THIS IS A NEW SPECIFICATION

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RECOGNISING ACHIEVEMENT

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Wednesday 5 June 2013 – Afternoon

GCSE TWENTY FIRST CENTURY SCIENCE ADDITIONAL SCIENCE A

A151/01 Modules B4 C4 P4 (Foundation Tier)

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)

Duration: 1 hour

A137080613

A151101

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.
- The Periodic Table is printed on the back page.
- The total number of marks for this paper is **60**.
- This document consists of **24** pages. Any blank pages are indicated.

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

Answer **all** the questions.

1 Chloe is a sprinter.
Her muscles respire **anaerobically**.

(a) Complete the word equation for anaerobic respiration.

Use words from this list.

carbon dioxide **glucose** **lactic acid** **oxygen** **water**

..... → ..... (+energy) **[2]**

(b) In which part of Chloe's muscle cells does **anaerobic** respiration take place?

Put a (ring) around the correct answer.

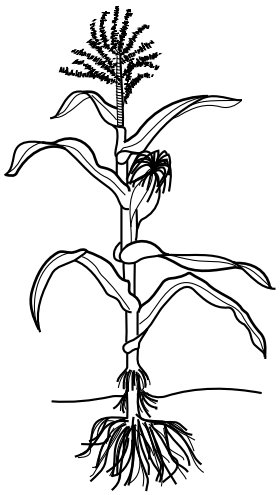
cell membrane **cytoplasm** **mitochondria** **nucleus**

[1]

[Total: 3]

Question 2 begins on page 4

2 Photosynthesis takes place in the leaves of a plant.



The gases carbon dioxide and oxygen diffuse in and out of the leaf.

The concentration of oxygen in the air is 21%.

The concentration of carbon dioxide in the air is 0.04%.

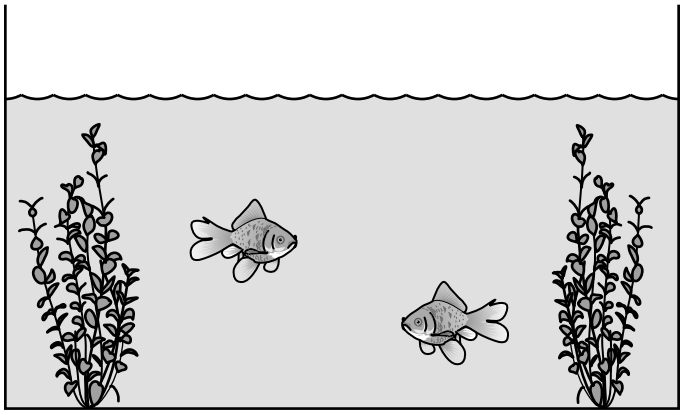
(a) Put ticks (✓) in the table to show the concentrations of oxygen and carbon dioxide **inside** the leaf at midday.

Put **one** tick in each row.

	Concentration inside the leaf		
	less than 0.04%	between 0.04% and 21%	greater than 21%
oxygen			
carbon dioxide			

[2]

(b) Kevin has a tank containing plants and fish.



He knows that both plants and fish use certain gases for chemical processes.

He also knows that these processes make other gases.

His teacher tells him that the plants and the fish need each other to survive.

Explain why.

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

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

[Total: 8]

3 Yeast uses an enzyme to make carbon dioxide from sugar.

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

The enzyme is made of

fat.	
sugar.	
protein.	

The instructions to make the enzyme are found in the

genes.	
cytoplasm.	
membrane.	

The sugar has to be the correct shape to fit into the

closed	
active	
genetic	

site of the enzyme.

[2]

(b) Yeast makes carbon dioxide during **anaerobic** respiration.

Write down **one** other substance that yeast makes during anaerobic respiration.

.....

[1]

[Total: 3]

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Question 4 begins on page 8

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4 Karen investigates osmosis using potato cylinders.

She cuts six potato cylinders, each 50 mm long.

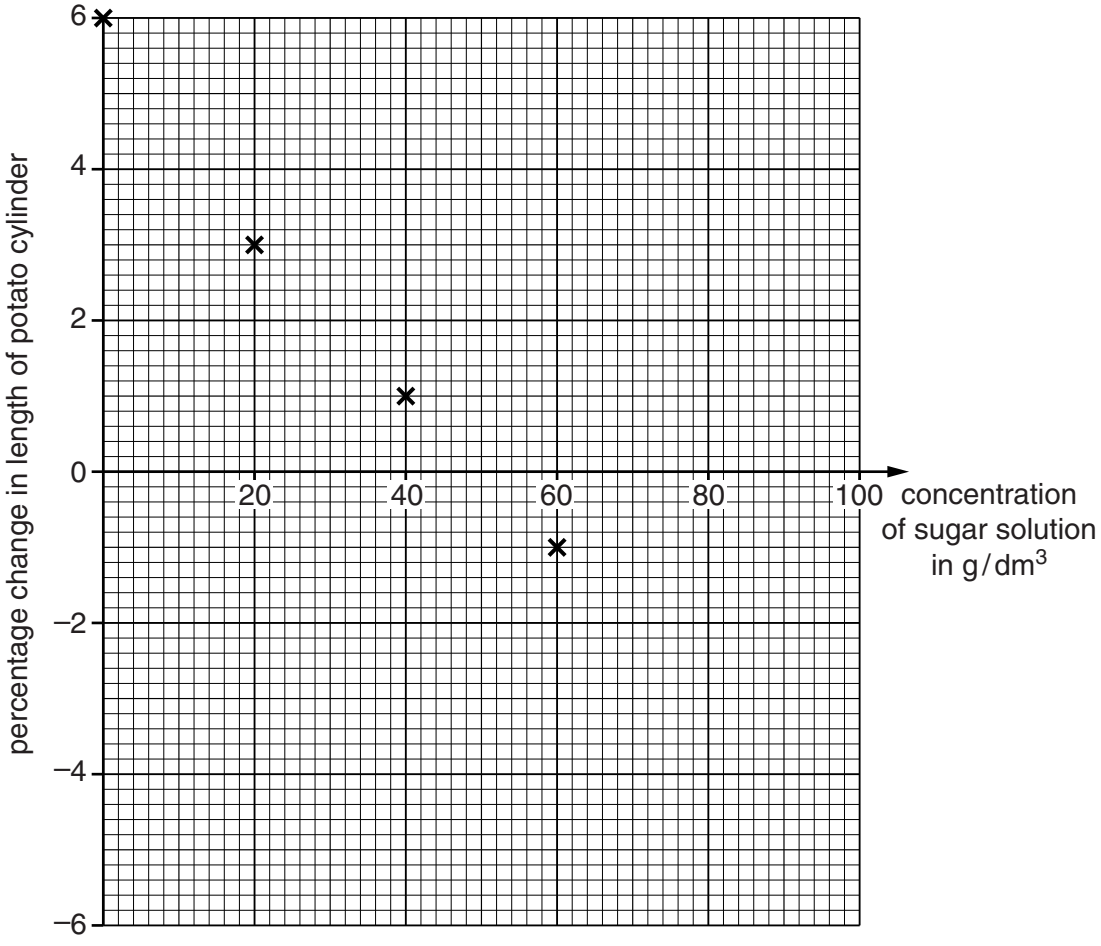
She places each potato cylinder in a different concentration of sugar solution.

After 60 minutes, she removes the potato cylinders and measures the length of each one.

Concentration of sugar solution in g/dm^3	% change in length of potato cylinder
0	+6
20	+3
40	+1
60	–1
80	–4
100	–6

(a) Plot a graph of these results on the axes and draw a straight line of best fit.

Four points have been done for you.



[2]

(b) What is the concentration inside the potato cells at the start of the experiment?

Justify your answer.

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

(c) Explain how Karen could improve her experiment to increase confidence in the conclusion.

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

[Total: 6]

Question 5 begins on page 10

5 James is studying the halogens.

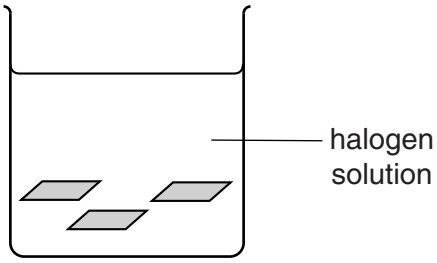
(a) A website tells James that chlorine boils at –35 °C and that iodine boils at 184 °C.

What is the boiling point of bromine?

Put a (ring) around the correct answer.

–184 °C –37 °C 59 °C 219 °C **[1]**

(b) James tries to bleach small pieces of coloured cloth with solutions of different halogens.



(i) Which halogen is likely to make the best bleach?
Put a (ring) around the correct answer.

chlorine bromine iodine **[1]**

(ii) Why is this halogen the best bleach?
Put a tick (✓) in the box next to the correct answer.

It has the greatest reactivity. ☐

It has the highest boiling point. ☐

It has the highest melting point. ☐

It is a liquid at room temperature. ☐

[1]

(c) James knows that chlorine, bromine and iodine are halogens.

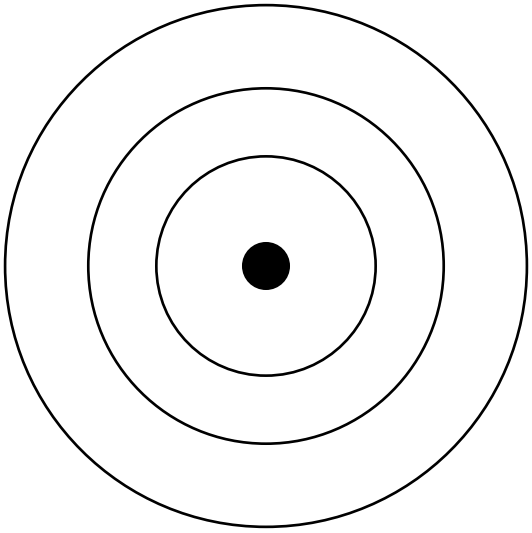
(i) Find the halogens in the Periodic Table at the back of this paper.

The relative atomic mass of one halogen is 80. Which one? ..... **[1]**

(ii) How many protons does a **chlorine** atom have? ..... **[1]**

(iii) Each chlorine atom has 17 electrons.
The electron arrangement is 2.8.7 for a chlorine atom.

Put crosses on the diagram to show all the electrons in an atom of chlorine.



[2]

(iv) When a chlorine atom reacts with a metal the chlorine atom becomes charged.
Use ideas about electrons to explain:

- what sort of charged particle is formed
- how the atom turns into a charged particle.

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

(v) Chlorine reacts with sodium to make sodium chloride.

Fill in the boxes to show a word equation for this reaction.

[ ] + [ ] → [ ] **[1]**

(vi) Chlorine also reacts with potassium.

What substance is made in this reaction? ..... **[1]**

[Total: 11]

6 Mendeleev arranged the elements into his Periodic Table in 1869.

- He put the elements into groups.
- He left empty places in some parts of his table.

Explain why these were good ideas, and why other scientists started to agree with him after a few years.

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

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

[Total: 6]

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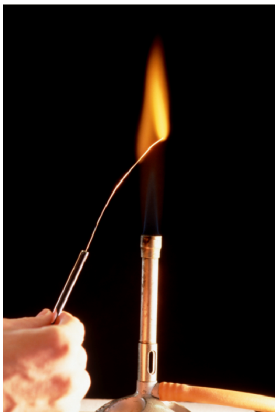
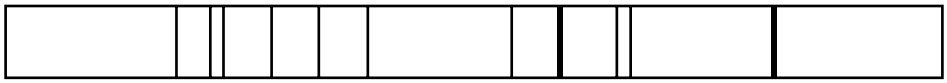
7 Nigella puts a substance into a flame.



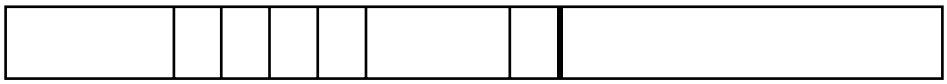
She photographs its spectrum.

sample 

Nigella thinks that the substance contains sodium compounds and potassium compounds.

Jo thinks it contains sodium compounds, but no potassium compounds.

They look up some spectra in a book.

sodium 

potassium 

Who is correct? Explain your answer.

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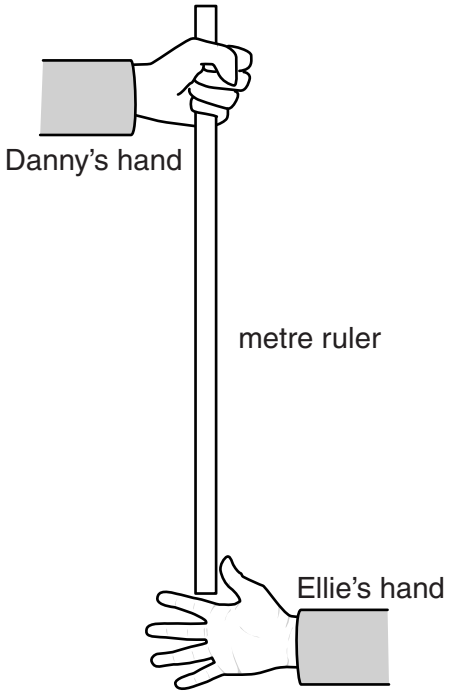
..... **[3]**

[Total: 3]

8 Danny holds a metre ruler above Ellie's open hand.
She catches the ruler when he lets go of it without warning.
They use the distance that the ruler falls to work out her reaction time.



(a) Here are their results.

Test	Reaction time in seconds
one	0.21
two	0.18
three	0.22
four	0.19

(i) What is the best estimate of the true value of her reaction time?
Put a (ring) around the correct answer.

0.18 s **0.19 s** **0.20 s** **0.21 s** **0.22 s** **[1]**

(ii) What is the range of the results?
Put a (ring) around the correct answer.

0.18 s to 0.22 s **0.19 s to 0.21 s** **0.20 s to 0.22 s** **0.21 s to 0.22 s** **[1]**

(b) Ellie drinks an energy drink.
Half an hour later Danny measures Ellie's reaction time again.
Here are their results.

Test	Distance fallen by ruler in cm	Reaction time in seconds
five	17	0.17
six	13	0.15
seven	15	0.16

What can you conclude about the effect of the energy drink?
Justify your answer. Use your answers to part **(a)** to help.

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

(c) The ruler speeds up as it falls.
Why does the ruler speed up?
Put a tick (✓) in the box next to the correct explanation.

Gravitational potential energy transfers to kinetic energy. ☐

The kinetic energy remains constant. ☐

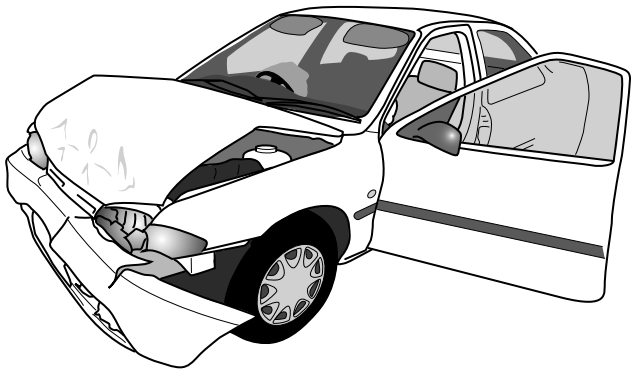
Kinetic energy transfers to gravitational potential energy. ☐

The gravitational potential energy remains constant. ☐

[1]

[Total: 6]

9 Modern cars are built with larger crumple zones than older cars.



Explain why larger crumple zones are more effective than small ones.

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

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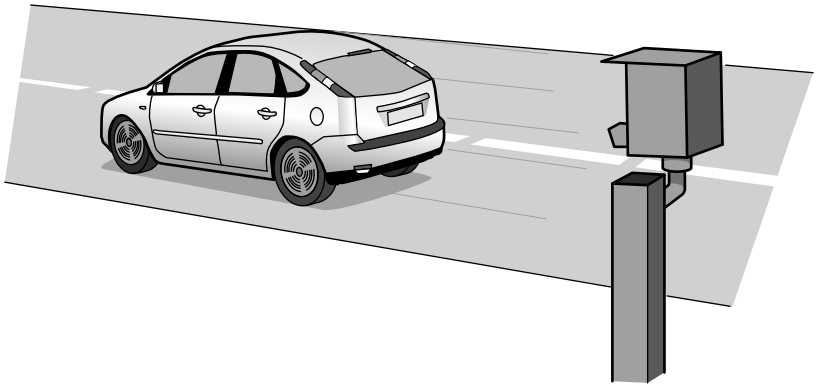
..... **[6]**

[Total: 6]

10 A speeding car sets off a speed camera.

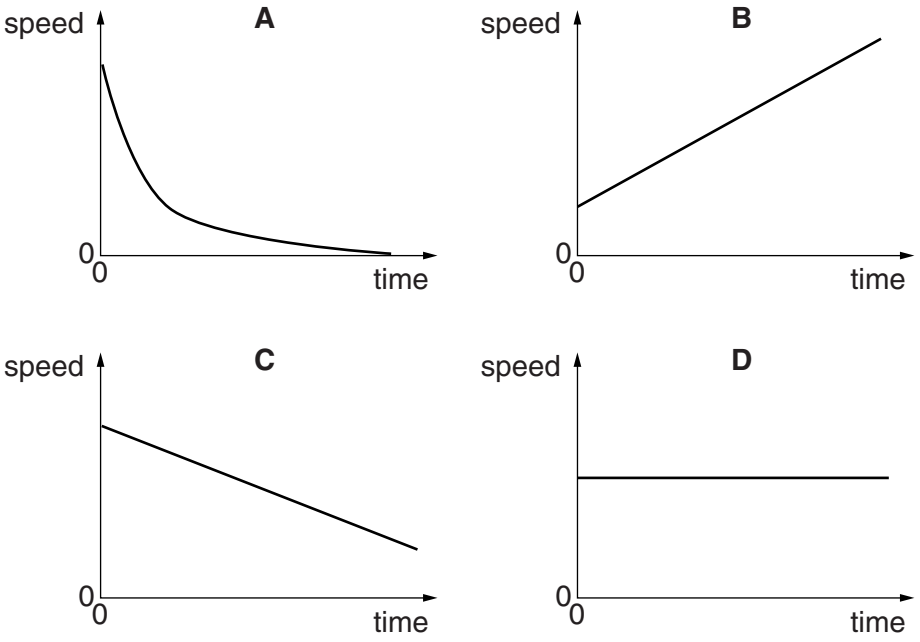


(a) The camera takes two photos of the car.

The photos are taken 0.40 s apart.
The car moves 8.0 m in this time.
Calculate the speed of the car.
Show your working.

speed = ... m/s **[2]**

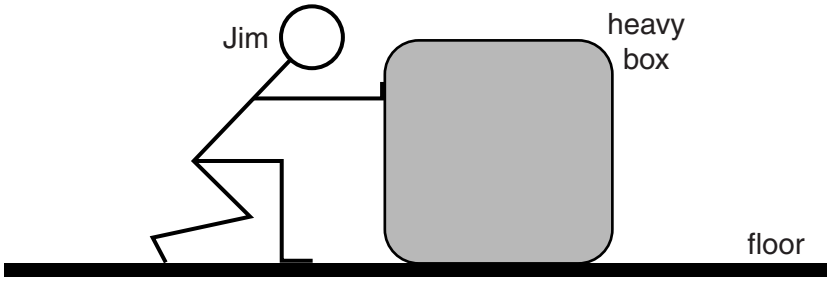
(b) The car accelerates away from the camera.
Which speed-time graph, **A**, **B**, **C** or **D**, shows this acceleration?



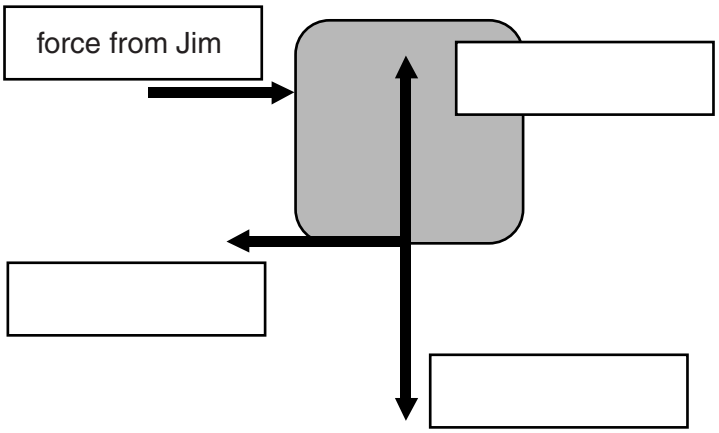
answer ..... **[1]**

[Total: 3]

11 Jim pushes a heavy box across a level floor.



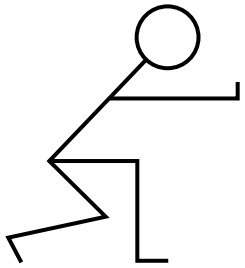
(a) Four different forces act on the heavy box, as shown below.



Add these labels to the diagram.

friction **reaction** **weight** **[2]**

(b) Jim pushes on the box with a force of 200 N.
Jim's weight is 800 N.
State and explain the size and direction of the force **on** Jim **from** the box.
You may draw on the diagram if you wish.



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

[Total: 5]

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.