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Thursday 2 February 2012 – Morning

GCSE TWENTY FIRST CENTURY SCIENCE ADDITIONAL SCIENCE A

A217/02 Unit 3: Modules B6 C6 P6 (Higher Tier)

A213520112

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: 40 minutes

A217702

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

- 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 page 2.
- The Periodic Table is printed on the back page.
- This document consists of **20** pages. Any blank pages are indicated.

TWENTY FIRST CENTURY SCIENCE EQUATIONS

Useful Relationships

Explaining Motion

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

$$\text{momentum} = \text{mass} \times \text{velocity}$$

$$\text{change of momentum} = \text{resultant force} \times \text{time for which it acts}$$

$$\text{work done by a force} = \text{force} \times \text{distance moved in the direction of the force}$$

$$\text{change in energy} = \text{work done}$$

$$\text{change in GPE} = \text{weight} \times \text{vertical height difference}$$

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

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 Julie goes shopping for a new digital TV.

(a) Her new TV uses optical fibre cable.

What carries the information through the optical fibre cable?

Put a (ring) around the correct answer.

infrared light **microwaves** **sound** **ultraviolet**

[1]

(b) Julie's old TV received analogue signals through a wire cable.

The picture quality wasn't very good.

This was because the signal picked up noise in the cable.

Her new TV gives a very clear picture.

Explain why noise doesn't affect **digital** TV.

Your answer should include a description of

- a digital signal
- noise.

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.....

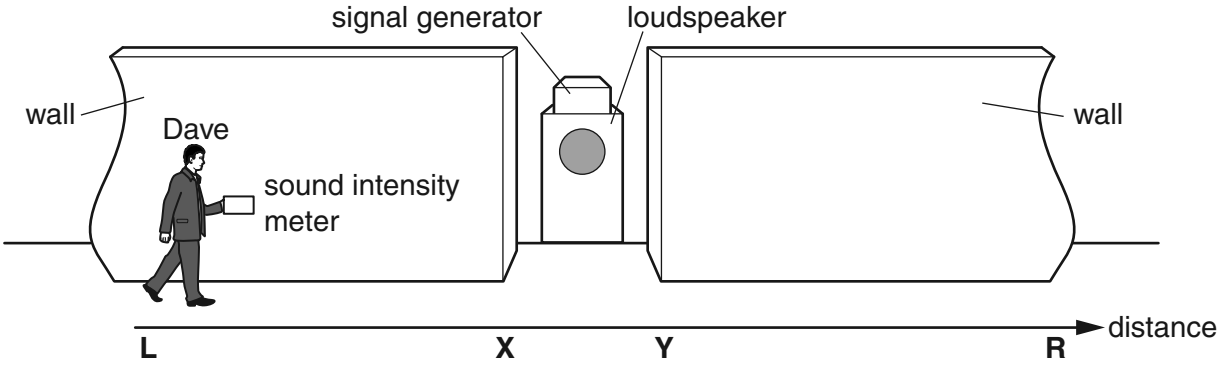
.....

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

[Total: 4]

2 Dave does an experiment with sound waves.

He places a loudspeaker and signal generator behind a gap in a wall.



The loudspeaker sends sound waves towards the gap.

Dave walks in front of the wall with a sound intensity meter.

(a) What does the sound wave carry from the loudspeaker to the meter?

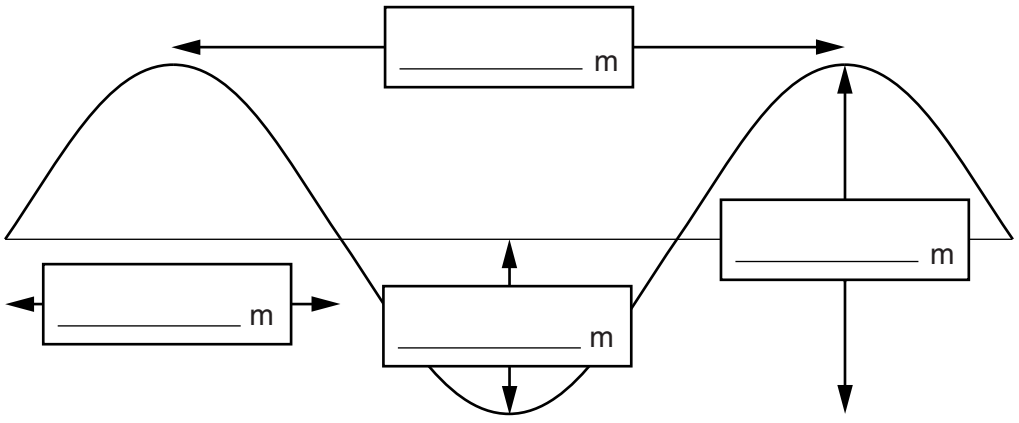
answer ..... **[1]**

(b) Dave sets the frequency of the signal generator to 680 Hz.

The speed of sound waves is 340 m/s.

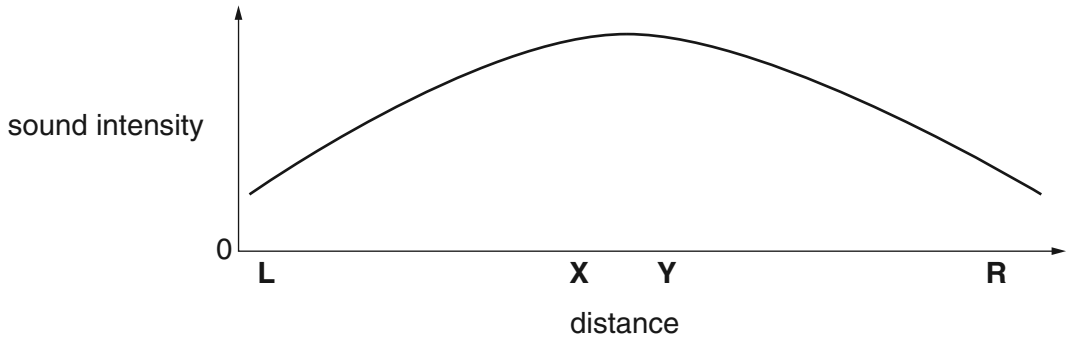
Calculate the wavelength of the waves.

Write the answer in the **one** correct box on the diagram of a wave.



[2]

(c) Dave plots this graph to show how the reading on the sound intensity meter changes as he walks in front of the wall from **L** to **R**.



Here are some possible explanations for the shape of the graph.

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

The sound waves are amplified by the wall. ☐

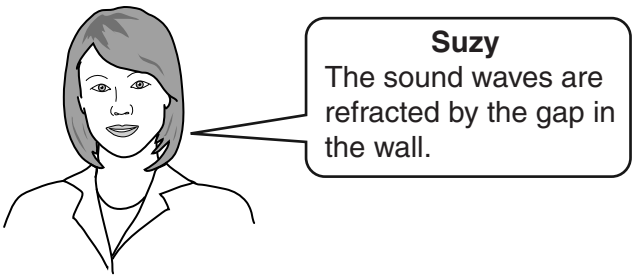
The sound waves are diffracted by the gap in the wall. ☐

The sound waves are transmitted through the wall. ☐

Sound waves which arrive at the gap pass straight through. ☐

[1]

(d) Suzy explains Dave's results **incorrectly**.

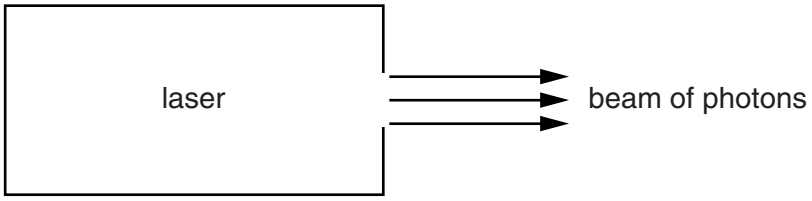


State the wave property which must change for refraction to happen.

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

[Total: 5]

3 A laser is a special high intensity light source.



(a) All of the photons from the laser are identical.

They have the same colour, direction and energy.

State **two** other properties which will be the same for all of the photons.

..... and ..... **[1]**

(b) The beam of laser light has a high intensity.

Here are some properties of the beam.

Which properties will affect the intensity of the beam?

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

The energy of each photon in the beam.	☐
The direction in which the beam travels.	☐
The number of photons emitted per second.	☐
The amplitude of the photons of laser light.	☐
The speed of the photons as they leave the laser.	☐

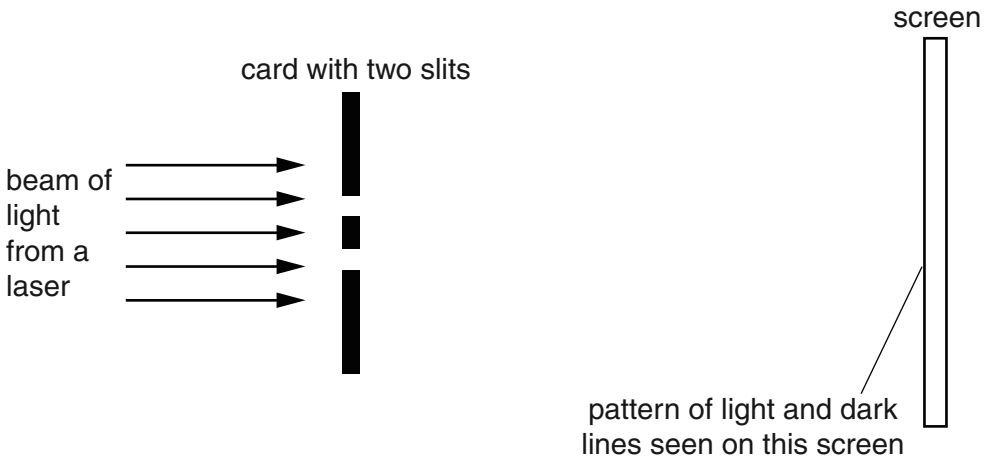
[2]

(c) Joe does an experiment with a laser.

He places a piece of card in the path of a laser beam.

The card has two slits, allowing two beams of light through to a screen.

Joe sees a pattern of light and dark lines on the screen.



(i) Complete the sentences by putting a (ring) around the correct words in **bold**.

The pattern is due to waves from **both / neither / one** of the slits.

When they arrive at the screen they **diffract / diverge / interfere**.

When the waves arrive at a bright line they are **in / out of** step.

When the waves arrive at a dark line they **cancel / reinforce** each other.

[1]

(ii) Here are some possible conclusions from this experiment.

Put a tick (✓) in the box next to the correct conclusion from this experiment.

The light from the laser has a wavelike nature. ☐

The energy of the laser light is carried by photons. ☐

The photons in the beam are attracted to each other. ☐

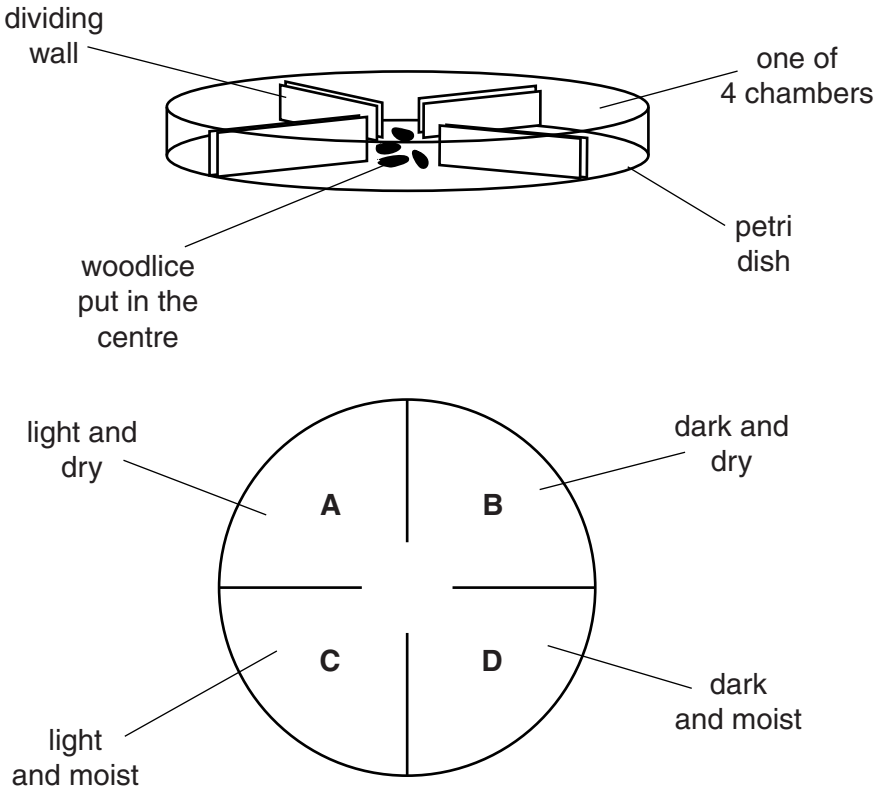
The wavelength of the light is very much larger than the slits. ☐

[1]

[Total: 5]

4 Emily does an experiment with woodlice.

She puts 30 woodlice into the centre of a Petri dish so that they can move freely into four chambers, **A**, **B**, **C** and **D**. Each chamber has different conditions.



After five minutes, Emily counts the woodlice in each chamber.

She records her results in a table.

chamber	conditions	number of woodlice
A	light and dry	2
B	dark and dry	10
C	light and moist	6
D	dark and moist	12

(a) What is the percentage of woodlice in chamber **D**?

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

(b) Look at Emily's results.

Which condition appears to most strongly attract the woodlice?

Put a (ring) around the correct answer.

dark **dry** **light** **moist**

[1]

(c) The type of behaviour shown by the woodlice helps them to survive.

Suggest two ways that it does this.

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

It helps to protect them from birds. ☐

It allows them to respond to new conditions. ☐

It helps them to investigate different habitats. ☐

It prevents the Sun from drying them out. ☐

It allows them to make food. ☐

It helps them to avoid competition with other woodlice. ☐

[2]

(d) In more complex animals, such as dogs, a conditioned reflex action can be learned.

Put ticks (✓) in the boxes next to the **two** correct statements about conditioned reflex actions.

A secondary stimulus is associated with a primary stimulus. ☐

A stimulus is not needed. ☐

More than one secondary stimulus is used. ☐

The final response has no direct link to the primary stimulus. ☐

The final response has no direct link to the secondary stimulus. ☐

[2]

(e) Emily picks up the lamp which was used to light the dish in her experiment.

This has become hot.

Her reflex is to drop the hot lamp.

She holds on to the lamp so it does not break.

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

In some circumstances the

brain	
spinal cord	
eye	

can modify a reflex.

This modification involves a

neuron	
receptor	
reflex	

linking to the arc.

This changes the action of the

sensory	
motor	
synapse	

neuron.

[2]

[Total: 8]

5 Fergus is ten years old.

He was found after surviving in the wild for most of his life.

He had no human contact in the wild.

(a) When he joins a human family he cannot learn to speak properly.

Which statement best explains this?

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

His brain has …

larger neurons than other children.	☐
fewer neurons than other children.	☐
passed the age at which it can acquire language skills.	☐
not developed any synapses.	☐

[1]

(b) Fergus can learn other skills.

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

As he learns, neuron

axons	☐
pathways	☐
sheaths	☐

will form.

With repetition some of these will be

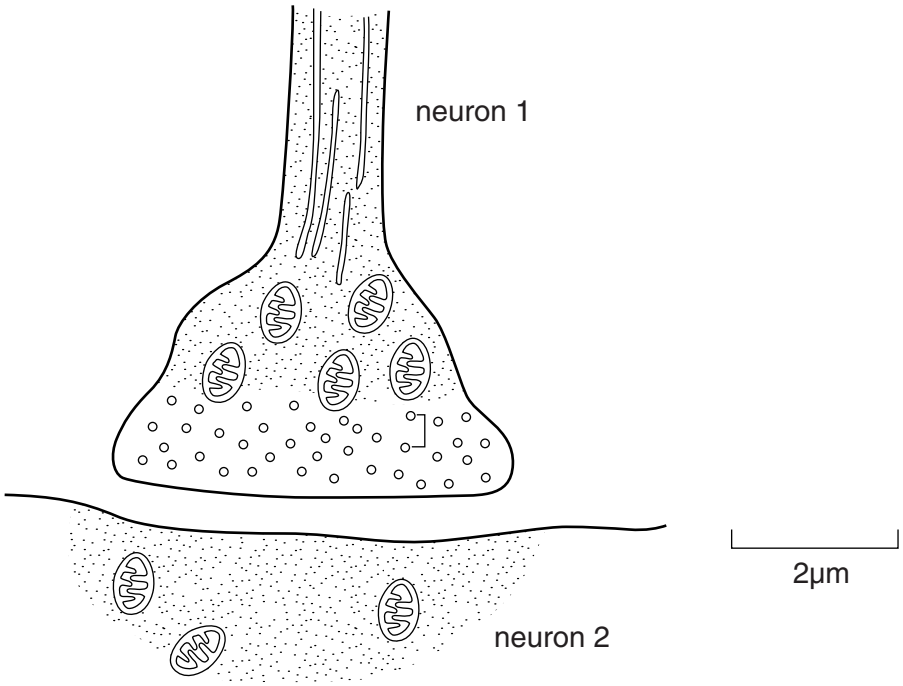
just as likely	☐
less likely	☐
more likely	☐

to transmit impulses.

[1]

[Total: 2]

6 The diagram shows a synapse between two neurons.



(a) Explain how chemicals found in neuron 1 cause an impulse to be started in neuron 2.

.....

.....

.....

.....

.....

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

(b) Nerve impulses in the brain are often transmitted between neurons by the chemical serotonin.

The drug Ecstasy can interfere with this process.

Draw **one** line to join the correct **action of Ecstasy** with its correct **effect on the brain**.

action of Ecstasy	**effect on brain**
blocks release of serotonin into synapse	decreases serotonin concentration, and so enhances mood
blocks removal of serotonin from synapse	increases serotonin concentration and so enhances mood
stimulates release of serotonin into synapse	decreases serotonin concentration and so depresses mood
stimulates the removal of serotonin from the synapse	increases serotonin concentration and so depresses mood.

[1]

[Total: 4]

7 The diagram shows lead nitrate solution being added to potassium iodide solution.

It makes a yellow precipitate of lead iodide.

Lead iodide does not dissolve in water.

The word equation for the reaction is

lead nitrate(aq) + potassium iodide(aq) ⟶ lead iodide(s) + potassium nitrate(aq)

(a) Julie adds a very small amount of lead nitrate solution to potassium iodide solution.

Which chemicals will be **dissolved** in the water **after** she has done this?

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

lead iodide ☐

lead nitrate ☐

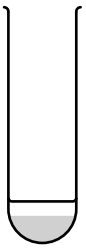
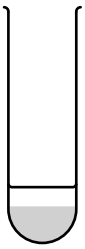
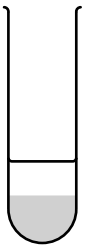
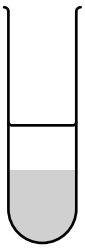
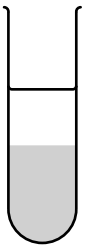
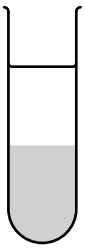
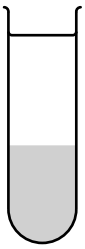
potassium iodide ☐

potassium nitrate ☐

[1]

(b) Julie puts 5 cm^3 of potassium iodide solution into each of seven test tubes.

She adds a different amount of lead nitrate solution to each tube.

tube number	1	2	3	4	5	6	7
volume of potassium iodide solution	5 cm^3	5 cm^3	5 cm^3	5 cm^3	5 cm^3	5 cm^3	5 cm^3
volume of lead nitrate solution	2 cm^3	4 cm^3	6 cm^3	8 cm^3	10 cm^3	12 cm^3	14 cm^3
diagram of results							
height of precipitate	1 cm	2 cm	3 cm	4 cm	5 cm	5 cm	5 cm

In this experiment, what is the smallest volume of lead nitrate solution that was needed to use up all of the potassium iodide solution in the reaction?

volume = ... cm^3 **[1]**

(c) After Julie has filtered off the lead iodide precipitate she washes it.

Explain why she washes the precipitate and why she uses **distilled** water.

.....

.....

.....

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

[Total: 5]

8 A chemical company has discovered a new way of making the medicine ibuprofen.

The new method has fewer stages.

The new method gives a higher yield than the old method.

(a) Suggest reasons why reactions never give 100% yield, and why the yield is even lower if there are several stages.

.....

.....

.....

.....

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

(b) The starting chemicals should make 5,000 tonnes of ibuprofen.

They actually make 4,500 tonnes.

(i) What is the percentage yield for the reaction?

Put a (ring) around the correct answer.

10% **11.1%** **45%** **80%** **90%**

[1]

(ii) Show how you worked out your answer.

[1]

[Total: 5]

9 Magnesium carbonate is sometimes used in acid indigestion tablets to neutralise excess hydrochloric acid in the stomach.

(a) Magnesium carbonate reacts with hydrochloric acid to make magnesium chloride, carbon dioxide and water.

Write a balanced equation for this reaction.

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

(b) Magnesium hydroxide is also used in acid indigestion cures.

When magnesium hydroxide dissolves in water it produces an ion which makes the solution alkaline.

Which ion must be present in the solution to make it alkaline?

answer ..... **[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.