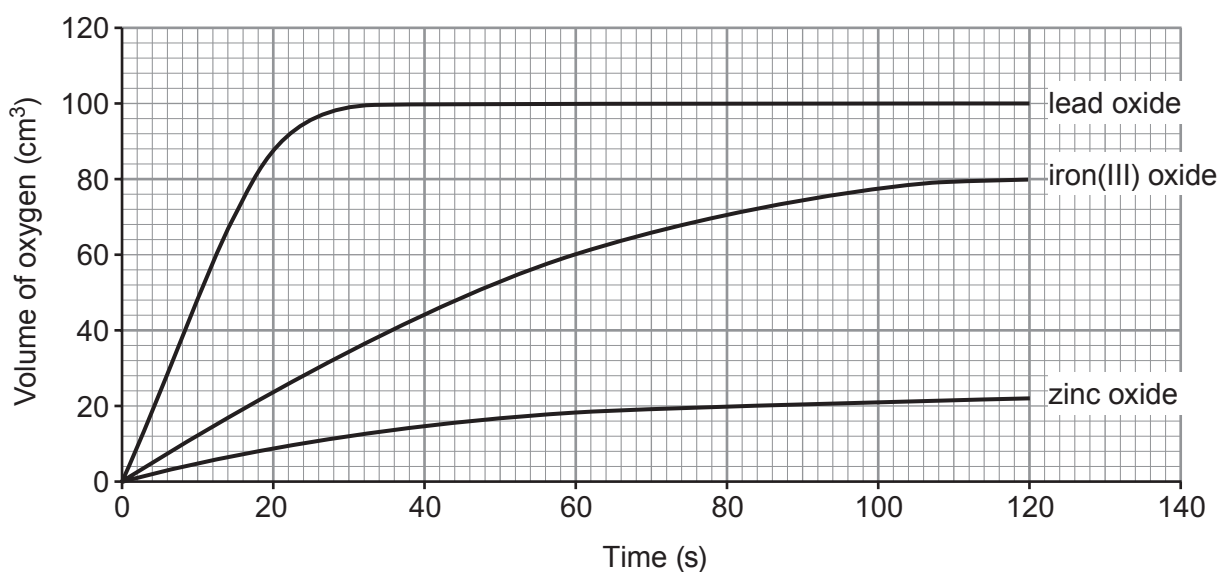


5. Hydrogen peroxide solution decomposes to give water and oxygen gas. Many metal oxides act as catalysts for the reaction.

(a) Use the symbol equation for the reaction to find the formula of hydrogen peroxide. [1]



(b) Catalysts are used to speed up the reaction. The graphs show the volume of oxygen formed over 120 seconds when 1.0g of different metal oxides were added to 50 cm³ of hydrogen peroxide solution.



(i) Use the graph to find the time taken to form 44 cm³ of oxygen using iron(III) oxide as the catalyst. [1]

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- (ii) State which metal oxide is the **best** catalyst. Give a reason for your answer. [1]

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- (iii) After 120 seconds, the contents of each beaker were washed into a filter paper and funnel. The catalyst left over on each filter paper was dried and weighed.

Tick (✓) the box next to the statement which is correct. [1]

the same mass of all catalysts is left over

more zinc oxide is left over than lead oxide

about 80% of the iron(III) oxide is left over

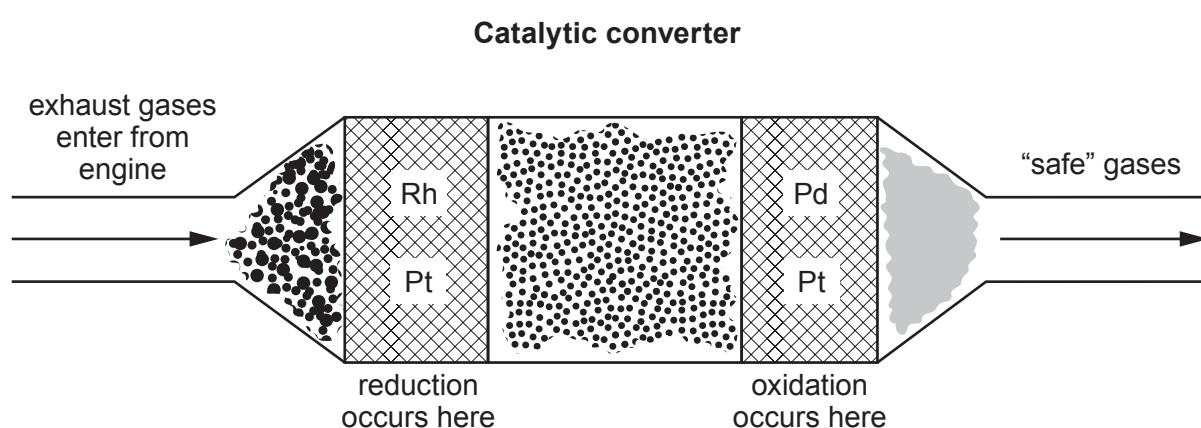
no lead oxide is left over



- (c) Exhaust gases from car engines contain harmful molecules, for example, carbon monoxide and nitrogen oxides. All cars are fitted with catalytic converters that split up these harmful molecules.

The catalysts are made from platinum (Pt) and palladium (Pd) or rhodium (Rh). A mesh structure is used that exposes the maximum surface area of catalyst to the exhaust gases, while also reducing the amount of catalyst required. Platinum, palladium and rhodium are extremely expensive.

As the exhaust gases from the engine pass over the catalysts, chemical reactions take place on their surfaces. The harmful molecules are broken up and converted into other gases that are “safe” to enter the air. These gases include carbon dioxide, nitrogen, oxygen and water.



There are two different types of catalyst, a **reduction catalyst** and an **oxidation catalyst**. The reduction catalyst removes oxygen from nitrogen oxides to make nitrogen and oxygen. The oxidation catalyst adds oxygen to carbon monoxide to make carbon dioxide.

One of the biggest drawbacks of the catalytic converter is that it only works effectively at high temperatures. The average running temperature of a car engine is between 90 and 110°C. It takes nearly 30 minutes for these temperatures to be reached.

The table opposite shows the percentages of carbon monoxide and nitrogen oxides converted to safe gases by a catalytic converter at different temperatures.



Temperature (°C)	Carbon monoxide converted (%)	Nitrogen oxides converted (%)
25	16	25
50	19	28
75	26	35
100	60	72
125	91	92
150	93	94
175	95	95
200	97	98

- (i) Using your knowledge of particle theory suggest why a catalyst in mesh form works better than a lump of catalyst. [2]

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- (ii) Tick (✓) the box that best describes the adverse effect that gases leaving the exhaust would have on the environment. [1]

they have no effect on the environment

they reduce oxygen levels

they deplete the ozone layer

they cause global warming



Examiner
only

(iii) Tick (✓) the box that best describes the conversion of carbon monoxide and nitrogen oxides into "safe" gases at different temperatures. [1]

equal amounts of carbon monoxide and nitrogen oxides are converted at every temperature

more carbon monoxide is converted than nitrogen oxides up to 100 °C

more nitrogen oxides are converted than carbon monoxide up to 100 °C

40% more nitrogen oxides are converted than carbon monoxide up to 100 °C

(iv) In your opinion how effective are catalytic converters? Explain your answer. [2]

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6. Describe how respiration and photosynthesis keep the carbon dioxide and oxygen content of the atmosphere approximately constant. Discuss how human activity is threatening this balance.

[6 QER]

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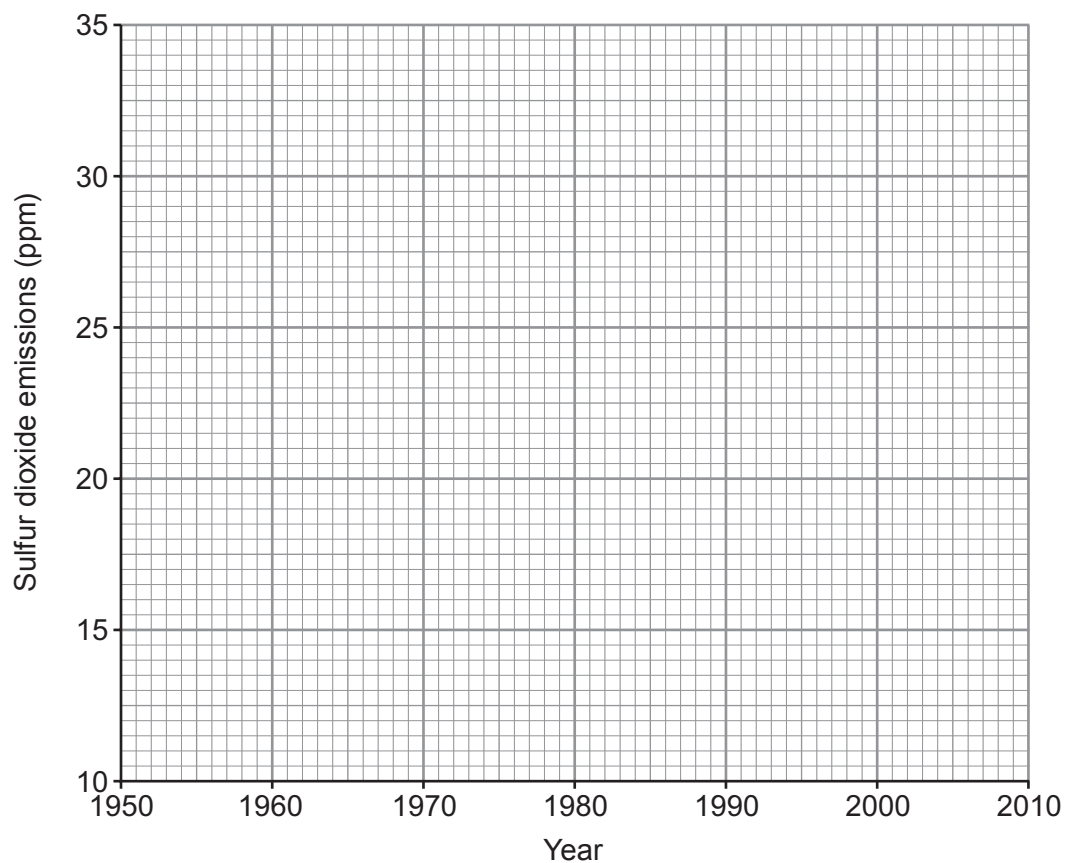
7. Burning fossil fuels containing sulfur causes sulfur dioxide, SO_2 , to be released into the atmosphere.

The table shows sulfur dioxide emissions in the UK between 1950 and 2010.

Year	Sulfur dioxide emissions (ppm)
1950	12.0
1960	16.0
1970	21.5
1980	29.5
1990	29.0
2000	24.0
2010	18.5

ppm = parts per million

- (a) (i) On the grid plot the sulfur dioxide emissions against the year and draw a suitable line. [3]



- (ii) Describe how sulfur dioxide emissions changed between 1950 and 2010. [2]

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- (iii) The UK government introduced a regulation to reduce sulfur dioxide emissions in the 1980s. From your graph, state why it is difficult to decide exactly the year when the regulation came into force. [1]

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- (b) Sulfur dioxide can be converted to sulfur and water by reacting it with hydrogen sulfide, H₂S.

Complete and balance the symbol equation for this reaction. [2]



8. The table shows some physical properties of Group 6 elements.

Element	Melting point (°C)	Boiling point (°C)	Density (g/cm ³)	Electrical conductor
oxygen	-219	-183	0.0014	no
sulfur	115	445	2.0	no
selenium	221	685	4.8	semi-conductor
tellurium	450	988	6.2	semi-conductor

(a) (i) Describe the trend in the melting points of the Group 6 elements. [1]

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(ii) Give the physical state of selenium at 400 °C. Give a reason for your choice. [2]

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(iii) Explain why it is difficult to classify selenium as either a metal or a non-metal. [1]

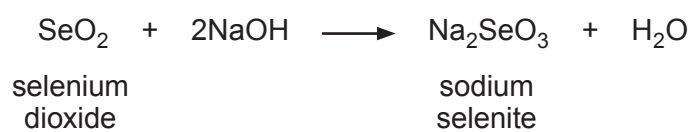
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(b) Selenium dioxide reacts with sodium hydroxide to produce sodium selenite and water.



(i) Calculate the relative formula mass (M_r) of sodium selenite, Na_2SeO_3 . [1]

$$A_r(\text{Na}) = 23 \quad A_r(\text{Se}) = 79 \quad A_r(\text{O}) = 16$$

$$M_r = \dots\dots\dots$$

(ii) Calculate the percentage by mass of selenium in sodium selenite. [2]

$$\text{Percentage} = \dots\dots\dots \%$$

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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+}		





24

THE PERIODIC TABLE

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14

24

7 Li Lithium 3	9 Be Beryllium 4	11 Na Sodium 11	12 Mg Magnesium 12	13 Al Aluminium 13	14 Si Silicon 14	15 P Phosphorus 15	16 S Sulfur 16	17 Cl Chlorine 17	18 Ar Argon 18								
19 K Potassium 19	20 Ca Calcium 20	23 Sc Scandium 21	24 Ti Titanium 22	25 V Vanadium 23	26 Cr Chromium 24	27 Mn Manganese 25	28 Fe Iron 26	29 Co Cobalt 27	30 Ni Nickel 28	31 Cu Copper 29	32 Zn Zinc 30	33 Ga Gallium 31	34 Ge Germanium 32	35 As Arsenic 33	36 Se Selenium 34	37 Br Bromine 35	38 Kr Krypton 36
37 Rb Rubidium 37	38 Sr Strontium 38	39 Y Yttrium 39	40 Zr Zirconium 40	41 Nb Niobium 41	42 Mo Molybdenum 42	43 Tc Technetium 43	44 Ru Ruthenium 44	45 Rh Rhodium 45	46 Pd Palladium 46	47 Ag Silver 47	48 Cd Cadmium 48	49 In Indium 49	50 Sn Tin 50	51 Sb Antimony 51	52 Te Tellurium 52	53 I Iodine 53	54 Xe Xenon 54
55 Cs Caesium 55	56 Ba Barium 56	57 La Lanthanum 57	72 Hf Hafnium 72	73 Ta Tantalum 73	74 W Tungsten 74	75 Re Rhenium 75	76 Os Osmium 76	77 Ir Iridium 77	78 Pt Platinum 78	79 Au Gold 79	80 Hg Mercury 80	81 Tl Thallium 81	82 Pb Lead 82	83 Bi Bismuth 83	84 Po Polonium 84	85 At Astatine 85	86 Rn Radon 86
87 Fr Francium 87	88 Ra Radium 88	89 Ac Actinium 89															

Key

relative atomic mass

