

GENERAL CERTIFICATE OF SECONDARY EDUCATION
TWENTY FIRST CENTURY SCIENCE
ADDITIONAL SCIENCE A
UNIT 2 – Modules B5 C5 P5 (Higher Tier)
FRIDAY 25 JANUARY 2008

Morning
Time: 40 minutes

Candidates answer on the question paper.

Additional materials (enclosed):

None

Calculators may be used.

Additional materials: Pencil
Ruler



Candidate
Forename

Candidate
Surname

Centre
Number

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Candidate
Number

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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.
- Do **not** write outside the box bordering each page.
- 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	5	
2	4	
3	5	
4	4	
5	2	
6	5	
7	2	
8	1	
9	4	
10	5	
11	5	
TOTAL	42	

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

TWENTY FIRST CENTURY SCIENCE EQUATIONS

Useful Relationships

Explaining Motion

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

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

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

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

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

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

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

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

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

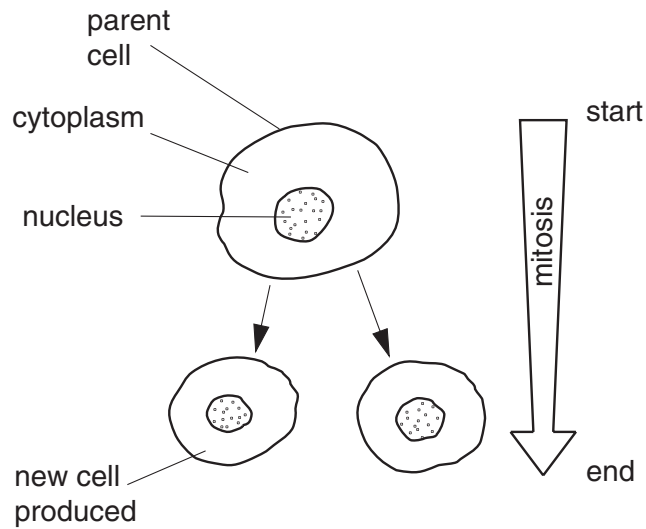
BLANK PAGE

Question 1 begins on page 4.

PLEASE DO NOT WRITE ON THIS PAGE

Answer **all** the questions.

- 1 James is studying cells which are undergoing mitosis.



- (a) James counts the number of chromosomes in the nuclei at the start and at the end of mitosis.

What does he notice about the number of chromosomes in each nucleus?

Put a tick (✓) in the correct box.

The chromosome number had decreased at the end of mitosis.

The chromosome number had increased at the end of mitosis.

The chromosome number had stayed the same at the end of mitosis.

[1]

- (b) What happens to the number of organelles in the cytoplasm **before** the start of mitosis?

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

decreases

increases

stays the same

[1]

(c) (i) Here are some statements about mitosis.

Some statements are true. Some are false.

Write **true** or **false** in the box next to each statement.

statement	true / false
The new cells produced are gametes.	
The new cells produced are identical to each other.	
There are four new cells produced from each complete mitosis.	
The new cells produced are identical to the parent cell.	

[2]

(ii) Which **cell** contains a set of chromosomes from each parent?

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

egg

sperm

zygote

[1]

[Total: 5]

- 2 Genes are made of DNA. The DNA contains four different bases (**A**, **T**, **C** and **G**).

The order of these bases makes a code which controls the order of amino acids in a protein made by a gene.

A **triplet** (sequence of three bases) is needed to code for each amino acid. Examples of this code are shown in the table.

amino acid	triplet base order
1	T G A
2	A A C
3	C G T
4	T A T

- (a) Which one of the four amino acids (1, 2, 3 or 4) will **not** be found in the protein produced by the following order of bases?

A G C T G A T A T C G T G G C

start
code

end
code

Put a (ring) around the correct answer.

1

2

3

4

[1]

- (b) What is the maximum number of triplets produced by the four bases?

Put a (ring) around the correct answer.

32

64

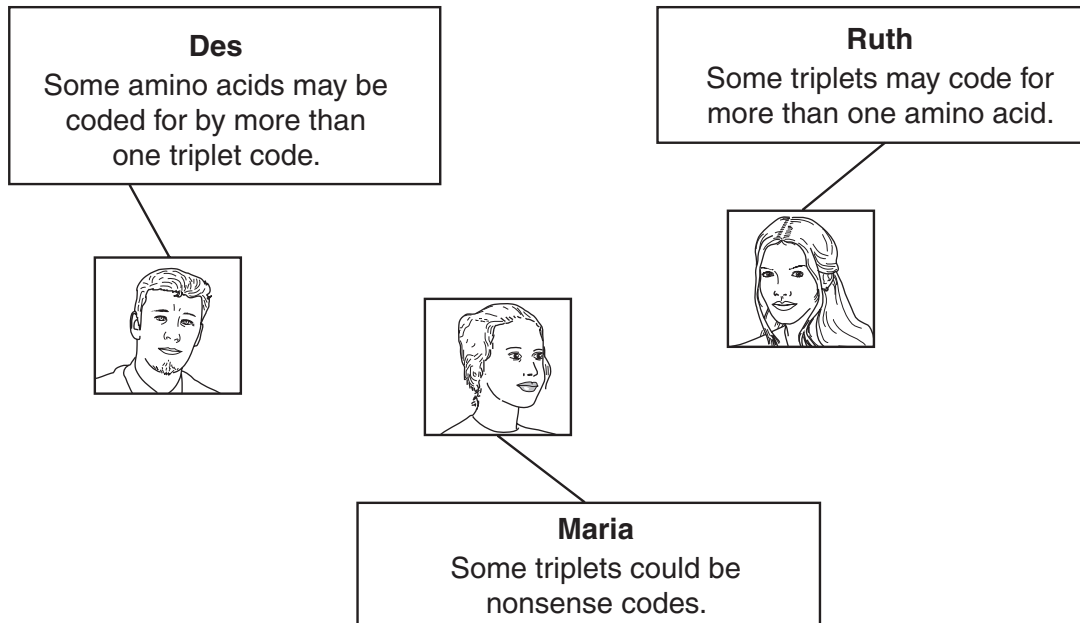
128

256

[1]

- (c) The number of different amino acids is less than the number of triplet codes available.

Three students were asked to explain this.



Who is most likely to be **wrong**?

Put a **ring** around the name of this student.

Des

Maria

Ruth

[1]

- (d) The DNA molecule contains two strands of bases held together in pairs.

Which bases pair together?

Draw a straight line to join each **base** to its **pair base**.

base	pair base
T	T
A	A
C	C
G	G

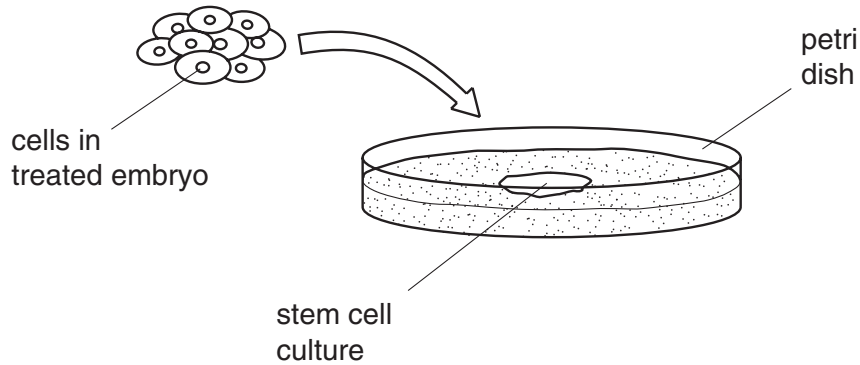
[1]

[Total: 4]

- 3 Rosie is a scientist working in a tissue culture laboratory. She carries out the following steps to grow tissues for transplanting into a particular patient.

A human embryo is grown from an egg cell with the original nucleus replaced with the nucleus from one of the patient's cells.

Cells are removed from the treated embryo to produce a stem cell culture.



- (a) Why was the egg cell nucleus replaced with one from the patient?

The following sentences are either true or false.

Put a tick (✓) in the correct box for each sentence.

	true	false
The stem cell culture can be used to form gametes for the patient.		
The stem cells have the potential to replace damaged tissues within the patient.		
The stem cells will be a close match to cells in the patient.		

[1]

- (b) Why are stem cells useful for transplanting into patients?

Put a **ring** around the **two** correct answers.

**they are
unspecialised**

**they are
differentiated**

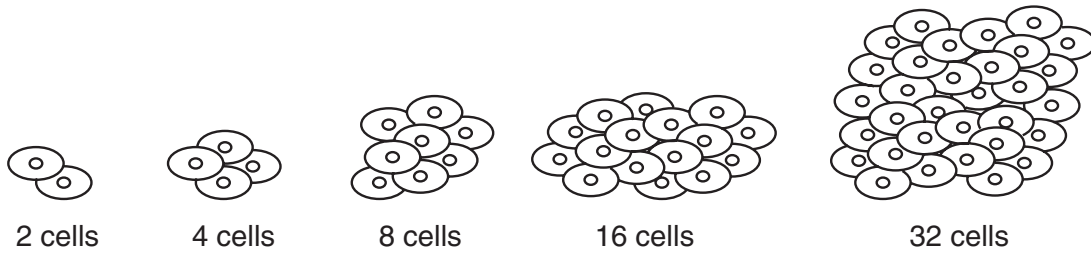
**they grow
rapidly**

**they divide
by meiosis**

[1]

(c) Which stages of development can be used successfully for collecting stem cells?

Put a ring around the latest stage that can be used successfully for collecting stem cells.



[1]

(d) Rosie asks a group of her friends to compare human cells with plant cells.

Jemima
Some plant cells remain unspecialised in the adult.

Lucy
Many cells in plants and animals have some of their genes inactive.

Laura
All plant cells become specialised in the adult.

Kirstie
All animal cells remain unspecialised in the adult.

Jimmy
All plant and animal cells can be used to form clones.

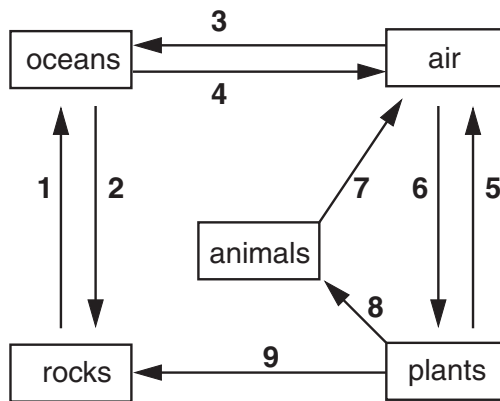
Which **two** people gave correct answers?

..... and

[2]

[Total: 5]

4 (a) Wilhelmina draws part of the carbon cycle.



(i) Which stage of the cycle (1 to 9) shows carbon being transferred to animals?

..... [1]

(ii) Carbon can get from the **air** into the **rocks** by two different routes.

Put **numbers** from the carbon cycle in the boxes to show **both** of these routes.

	first stage	second stage
Route A	<input type="text"/>	<input type="text"/>
Route B	<input type="text"/>	<input type="text"/>

[1]

(b) Wilhelmina finds out the composition of some of the molecules involved in the carbon cycle.

	% composition by mass			
	carbon	hydrogen	oxygen	nitrogen
fat	76.9	12.4	10.7	–
carbohydrate	40	6.7	53.3	–
DNA	33.2	4.0	44.3	8.6
protein	32	6.7	42.7	18.6

(i) Which **two** types of molecules contain **only** carbon, hydrogen and oxygen?

..... and [1]

(ii) Name **all** the elements in protein.

..... [1]

[Total: 4]

5 These are the chemical symbols for some ions.



(a) What is the formula of **magnesium bromide**?

Put a (ring) around the correct answer.



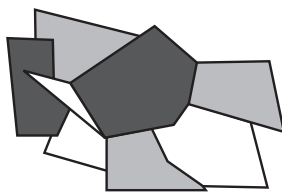
(b) What is the formula of **sodium sulfate**?

Put a (ring) around the correct answer.



[Total: 2]

- 6 A lump of metal ore contains different substances.



- (a) The following sentences about ores are either **true** or **false**.

Put a tick (✓) in the correct box for each sentence.

	true	false
They contain varying amounts of minerals.		
Metals can be extracted from them.		
They are pure compounds.		

[1]

- (b) Aluminium is obtained from its ore by **electrolysis**.

Here are some statements about electrolysis.

Some statements are correct, some are incorrect.

Put a tick (✓) in the best box for each statement.

	correct	incorrect
Ions are produced when the ore melts.		
Ions are present in the solid ore.		
Ions in the solid move to the electrodes.		
Negative ions move towards the anode during electrolysis.		
Metals are discharged when their ions gain electrons.		
Positive ions move towards the cathode during electrolysis.		
Ions in the liquid move to the electrodes.		

[3]

- (c) Aluminium ore is made of aluminium oxide, Al_2O_3 .

How much aluminium is in 100 tonnes of pure aluminium oxide?

[Relative atomic mass **O** = 16 ; **Al** = 27]

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

26.5 tonnes

40 tonnes

52.9 tonnes

66.6 tonnes

[1]

[Total: 5]

7 This question is about ores.

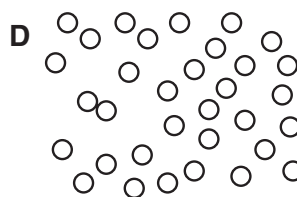
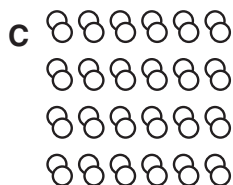
(a) A sample of a copper ore is made of crystals.

Choose the **best** explanation, **A**, **B**, **C** or **D**, for this.

- A The molten rock cooled very rapidly.
- B The molten rock was under huge pressure.
- C Atoms in the rock arranged themselves in a regular way.
- D There was only a small space in which the rock could solidify.

answer [1]

(b) The diagrams show different ways of arranging particles in a solid.



Which of these solids, **A**, **B**, **C** and **D**, are made of crystals?

answer [1]

[Total: 2]

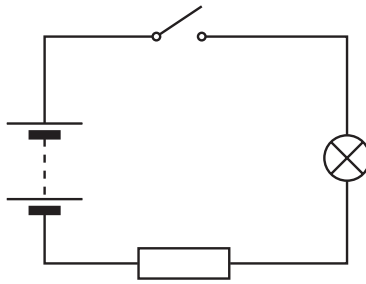
8 Which statement is the **best** explanation of why air is a gas?

- A Air is made of several substances.
- B The forces inside each molecule are weak.
- C The forces between molecules are weak.
- D Air has a low density.

answer [1]

[Total: 1]

9 Karen makes this electric circuit.



(a) When the switch is open, the lamp does not light.

Put a tick (✓) in **one** box to show the best way to complete each sentence.

(i)

tick (✓)

The air gap in the switch acts as

a conductor	<input type="checkbox"/>
an insulator	<input type="checkbox"/>
a transformer	<input type="checkbox"/>
a transmitter	<input type="checkbox"/>

[1]

(ii)

tick (✓)

When the switch is closed,

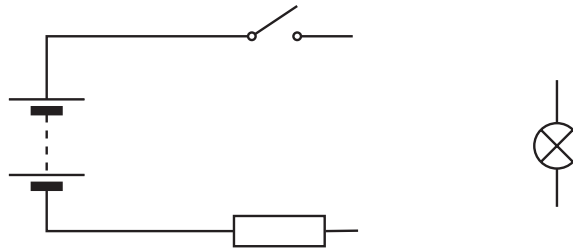
charge	<input type="checkbox"/>
potential difference	<input type="checkbox"/>
resistance	<input type="checkbox"/>
voltage	<input type="checkbox"/>

moves round the circuit.

[1]

(b) Karen now connects an ammeter to measure the current in the lamp.

Add an ammeter to the circuit diagram **and** complete the circuit.



[1]

(c) The lamp only glows dimly when Karen presses the switch.

Karen wants to increase the current in the lamp.

She tries different ways of doing this.

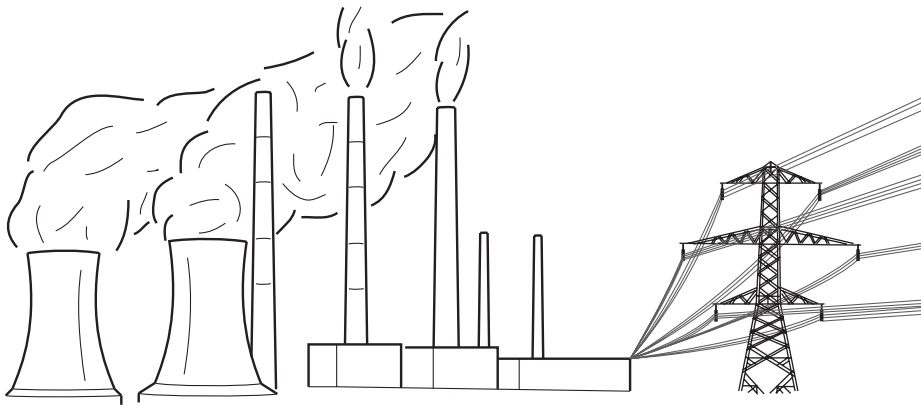
Complete the table by writing **true** or **false** in each box.

To increase the current in the lamp, Karen should ...	true / false
... assemble the circuit without the resistor.	
... connect the resistor in parallel with the lamp.	
... connect a second resistor in series with the lamp.	

[1]

[Total: 4]

10 Most of our electricity is made in power stations.



(a) The generator in a power station produces an alternating voltage.

What is the name of the process used to generate electricity?

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

metallic conduction

electrostatic induction

electromagnetic induction

[1]

(b) The sentences explain how electricity is produced in a power station and transferred to our homes.

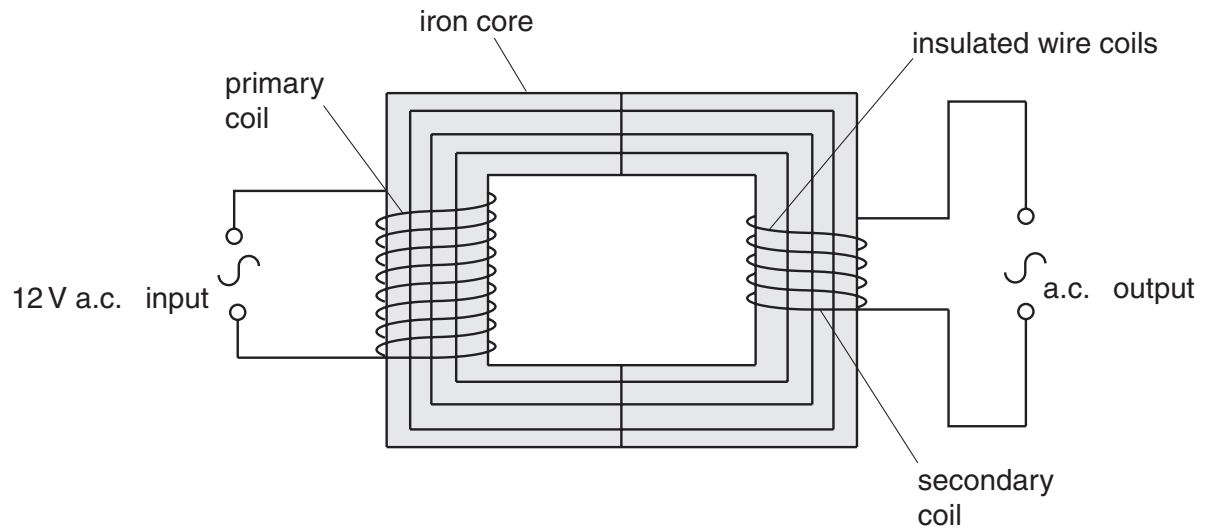
A	The voltage is stepped up by a transformer.
B	There is an alternating voltage across the coil.
C	The voltage is stepped down by a transformer.
D	Alternating current is carried by the National Grid.
E	Alternating current transfers energy in our homes.
F	A magnet spins around a coil of wire in the generator.

Complete the table to show the correct order of the sentences.

F					E
----------	--	--	--	--	----------

[3]

(c) The primary coil of a transformer is connected to a 12 V a.c. input.



Which **one** of these is the correct calculation for the voltage of the a.c. output?

Put a (ring) around the correct calculation.

$$12 \times 9 \times 5$$

$$12 \times \frac{9}{5}$$

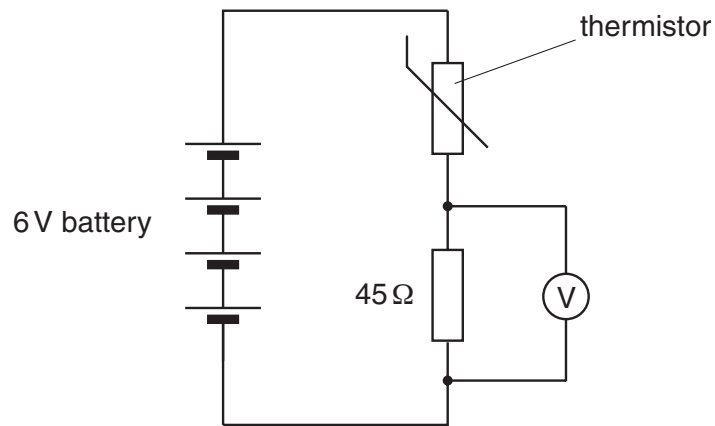
$$12 \times \frac{5}{9}$$

$$5 \times \frac{9}{12}$$

[1]

[Total: 5]

11 This circuit contains a thermistor.



(a) The temperature increases.

The sentences explain the change in the voltmeter reading.

They are in the **wrong** order.

A	The potential difference across the resistor increases.
B	The resistance of the thermistor decreases.
C	The current in the circuit increases.

Show the correct order by writing **A**, **B** or **C** in each box.

--	--	--

[2]

(b) Draw straight lines to link each **statement** with its best **explanation**.

statement**explanation**

The current in the thermistor is the same as the current in the resistor.

The battery pushes free electrons through the components.

As the free electrons leave one component, they flow straight into the next one.

The voltages across the thermistor and resistor add up to the voltage of the battery.

The free electrons transfer the energy gained from the battery to the resistor and thermistor.

[2]

(c) The battery supplies a potential difference of 6 V.

At a certain temperature the current in the $45\ \Omega$ resistor is 0.08 A.

Which is the correct calculation for the potential difference across the **thermistor**?

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

$$6 - (0.08 \times 45)$$

$$6 + (0.08 \times 45)$$

$$0.08 \times 45$$

$$\frac{45}{0.08}$$

[1]

[Total: 5]

END OF QUESTION PAPER

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The Periodic Table of the Elements

	1	2	3	4	5	6	7	0										
	7 Li lithium 3	9 Be beryllium 4	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> 1 H hydrogen 1 </div>					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	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> Key relative atomic mass atomic symbol name atomic (proton) number </div>					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.