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A217/02

GENERAL CERTIFICATE OF SECONDARY EDUCATION
TWENTY FIRST CENTURY SCIENCE
ADDITIONAL SCIENCE A
Unit 3 Modules B6 C6 P6 (Higher Tier)

FRIDAY 20 JUNE 2008

Morning
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.
* 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	5	
4	4	
5	7	
6	3	
7	4	
8	2	
9	1	
10	3	
11	4	
TOTAL	**42**	

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

TWENTY FIRST CENTURY SCIENCE EQUATIONS

Useful Relationships

Explaining Motion

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

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

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

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

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

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

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

Electric Circuits

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

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

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

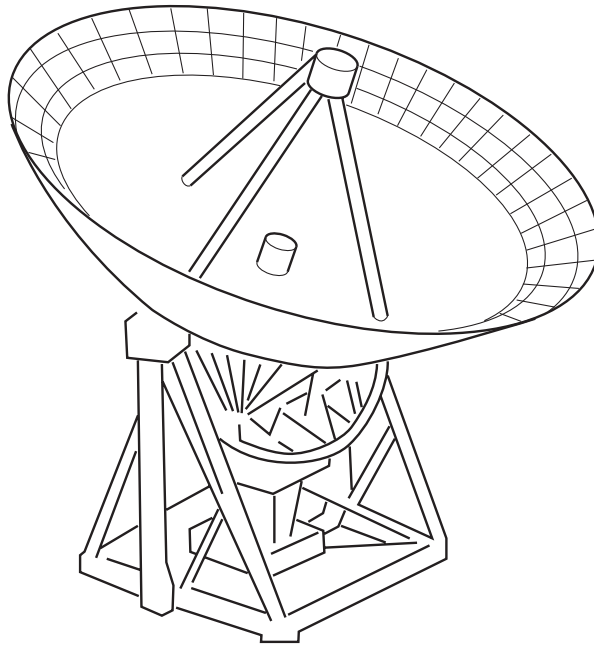$$\text{power} = \text{potential difference} \times \text{current}$$

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

The Wave Model of Radiation

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

Answer **all** the questions.

1 Large metal dishes receive radio waves from satellites in space.

(a) Here are some reasons why radio waves are used to communicate with satellites in space.

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

Radio waves are ...

... not absorbed by the atmosphere.

... able to travel through empty space.

... safer than other electromagnetic waves.

... the fastest of the electromagnetic waves.

... more powerful than other electromagnetic waves.

[2]

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

<div align="center">

speed   direction   induction

amplitude   frequency   modulation
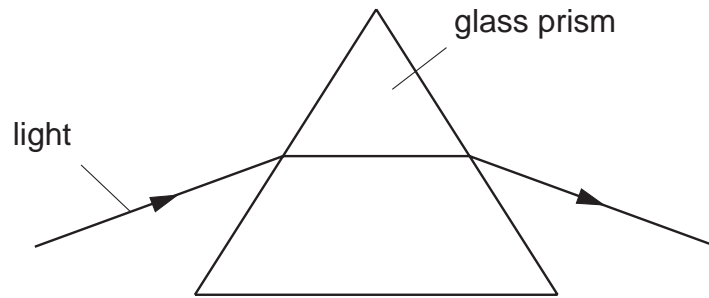
</div>

Information is put into radio waves by altering their .... or ....

This process is called ....

[2]

[Total: 4]

[Turn over

2 This diagram shows a beam of light passing through a glass prism.

(a) What does the diagram show?

Put a (ring) around the correct answer.

diffraction   interference   reflection   refraction

[1]

(b) The light changes direction as it enters the glass.

Complete the sentences. Choose words from this list.

Each word may be used once, more than once or not at all.

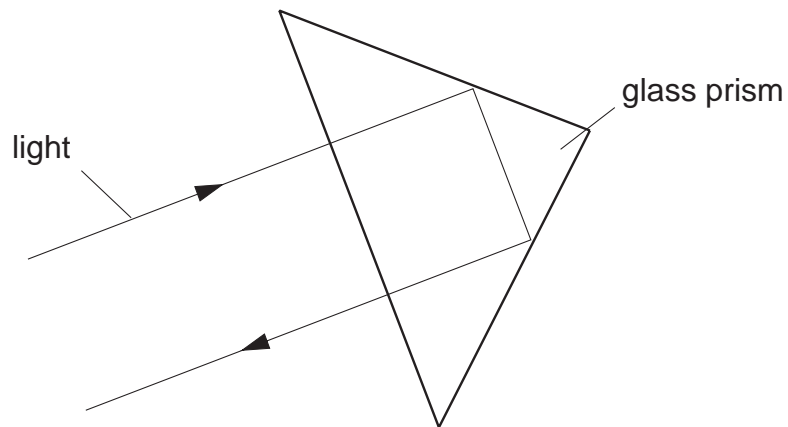**decreases   increases   doesn't change**

The speed of the light .... as it passes from air to glass.

The frequency of the light ...., so the wavelength ....

[3]

(c) A different glass prism is used, changing the path followed by the beam of light.

light

glass prism

The light is totally internally reflected twice before it leaves the glass again.

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

The light is reflected because ...

... the angle of reflection is exactly 45°. ☐

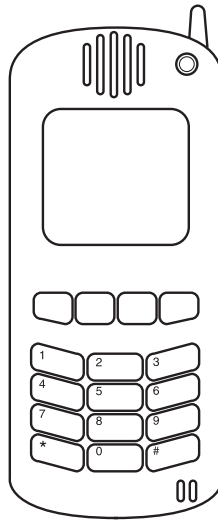... the angle of reflection is less than 90°. ☐

... the angle of refraction would be less than 90°. ☐

... the angle of refraction would be greater than 90°. ☐

[1]

[Total: 5]

[Turn over

3 A mobile phone transmits sounds as digital signals, using radio waves.

(a) The sentences describe the process of transmitting sounds with digital signals. They are in the wrong order.

> **A** The signal is cleaned up at the receiver.
>
> **B** The sound wave is converted into a digital code.
>
> **C** The signal is decoded to produce a copy of the sound wave.
>
> **D** The code controls the amplitude of radio waves from the phone.

Fill in the boxes to show the correct order. The last one has been done for you.

			C

[2]

(b) Here is a disturbance-distance graph for a radio wave.
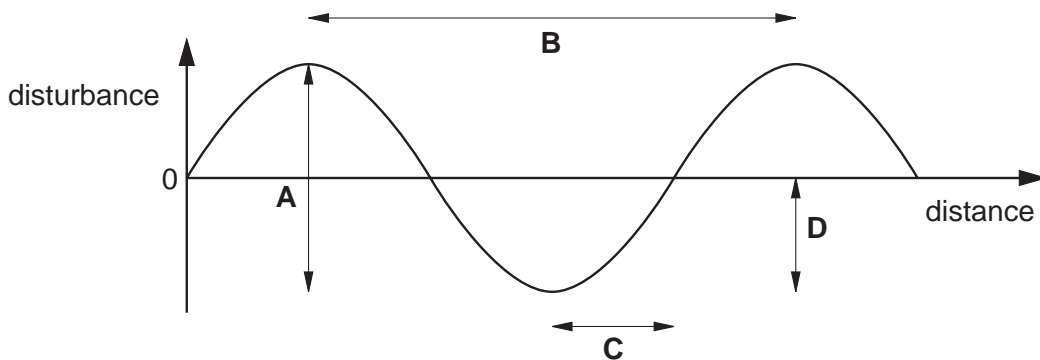
Which distance, **A**, **B**, **C** or **D**, is the amplitude of the wave?

answer .... [1]

(c) Why is digital transmission of sound with radio waves of higher quality than analogue transmission?

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

A digital signal can usually be separated from noise in a radio signal. ☐

An analogue signal has the same frequency as the original sound. ☐

A radio signal decreases in amplitude as it travels. ☐

Radio signals pick up noise as they pass from transmitter to receiver. ☐

The radio signal has to be amplified at the receiver before it is decoded. ☐

[2]

[Total: 5]

4 Like many animals, pond snails use their nervous system to detect and respond to changes in their environment.

© Roy Anderson

(a) Complete the following sentences. They compare pond snails and humans.

Choose words from this list.

complex   involuntary   unhelpful   reflexes   tropisms

Pond snails use simple .... to find food.

Humans respond better than snails to a new situation because their behaviour is

....

Both humans and snails respond to bright light. This response is ....

[2]

(b) The pond snail's nervous system contains both receptors and effectors.

Which cells are effectors, which are receptors, and which are neither?

Put a tick (✓) in the correct box for each type of cell.

type of cell	effectors	receptors	neither effectors nor receptors
muscle cells			
egg cells			
slime-secreting cells			
light-sensitive cells			

[2]

[Total: 4]

9

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PLEASE DO NOT WRITE ON THIS PAGE

5 Humans can store and retrieve information. This is called memory.

(a) Scientists have created models for memory.

The diagram shows one example, the **multi-store model**.
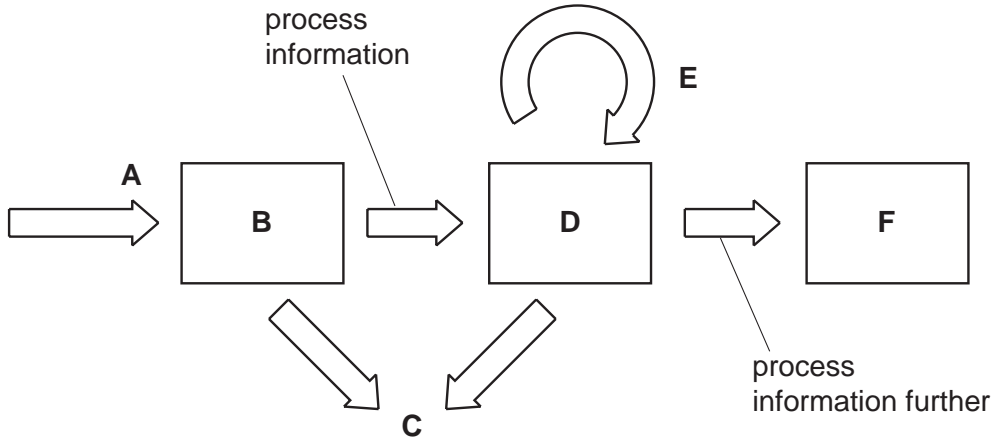
There are several stages in this process.

Write the correct letter, **A**, **B**, **C**, **D**, **E** or **F**, in the box next to each stage.

stage in the model	letter
environmental stimuli are received	
information is lost	
long term memory	
sensory memory store	
information is rehearsed	
short term memory	

[2]

(b) Remembering information is an important part of our lives.

Finish the sentences. Choose words from this list.

Each word may only be used once.

  memory   **pattern**   **repetition**   **shape**   **smell**

We are more likely to remember information if it has a ....

It also helps if the information is associated with a stimulus, such as ....

Memory is reinforced when there is .... of the information.

[3]

(c) Where do we process memories?

Put a (ring) around the correct answer.

cerebral cortex   **hypothalamus**   **pituitary gland**   **spinal cord**

[1]

(d) Three people were asked to describe the way in which neuron pathways operate to retain memory.

Josh
Certain neuron pathways become more likely to transmit impulses than others.

Bess
New pathways are formed as a result of changes in the environment.

Xena
Some pathways stop working because the neurons no longer function.

Who gave the **wrong** description of the retention of memory?

answer …………………………..

[1]

[Total: 7]

[Turn over

6 Neurons use chemical and electrical methods for transmitting impulses.

receptor molecules break
down serotonin

impulse

end of neuron

serotonin in the synapse

cell body
of neuron
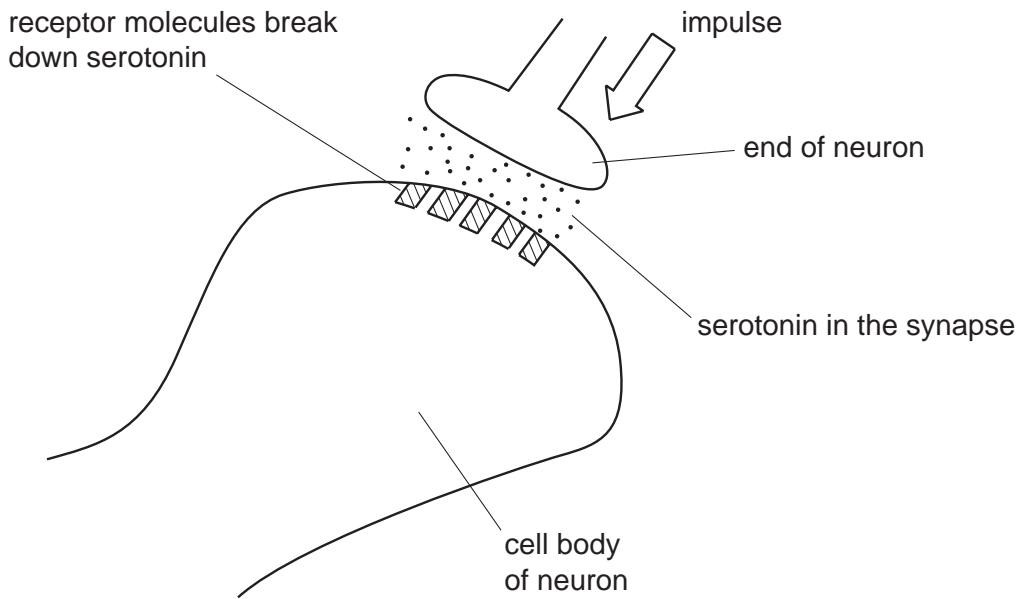
(a) The diagram shows a synapse between two neurons.

Here are some statements about synapses.

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

Synapses weaken the strength of impulses.

Synapses slow down transmission of impulses.

A synapse closes up when each impulse arrives.

Synapses only allow impulses to travel in one direction.

Increasing the gap in a synapse speeds up the transmission of impulses.

[2]

(b) Serotonin is a chemical found in some brain synapses.
Serotonin is broken down by receptor molecules.
The drug Ecstasy blocks the action of the receptor molecules, resulting in a feeling of well-being.

Here are some possible explanations for this effect.

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

The level of …

... serotonin falls.

... Ecstasy increases.

... serotonin increases.

... Ecstasy stays the same.

... serotonin stays the same.

[1]

[Total: 3]

[Turn over

7 Baking powder contains small grains of a solid acid and a solid alkali.
When you put baking powder into water it starts to fizz slightly.

(a) Which **solid acid** could be used to make baking powder?

Put a (ring) around the correct answer.

ethanoic acid

hydrogen chloride

nitric acid

sulfuric acid

tartaric acid

[1]

(b) Baking powder doesn't react until water is added.

Angela discusses reasons for this with her friends.

Brenda
The acid and the alkali dissolve in water.

Angela
The powder is cool and dry while it is in a packet.

Clarissa
The surface area of the solid particles is too small.

Daphne
Baking powder contains preservatives.

Who gives the correct reason why the reaction only happens when water is added?

answer ....[1]

(c) Which particles are produced when an acid dissolves in water?

Put a ⟨ring⟩ around the correct answer.

H_2 H H^+ OH^-

[1]

(d) When acids react with metals they give off a gas.

Put a ⟨ring⟩ around the formula of this gas.

H_2 CO_2 O_2 N_2

[1]

[Total: 4]

[Turn over

8 The catalytic converter on a car normally converts most of the pollutants into harmless gases.

The operation of the catalyst depends on its temperature.

time engine has been going
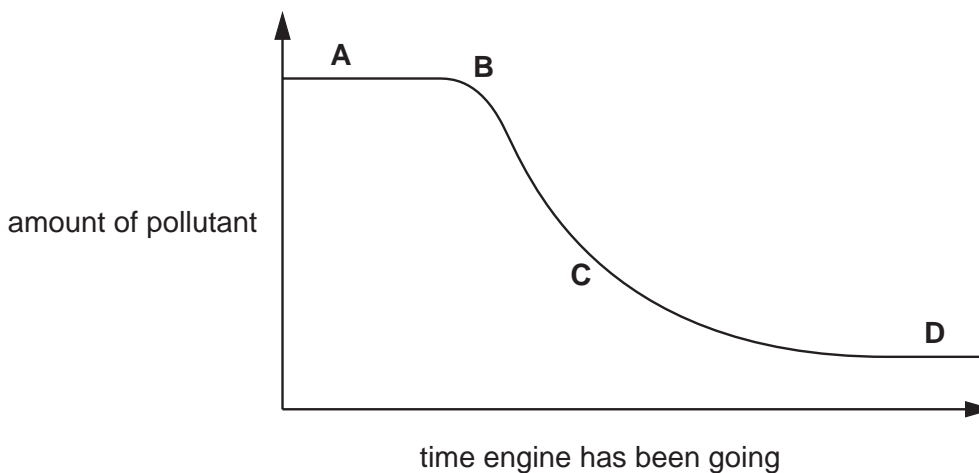
The graph shows the amount of pollutant that comes from a car exhaust. Four points have been labelled **A**, **B**, **C** and **D**.

(a) When is the catalyst operating at its optimum temperature?

Put a ⬭ring around the correct letter.

<div align="center">

A　　　**B**　　　**C**　　　**D**

</div>

[1]

(b) Here are some statements about a catalyst.

Draw **one** straight line from the correct **statement about the catalyst** to the correct **amount of pollutant**.

statement about the catalyst (choose one)	amount of pollutant (choose one)
It increases the rate of reaction.	The same amount of pollutant is converted to harmless gases.
It doesn't affect the rate of reaction.	More pollutant is converted to harmless gases.
It decreases the rate of reaction.	Less pollutant is converted to harmless gases.

[1]

[Total: 2]

9   Mary needs to choose an indicator for an acid-alkali titration.

She asks some friends for advice about the indicator.

Alex
The colour should change gradually.

Bron
There should be a range of colour changes.

Doug
There should be one sudden colour change.

Chas
It should give off a gas when it reacts.

Ellie
All the colours that it goes must be strong.

Who gives the **best** advice?

answer .... [1]

[Total: 1]

10 Here are the equations for the reactions between some solutions of acids and alkalis.

(a) Which of these equations is **not** balanced?

A HCl + $NaOH$ $\rightarrow$ $NaCl$ + H_2O

B H_2SO_4 + $NaOH$ $\rightarrow$ Na_2SO_4 + H_2O

C $2HCl$ + $Mg(OH)_2$ $\rightarrow$ $MgCl_2$ + $2H_2O$

D H_2SO_4 + $Mg(OH)_2$ $\rightarrow$ $MgSO_4$ + $2H_2O$

answer ....[1]

(b) Arthur writes an equation to show what happens when **any** acid neutralises **any** base.

A H^- + OH^+ $\rightarrow$ H_2O

B H^+ + OH^- $\rightarrow$ H_2O

C HCl + $NaOH$ $\rightarrow$ $NaCl$ + H_2O

D $2HCl$ + $CaCO_3$ $\rightarrow$ $CaCl_2$ + H_2O + CO_2
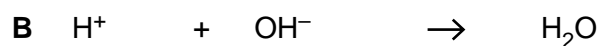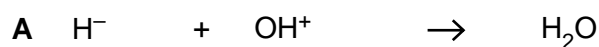
Which of **A**, **B**, **C** or **D** is the correct equation?

answer ....[1]

(c) Arthur reacts solid lumps of calcium carbonate with hydrochloric acid.
The lumps disappear into the liquid and a gas is given off.

Add state symbols to the equation for this reaction. Two have been done for you.

$2HCl$[aq] + $CaCO_3$[s] $\rightarrow$ $CaCl_2$ [...............] + H_2O[...............] + CO_2 [...............]
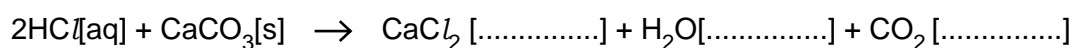
[1]

[Total: 3]

11 You can use relative atomic masses to work out reacting masses in an equation.

(a) Jane knows that the relative atomic mass of carbon is 12.

What does this tell her?

    A   A carbon atom has 12 protons.

    B   A carbon atom has 12 neutrons.

    C   A carbon atom has 12 electrons.

    D   A carbon atom has 12 times the mass of a hydrogen atom.

answer ....[1]

(b) Relative atomic masses can be used to work out amounts of reacting chemicals.

Here are some relative atomic masses: C = 12, O = 16, Fe = 56.

Fill in the boxes for this reaction. The first one has been done for you.

$$C \quad + \quad 2FeO \quad \rightarrow \quad 2Fe \quad + \quad CO_2$$

12g	g		g	g

[3]

[Total: 4]

END OF QUESTION PAPER

The Periodic Table of the Elements

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

Example:
1
H
hydrogen
1

Group 1	Group 2		Group 3	Group 4	Group 5	Group 6	Group 7	Group 0
								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		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		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		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							

Transition elements:

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
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
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
[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

* 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