

**GENERAL CERTIFICATE OF SECONDARY EDUCATION  
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)

**Monday 24 January 2011  
Afternoon**

**Duration: 40 minutes**



Candidate forename		Candidate surname	
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Centre number						Candidate number				
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**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. Pencil may be used for graphs and diagrams only.
- 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).
- Answer **all** the questions.
- 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

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

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

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

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

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

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

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

#### 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 Air is a mixture of different gases.

Each year we extract thousands of tonnes of gases from the air.

Many of these gases are very useful.

(a) We extract each gas by cooling the air until the gas turns into a liquid.

Different gases turn into liquids at different temperatures.

Here is some information about the gases.

gas	melting point in K	boiling point in K
argon	84	87
nitrogen	63	77
oxygen	55	90
water vapour	273	373

Which gas turns from a gas into a liquid at the **lowest** temperature?

answer ..... [1]

(b) Oxygen is made of molecules.

Liquid oxygen turns into a gas at extremely low temperatures.

Explain why.

Use your understanding of forces and molecules in your answer.

.....

.....

.....

..... [3]

[Total: 4]

2 We have extracted iron since the Iron Age.

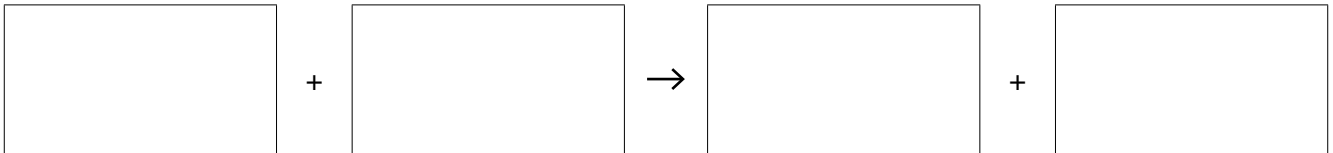
We still use the same method.

We extract the iron by heating iron oxide with carbon in a furnace.

Different reactions take place in the furnace.

(a) In one reaction, carbon takes the oxygen away from iron oxide.

(i) Fill in the boxes to write a word equation for this reaction.



[2]

(ii) Use words from this list to complete the sentences below.

**combined      electrolysed      melted      oxidised      precipitated      reduced**

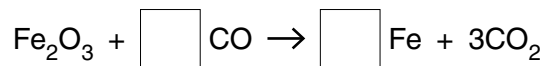
When carbon gains oxygen we say that the carbon has been .....

When a metal oxide loses oxygen we say that the metal has been .....

[1]

(iii) Another reaction for making iron is between iron oxide and carbon monoxide gas.

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



[2]

(b) Not all metals are extracted by heating their ores with carbon.

Some metals are extracted by electrolysis.

metal	extracted by	melting point of the metal in K
lead	heating with carbon	601
magnesium	electrolysis	922
aluminium	electrolysis	933
calcium	electrolysis	1112
cobalt	heating with carbon	1768
iron	heating with carbon	1808

Use the table to decide which three metals are likely to be more reactive than the others.

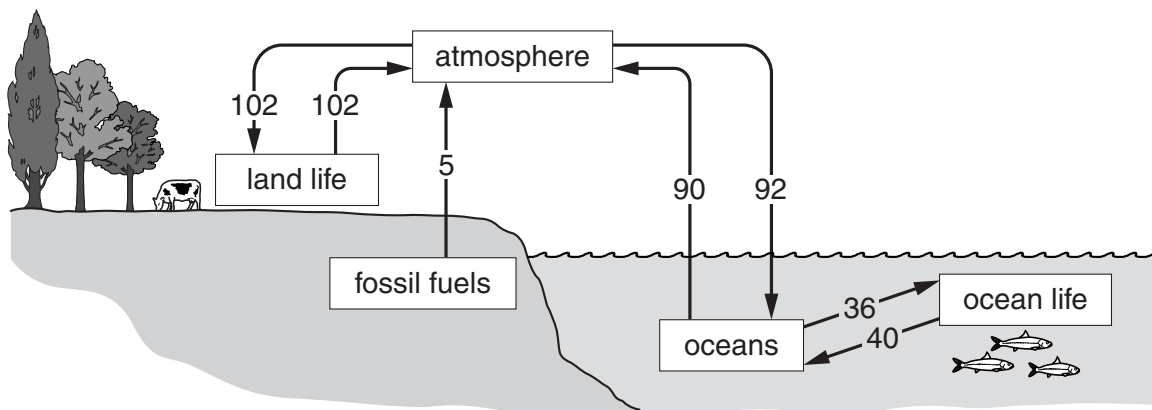
answer ..... and ..... and ..... [1]

[Total: 6]

- 3 Scientists are worried about the increasing amounts of carbon in our atmosphere.

Look at the diagram of the carbon cycle.

The numbers show how many gigatonnes of carbon move in each direction every year.



- (a) The amount of carbon in the atmosphere is increasing.

By how many gigatonnes does it increase every year?

Put a (ring) around the correct answer.

2            3            5            90            102            [1]

- (b) Most of the carbon in the atmosphere is in the form of carbon dioxide.

The diagram shows that 92 gigatonnes of carbon dissolve in the oceans every year.

How many gigatonnes of carbon dioxide does this represent?

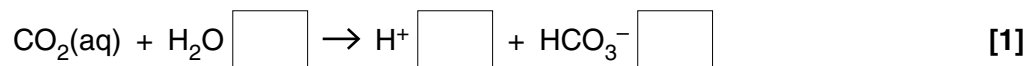
Put a (ring) around the answer.

$\frac{12}{44} \times 92$              $\frac{12}{32} \times 92$              $\frac{32}{12} \times 92$              $\frac{44}{12} \times 92$             [1]

- (c) Carbon dioxide dissolves in seawater.

Carbon dioxide in solution reacts with water to form ions.

- (i) Put **state symbols** in the boxes to complete the equation for this reaction.



- (ii) Mary wants to see if sea water really is an ionic solution.

What could she measure to show that it contains ions?

..... [1]

[Total: 4]

4 Mains electricity is produced by generators in power stations.



Each generator contains a magnet and a coil of wire.

(a) Describe how the magnet and the coil of wire are used to make electricity.

Include the name of the process.

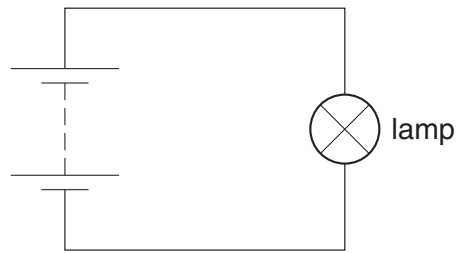
.....  
.....  
.....  
..... [2]

(b) State **two** ways of increasing the voltage of the electricity produced by a generator.

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

[Total: 4]

5 Charles puts this circuit together.



(a) The lamp glows.

Here are some statements about the circuit.

Which **two** statements, when taken together, explain why the lamp glows?

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

The wires have some resistance.

The current in the lamp heats it up.

The battery pushes charges through the lamp.

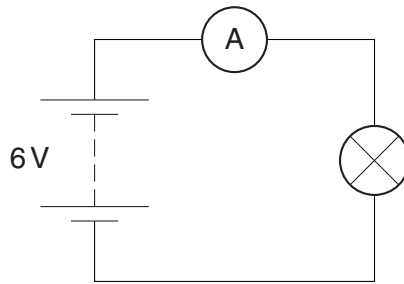
The wires have charges that are free to move.

Only the lamp has charges that are free to move.

[2]



- (b) Charles adds an ammeter to measure the current in the lamp.



The lamp has a power of 3W.

What does the ammeter read?

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

**0.5 A**

**2.0 A**

**6.0 A**

**18 A**

[1]

- (c) There is not enough current in the circuit to make the lamp glow brightly.

Charles adds another battery and the lamp glows brightly.

Complete the sentences. Choose words from this list.

**decreases**

**increases**

**parallel**

**series**

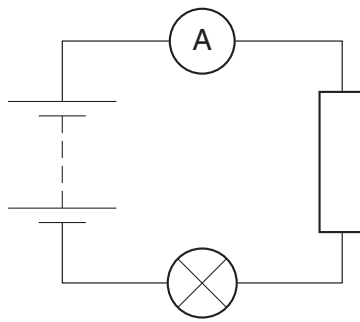
Charles adds the second battery in ..... to the first one.

This ..... the potential difference across the lamp.

[1]

[Total: 4]

6 Fleur puts this circuit together.



(a) The resistor, ammeter and lamp are **in series**.

Explain why all three components have exactly the same current.

.....

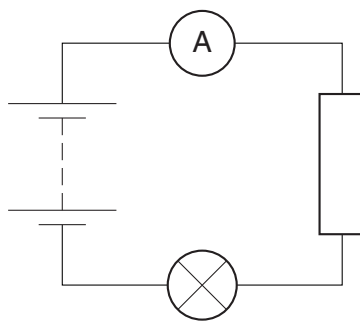
.....

.....

..... [2]

(b) Fleur wants to add a voltmeter to measure the potential difference across the resistor.

(i) Draw on this circuit diagram to show how Fleur should connect the voltmeter.



[1]

- (ii) Fleur finds that the potential difference across the resistor is 6V.

The potential difference across the battery is 9V.

The ammeter reads 0.5A.

What is the resistance of the **lamp**?

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

**6  $\Omega$**

**12  $\Omega$**

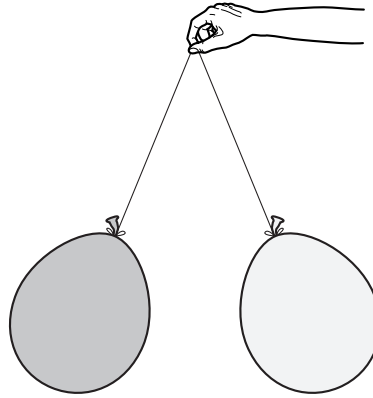
**18  $\Omega$**

**30  $\Omega$**

[1]

[Total: 4]

- 7 Zara does an experiment with a pair of balloons on strings.  
She rubs each balloon against her clothing.  
Zara then holds the balloons up by their strings.



Complete this explanation of why the balloons hang like this.

Choose the best words from the list.

- atoms**      **attract**      **different**      **electrons**      **identical**  
**shield**      **negative**      **neutral**      **positive**      **protons**      **repel**

The rubbing transfers some ..... from each balloon to Zara's clothing.

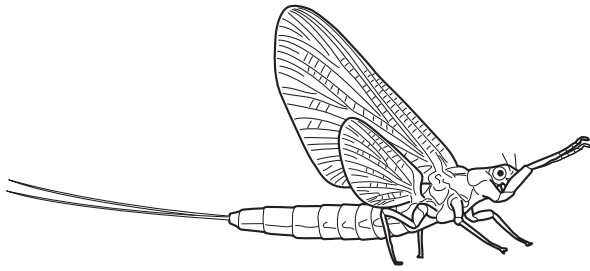
This leaves each balloon with a ..... charge.

The reason the balloons ..... each other is because they have .....  
kinds of charge. [2]

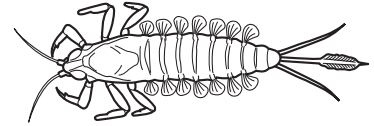
**[Total: 2]**

8 Martin is studying mayflies.

He looks at an adult mayfly and a mayfly nymph.



adult mayfly

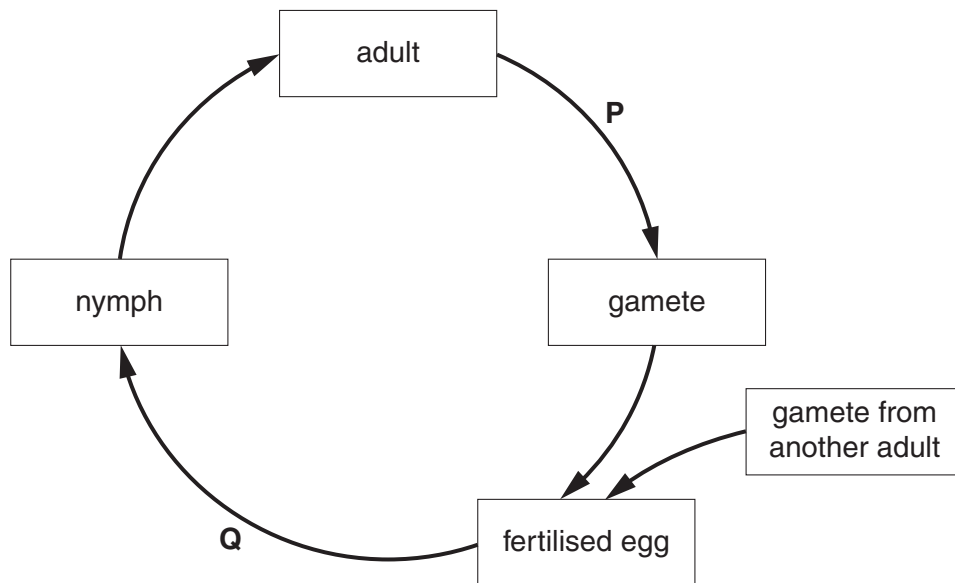


mayfly nymph

(a) (i) The adult mayfly lays eggs in the water.

The eggs hatch into nymphs.

The nymphs grow bigger.



Complete the sentences.

The type of cell division at **P** is ..... , which makes cells that have ..... number of chromosomes as the adult cells.

The type of cell division at **Q** is ..... , which makes cells that have ..... number of chromosomes as the fertilised egg.

[2]

(ii) The statements **A** to **D** are about processes of the cell cycle.

Put the letters **A**, **B**, **C** and **D** in the correct column of the table to show whether the processes occur during **cell growth** or **cell division**.

- A** the numbers of organelles increase
- B** copies of the chromosomes separate
- C** new strands of DNA form
- D** strands of each DNA molecule separate

cell growth	cell division

[2]

(b) When a nymph grows into an adult, it has different specialised tissues.

Five people are asked to explain this.

**Jeremy**  
All of the genes are switched on and become active.

**Teresa**  
Some of the genes are lost from the cells.

**Vick**  
Some of the active genes are switched off.

**Cassie**  
Some genes are added to the cells.

**Andrew**  
Some of the inactive genes are activated.

Which **two** people give the best explanations?

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

[Total: 5]

9 Susie sees a plant she likes in a friend's garden.

She asks if she can take a cutting.

(a) Which part of her friend's plant should Susie use to grow an identical plant?

Put a ring around the correct answer.

**flower**      **fruit**      **seed**      **stem**

[1]

(b) Susie dips the bottom of her cutting in some rooting powder.

She then puts the cutting into a pot of soil.

What does the rooting powder contain that helps the cutting grow roots?

..... [1]

(c) Susie's cutting grows into a new plant.

Which statements explain how this is possible?

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

Some unspecialised cells develop into other tissues.

Some unspecialised cells develop into organs.

Some xylem cells become phloem cells.

Some plant cells become unspecialised.

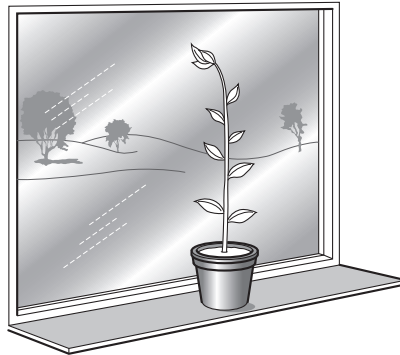
Some leaf cells become root cells.

[2]



(d) Susie keeps her new plant in a pot near a window.

The shoot grows towards the light.



Draw **one** line to join the **effect of light** on the distribution of auxin to its **effect on the cells** in the shoot.

**effect of light**

more auxin on  
lit side

**or**

more auxin on  
shaded side

**effect on the cells**

makes these cells  
grow more slowly

**or**

makes these cells  
grow more quickly

[1]

[Total: 5]

10 DNA carries genetic information.

(a) What is the name given to the shape of DNA?

..... [1]

(b) DNA in one part of the cell codes for the production of molecules in another part of the cell.

Explain how this happens.

In your answer write about

- the code in DNA
- different sites in the cell
- the type of molecule produced.

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

[Total: 4]

END OF QUESTION PAPER

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# The Periodic Table of the Elements

1	2	3	4	5	6	7	0	
7 <b>Li</b> lithium 3	9 <b>Be</b> beryllium 4	11 <b>Na</b> sodium 11	12 <b>C</b> carbon 6	13 <b>Al</b> aluminium 13	14 <b>N</b> nitrogen 7	15 <b>O</b> oxygen 8	16 <b>F</b> fluorine 9	17 <b>Ne</b> neon 10
19 <b>K</b> potassium 19	20 <b>Ca</b> calcium 20	21 <b>Sc</b> scandium	22 <b>Ti</b> titanium	23 <b>V</b> vanadium	24 <b>Cr</b> chromium	25 <b>Mn</b> manganese	26 <b>Fe</b> iron	27 <b>Co</b> cobalt
37 <b>Rb</b> rubidium	38 <b>Sr</b> strontium	39 <b>Y</b> yttrium	40 <b>Zr</b> zirconium	41 <b>Nb</b> niobium	42 <b>Mo</b> molybdenum	43 <b>Tc</b> technetium	44 <b>Ru</b> ruthenium	45 <b>Rh</b> rhodium
55 <b>Cs</b> caesium	56 <b>Ba</b> barium	57 <b>La*</b> lanthanum	72 <b>Hf</b> hafnium	73 <b>Ta</b> tantalum	74 <b>W</b> tungsten	75 <b>Re</b> rhenium	76 <b>Os</b> osmium	77 <b>Ir</b> iridium
83 <b>Bi</b> bismuth	84 <b>Po</b> polonium	85 <b>At</b> astatine	86 <b>Rn</b> radon	Elements with atomic numbers 112-116 have been reported but not fully authenticated				
87 <b>Fr</b> francium	88 <b>Ra</b> radium	89 <b>Ac*</b> actinium	104 <b>Rf</b> rutherfordium	105 <b>Db</b> dubnium	106 <b>Sg</b> seaborgium	107 <b>Bh</b> bohrium	108 <b>Hs</b> hassium	109 <b>Mt</b> meitnerium
119 <b>In</b> indium	120 <b>Cn</b> copernicium	121 <b>Nh</b> nihonium	122 <b>Fl</b> flerovium	123 <b>Mc</b> moscovium	124 <b>Lv</b> livermorium	125 <b>Ts</b> tennessine	126 <b>Og</b> oganeson	127 <b>Uue</b> ununoctium
131 <b>Xe</b> xenon	132 <b>Rn</b> radon	133 <b>Uu*</b> ununium	134 <b>Uub*</b> ununium	135 <b>Uut*</b> ununium	136 <b>Uuq*</b> ununium	137 <b>Uuq*</b> ununium	138 <b>Uuo*</b> ununium	139 <b>Uu*</b> ununium
151 <b>Lu</b> lutetium	152 <b>Hf</b> hafnium	153 <b>Ta</b> tantalum	154 <b>W</b> tungsten	155 <b>Re</b> rhenium	156 <b>Os</b> osmium	157 <b>Ir</b> iridium	158 <b>Pt</b> platinum	159 <b>Au</b> gold
161 <b>La</b> lanthanum	162 <b>Ce</b> cerium	163 <b>Pr</b> praseodymium	164 <b>Nd</b> neodymium	165 <b>Pm</b> promethium	166 <b>Sm</b> samarium	167 <b>Eu</b> europium	168 <b>Gd</b> gadolinium	169 <b>Tb</b> terbium
171 <b>Lu</b> lutetium	172 <b>Hf</b> hafnium	173 <b>Ta</b> tantalum	174 <b>W</b> tungsten	175 <b>Re</b> rhenium	176 <b>Os</b> osmium	177 <b>Ir</b> iridium	178 <b>Pt</b> platinum	179 <b>Au</b> gold
181 <b>La</b> lanthanum	182 <b>Ce</b> cerium	183 <b>Pr</b> praseodymium	184 <b>Nd</b> neodymium	185 <b>Pm</b> promethium	186 <b>Sm</b> samarium	187 <b>Eu</b> europium	188 <b>Gd</b> gadolinium	189 <b>Tb</b> terbium
191 <b>Lu</b> lutetium	192 <b>Hf</b> hafnium	193 <b>Ta</b> tantalum	194 <b>W</b> tungsten	195 <b>Re</b> rhenium	196 <b>Os</b> osmium	197 <b>Ir</b> iridium	198 <b>Pt</b> platinum	199 <b>Au</b> gold
201 <b>Hg</b> mercury	202 <b>Tl</b> thallium	203 <b>Pb</b> lead	204 <b>Bi</b> bismuth	205 <b>Po</b> polonium	206 <b>At</b> astatine	207 <b>Rn</b> radon	208 <b>Uue</b> ununium	209 <b>Uuq</b> ununium
211 <b>Po</b> polonium	212 <b>At</b> astatine	213 <b>Rn</b> radon	214 <b>Uu*</b> ununium	215 <b>Uub*</b> ununium	216 <b>Uut*</b> ununium	217 <b>Uuq*</b> ununium	218 <b>Uuo*</b> ununium	219 <b>Uu*</b> ununium
221 <b>Uu*</b> ununium	222 <b>Uuq*</b> ununium	223 <b>Uuq*</b> ununium	224 <b>Uuo*</b> ununium	225 <b>Uu*</b> ununium	226 <b>Uuq*</b> ununium	227 <b>Uuo*</b> ununium	228 <b>Uu*</b> ununium	229 <b>Uu*</b> ununium
231 <b>Uu*</b> ununium	232 <b>Uuq*</b> ununium	233 <b>Uuo*</b> ununium	234 <b>Uu*</b> ununium	235 <b>Uuq*</b> ununium	236 <b>Uuo*</b> ununium	237 <b>Uu*</b> ununium	238 <b>Uuq*</b> ununium	239 <b>Uuo*</b> ununium
241 <b>Uu*</b> ununium	242 <b>Uuq*</b> ununium	243 <b>Uuo*</b> ununium	244 <b>Uu*</b> ununium	245 <b>Uuq*</b> ununium	246 <b>Uuo*</b> ununium	247 <b>Uu*</b> ununium	248 <b>Uuq*</b> ununium	249 <b>Uuo*</b> ununium
251 <b>Uu*</b> ununium	252 <b>Uuq*</b> ununium	253 <b>Uuo*</b> ununium	254 <b>Uu*</b> ununium	255 <b>Uuq*</b> ununium	256 <b>Uuo*</b> ununium	257 <b>Uu*</b> ununium	258 <b>Uuq*</b> ununium	259 <b>Uuo*</b> ununium
261 <b>Uu*</b> ununium	262 <b>Uuq*</b> ununium	263 <b>Uuo*</b> ununium	264 <b>Uu*</b> ununium	265 <b>Uuq*</b> ununium	266 <b>Uuo*</b> ununium	267 <b>Uu*</b> ununium	268 <b>Uuq*</b> ununium	269 <b>Uuo*</b> ununium
271 <b>Uu*</b> ununium	272 <b>Uuq*</b> ununium	273 <b>Uuo*</b> ununium	274 <b>Uu*</b> ununium	275 <b>Uuq*</b> ununium	276 <b>Uuo*</b> ununium	277 <b>Uu*</b> ununium	278 <b>Uuq*</b> ununium	279 <b>Uuo*</b> ununium
281 <b>Uu*</b> ununium	282 <b>Uuq*</b> ununium	283 <b>Uuo*</b> ununium	284 <b>Uu*</b> ununium	285 <b>Uuq*</b> ununium	286 <b>Uuo*</b> ununium	287 <b>Uu*</b> ununium	288 <b>Uuq*</b> ununium	289 <b>Uuo*</b> ununium
291 <b>Uu*</b> ununium	292 <b>Uuq*</b> ununium	293 <b>Uuo*</b> ununium	294 <b>Uu*</b> ununium	295 <b>Uuq*</b> ununium	296 <b>Uuo*</b> ununium	297 <b>Uu*</b> ununium	298 <b>Uuq*</b> ununium	299 <b>Uuo*</b> ununium
301 <b>Uu*</b> ununium	302 <b>Uuq*</b> ununium	303 <b>Uuo*</b> ununium	304 <b>Uu*</b> ununium	305 <b>Uuq*</b> ununium	306 <b>Uuo*</b> ununium	307 <b>Uu*</b> ununium	308 <b>Uuq*</b> ununium	309 <b>Uuo*</b> ununium
311 <b>Uu*</b> ununium	312 <b>Uuq*</b> ununium	313 <b>Uuo*</b> ununium	314 <b>Uu*</b> ununium	315 <b>Uuq*</b> ununium	316 <b>Uuo*</b> ununium	317 <b>Uu*</b> ununium	318 <b>Uuq*</b> ununium	319 <b>Uuo*</b> ununium

1 <b>H</b> hydrogen 1
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relative atomic mass atomic symbol name atomic (proton) number
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\* 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.