

**Monday 25 June 2012 – Afternoon**

**GCSE TWENTY FIRST CENTURY SCIENCE  
ADDITIONAL SCIENCE A**

**A216/02** Unit 2: Modules B5 C5 P5 (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:** 40 minutes



Candidate  
forename

Candidate  
surname

Centre number

Candidate number

**MODIFIED LANGUAGE**

**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** Read this article.

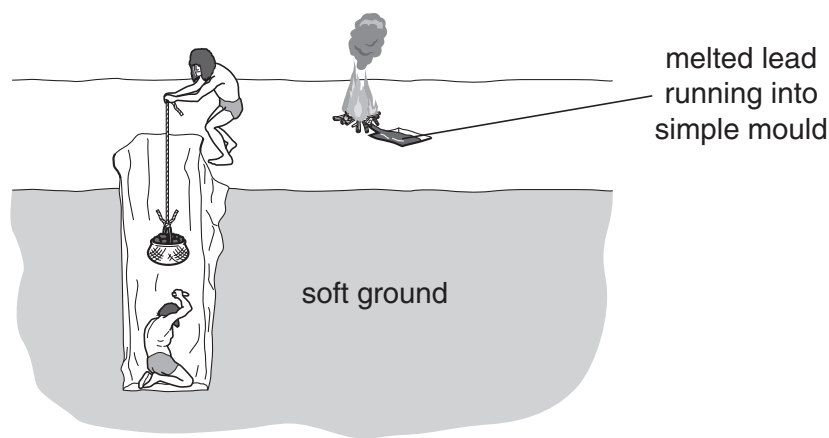
Archaeologists have discovered a small lead mine that was used 4000 years ago.

The miners made a deep hole through soft ground until they reached the lead ore.

They then dug out the ore and loaded it into baskets.

A second group of men lifted the ore out of the mine and put it into a wood fire. The carbon in the wood reacted with the ore to make sulfur dioxide, carbon dioxide, and molten lead.

The molten lead was run into moulds where it cooled and solidified.



Here is some information about three of the substances involved in the process.

	<b>lead</b>	<b>lead ore</b>	<b>sulfur dioxide</b>
<b>hazard</b>	exposure to dust or fumes for a long time is harmful	exposure to dust or fumes for a long time is harmful	acidic gas

**(a)** Use information in the article and table above to suggest two risks of the process.

Include in your answer

- what causes each risk
- who would be at risk.

.....

.....

.....

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

(b) The lead ore contains lead sulfide. When lead sulfide is heated in the fire, there are two reactions.

- (i) In the first reaction in the fire, oxygen gas reacts with solid lead sulfide to make solid lead oxide and sulfur dioxide gas.

Complete the table to show the state symbols for the substances in this reaction.

One has been done for you.

substance	state symbol
oxygen	g
lead sulfide	
lead oxide	
sulfur dioxide	

[1]

- (ii) In the second reaction, carbon takes oxygen away from the lead oxide to make lead and another substance.

Suggest a word equation for this reaction.

..... [1]

- (iii) Carbon takes oxygen away from lead oxide.

What does this tell you about lead?

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

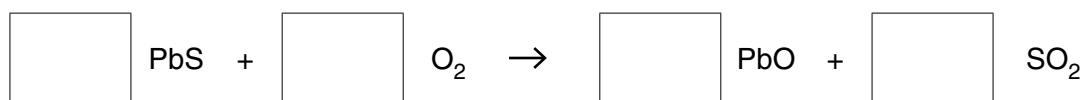
- It is a silvery metal. ☐
- It is not very reactive. ☐
- It is a pollutant. ☐
- It is a dense metal. ☐

[1]

- (iv) What do we call a reaction in which oxygen is removed?

..... [1]

(v) Put numbers in the boxes to balance the equation for this reaction.



[1]

(c) Many lead ores contain a high percentage of lead.

Calculate the percentage mass of Pb in PbS.

(relative atomic masses : sulfur = 32, lead = 207)

answer = ..... % [1]

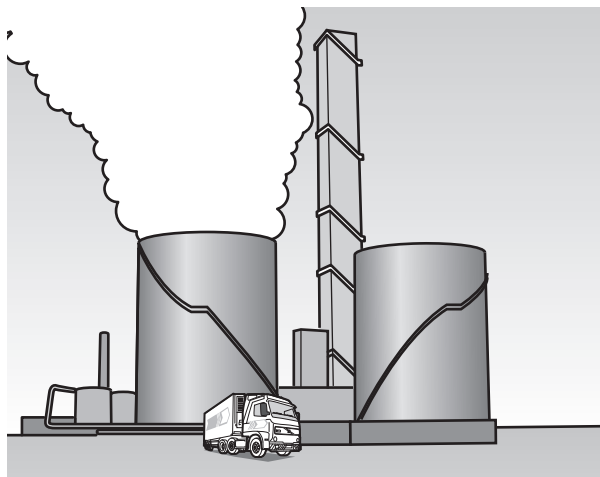
[Total: 9]

- 2 British industry uses thousands of tonnes of oxygen and nitrogen every year.

We take these gases out of the air.

The air is cooled to a very low temperature until it turns into a liquid.

Oxygen and nitrogen can then be separated by warming the liquid.



The gases can be separated because they have different boiling points.

Nitrogen has a lower boiling point than oxygen.

Explain why nitrogen has the lower boiling point.

.....

.....

.....

..... [3]

[Total: 3]

- 3 Magnesium chloride can be extracted from seawater.

Magnesium chloride is an ionic solid.

What happens when it dissolves in water?

Draw **one** line from the correct **start** to the correct **description of the solution**.

**start**

Ions are already  
present before  
the solid dissolves.

OR

Ions only form when  
the solid  
has dissolved.

OR

Ions only form  
when a current  
is turned on.

**description of  
the solution**

Ions of opposite  
charge come  
together in the liquid.

OR

Ions are spread  
through the liquid.

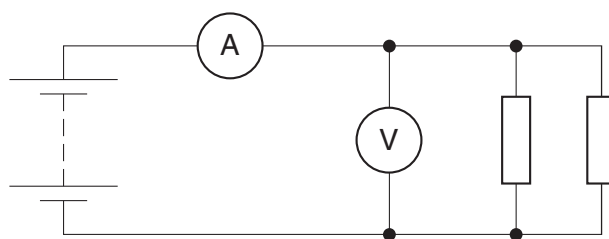
OR

Ions sink to the  
bottom of the liquid.

[2]

[Total: 2]

- 4 Alyson uses this circuit to investigate the current drawn from a battery by resistors in parallel.



The diagram shows Alyson's circuit when she has **two** identical resistors in parallel.

She changes the number of identical resistors in parallel and obtains these results.

number of resistors	current in amps	p.d. in volts
none	0.00	2.8
one	0.07	2.8
two	0.14	2.8
three	0.21	2.8

- (a) Calculate the resistance of just **one** of the resistors.

resistance = .....  $\Omega$  [1]

- (b) Alyson notices that when she increases the number of resistors the current increases.

Use ideas about parallel circuits to explain the pattern in Alyson's results.

.....

.....

.....

.....

.....

..... [3]

[Total: 4]

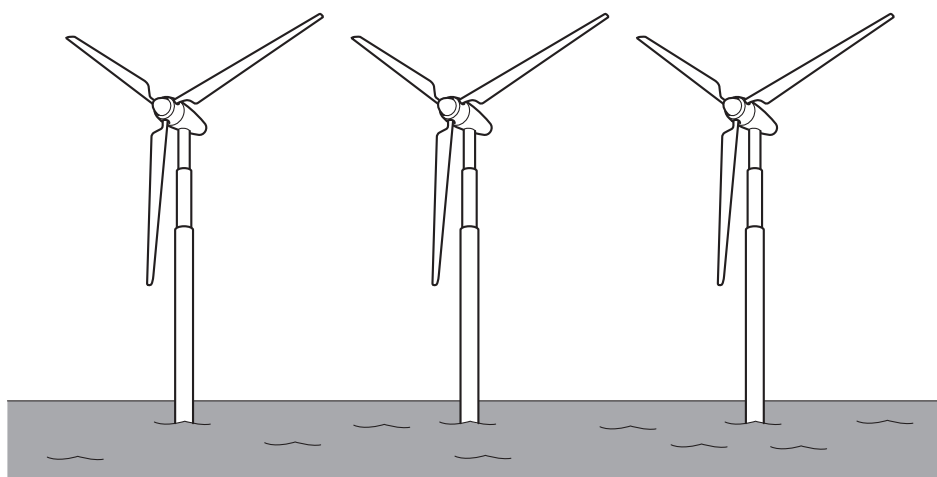


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**Question 5 begins on page 10**

**PLEASE DO NOT WRITE ON THIS PAGE**

- 5 At least 10% of mains electricity in the UK comes from wind turbines out at sea.



- (a) The turbines generate a.c. electricity.

Here are some possible reasons why.

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

a.c. is much safer than d.c.

☐

d.c. can only come from batteries.

☐

a.c. is easier to generate than d.c.

☐

a.c. can be at a much higher power than d.c.

☐

a.c. can be distributed more efficiently than d.c.

☐

[2]

- (b) The generator in each turbine contains a magnet which spins near a coil of wire.

- (i) Here are some ways to increase the voltage from a generator.

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

Put some **aluminium** / **copper** / **iron** inside the coil.

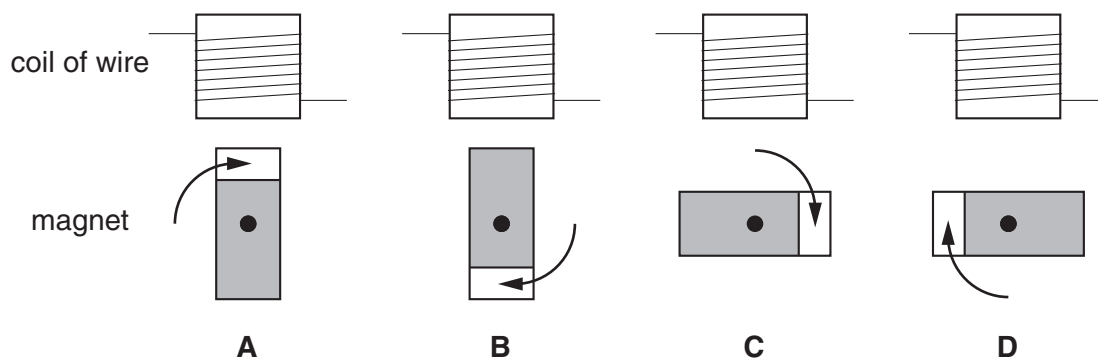
Make the magnet spin **faster** / **slower**.

Replace the coil with one that has **fewer** / **more** turns of wire.

[1]

(ii) The magnet rotates **clockwise**.

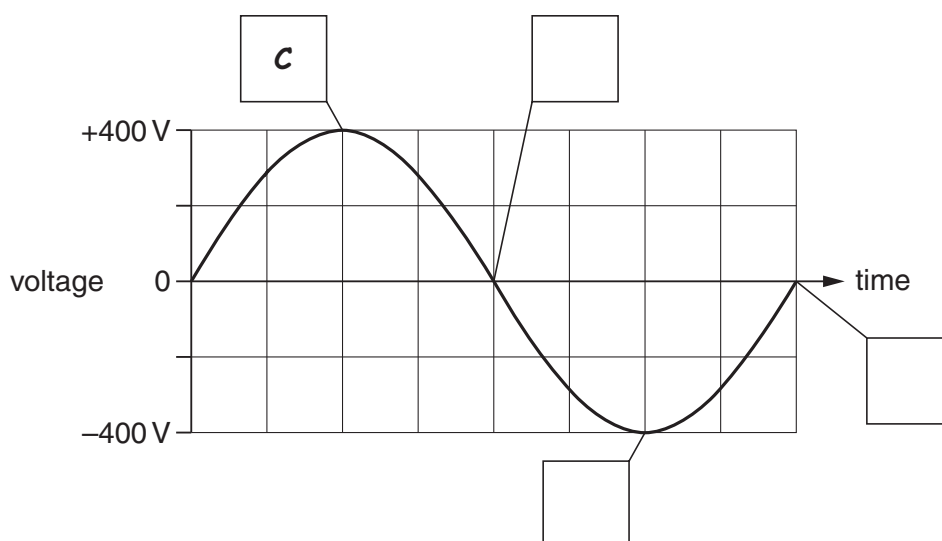
Here are four positions the magnet can take.



The graph shows how the voltage across the coil changes as the magnet rotates.

Complete the boxes to show the position of the magnet at that time.

One box has been completed for you.



[1]

(c) Here are some data for the output of a generator in a wind turbine.

frequency	50 Hz
potential difference	1200 V
output power	2400 kW

What is the current in the coil of the generator?

Put a **ring** around the correct answer.

**0.02 A**

**0.5 A**

**2 A**

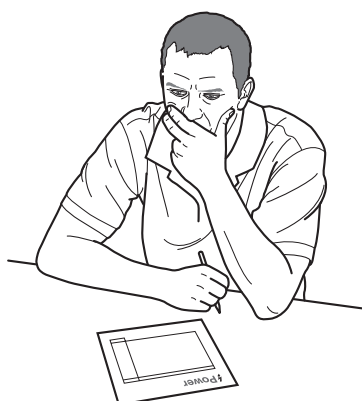
**2000 A**

[1]

[Total: 5]

Turn over

- 6 Bill worries about how much he pays for electricity.



He investigates the energy used by the appliances in his home.

- (a) The table shows the electricity he uses at home in a typical week.

appliance	power in kW	hours of use
power shower	5.0	2
fan heater	1.5	20
computer	0.5	30
lights	1.0	15

- (i) Which appliance uses the most electricity in a week?

answer ..... [1]

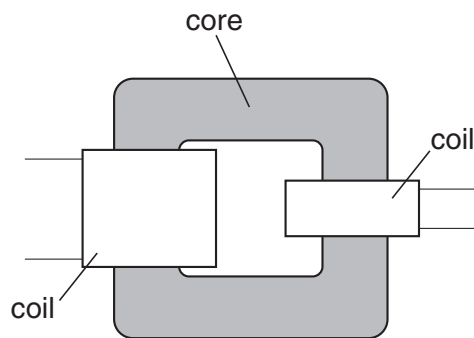
- (ii) Bill pays 12p for each kilowatt hour of electricity.

Calculate how much he pays for electricity in a typical week.

cost = ..... p [1]

- (b) Bill's computer is connected to the mains electricity supply by a transformer.

The transformer contains two coils of wire wound around a core.



- (i) Write down the best material to use for the core.

answer ..... [1]

- (ii) The transformer reduces the 230V a.c. mains supply to 9.2V a.c.

The primary coil contains 10 000 turns of wire.

How many turns of wire does the secondary coil have?

Put a ring around the correct answer.

**25                  400                  92 000                  250 000**

[1]

- (iii) The transformer has an efficiency of 98% when its input power is 500W.

Calculate the energy that the transformer wastes as heat in one second.

waste energy in one second = ..... J [1]

[Total: 5]

7 This question is about DNA and cell division.

(a) Look at the statements about DNA and proteins.

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

DNA is cut up into lengths of protein.

☐

A copy of the DNA is carried to where proteins are made.

☐

Parts of the protein are made next to the DNA then taken away to be put together.

☐

DNA is changed into amino acids, which then move around the cell.

☐

[1]

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

The bases join together to hold one

<b>chromosome</b>	<input type="checkbox"/>
<b>DNA strand</b>	<input type="checkbox"/>
<b>gene</b>	<input type="checkbox"/>

to another.

During mitosis

<b>chromosomes</b>	<input type="checkbox"/>
<b>DNA strands</b>	<input type="checkbox"/>
<b>genes</b>	<input type="checkbox"/>

separate.

During the growth part of the cell cycle

<b>chromosomes</b>	<input type="checkbox"/>
<b>DNA strands</b>	<input type="checkbox"/>
<b>genes</b>	<input type="checkbox"/>

separate.

[2]

- (c) Mitosis produces new cells from a parent cell.

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

Each parent cell produces four new cells.

☐

The new cells are genetically different from each other.

☐

The new cells are genetically identical to the parent cell.

☐

The parent cell has more genes than the new cells.

☐

[1]

- (d) Mutations can occur in DNA.

Sometimes this results in an extra base being added to the base sequence in a gene.

Explain how the extra base could change the protein the gene codes for.

.....

.....

.....

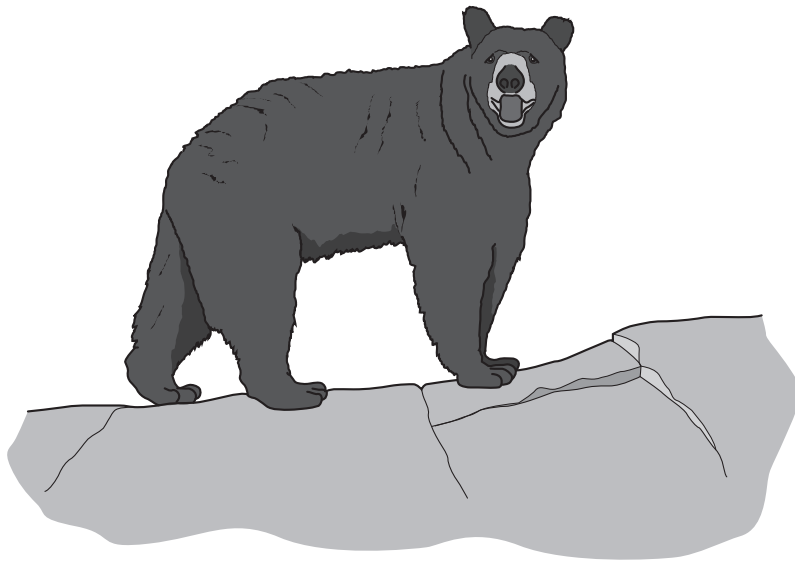
.....

..... [3]

[Total: 7]

8 Ben is going camping in North America.

He hopes to see black bears.



(a) They are called black bears, but they do not all have black fur.

The colour of the fur depends on the proteins produced in hair-growing cells.

Put a ring around the correct words to join the start of each sentence to its end.

The genes for the colour proteins are found ...

**only in hair-growing cells**

**only in secreting cells**

**in every cell**

**only in reproductive cells**

... of the black bear.

Each cell in the bear has ...

**none**

**one**

**many**

**all**

... of its genes inactive.

[2]



- (b) An adult black bear has 74 chromosomes in each body cell.

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

The black bear produces gametes by

<b>meiosis.</b>	
<b>mitosis.</b>	
<b>fertilisation.</b>	
<b>tropism.</b>	

After fertilisation, each zygote will contain

<b>37</b>	
<b>46</b>	
<b>74</b>	
<b>148</b>	

chromosomes  
from each parent.

The zygote divides by

<b>meiosis</b>	
<b>mitosis</b>	
<b>fertilisation</b>	
<b>tropism</b>	

to form an embryo.

[2]

[Total: 4]

- 9 A plant next to a window bends as the stem grows towards the light. Four friends comment on what is happening.

They try to explain what is happening.



- (a) Which two friends make correct statements?

answer ..... and ..... [1]

- (b) Which **two** words can be used to describe the chemical that causes this growth towards the light?

Put rings around the **two** correct answers.

**auxin**

**chlorophyll**

**enzyme**

**hormone**

**meristem**

[1]

(c) Draw **one** line to join **where the chemical collects** with **its effect on plant growth**.

**where the  
chemical collects**

**its effect on  
plant growth**

at the tip of the  
shoot

makes the tip  
grow more

on both sides of  
the shoot

makes the side in  
the light shorten

on the shaded  
side of the shoot

makes the shaded  
side lengthen

on the side of the  
shoot in the light

makes the side in  
the light lengthen

makes the shaded  
side shorten

[1]

[Total: 3]

**END OF QUESTION PAPER**

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# The Periodic Table of the Elements

20

1	2	Key					3	4	5	6	7	0					
		relative atomic mass atomic symbol name atomic (proton) number															
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						

\* 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.