Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
GENERAL CERTIFICATE OF SECONDARY EDUCATION

A217/01

TWENTY FIRST CENTURY SCIENCE
ADDITIONAL SCIENCE A

Unit 3: Modules B6 C6 P6 (Foundation Tier)

MONDAY 1 FEBRUARY 2010: Afternoon
DURATION: 40 minutes

SUITABLE FOR VISUALLY IMPAIRED CANDIDATES

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)

READ INSTRUCTIONS OVERLEAF

DC (KN/CGW) MEP10256 24660/1

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number on the first page.
- Use 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.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

INFORMATION FOR CANDIDATES

- The number of marks 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 pages 4–5.
- A copy of the Periodic Table is provided.

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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

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

ELECTRIC CIRCUITS

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

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

$$\text{energy transferred} = \text{power} \times \text{time}$$

$$\text{power} = \text{potential difference} \times \text{current}$$

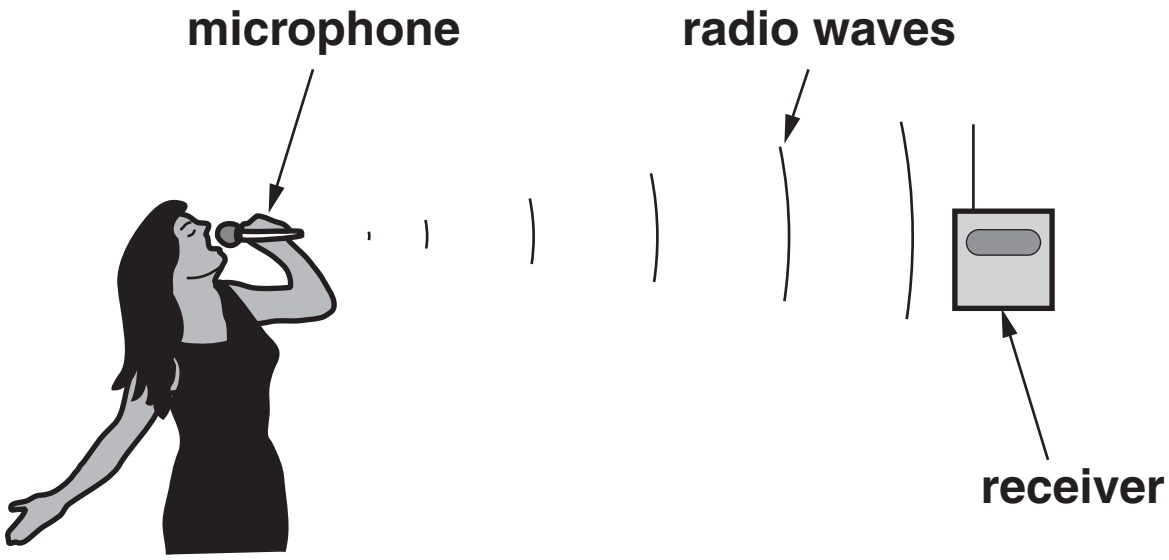
$$\text{efficiency} = \frac{\text{energy usefully transferred}}{\text{total energy supplied}} \times 100\%$$

THE WAVE MODEL OF RADIATION

$$\text{wave speed} = \text{frequency} \times \text{wavelength}$$

Answer ALL the questions.

1 Sam uses a digital radio microphone when she sings karaoke.



(a) Radio waves are part of the electromagnetic spectrum.

Write RADIO in the correct place in the spectrum.

	micro-waves		visible		X-ray	

low frequency → high frequency

[1]

(b) Put a ring around the BEST choice to complete each sentence.

Sam sings into her radio microphone.

Sam's microphone acts as

a DECODER / RECEIVER / TRANSMITTER

of radio waves.

The sound of Sam's singing is used to

MODULATE / OSCILLATE / REFLECT the

radio waves.

The radio waves travel away from the microphone.

Their intensity DECREASES /

DOESN'T CHANGE / INCREASES as they

travel.

[3]

(c) Sam's radio microphone transmits her sound digitally.

Put a tick (✔) in the box next to the BEST reason for this.

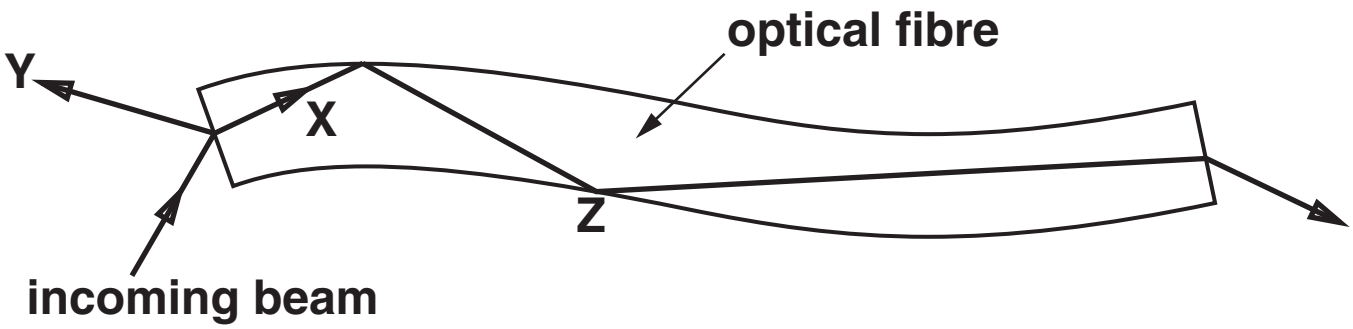
Digital signals need to use expensive circuits.	☐
Analogue transmission stops other microphones working.	☐
It is easier to remove noise from the signal at the receiver.	☐
Radio waves travel faster when they are pulsed on and off.	☐

[1]

[Total: 5]

2 TV cable networks use optical fibres made of glass to carry digital signals.

(a) The diagram shows a beam of infrared light entering and leaving an optical fibre.



Complete the sentences. Choose words from this list.

ABSORBED
DIFFRACTED
REFLECTED
REFRACTED

At the start of the optical fibre the incoming beam splits.

One part of the beam goes to X, the other part goes to Y.

The part which goes to X is _____ .

The part which goes to Y is _____ .

[2]

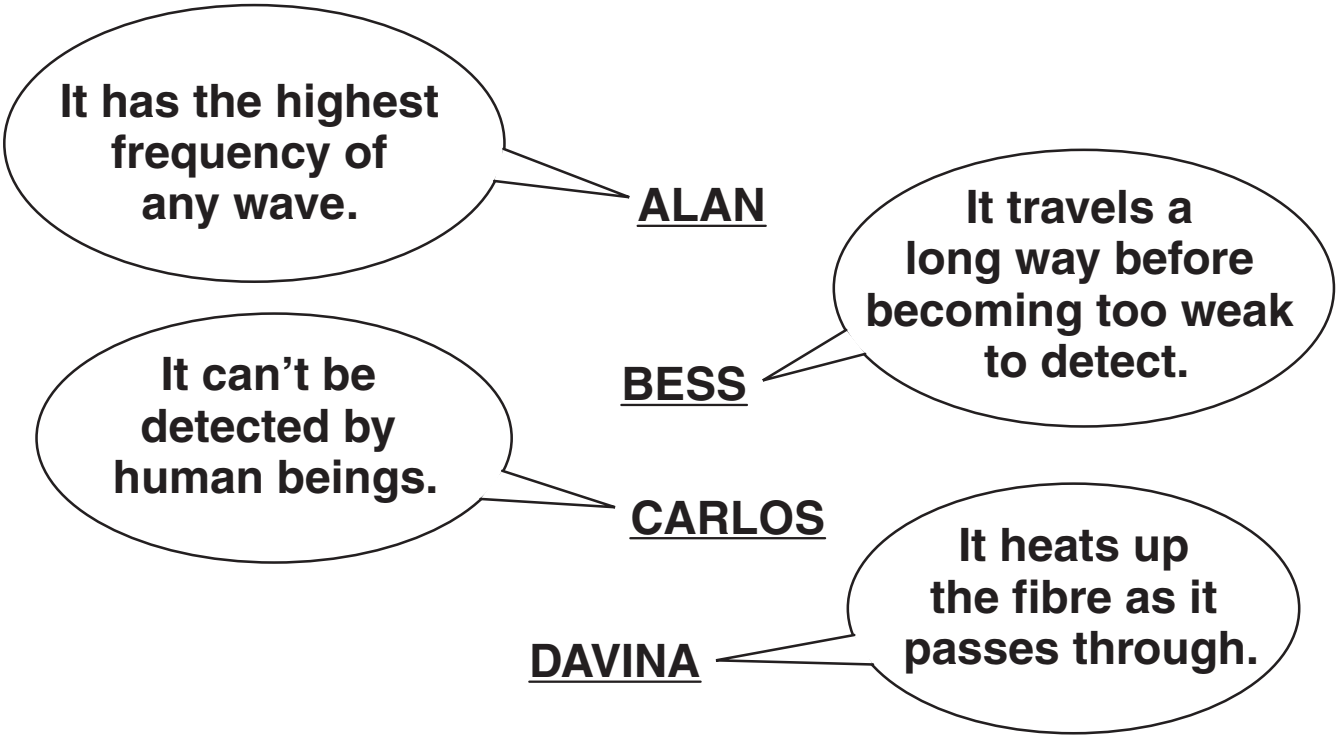
(b) At point Z, the beam is <u>TOTALLY INTERNALLY REFLECTED</u>. Why does this happen?

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

Infrared light travels faster through glass than through air.	☐
None of the energy of the infrared light is absorbed by the glass.	☐
The angle of refraction of the emerging beam would be more than 90°.	☐
The glass has been coated with black plastic to absorb the infrared light.	☐

[1]

(c) Four friends discuss why infrared is used to carry TV signals through optical fibres.



Who has the correct reason why infrared light is used to carry TV information through optical fibres?

answer _____ [1]

[Total: 4]

3 Microwave ovens are used to heat food.

(a) When the oven is switched on it produces microwave photons.

These photons all have the same frequency.

Suppose that the frequency of the photons is increased.

What effect does this INCREASE have on the energy and speed of the photons?

effect on energy _____

_____

effect on speed _____

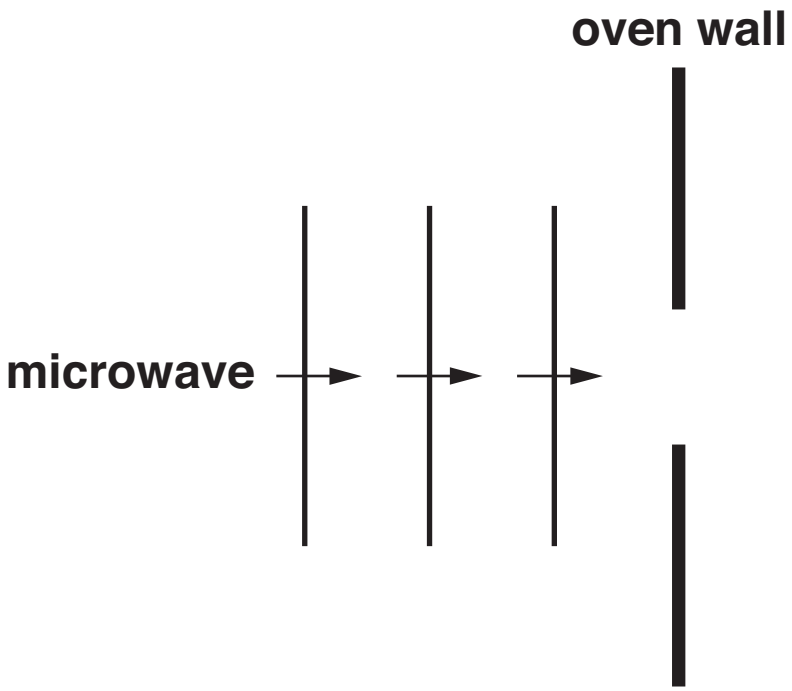
_____ **[2]**

(b) The microwaves enter the oven through a small hole.

The diagram shows waves approaching the hole.

They DIFFRACT as they pass through the hole.

On the diagram, draw the waves after they have passed through the hole.



[1]

(c) Jo puts some food on a plastic plate in her microwave oven for two minutes.

Why does the food get hot but the plate stay cold?

_____

_____

_____ [2]

[Total: 5]

4 Hannah is walking on a woodland path when she stumbles into some stinging nettles.

She jumps away from them when they sting her.

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

LEARNED
MOTOR
MUSCLES
NERVES
REFLEX
SENSORY

This type of response is a _____ response.

The pain signal is carried by _____ neurons.

The effectors are _____ .

The signal to the effectors is carried by

_____ neurons.

[3]

(b) Hannah's first response is to jump back.

She then realises that she has dropped her phone in the nettles.

Hannah reaches into the nettles to pick up the phone.

She knows the nettles will sting her.

Her brain makes it possible for her to <u>ADAPT HER BEHAVIOUR</u> in this way.

What is it about her brain that makes it possible to do this?

Put a tick (✔) in the box next to the <u>BEST</u> answer.

Her brain has many neurons.	☐
Her brain has many possible pathways between the neurons.	☐
Her brain is connected to her muscles.	☐
Her brain has a fixed number of neuron pathways.	☐
Her brain is in her central nervous system.	☐

[1]

[Total: 4]

5 Brian walks out of the cinema into bright sunshine.

He is dazzled by the bright light until his eyes adjust.

His pupils get smaller. This is called the pupil reflex.

(a) Draw lines to join each COMPONENT to the correct PART OF THE REFLEX ARC.

COMPONENT	PART OF THE REFLEX ARC
muscle cells in the iris	processor
light sensitive cells in the retina	effector
central nervous system	receptor

[2]

(b) (i) Newborn babies have some reflexes which disappear after a time. These are called newborn reflexes.

When a baby is born, the nurse checks these newborn reflexes.

Give two newborn reflexes.

1 _____

_____

2 _____

_____ [2]

(ii) Newborn babies have other reflexes which do <u>NOT</u> disappear after a time.

One example is the pupil reflex.

Give another reflex which does not disappear as the body gets older.

_____

_____ [1]

[Total: 5]

6 Scientists study the brain to see how it works.

One part of the brain is mainly concerned with memory and language.

(a) Which part of the brain is mainly concerned with memory and language?

Put a ring around the correct answer.

CORTEX

MOTOR NEURON

OPTIC NERVE

SPINAL CORD

[1]

(b) Put ticks (✔) in the TWO boxes next to methods that scientists use to investigate activity in this part of the brain.

X-rays	☐
IQ tests	☐
ultrasound	☐
MRI scans	☐
electrical stimulation	☐

[2]

[Total: 3]

7 This question is about how signals are transmitted around the nervous system.

Put a ring around the correct choice for each sentence.

Nerve signals travel along a neuron
as ELECTRICAL / MAGNETIC / MECHANICAL
impulses.

Gaps between neurons are called
ARCS / HOLES / SYNAPSES.

Some neurons have a fatty sheath.

This SPEEDS UP / SLOWS DOWN / STOPS
the impulses.

[2]

[Total: 2]

8 Geoff reacts carbonates with acids.

(a) What would Geoff expect to notice?

Put a tick (✔) in the box next to the BEST answer.

Bubbles appear in the liquid. ☐

The liquid becomes sticky. ☐

The liquid dries up. ☐

[1]

(b) One reaction that he tries is copper carbonate with hydrochloric acid.

(i) Here is the equation for the reaction.

Write the name of each chemical in its box.

The first three have been done for you.

$CuCO_3$	+	$2HCl$	→	$CuCl_2$	+
copper carbonate	+	hydrochloric acid	→	copper chloride	+

H_2O	+	CO_2
	+	

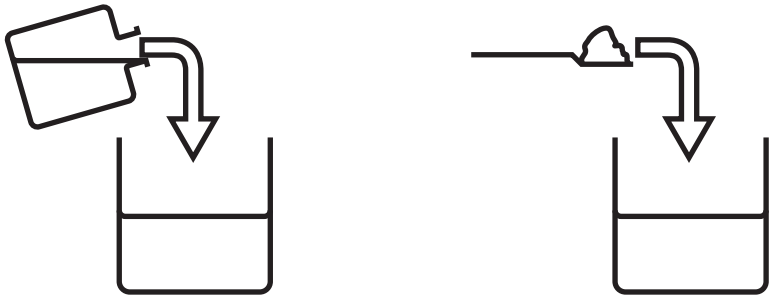
[1]

(ii) Here are the instructions that Geoff uses to carry out the reaction.

1. Pour the acid into a beaker.

2. Add one spatula of carbonate and allow it to react.

3. Add more carbonate and stir until all the acid has reacted.



STAGE 1 STAGES 2 AND 3

How can he tell when ALL the acid has reacted?

Put a tick (✔) in the box next to the BEST answer.

The liquid warms up. ☐

Solid is left in the beaker. ☐

The solution changes colour. ☐

All the carbonate has disappeared. ☐

[1]

(iii) **Geoff wants to make crystals of the salt from his solution.**

What method should he use?

Put a tick (✔) in the box next to the <u>BEST</u> answer.

distil the solution	☐
dilute the solution	☐
evaporate some of the water	☐
put the solution into a freezer	☐

[1]

[Total: 4]

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9 Geoff investigates how quickly copper carbonate reacts with hydrochloric acid.

(a) Suggest <u>TWO</u> ways in which Geoff could make the reaction go faster.

1 _____

_____

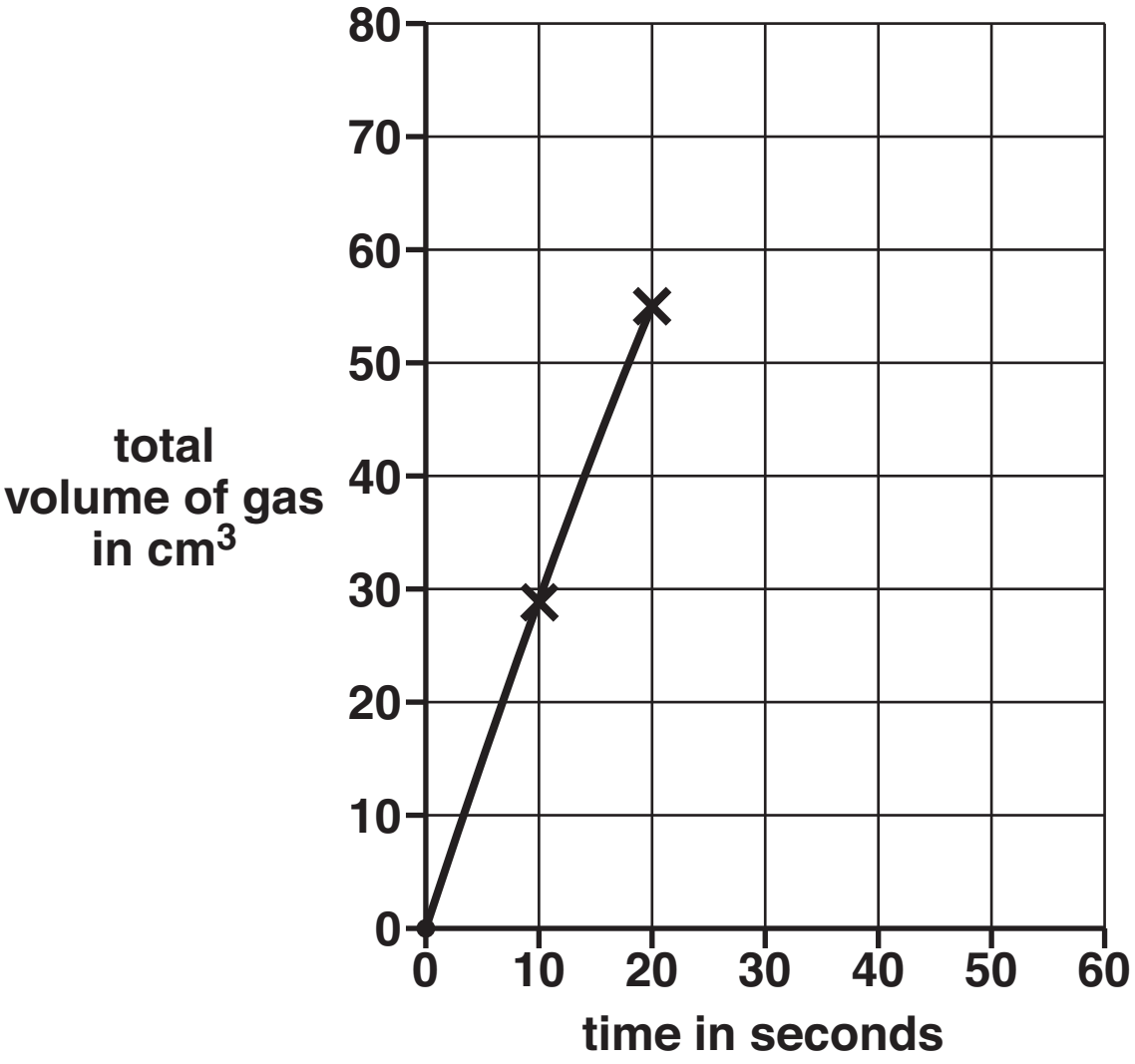
2 _____

_____ [1]

(b) Geoff measures the volume of carbon dioxide given off every ten seconds.

TIME IN SECONDS	TOTAL VOLUME OF GAS IN CM^3
0	0
10	29
20	55
30	66
40	72
50	74

(i) Finish the graph of these results. The first three points have been done for you.



[2]

(ii) Why does the reaction gradually slow down?

_____

_____ [1]

[Total: 4]

10 The chemical industry makes millions of tonnes of sulfuric acid every year.

The equation for one of the stages in the reaction is

$$2SO_2 + O_2 \rightarrow 2SO_3$$

(a) (i) How many atoms of sulfur are shown on the left side of the equation?

Put a (ring) around the correct answer.

1 2 3 4 5

[1]

(ii) Chemical engineers need to know the total number of reactant molecules in the equation.

Give the number of reactant molecules shown in the equation.

answer _____ [1]

(b) The chemical engineers need to control the rate of the reaction.

(i) What does '<u>RATE OF REACTION</u>' tell you?

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

how fast the reaction goes	☐
how much reacts	☐
how much energy the reaction needs	☐
how much product forms	☐

[1]

(ii) The reaction uses a catalyst.

Which of these statements about catalysts are true?

Put ticks (✔) in the boxes next to the <u>TWO</u> correct statements.

Catalysts decrease the yield.	☐
Catalysts are biodegradable.	☐
Catalysts speed up a reaction.	☐
Catalysts are not used up in a reaction.	☐

[1]

(iii) There are problems at the factory when the chemical engineers get the wrong speed for the reaction.

Draw a straight line from each PROBLEM to its CAUSE.

PROBLEM	CAUSE
not enough sulfuric acid is made	reaction too fast
safety valves release chemicals into the air	reaction too slow
tanks not big enough to hold all the products	

[2]

[Total: 6]

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.