

**Tuesday 12 June 2012 – Morning**

**GCSE GATEWAY SCIENCE  
SCIENCE B**

**B711/02** Science modules B1, C1, P1 (Higher 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 15 minutes



Candidate forename		Candidate surname	
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Centre number						Candidate number				
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**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 (✎).
- A list of equations can be found on page 2.
- The Periodic Table can be found on the back page.
- 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 **75**.
- This document consists of **28** pages. Any blank pages are indicated.

**EQUATIONS**

energy = mass × specific heat capacity × temperature change

energy = mass × specific latent heat

efficiency =  $\frac{\text{useful energy output} (\times 100\%)}{\text{total energy input}}$

wave speed = frequency × wavelength

power = voltage × current

energy supplied = power × time

average speed =  $\frac{\text{distance}}{\text{time}}$

distance = average speed × time

$$s = \frac{(u + v)}{2} \times t$$

acceleration =  $\frac{\text{change in speed}}{\text{time taken}}$

force = mass × acceleration

weight = mass × gravitational field strength

work done = force × distance

power =  $\frac{\text{work done}}{\text{time}}$

power = force × speed

$$\text{KE} = \frac{1}{2}mv^2$$

momentum = mass × velocity

force =  $\frac{\text{change in momentum}}{\text{time}}$

GPE = mgh

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

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**Question 1 begins on page 4.**

**PLEASE DO NOT WRITE ON THIS PAGE**

Answer **all** the questions.

**Section A – Module B1**

1 Bethany is a scientist.



(a) Bethany is female.

Her sex is determined by structures inside her body cells.

Write down the **name** of these structures and show the **combination** that makes her female.

..... [2]

(b) Bethany is testing some common foods to find their protein content.

Proteins are made of lots of small molecules joined together.

Write down the name of these molecules.

..... [1]



2 Malaria is an infectious disease.

(a) (i) The pathogen that causes malaria is a protozoa called *Plasmodium*.

Complete the following sentences about how malaria is spread.

Choose words from this list.

**bacteria**      **host**      **parasite**      **vaccine**      **vector**      **virus**

*Plasmodium* is a ..... which causes harm to a human .....

A mosquito acts as a ..... for *Plasmodium* when it feeds on human blood. [3]

(ii) One symptom of malaria is a high fever.

Core body temperature is normally maintained at 37°C.

How can a very high temperature lead to death?

..... [1]

(b) Malaria is common in many African countries.

**Sickle cell anaemia** is a disorder also found in these countries.

Read the information on a new treatment for sickle cell anaemia.

Severe sickle cell anaemia can be treated with a medicine called hydroxyurea.

Doctors are studying the long-term effects of hydroxyurea on people who have sickle cell anaemia.

In a trial to test hydroxyurea, one group of young patients will be given hydroxyurea and another group will be given a substance that is known to have no effect on the body.

Doctors will monitor the effects of the treatment on each group but will **not** know which group is treated with hydroxyurea until the end of the trial.

What type of trial is this and why do doctors **not** want to know which group is treated with hydroxyurea until the end of the trial?

.....

.....

..... [2]

[Total: 6]

3 Cystic fibrosis is a genetic disorder.

Akinyi is a child who has cystic fibrosis.

It is caused by a **recessive** allele.

Neither of Akinyi's parents have cystic fibrosis.

They want to have another child.

(a) What is the probability of their next child having cystic fibrosis?

Draw a genetic diagram to explain your answer.

(Use **F** for the dominant allele and **f** for the recessive allele).

probability of next child having cystic fibrosis ..... [2]

(b) Akinyi's parents are expecting another child.

They are trying to decide whether to have the foetus tested for cystic fibrosis.

Suggest what they need to consider and why it may be difficult for them to make such a decision.

.....

.....

.....

..... [2]

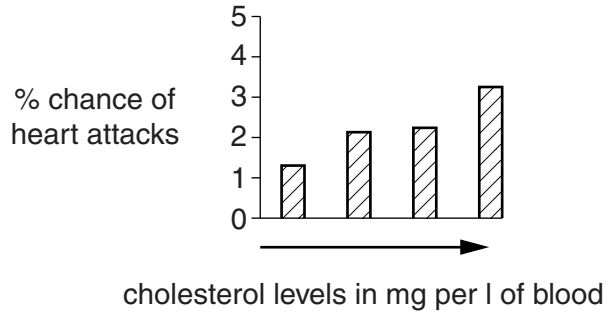
[Total: 4]



4 Scientists have made links between fatty foods and heart attacks.

Cholesterol is a substance found in fatty foods.

Look at the graph.



Describe and explain the link between cholesterol levels and heart attacks.

.....

.....

.....

.....

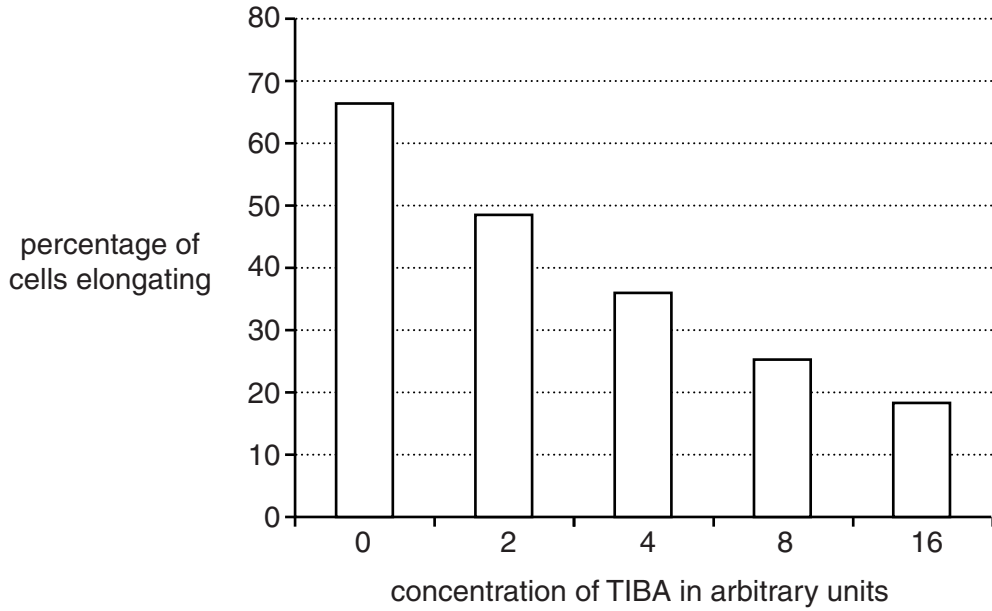
..... [3]

[Total: 3]

5 This question is about plant growth.

Look at the graph.

It shows the results of an experiment measuring the effect of a chemical called TIBA on cells in the shoot **tips** of plants.



(a) TIBA inhibits the action of a plant hormone.

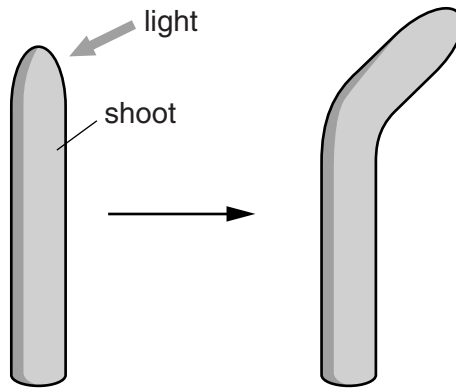
From the evidence in the graph suggest the name of this hormone.

..... [1]

(b) Judith is investigating growth of wheat shoots.

She grows wheat shoots with light shining from one direction.

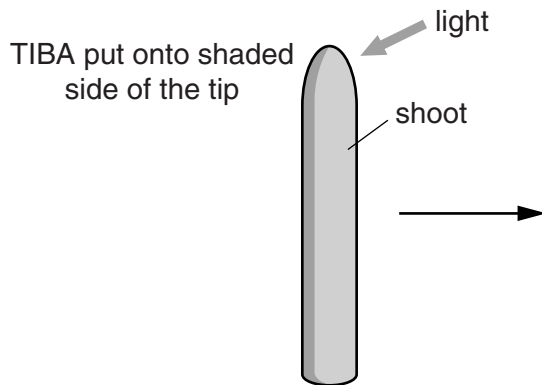
The growth of the wheat shoots is shown in the diagram.



Judith does a second experiment.

She puts TIBA on the shaded side of a growing wheat shoot.

She shines light from one direction.



Draw what will happen to the growth of the wheat shoot and explain why this happens.

.....

.....

.....

..... [2]

[Total: 3]

Turn over

Section B – Module C1

6 Coal, crude oil and natural gas are **non-renewable** fuels.

(a) Crude oil is a non-renewable fuel.

What is meant by non-renewable?

.....  
..... [1]

(b) Scientists have tried to estimate how many years it will be before these fuels run out.

Look at the table.

It shows one estimate for how many years are left before the fuels will run out.

<b>fuel</b>	<b>how many years before the fuel will run out</b>
coal	143
natural gas	61
crude oil	43

Other scientists have arrived at different figures than those in the table.

It is very difficult to estimate how many years it will take for a non-renewable fuel to run out.

Suggest **two** reasons why.

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

[Total: 3]

- 7 Crude oil contains a mixture of hydrocarbons called alkanes.

Look at the table. It gives some information about some of these alkanes.

alkane	molecular formula	boiling point in °C
butane	$C_4H_{10}$	0
hexane	$C_6H_{14}$	69
decane	$C_{10}H_{22}$	174
hexadecane	$C_{16}H_{34}$	287

- (a) Crude oil is separated by fractional distillation.

Explain, in terms of intermolecular forces, why crude oil can be separated by fractional distillation.

.....

.....

.....

..... [2]

- (b) LPG contains propane and butane.

- (i) There is a link between the number of carbon atoms and the number of hydrogen atoms in an alkane molecule.

A molecule of propane has 3 carbon atoms.

The molecular formula for propane is  $C_3H_x$ .

Work out the value for  $x$ .

.....

..... [1]

- (ii) Propane reacts with oxygen,  $O_2$ .

Carbon dioxide and water are made.

Construct the **balanced symbol** equation for this reaction.

..... [2]

(c) Debbie is thinking of buying a new petrol-engined car.

She finds this information about a new car.

fuel consumption in km per litre	16
carbon dioxide emissions in g/km	90

This information was obtained for a car moving at a steady speed of 80 km/h.

(i) Show, by calculation, that the mass of carbon dioxide made when she uses 5.0 litres of petrol is 7200 g.

.....

.....

.....

..... [2]

(ii) Debbie uses 5.0 litres of petrol when **driving around a large town**.

Will Debbie make 7200 g of carbon dioxide **every time** she uses 5.0 litres of petrol?

Explain your answer.

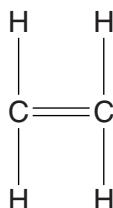
.....

..... [1]

[Total: 8]

8 Ethene is an unsaturated hydrocarbon.

Look at the displayed formula for ethene.



(a) Explain why ethene is both unsaturated and a hydrocarbon.

.....

.....

.....

..... [2]

(b) Ethene is an alkene.

Bromine water can be used to test for an alkene.

What is the colour change when ethene is bubbled through bromine water?

colour at start .....

colour at end ..... [2]

(c) Ethene is used to make poly(ethene).

Poly(ethene) is an addition polymer.

Draw the displayed formula for poly(ethene).

[1]

[Total: 5]

9 Paints contain pigments.

Some pigments are **thermochromic** and others are **phosphorescent**.

They are used to colour a number of objects.

(a) Write down one use of a thermochromic pigment and explain why it is suitable for this use.

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

(b) Modern 'glow in the dark' watches are made using phosphorescent pigments.

Seventy years ago 'glow in the dark' watches were not as safe as they are today.

Explain why.

.....  
..... [1]

[Total: 3]





Section C – Module P1

11 (a) Nihal takes a black and white **thermogram** picture of his house.



Thermograms can be used to measure temperature.

(i) What is **temperature**?

.....  
..... [1]

(ii) Explain how temperature could be measured using Nihal's thermogram.

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

(b) Nihal decides to add curtains to all the windows.

type of curtain	cost to fit in £	saving on fuel bills per year in £	payback time in years
lightweight curtains	130	10	
heavyweight curtains	2000	100	

(i) Calculate the **payback time** for **both** types of curtain.

Write your answers in the table.

[1]

(ii) Nihal expects to keep the curtains for 25 years.

Use this information to **explain** which type of curtain would be the **best** to fit.

.....

.....

.....

..... [2]

[Total: 6]

12 Mobile phones use microwave radiation.

(a) Scientific studies look at the **effects** of mobile phone microwave radiation.

Results from these studies are published.

Explain why scientists publish their results.

.....

.....

..... [2]

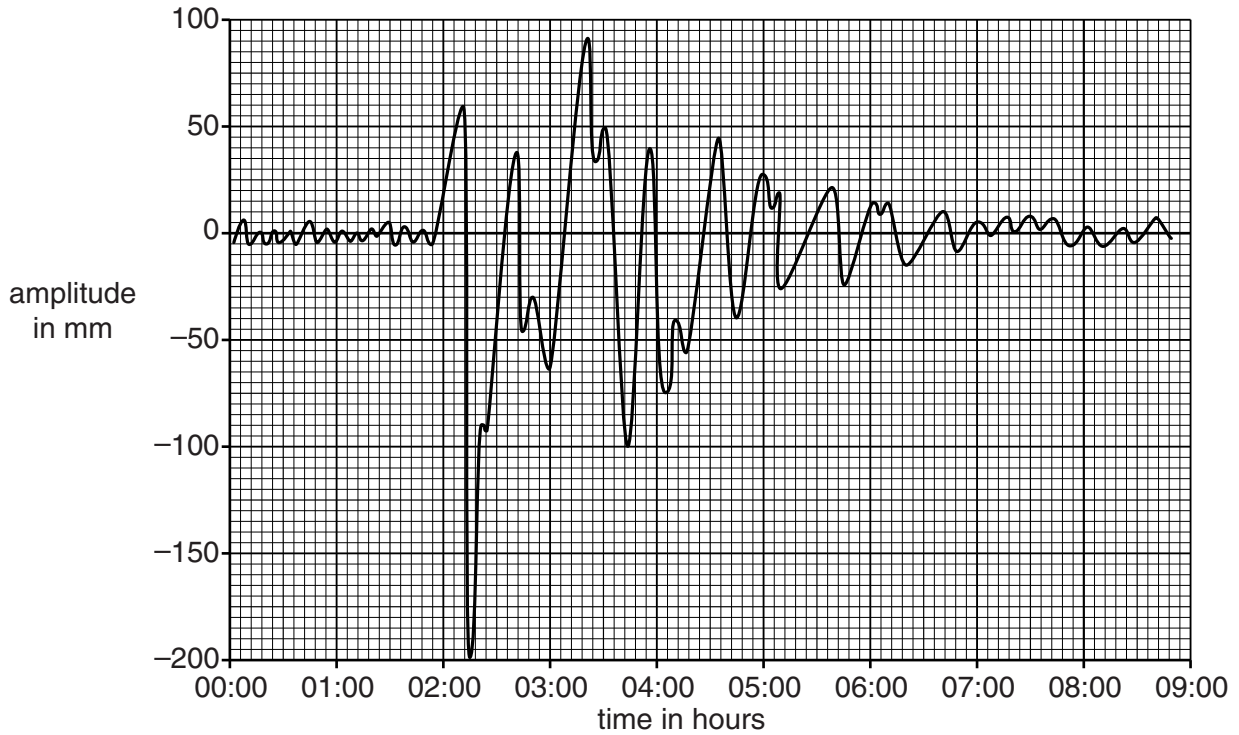


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13 Earthquakes produce seismic waves.

(a) Look at the recording of seismic waves.



Use the recording to describe the amplitude and timing of the **largest** seismic wave.

.....  
 .....  
 ..... [1]

(b) The **two** types of seismic waves are **P waves** and **S waves**.

Which type of wave will be seen first on the recording and why?

**type** of wave .....

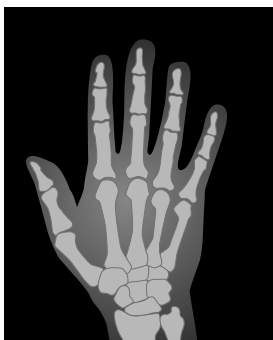
**reason** .....

..... [1]

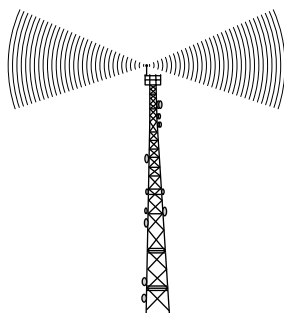
[Total: 2]

14 This question is about the **electromagnetic spectrum**.

Look at the diagrams.



X-ray of a hand



radio mast



microwave oven



candles giving off visible light



ultraviolet light showing a hand print

(a) The diagrams show five different types of electromagnetic wave being used.

Put the five types of electromagnetic wave in the table in order of **increasing** wavelength.

Two other types of electromagnetic wave are already in the table.

average wavelength in m	type of electromagnetic wave
$10^{-12}$	gamma ray
$10^{-10}$	
$10^{-8}$	
$0.5 \times 10^{-6}$	
$10^{-5}$	infrared wave
$10^{-2}$	
$10^3$	

[2]



(b) The speed of electromagnetic waves in a vacuum is  $300 \times 10^6$  m/s.

Use the data in the table in part (a) to calculate the average **frequency** of **infrared** waves.

.....

.....

.....

answer ..... Hz [2]

(c) The range of **infrared** frequencies can be divided into three bands.

Look at the table.

band	wavelength range in m	frequency range in Hz	energy range in J
IR-A	$7 \times 10^{-7}$ to $1.4 \times 10^{-6}$	$4.3 \times 10^{14}$ to $2.1 \times 10^{14}$	$3 \times 10^{-19}$
IR-B	$1.4 \times 10^{-6}$ to $3 \times 10^{-6}$	$2.1 \times 10^{14}$ to $1 \times 10^{14}$	↓
IR-C	$3 \times 10^{-6}$ to $1 \times 10^{-3}$	$1 \times 10^{14}$ to $3 \times 10^{11}$	$2 \times 10^{-22}$

Use the data in this table to answer the questions.

(i) Which **band** does the frequency you calculated in part (b) fit into?

..... [1]

(ii) Predict the **energy** of band IR-B.

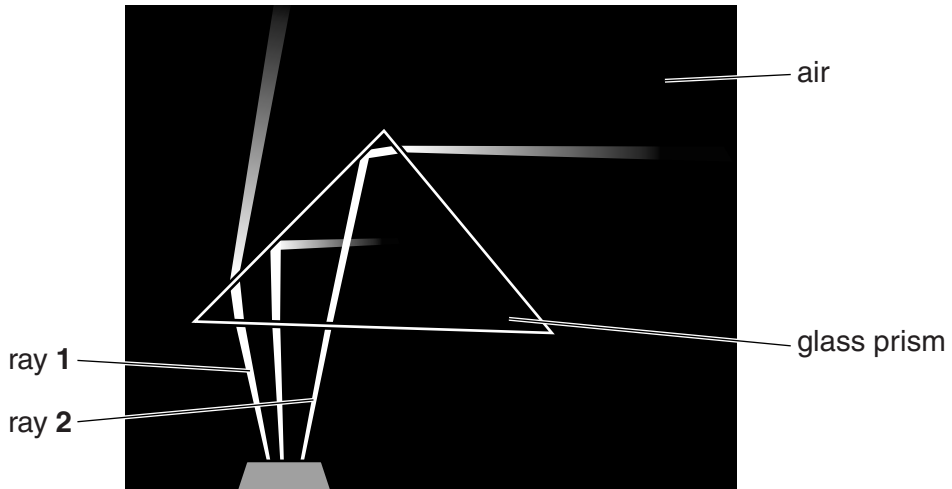
..... [1]

(iii) Describe the relationship between wavelength and energy.

.....

..... [1]

(d) Look at the picture of a prism.



Describe, using properties of light, the **differences** between the path taken by ray 1 and the path taken by ray 2.

.....

.....

.....

.....

.....

.....

..... [2]

[Total: 9]

END OF QUESTION PAPER

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# The Periodic Table of the Elements

1	2	3	4	5	6	7	0										
		<div style="border: 1px solid black; padding: 5px; margin: 5px auto; width: fit-content;">                     1  <b>H</b>                      hydrogen                      1                 </div>					<div style="border: 1px solid black; padding: 5px; margin: 5px auto; width: fit-content;">                     4  <b>He</b>                      helium                      2                 </div>										
7 <b>Li</b> lithium 3	9 <b>Be</b> beryllium 4	<div style="border: 1px solid black; padding: 5px; margin: 5px auto; width: fit-content;">                     relative atomic mass                      atomic symbol                      name                      atomic (proton) number                 </div>				11 <b>B</b> boron 5	12 <b>C</b> carbon 6	14 <b>N</b> nitrogen 7	16 <b>O</b> oxygen 8	19 <b>F</b> fluorine 9	20 <b>Ne</b> neon 10						
23 <b>Na</b> sodium 11	24 <b>Mg</b> magnesium 12	27 <b>Al</b> aluminium 13	28 <b>Si</b> silicon 14	31 <b>P</b> phosphorus 15	32 <b>S</b> sulfur 16	35.5 <b>Cl</b> chlorine 17	40 <b>Ar</b> argon 18										
39 <b>K</b> potassium 19	40 <b>Ca</b> calcium 20	45 <b>Sc</b> scandium 21	48 <b>Ti</b> titanium 22	51 <b>V</b> vanadium 23	52 <b>Cr</b> chromium 24	55 <b>Mn</b> manganese 25	56 <b>Fe</b> iron 26	59 <b>Co</b> cobalt 27	59 <b>Ni</b> nickel 28	63.5 <b>Cu</b> copper 29	70 <b>Ga</b> gallium 31	73 <b>Ge</b> germanium 32	75 <b>As</b> arsenic 33	79 <b>Se</b> selenium 34	80 <b>Br</b> bromine 35	84 <b>Kr</b> krypton 36	
85 <b>Rb</b> rubidium 37	88 <b>Sr</b> strontium 38	89 <b>Y</b> yttrium 39	91 <b>Zr</b> zirconium 40	93 <b>Nb</b> niobium 41	96 <b>Mo</b> molybdenum 42	[98] <b>Tc</b> technetium 43	101 <b>Ru</b> ruthenium 44	103 <b>Rh</b> rhodium 45	106 <b>Pd</b> palladium 46	108 <b>Ag</b> silver 47	112 <b>Cd</b> cadmium 48	115 <b>In</b> indium 49	119 <b>Sn</b> tin 50	122 <b>Sb</b> antimony 51	127 <b>I</b> iodine 53	131 <b>Xe</b> xenon 54	
133 <b>Cs</b> caesium 55	137 <b>Ba</b> barium 56	139 <b>La*</b> lanthanum 57	178 <b>Hf</b> hafnium 72	181 <b>Ta</b> tantalum 73	184 <b>W</b> tungsten 74	186 <b>Re</b> rhenium 75	190 <b>Os</b> osmium 76	192 <b>Ir</b> iridium 77	195 <b>Pt</b> platinum 78	197 <b>Au</b> gold 79	201 <b>Hg</b> mercury 80	204 <b>Tl</b> thallium 81	207 <b>Pb</b> lead 82	209 <b>Bi</b> bismuth 83	[209] <b>Po</b> polonium 84	[210] <b>At</b> astatine 85	[222] <b>Rn</b> radon 86
[223] <b>Fr</b> francium 87	[226] <b>Ra</b> radium 88	[227] <b>Ac*</b> actinium 89	[261] <b>Rf</b> rutherfordium 104	[262] <b>Db</b> dubnium 105	[266] <b>Sg</b> seaborgium 106	[264] <b>Bh</b> bohrium 107	[277] <b>Hs</b> hassium 108	[268] <b>Mt</b> meitnerium 109	[271] <b>Ds</b> darmstadtium 110	[272] <b>Rg</b> 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.