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RECOGNISING ACHIEVEMENT

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A215/02

GENERAL CERTIFICATE OF SECONDARY EDUCATION
TWENTY FIRST CENTURY SCIENCE
ADDITIONAL SCIENCE A
Unit 1 Modules B4 C4 P4 (Higher Tier)

WEDNESDAY 23 JANUARY 2008

Afternoon
Time: 40 minutes

Candidates answer on the question paper.
Additional materials (enclosed):
None

Calculators may be used.
Additional materials: Pencil
Ruler (cm/mm)

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

INSTRUCTIONS TO CANDIDATES

- Write your name in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use blue or black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Do **not** write outside the box bordering each page.
- Write your answer to each question in the space provided.

INFORMATION FOR CANDIDATES

- The number of marks for each question is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is **42**.
- A list of physics equations is printed on page two.
- The Periodic Table is printed on the back page.

FOR EXAMINER'S USE		
Qu.	**Max**	**Mark**
1	4	
2	5	
3	1	
4	1	
5	3	
6	4	
7	5	
8	5	
9	4	
10	6	
11	4	
TOTAL	42	

This document consists of **19** printed pages and **1** blank page.

TWENTY FIRST CENTURY SCIENCE EQUATIONS

Useful Relationships

Explaining Motion

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

momentum = mass × velocity

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

work done by a force = force × distance moved by the force

change in energy = work done

change in GPE = weight × vertical height difference

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

Electric Circuits

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

$$\frac{V_p}{V_s} = \frac{N_p}{N_s}$$

energy transferred = power × time

power = potential difference × current

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

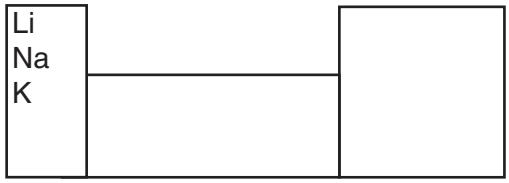
The Wave Model of Radiation

wave speed = frequency × wavelength

Answer **all** the questions.

1 Jenny studies three elements, **Li**, **Na** and **K**.

She finds this information in a data booklet.



PERIODIC TABLE

	melting point °C	boiling point °C
Li	180	1342
Na		883
K	63	

(a) Suggest a melting point for **Na**.

answer ..... [1]

(b) Suggest a boiling point for **K**.

answer ..... [1]

(c) Another data book gives the boiling point for **Li** as 1330 °C instead of 1342 °C. Jenny thinks of some reasons for this.

Put a tick (✓) in the box next to the best reason.

Boiling points increase each time they are measured. ☐

The measurements were made with different amounts of Li. ☐

It is difficult to measure such a high boiling point accurately. ☐

The second book rounded the numbers to the nearest ten degrees. ☐ [1]

(d) Potassium reacts with chlorine gas to make potassium chloride.

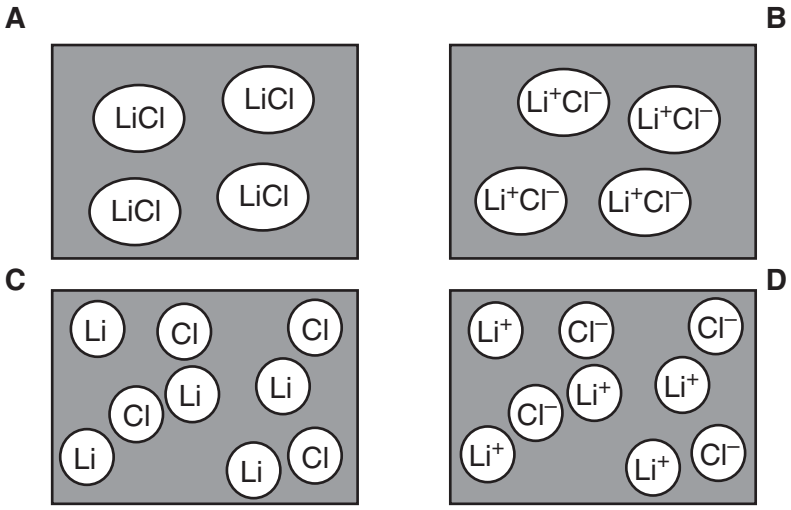
What is the formula of **potassium chloride**?

answer ..... [1]

[Total: 4]

2 Lithium chloride is an ionic compound. It dissolves in water.

(a) Which diagram, **A**, **B**, **C** or **D**, shows the particles in a lithium chloride solution?



answer ..... [1]

(b) How can we be certain that lithium chloride is ionic?

Put a tick (✓) in the box next to the correct answer.

Solid lithium conducts electricity.	☐
Solid lithium chloride conducts electricity.	☐
Molten lithium chloride conducts electricity.	☐
Lithium chloride has a high melting point.	☐

[1]

(c) Lithium reacts with bromine.

Balance the equation for this reaction.

☐ **Li** + **Br_2** → ☐ **LiBr** [2]

(d) Solid iron also reacts with bromine vapour. It makes crystals of iron bromide.

Add **state symbols** to the equation below.

$3Br_2(.....) + 2Fe(.....) \rightarrow 2FeBr_3(.....)$ [1]

[Total: 5]

3 When Bobby throws copper compounds into a flame, the flame gives a green light.

When Bobby throws calcium compounds into a flame, the flame gives a red light.

He uses a spectrometer to compare the spectrum of calcium with that of copper.

A spectrum is made of a series of lines.

Put a tick (✓) in the box next to the correct statement about a **calcium** spectrum.

The lines are in the same place as the copper lines.
All the lines are red. ☐

The lines are in different places from the copper lines.
Each line is a different colour. ☐

The lines are in the same place as the copper lines.
Each line is a different colour. ☐

The lines are in different places from the copper lines.
All the lines are green. ☐

[1]

[Total: 1]

4 The formula of sodium phosphate is Na_3PO_4. The sodium ion is Na^+.

Put a (ring) around the correct formula of the **phosphate** ion.

PO_4^{3+} PO_4^{4+} PO_4^{3-} PO_4^{4-} [1]

[Total: 1]

5 The table shows the numbers of protons, neutrons and electrons in different particles **A**, **B**, **C**, **D** and **E**.

	A	**B**	**C**	**D**	**E**
number of protons	11	11	11	9	9
number of neutrons	11	12	11	10	10
number of electrons	11	11	10	9	10

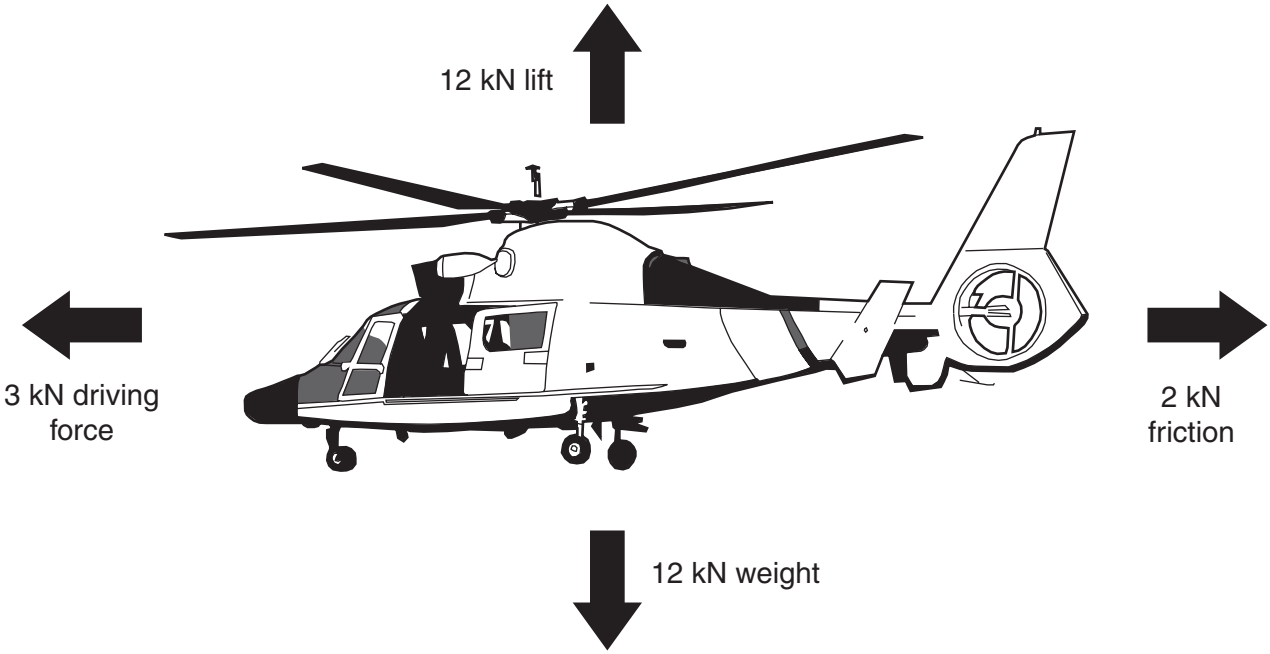
(a) Which particle has the greatest mass? .....

(b) Which particle has a negative charge? .....

(c) Which particles are atoms? ..... [3]

[Total: 3]

6 The diagram shows the forces acting on a helicopter in level flight.



(a) What is the **direction** of the resultant force on the helicopter?

Put a (ring) around the correct answer.

backwards **downwards** **forwards** **upwards** [1]

(b) What is the **size** of the resultant force on the helicopter?

Put a (ring) around the correct answer.

1 kN **2 kN** **3 kN** **5 kN** **12 kN** [1]

(c) Which quantities will be **increasing** for the helicopter?

Put ticks (✓) in the boxes next to the **two** correct answers.

height	☐
weight	☐
momentum	☐
kinetic energy	☐
gravitational potential energy	☐

[2]

[Total: 4]

7 Paul is a taxi driver in town.

He claims that his **speed** is always less than 50 km / h, and he can use **friction** to reduce his **velocity** to zero.

(a) Draw a straight line from each **quantity** to its correct **definition**.

quantity	**definition**
speed	the force needed to stop an object moving
friction	the distance moved by an object in each second
velocity	how fast and in what direction an object is moving
	a counter force arising from the motion of an object

[1]

(b) What is the correct way of converting 50 kilometres per hour into metres per second?

Put a (ring) around the correct answer.

$\frac{50\,000}{3600}$ **50 000 × 3600** $\frac{3600}{50\,000}$

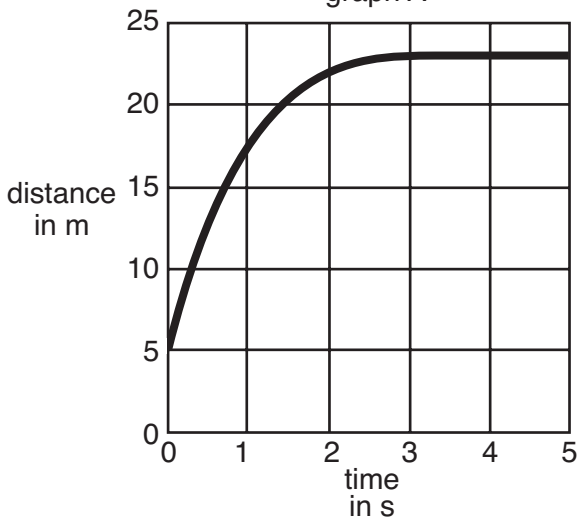
[1]

(c) Paul's momentum is 900 kg m/s when he is travelling at 50 km/h.

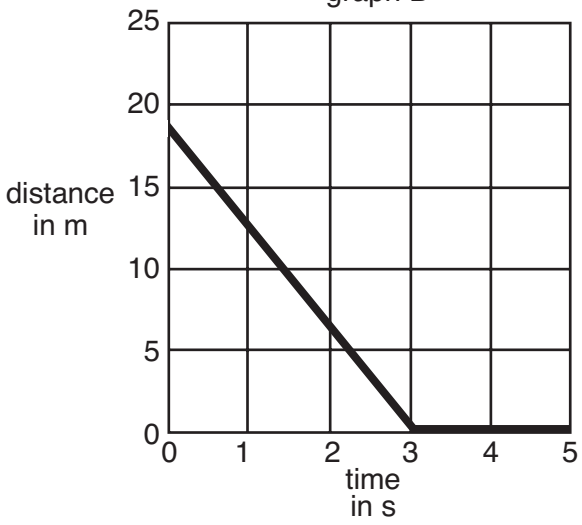
He slams on the brakes and stops the car in 3.0 s, moving a distance of 18 m.

(i) Which is the correct distance-time graph for Paul from the time he applies the brakes?

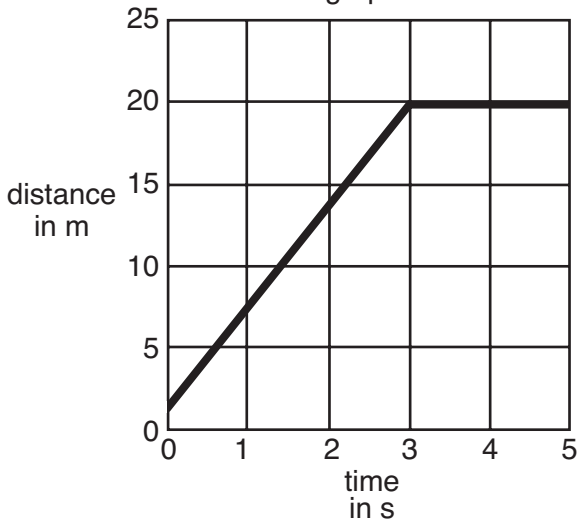
graph A



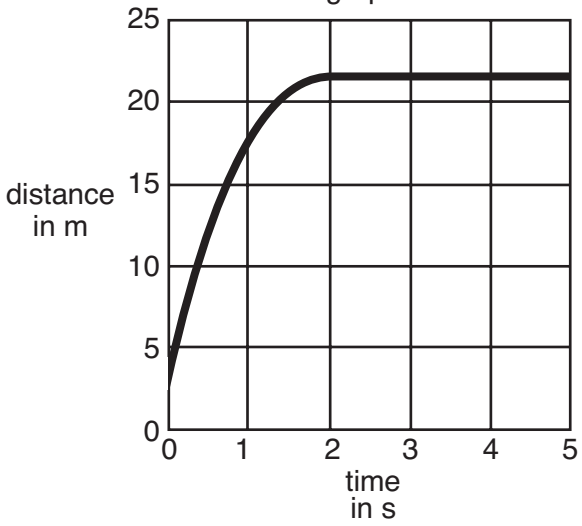
graph B



graph C



graph D



answer ..... [1]

(ii) How big is the force needed to stop Paul moving?

Put a (ring) around the best answer.

18 N **50 N** **300 N** **900 N** **2700 N** [1]

(d) Why should Paul wear a seatbelt?

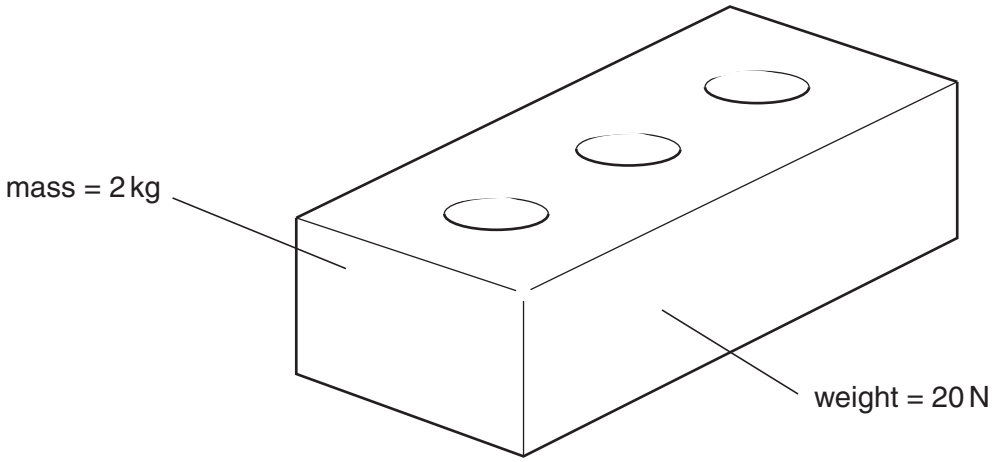
Put a tick (✓) in the box next to the correct answer.

A seatbelt increases the counter force on him in a crash.	☐
A seatbelt transfers less energy to him as the car slows down.	☐
A seatbelt increases the time it takes for him to slow down in a crash.	☐
A seatbelt reduces the amount of momentum he needs to lose in a crash.	☐

[1]

[Total: 5]

8 Julie drops a brick into a deep well.



The brick falls through the air until it hits the water.

(a) Finish the sentences. Choose words from this list.

weight

mass

gravitational potential energy

kinetic energy

As the brick falls through the air, work is done by its ..... .

This increases its ..... . [2]

(b) The brick is moving at 30 m/s when it hits the water.
The mass of the brick is 2 kg.
The weight of the brick is 20 N.

How much kinetic energy does it have?

Put a (ring) around the correct answer.

30 J

60 J

600 J

900 J

9000 J [1]

(c) Julie knows that the brick's gravitational potential energy changes by 1000 J as it falls down the well into the water. She uses this to calculate the velocity of the brick when it hits the water.

Put a (ring) around the correct calculation.

$\sqrt{\frac{1000}{\frac{1}{2} \times 2}}$ $\sqrt{\frac{1000}{10}}$ $\frac{1000}{10}$ $\frac{1000}{2}$ [1]

(d) Julie's calculated value is **not** 30 m/s.

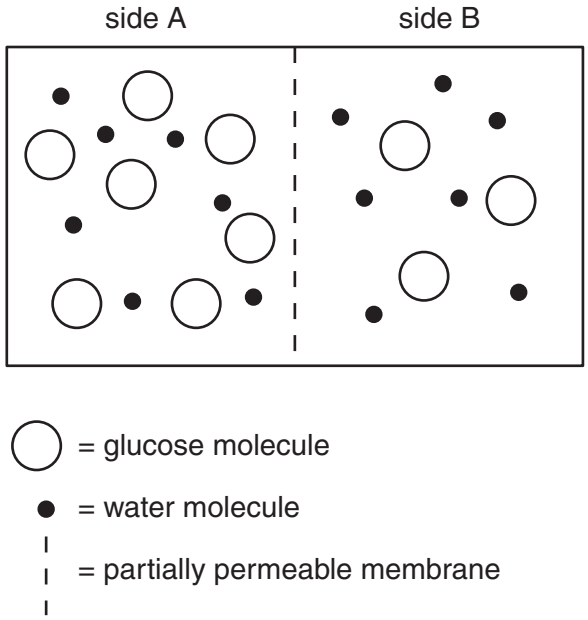
Put a tick (✓) in the box next to the correct reason.

The brick speeds up as it falls through the air.	☐
Air resistance dissipates some energy through heating.	☐
The weight of the brick increases as it moves down the well.	☐
Some of the brick's momentum is transferred through heating.	☐

[1]

[Total: 5]

9 Andrew draws a model to show osmosis.



(a) What does side B in the model represent?

Put a tick (✓) in the box next to the correct answer.

A concentrated solution. ☐

A dilute solution. ☐

Pure water. ☐ [1]

(b) Why did Andrew include a partially permeable membrane in his model?

Put a tick (✓) in the box next to the correct answer.

To stop glucose molecules and water molecules from passing through. ☐

To stop glucose molecules from passing through. ☐

To stop water molecules from passing through. ☐ [1]

(c) What happens to the water molecules?

Put a tick (✓) in the box next to the correct answer.

Water molecules move mostly from side **A** to side **B**. ☐

Water molecules move mostly from side **B** to side **A**. ☐

Water molecules move equally between side **A** and side **B**. ☐

Water molecules do not move between side **A** and side **B**. ☐ [1]

(d) What will happen when Andrew adds four more glucose molecules to **side B** in his model?

Put a tick (✓) in the box next to the correct answer.

Water molecules move mostly from side **A** to side **B**. ☐

Water molecules move mostly from side **B** to side **A**. ☐

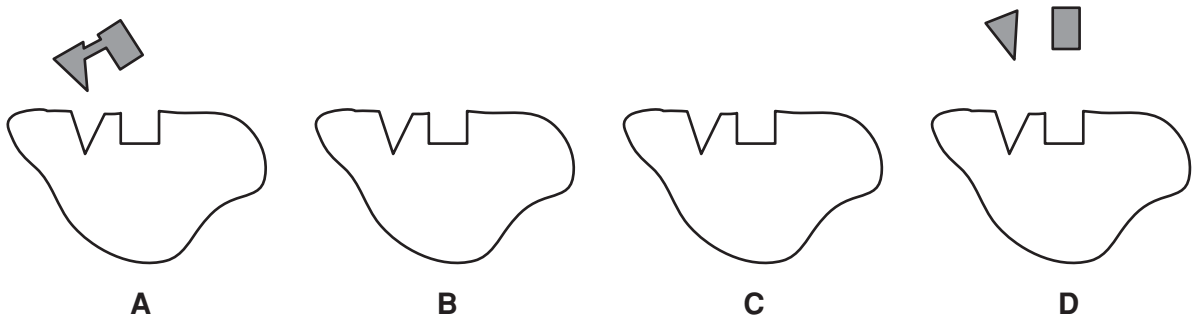
Water molecules move equally between side **A** and side **B**. ☐

Water molecules do not move between side **A** and side **B**. ☐ [1]

[Total: 4]

10 Liz draws a model to show the different stages which take place when an enzyme speeds up the breakdown of a molecule.

(a) Complete diagrams **B** and **C** to show the stages in the breakdown of a molecule.



[2]

(b) What is the name of this model?

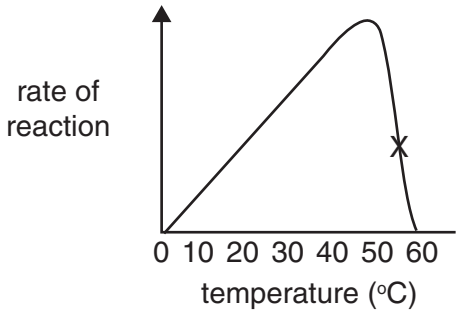
Put a (ring) around the correct answer.

kinetic theory model	**lock and key model**	**random collision model**	**nut and bolt model**

[1]

(c) Liz then carries out an experiment and draws a graph of her results.

The graph shows the rate of reaction of an enzyme at different temperatures.



15

Liz asks five friends to explain what happened at part X of her graph.

Some of her friends gave correct explanations, others did not.

Which friends gave correct explanations?

..... and ..... [2]

(d) Which variable can alter the shape of the active site of the enzyme?

Put a tick (✓) in the box next to the correct variable.

Concentration of enzyme.	☐
Concentration of substrate.	☐
pH of mixture.	☐
Speed of collisions.	☐

[1]

[Total: 6]

11 This question is about the hormone ADH.

(a) Which part of the body releases ADH?

Put a (ring) around the correct answer.

adrenal gland **kidney** **pituitary gland** **testes** [1]

(b) How is ADH transported around the body and what is its function?

Draw **one** straight line from the correct method of **transport** of ADH to the correct **function** of ADH.

transport	**function**
lymph	control of urine concentration
digestive tract	releasing digestive enzymes
neurons	converting glucose into glycogen
blood	decreasing vasodilation

[2]

(c) What happens to the production of urine by the kidneys when a person takes the drug ecstasy?

Draw **one** straight line from the correct change in the **volume of urine** to the correct change in its **concentration** caused by the drug ecstasy.

volume of urine	**concentration**
greater	less dilute
smaller	more dilute
stays the same	stays the same

[1]

[Total: 4]

END OF QUESTION PAPER

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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.