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Monday 25 June 2012 – Afternoon

GCSE TWENTY FIRST CENTURY SCIENCE ADDITIONAL SCIENCE A

A152/01 Modules B5 C5 P5 (Foundation Tier)

A135730612

Candidates answer on the Question Paper.
A calculator may be used for this paper.

OCR supplied materials:
None

Other materials required:
- Pencil
- Ruler (cm/mm)
- Calculator

Duration: 1 hour

A152201

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- Your quality of written communication is assessed in questions marked with a pencil (✎).
- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- A list of physics equations is printed on page 2.
- A list of qualitative tests for ions is printed on page 3.
- The Periodic Table is printed on the back page.
- The total number of marks for this paper is **60**.
- This document consists of **20** pages. Any blank pages are indicated.

DC (LEO/CGW) 51614/5

TWENTY FIRST CENTURY SCIENCE EQUATIONS

Useful relationships

The Earth in the Universe

distance = wave speed × time

wave speed = frequency × wavelength

Sustainable energy

energy transferred = power × time

power = voltage × current

$$\text{efficiency} = \frac{\text{energy usefully transferred}}{\text{total energy supplied}} \times 100\%$$

Explaining motion

$$\text{speed} = \frac{\text{distance travelled}}{\text{time taken}}$$

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}}$$

momentum = mass × velocity

change of momentum = resultant force × time for which it acts

work done by a force = force × distance moved in the direction of the force

amount of energy transferred = work done

change in gravitational potential energy = weight × vertical height difference

$$\text{kinetic energy} = \frac{1}{2} \times \text{mass} \times [\text{velocity}]^2$$

Electric circuits

power = voltage × current

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

$$\frac{\text{voltage across primary coil}}{\text{voltage across secondary coil}} = \frac{\text{number of turns in primary coil}}{\text{number of turns in secondary coil}}$$

Radioactive materials

energy = mass × [speed of light in a vacuum]^2

TWENTY FIRST CENTURY SCIENCE DATA SHEET

Qualitative analysis

Tests for ions with a positive charge

Ion	Test	Observation
calcium Ca^{2+}	add dilute sodium hydroxide	a white precipitate forms; the precipitate does not dissolve in excess sodium hydroxide
copper Cu^{2+}	add dilute sodium hydroxide	a light blue precipitate forms; the precipitate does not dissolve in excess sodium hydroxide
iron(II) Fe^{2+}	add dilute sodium hydroxide	a green precipitate forms; the precipitate does not dissolve in excess sodium hydroxide
iron(III) Fe^{3+}	add dilute sodium hydroxide	a red-brown precipitate forms; the precipitate does not dissolve in excess sodium hydroxide
zinc Zn^{2+}	add dilute sodium hydroxide	a white precipitate forms; the precipitate dissolves in excess sodium hydroxide

Tests for ions with a negative charge

Ion	Test	Observation
carbonate CO_3^{2-}	add dilute acid	the solution effervesces; carbon dioxide gas is produced (the gas turns lime water from colourless to milky)
chloride Cl^-	add dilute nitric acid, then add silver nitrate	a white precipitate forms
bromide Br^-	add dilute nitric acid, then add silver nitrate	a cream precipitate forms
iodide I^-	add dilute nitric acid, then add silver nitrate	a yellow precipitate forms
sulfate SO_4^{2-}	add dilute acid, then add barium chloride or barium nitrate	a white precipitate forms

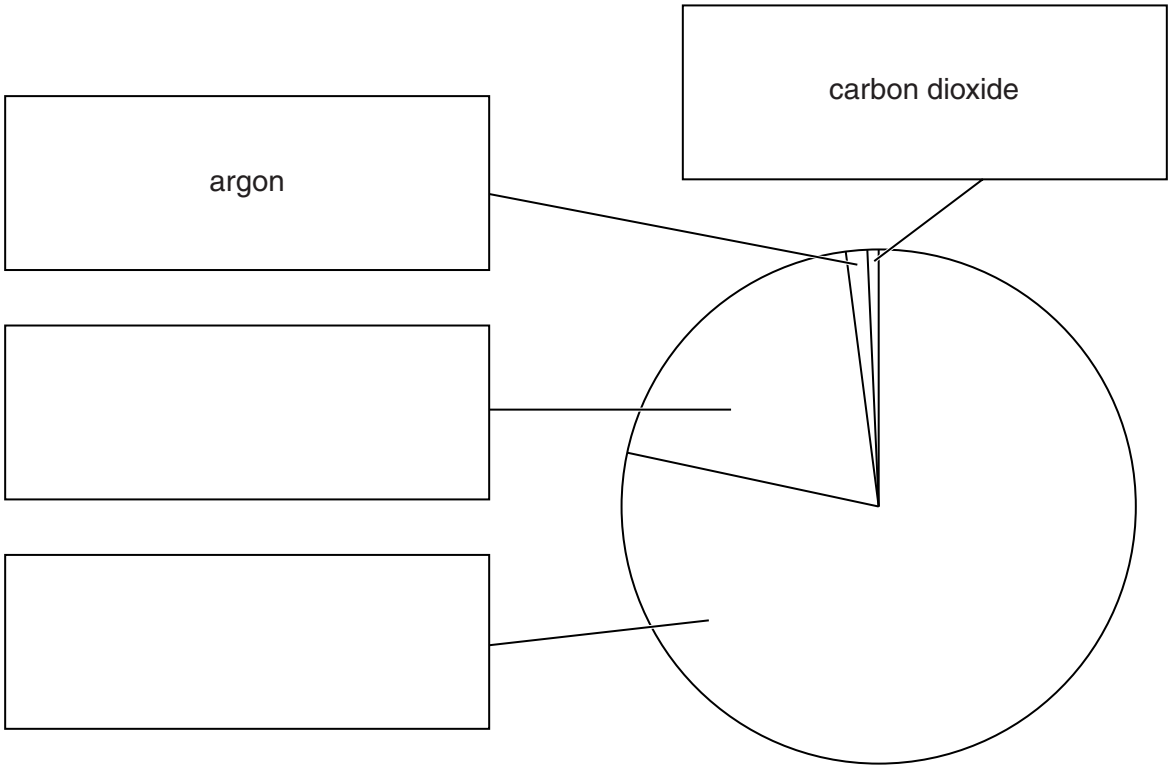
Answer **all** the questions.

1 Industry in Britain uses thousands of tonnes of gases from the air every year.

(a) The pie chart shows the amounts of the four main gases in dry air.

Write the names of the gases in the boxes.

Two have been done for you.



[1]

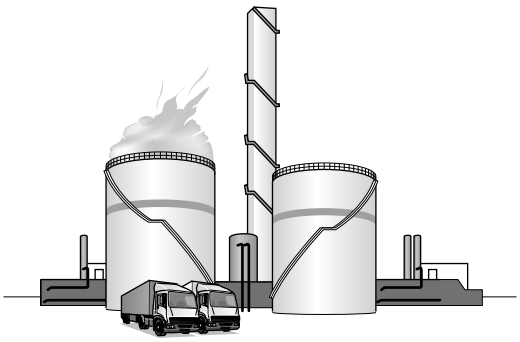
(b) Complete the table to show the chemical symbol for argon and the formula for carbon dioxide.

	Argon	**Carbon dioxide**
Symbol or formula		

[2]

(c) When air is cooled to a very low temperature it turns into a liquid.

Oxygen and nitrogen can then be separated by warming the liquid.



Gases in the air have low boiling points.

Explain why.

Use ideas about

- size of molecules
- forces between molecules.

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..... **[3]**

(d) **(i)** The relative atomic mass of nitrogen = 14.

What is the relative formula mass of a nitrogen molecule, N_2?

Put a (ring) around the correct answer.

2 **7** **14** **28**

[1]

(ii) A gas cylinder contains 40 formula masses (in grams) of nitrogen molecules.

What mass in grams of nitrogen gas is in the cylinder?

Put a (ring) around the correct answer.

80 g **280 g** **560 g** **1120 g**

[1]

[Total: 8]

2 Mary says that tap water contains chloride ions.

Jo says that it contains iodide ions.

How can you show who is correct?

Describe the test you would use, and say how the results show who is correct.

Use the data sheet to help you.

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..... **[3]**

[Total: 3]

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Question 3 begins on page 8

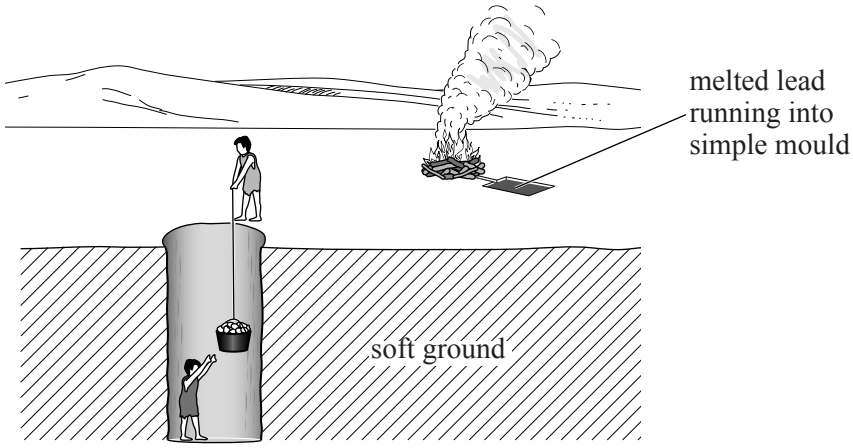
PLEASE DO NOT WRITE ON THIS PAGE

3 Read this article about lead mining.

Archaeologists have discovered a small lead mine that was used 4000 years ago.

The miners made a deep hole through soft ground until they reached the lead ore. They then dug out the ore and loaded it into baskets.

A second group of people lifted the ore out of the mine and put it into a wood fire. In the fire the ore reacted to make sulfur dioxide, carbon dioxide and melted lead. The melted lead was run into moulds and allowed to solidify.



(a) Here is some information about three of the substances involved in the process.

	Lead	Lead ore	Sulfur dioxide
Melting point in °C	327	1114	–73
Boiling point in °C	1744	1281	–10
Hazard	prolonged exposure to dust or fumes is harmful	prolonged exposure to dust or fumes is harmful	acidic gas

Use the information in the article and table above to suggest and describe at least four likely risks to people. Explain how each risk is created and who would be affected.

The quality of written communication will be assessed in your answer.

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..... **[6]**

(b) Two reactions take place when lead ore is heated in the fire.

reaction 1 $2PbS + 3O_2 \rightarrow 2PbO + 2SO_2$

reaction 2 $2PbO + C \rightarrow 2Pb + CO_2$

(i) What is the total number of **atoms** in one molecule of SO_2?

answer = ... atoms **[1]**

(ii) How many different **elements** are in 2PbO?

answer = ... elements **[1]**

(iii) In reaction 2 the lead oxide loses oxygen.

What do we call this type of reaction?

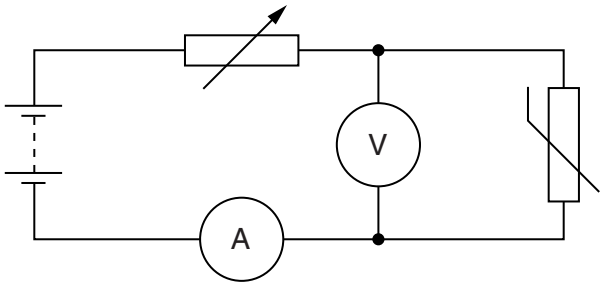
Put a (ring) around the correct answer.

extraction **neutralisation** **oxidation** **reduction**

[1]

[Total: 9]

4 Anna uses this circuit to find out how the resistance of a thermistor depends on the power delivered to it.



Here are her results.

Power delivered in W	Resistance of thermistor in Ω
0.10	10.0
0.50	8.0
3.20	5.0

(a) What is the correlation between the resistance and the power?

Use ideas about thermistors to explain the correlation.

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..... **[3]**

(b) Anna takes this pair of readings to check the correlation.

voltage = 3.0 V

current = 0.50 A

Calculate the resistance and power of the thermistor for these readings.

How do these results affect your confidence in the correlation shown in the table?

resistance = ... Ω

power = ... W

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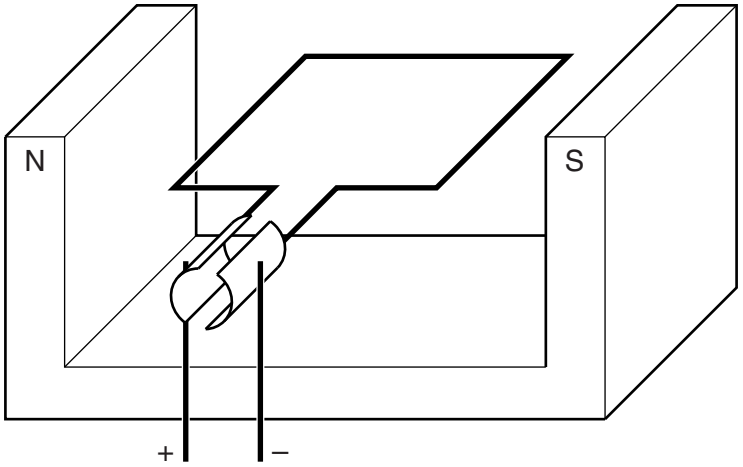
[3]

[Total: 6]

5 The diagram shows a simple electric motor.



Add labels to the diagram and use them to explain how this simple electric motor operates.

The quality of written communication will be assessed in your answer.

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..... **[6]**

[Total: 6]

6 Sanjay has a lamp which has the following information printed on its box.

frequency	50 Hz
power	20 W
voltage	12 V

(a) Which piece of information tells Sanjay that the lamp can operate from an a.c. supply?

Put a (ring) around the correct answer.

frequency **power** **voltage**

[1]

(b) Sanjay uses a transformer to step down the 230 V mains supply for the 12 V lamp.

(i) Complete the sentence.

Choose a word from this list.

two **three** **four**

To make a simple transformer you need ..... coils of wire on an iron core.

[1]

(ii) Transformers use electromagnetic induction.

Here are some descriptions of electromagnetic induction in a transformer.

Put a tick (✓) in the box next to the **one** correct description.

A coil of wire is charged when it is rubbed by a magnet. ☐

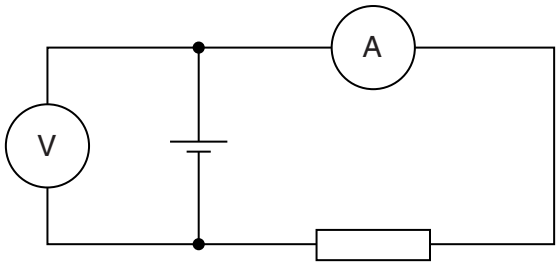
Changing the magnetic field in a coil of wire makes a voltage. ☐

Leaving a magnet in a coil of wire results in an electric current. ☐

[1]

[Total: 3]

7 Bill assembles this circuit.

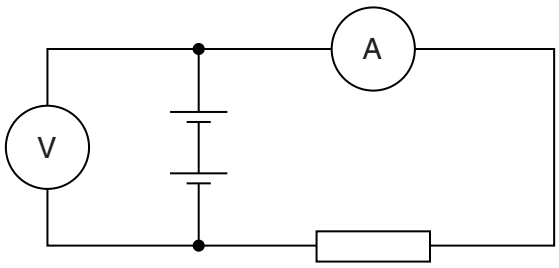


(a) Draw straight lines to link the **start** of each sentence to its correct **end**.

start	end
The battery ...	... measures the rate at which charge flows in the circuit.
The resistor ...	... measures the potential difference across the battery.
The ammeter ...	... pushes charges around the circuit.
The voltmeter ...	... has a value measured in ohms.

[3]

(b) Bill adds a second identical battery to his circuit.



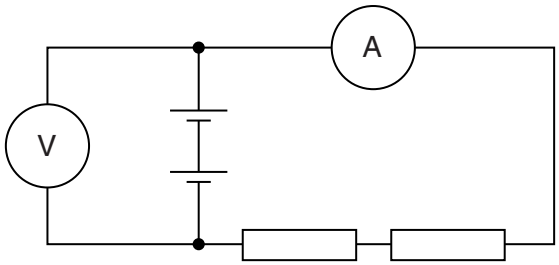
What effect does this have on the meter readings?

Put a tick (✓) in the box next to the correct row of the table.

Voltmeter reading	Ammeter reading	(✓)
doubles	doubles	
doubles	no change	
no change	doubles	
no change	no change	

[1]

(c) Bill now adds another identical resistor to the circuit.



Complete each sentence by putting a (ring) around the correct word in **bold**.

The extra resistor **doubles / halves / does not change** the resistance of the circuit.

This means that the current **doubles / halves / does not change.**

[1]

[Total: 5]

8 Tony is a forestry worker.

Each year he keeps records of the width of four tree trunks.

Tree	Width of tree in each year in cm			
	2009	**2010**	**2011**	**2012**
A	21	23	25	27
B	20	22	24	25
C	21	23	24	25
D	23	25	26	28

(a) Tony thinks that tree **A** has had the most cell divisions in its trunk.

Do you agree?

Use information from the table to support your answer.

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..... **[2]**

(b) Tony takes a cutting from one of the trees.

He dips the cutting into a powder.

Describe the processes that will help the cutting develop into a new, identical tree.

The quality of written communication will be assessed in your answer.

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..... **[6]**

[Total: 8]

9 Scientists analysed a sample of DNA from a muscle cell.

DNA is made up of four different bases, A, T, C and G.

The bases always pair up in the same way.

(a) Complete the table to show the percentage of each base present in the muscle cell.

Base	Percentage present
A	21
T	21
C	
G	

[2]

(b) The order of the four bases is the genetic code.

This is the code to make proteins.

Put a tick (✓) in the box next to the correct word to complete the sentence.

The proteins are made in the

cytoplasm	
membrane	
nucleus	

of the cells.

[1]

(c) A scientist claims to have found a gene that makes stronger muscles.

The stronger muscle cells have a particular protein.

He tested 23 young men who had strong muscles to find out if they had the gene.

Suggest **three** ways the scientist could improve his investigation.

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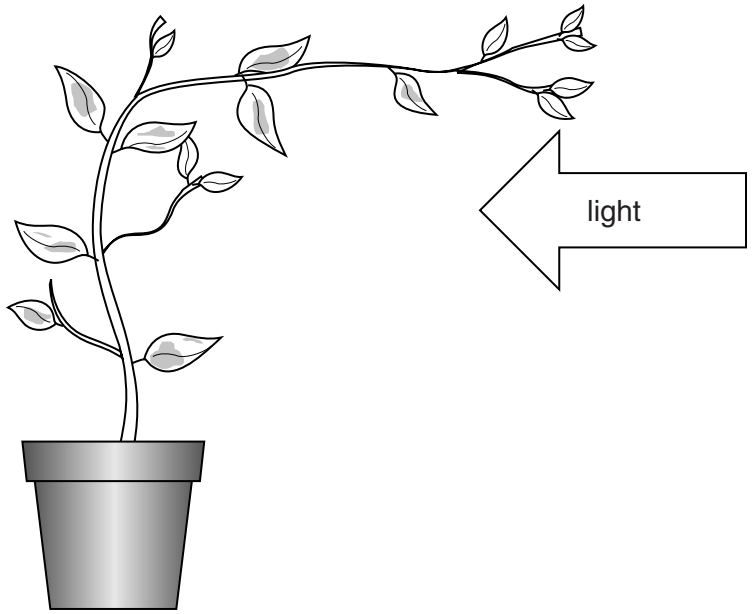
..... **[3]**

[Total: 6]

10 Trudy puts a plant in the middle of a room.



The plant stem grows towards the light.

(a) What is the name of this process?

Put a (ring) around the correct answer.

cloning **meiosis** **phototropism**

[1]

(b) Explain how growing towards the light helps plants.

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..... **[3]**

[Total: 4]

11 Mary studies the development of human embryos.

(a) Mary knows that a fertilised egg cell (zygote) develops into an embryo.

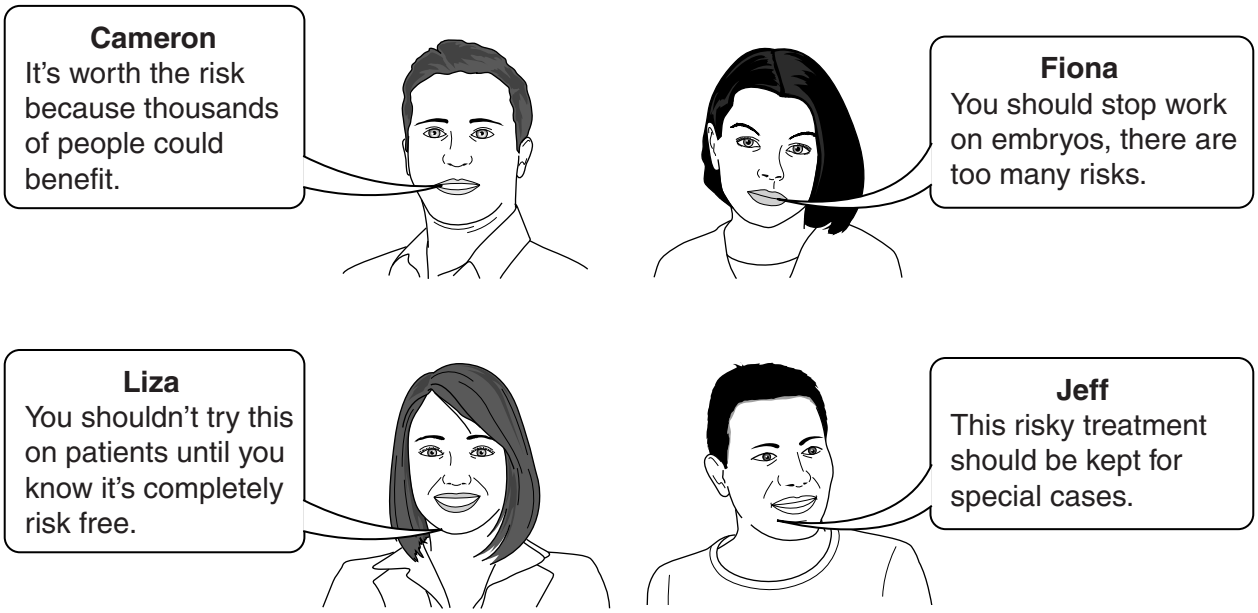
There are 46 chromosomes in the fertilised egg cell.

How many chromosomes are there in each cell of the embryo?

answer ..... **[1]**

(b) Mary hopes that her research will lead to embryonic stem cells being available to replace damaged tissues in accident victims.

Four of her friends discuss her work with her.



Which person wants something which is **not** possible to achieve?

answer ..... **[1]**

[Total: 2]

END OF QUESTION PAPER

The Periodic Table of the Elements

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
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **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	178 **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	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

**** The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.***

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.