Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
GENERAL CERTIFICATE OF SECONDARY EDUCATION

A217/02

TWENTY FIRST CENTURY SCIENCE

ADDITIONAL SCIENCE A
Unit 3: Modules B6 C6 P6
(Higher Tier)

TUESDAY 22 JUNE 2010: Morning
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 (SLM/SW) MEP60577 32380/1

INSTRUCTIONS TO CANDIDATES

- **Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes 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. Additional paper may be used if necessary but you must clearly show your Candidate Number, Centre Number and question number(s).**

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.**
- **The Periodic Table is printed on the back page.**

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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

kinetic energy = $\frac{1}{2}$ × mass × [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 Ted shouts, making a sound wave of frequency 1500 Hz with a wavelength of 0.2 m.

(a) What is the speed of the wave?

Put a (ring) around the correct answer.

30 m/s 300 m/s 3000 m/s 30 000 m/s

[1]

(b) Draw straight lines to link each WAVE PROPERTY to its MEANING.

WAVE PROPERTY	MEANING
intensity	waves per second
amplitude	energy per second
frequency	size of disturbance
wavelength	distance between crests

[2]

(c) Complete the sentences below using words from this list.

INCREASES DECREASES STAYS THE SAME

The sound wave travels away from Ted.

Its amplitude _____ as it travels away.

Its speed _____ as it travels away.

[1]

[Total: 4]

2 Jane uses her mobile phone to talk to Mike.

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

AMPLIFY ANALOGUE DIGITAL MORSE

MODULATE NOISE PULSES SOUND TRANSMIT

Jane speaks into the microphone of her phone.

The microphone output is converted into a series of pulses, called a _____ code.

These pulses _____ the amplitude of the waves which leave the phone.

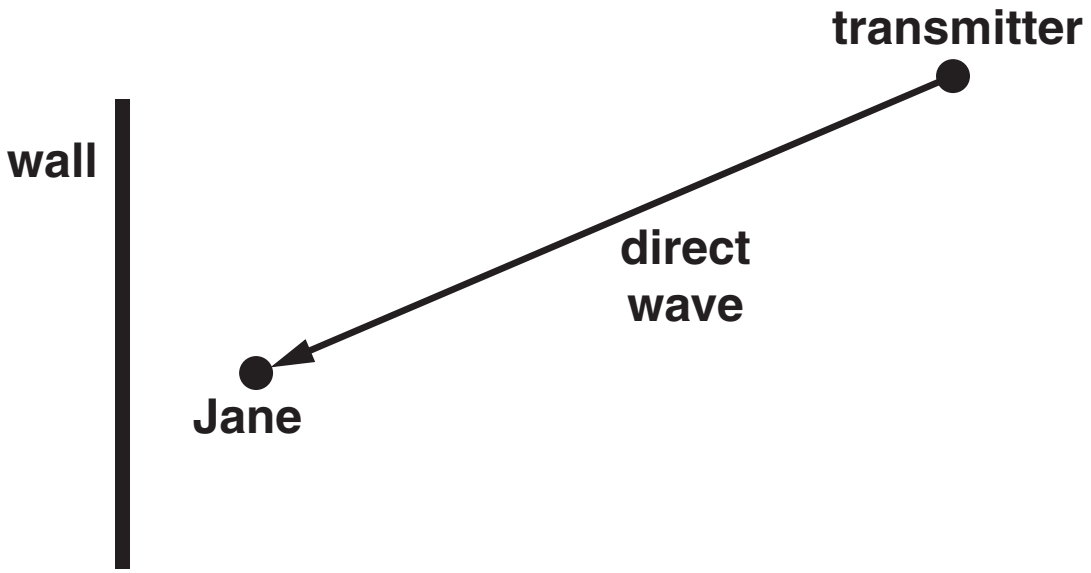
Waves that her phone receives pick up _____ on the way from the transmitter.

This can be removed to restore the correct pattern of wave _____ . [2]

(b) Jane finds that mobile phone reception is very bad when she stands close to a wall.

She thinks that this is because waves from the transmitter reflect off the wall.

(i) The diagram shows the direction of a wave travelling directly from the transmitter to Jane.



Another wave reaches Jane from the transmitter.

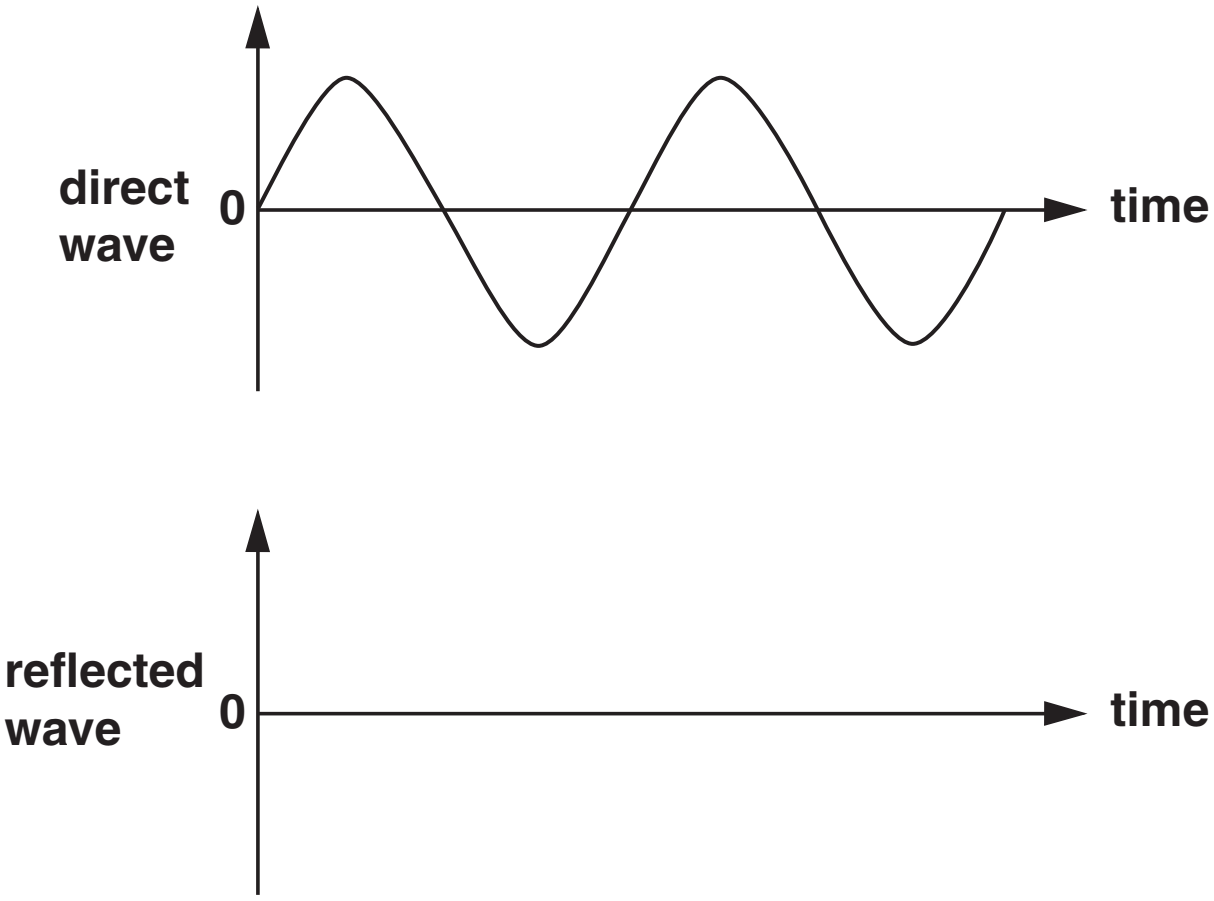
It reflects off the wall before it reaches her.

Draw this wave on the diagram. **[1]**

(ii) **Jane's phone reception is bad because of the reflected wave.**

The diagram shows the direct wave.

Complete the diagram to show the reflected wave



[1]

(iii) Jane finds that she can improve the phone reception by choosing carefully where she stands near the wall.

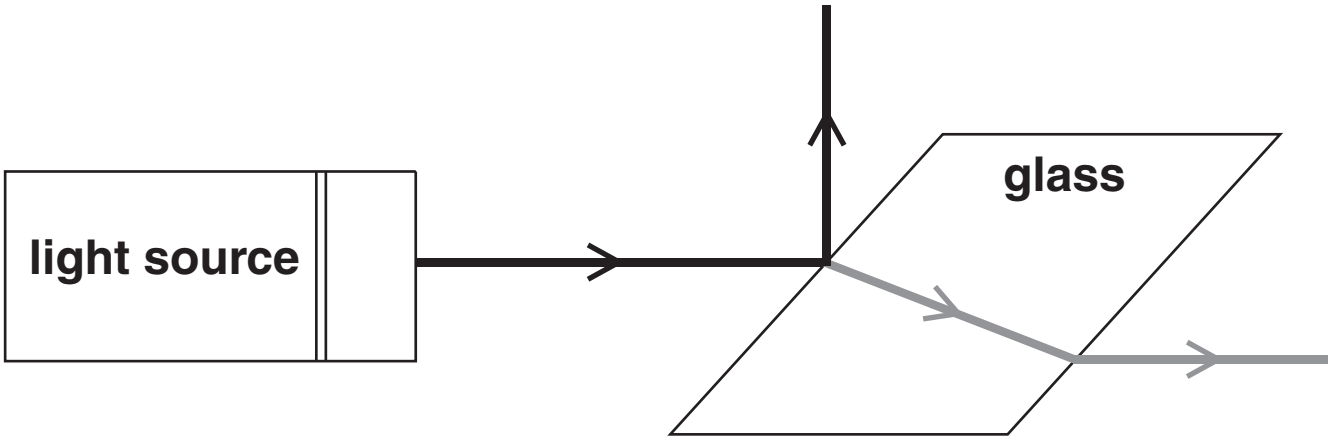
Put ticks (✓) in the boxes next to the <u>TWO</u> statements that explain this.

The wall attracts waves from the transmitter.	☐
Waves which arrive in step add and reinforce each other.	☐
The direct wave absorbs the reflected wave when they overlap.	☐
The amplitude of the reflected wave increases as it reflects off the wall.	☐
There is an interference pattern where the direct and reflected waves overlap.	☐

[1]

[Total: 5]

3 Fiona shines a beam of light onto a block of glass.

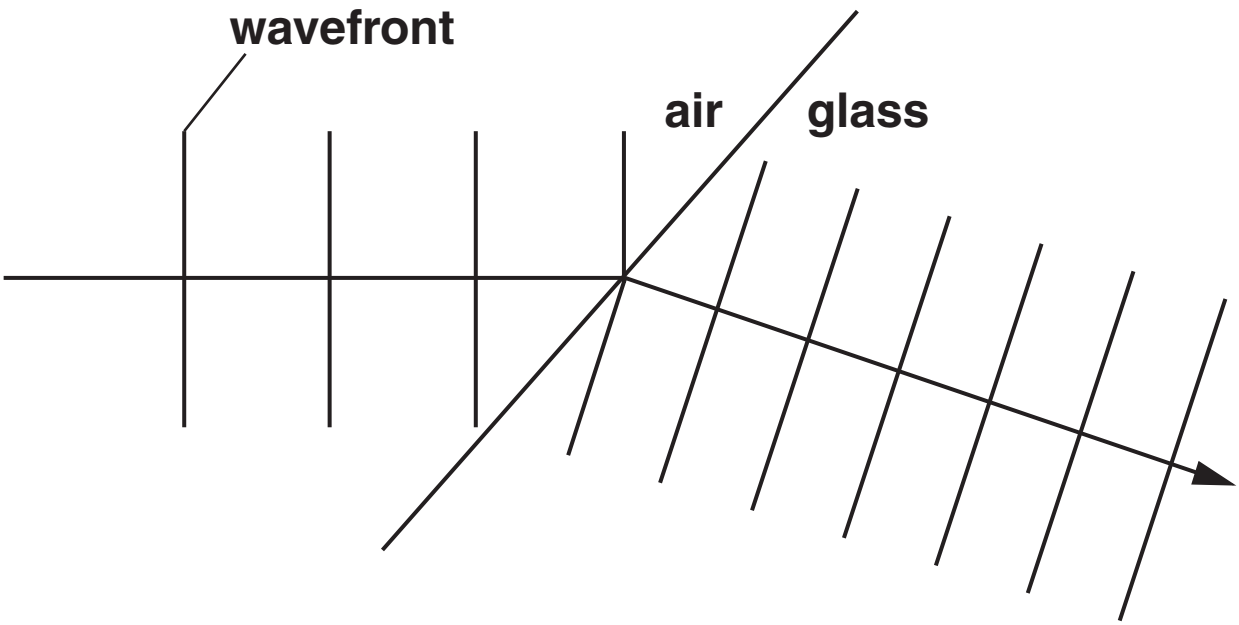


(a) Draw straight lines to link the START of each sentence to its best ENDING.

START	ENDING
The light does not change speed ...	... as it enters and leaves the glass.
The light slows down ...	... as it reflects off the glass.
The light speeds up ...	... as it enters the glass.
The light refracts ...	... as it leaves the glass.

[2]

(b) The diagram shows what happens to wavefronts of the light as it enters the glass.



Explain the change in spacing of the wavefronts as the light enters the glass.

Your answer should refer to the wavelength, frequency and speed of the wave.

_____

_____

_____

_____ **[2]**

(c) The light is an electromagnetic wave.

Here are some electromagnetic waves in the spectrum, in order of frequency.

Complete the table by writing in the missing parts of the spectrum shown opposite. [1]

[Total: 5]

	microwaves	**infrared**		**ultraviolet**	**X-rays**	

4 Daisy chooses an acid to clean metals.

Acids can be bought with different levels of purity.

Some are very pure. Others still contain impurities.

(a) Suggest and explain why she chooses an impure acid to clean metals.

_____

_____

_____ **[2]**

(b) Daisy wants to find the pH of the acid before she uses it.

Give <u>TWO</u> ways that she could do this.

For each method

- **state what she will use**
- **describe what she will see.**

method one _____

_____

_____

method two _____

_____

_____

[2]

[Total: 4]

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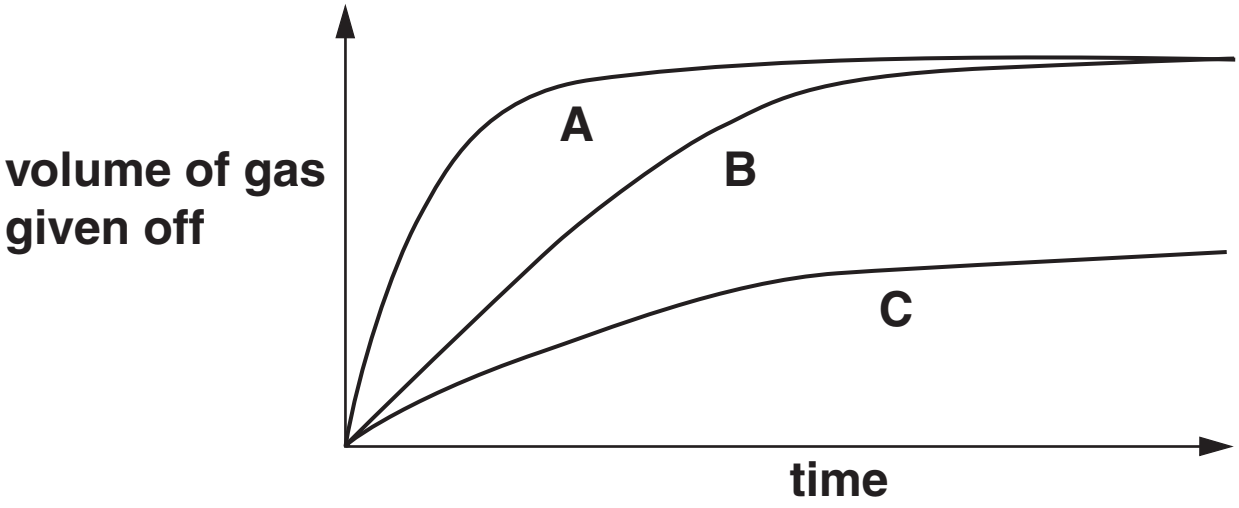
5 **Arthur, Beth and Chet measure how fast a gas is given off when they react acid with an excess of marble chips.**

They each carry out two different experiments but they all use the same size of marble chips.

The experiments that they carry out are shown in the table opposite.

They plot their results.



Complete the table with A, B or C to show the shape of the graph that would be expected for each experiment.

STUDENT	EXPERIMENT 1	EXPERIMENT 2
Arthur		
Beth		
Chet		

[4]

[Total: 4]

STUDENT	EXPERIMENT	VOLUME OF ACID IN cm^3	RELATIVE CONCENTRATION OF ACID	TEMPERATURE IN °C
Arthur	1	50	1.0	20
Arthur	2	50	1.0	30
Beth	1	50	1.0	20
Beth	2	25	1.0	20
Chet	1	50	1.0	20
Chet	2	25	2.0	20

6 Acids react with alkalis.

(a) Put (ring) around the TWO alkalis in this list.

$CaCl_2$ $CaSO_4$ $Mg(OH)_2$ $NaCl$ $NaOH$ $MgSO_4$

[1]

(b) Nitric acid reacts with sodium carbonate.

What substances are formed?

_____ **[2]**

(c) Acids also react with metal oxides.

When hydrochloric acid reacts with copper oxide, CuO, it makes copper chloride, $CuCl_2$, and another substance.

Write a balanced symbol equation for this reaction.

_____ **+** _____ **→**

_____ **+** _____ **[3]**

[Total: 6]

7 Amelia is learning the words for her part in the school play.

(a) What is happening to the information in Amelia's memory as she rehearses the play?

Put a (ring) around each of the TWO words which best describe what is happening.

DUPLICATION LOSS RETRIEVAL

STORAGE TRANSMISSION

[1]

(b) The sentences describe what happens in her brain.

Complete the sentences below using the BEST words from this list.

AXON BILLIONS EXPERIENCE HUNDREDS

RESPONSE THOUSANDS TRANSMIT

Amelia's brain has _____ of neurons.

They can connect together to make pathways.

When she first reads her words, they are a new

_____ .

This causes new pathways to form.

When she repeats the words, these new pathways are more likely to _____ impulses.

[2]

(c) After a week of rehearsals, some of Amelia's words in the play are changed.

She has to learn new words.

How is this possible?

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

Some neurons will stop transmitting impulses.	☐
New pathways are created by moving neurons around.	☐
New experiences remove existing pathways in the brain.	☐
The variety of potential pathways makes it possible to adapt to new situations.	☐

[1]

[Total: 4]

8 Keith is looking after a puppy.

(a) Keith buys frozen food for his puppy.

He heats the food in a microwave oven.

The puppy produces saliva when it smells the food heating up.

The microwave oven rings a bell when the heating is complete.

After some time the puppy produces saliva every time a bell rings.

(i) Draw a straight line from each PART OF THE REFLEX to the correct EVENT.

PART OF THE REFLEX	EVENT
	puppy eats food
response	
	puppy barks
primary stimulus	puppy produces saliva
	smell of food
secondary stimulus	
	sound of bell

[2]

(ii) A <u>CONDITIONED REFLEX</u> has been created in the puppy.

Here are some statements about conditioned reflexes.

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

The final response of a conditioned reflex ...

... has no connection at all to the secondary stimulus. ☐

... has a direct connection to the primary stimulus. ☐

... has no direct connection to the primary stimulus. ☐

... has a voluntary connection to the secondary stimulus. ☐

[1]

(b) The puppy tries to catch a fly but the fly moves.

The fly moving is an example of a <u>SIMPLE REFLEX</u> action.

Describe the advantages and disadvantages to the fly of using simple reflexes.

_____

_____

_____

_____

_____ **[3]**

[Total: 6]

9 Diane puts her hand into a sewing box and stabs her finger on a needle.

She pulls her hand away quickly.

The reaction involves a reflex arc.

Some of the statements below can be arranged in sequence to describe what happens in part of a reflex arc.

In each pair of statements, only one is true for a reflex arc.

A this reaches the myelin sheath
B this reaches the synapse

C causing release of a chemical transmitter
D causing release of an electrical spark

E an electrical impulse travels up the sensory neuron
F a chemical impulse travels up the sensory neuron

G and binds to receptor molecules on the membrane of the motor neuron
H and enters the motor neuron through the membrane

I this jumps to the next neuron
J this diffuses to the next neuron

Put a (ring) around the letter of the correct statement in each pair.

Arrange the correct statements in the right order for the sequence of events in a reflex arc.

[4]

[Total: 4]

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.