THIS IS A NEW SPECIFICATION

OCR
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Monday 21 May 2012 – Morning

GCSE TWENTY FIRST CENTURY SCIENCE ADDITIONAL SCIENCE A

A151/01 Modules B4 C4 P4 (Foundation 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

Candidate forename		Candidate surname	

Centre number						Candidate number				

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 (✐).
- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- A list of physics equations is printed on page 2.
- The Periodic Table is printed on the back page.
- The total number of marks for this paper is **60**.
- This document consists of **24** pages. Any blank pages are indicated.

TWENTY FIRST CENTURY SCIENCE EQUATIONS

Useful relationships

The Earth in the Universe

distance = wave speed × time

wave speed = frequency × wavelength

Sustainable energy

energy transferred = power × time

power = voltage × current

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

Explaining motion

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

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

momentum = mass × velocity

change of momentum = resultant force × time for which it acts

work done by a force = force × distance moved in the direction of the force

amount of energy transferred = work done

change in gravitational potential energy = weight × vertical height difference

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

Electric circuits

power = voltage × current

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

$$\frac{\text{voltage across primary coil}}{\text{voltage across secondary coil}} = \frac{\text{number of turns in primary coil}}{\text{number of turns in secondary coil}}$$

Radioactive materials

$$\text{energy} = \text{mass} \times [\text{speed of light in a vacuum}]^2$$

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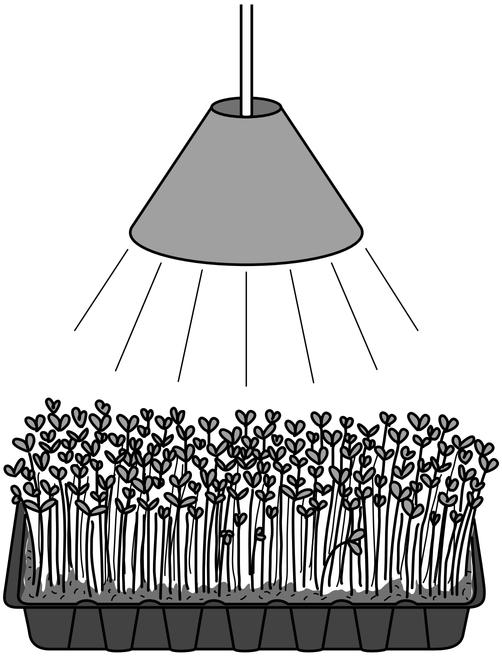
Question 1 begins on page 4

PLEASE DO NOT WRITE ON THIS PAGE

Answer **all** the questions.

1 Paul is investigating photosynthesis.
He grows five samples of cress, **A**, **B**, **C**, **D** and **E**.
Each sample gets a different number of hours of light per day for three days.



Here are his results.

Sample	**Hours of light per day in hours**	**Average height at start in mm**	**Average height at end in mm**	**Height gained in mm**
A	2	8	9	1
B	6	8		
C	12	8	14	6
D	18	8	17	9
E	24	8	17	9

(a) **(i)** Suggest what **height gain** Paul is likely to find for sample **B**.

answer .... mm **[1]**

(ii) Paul wants to grow lots of cress.
The lighting is expensive to use.
He uses the results to decide how many hours he will run the lights for each day.

How many hours should Paul run the lights for each day?

Explain your answer.

....

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....

.... **[2]**

(iii) Paul's experiment investigates the link between two factors.

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

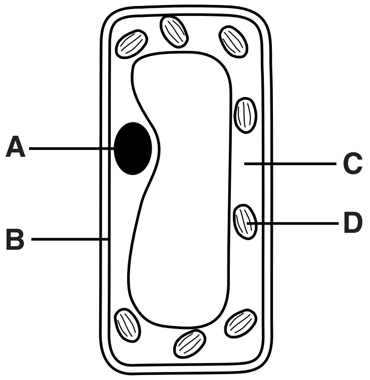
The factor that Paul changes is the amount of	light.	☐
	growth.	☐
	chlorophyll.	☐

At first, as this factor increases, there is	a decrease	☐	in the growth.
	an increase	☐	
	no change	☐	

To allow other scientists to repeat his investigation, Paul has to write a clear	method	☐	in his report.
	title	☐	
	conclusion	☐	

[2]

(b) Here is a diagram of a cell from the leaf of a plant.



The structures shown in the diagram have different roles in photosynthesis.

Identify the structures and describe their roles in photosynthesis.

The quality of written communication will be assessed in your answer.

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.... **[6]**

[Total: 11]

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Question 2 begins on page 8

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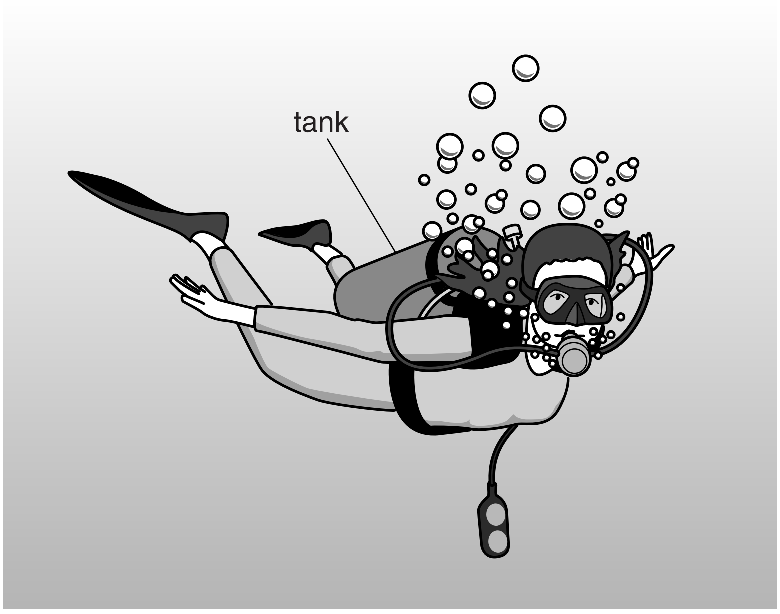
2 Caitlin goes scuba diving.



She uses air from a tank on her back while she is underwater.

(a) When Caitlin is resting she uses 4 litres of air in a minute.
When she is swimming she uses 6 litres of air in a minute.

Explain why there is this difference.

....

....

.... **[2]**

(b) Caitlin's tank gives her 180 litres of air.
She uses 6 litres of air a minute.
Caitlin can choose a dive that lasts 20, 25 or 30 minutes.
Caitlin has to allow a 5 minute safety margin.
She wants to go on the longest dive possible using this tank.

Explain which dive she should choose.

Use calculations in your answer.

....

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.... **[2]**

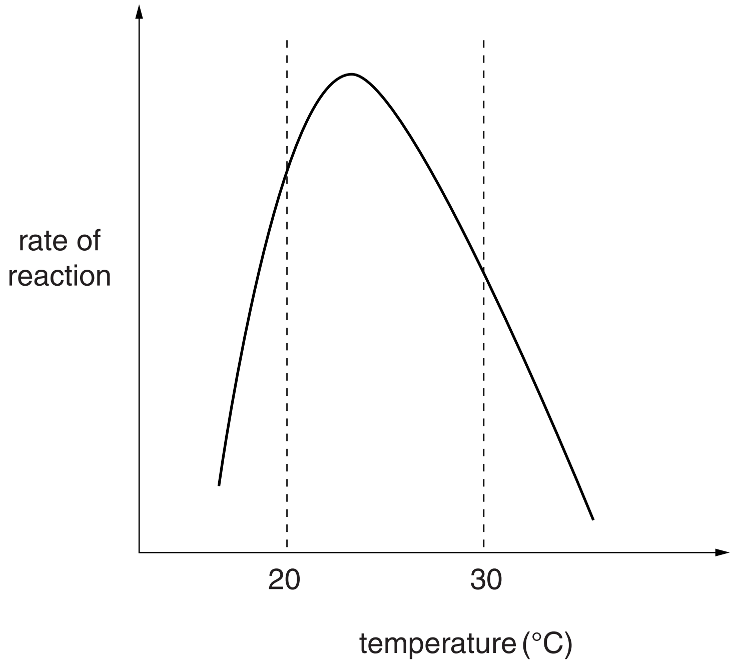
(c) While Caitlin has lots of air, energy is released by aerobic respiration.
If she runs out of air underwater she uses a different form of respiration to swim to the surface.

Name this type of respiration.

.... **[1]**

[Total: 5]

3 Gary investigates the effect of temperature on the activity of an enzyme which attacks stains.



(a) A biological washing powder cleans clothes at 70 °C.
Gary thinks that the enzyme is suitable to use at this temperature.

Is Gary correct?

Explain your answer.

....

....

....

.... **[2]**

(b) A scientist claims to have made a new enzyme which works well at all temperatures.
She makes her claim in a newspaper before she tells any other scientists.
Other scientists question her claim.

What are the reasons for scientists questioning the claim?

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

Making enzymes is very expensive. ☐

The work has not been peer reviewed. ☐

The enzyme has only been made in small amounts. ☐

The enzyme is easy to make. ☐

The enzyme has not been tested by other scientists. ☐

[2]

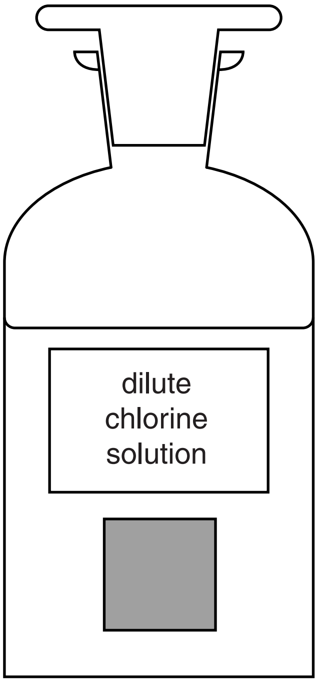
[Total: 4]

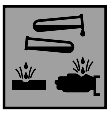
4 Chlorine is used to kill bacteria in swimming pools.

(a) A dilute solution of chlorine is harmful, but not toxic.

Which symbol should go on bottles of chlorine solution?

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



 ☐

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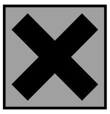
 ☐

[1]

(b) Chlorine, bromine and iodine are halogens.
Some halogens will react with other halogen compounds.

Halogen added	**Sodium bromide solution**	**Sodium chloride solution**	**Sodium iodide solution**
Bromine	no reaction	no reaction	reaction
Chlorine	reaction	no reaction	reaction
Iodine	no reaction	no reaction	no reaction

Use the table to put the three halogens in order of their reactivity.

most reactive ....

....

least reactive .... **[1]**

(c) Chlorine reacts with sodium iodide.

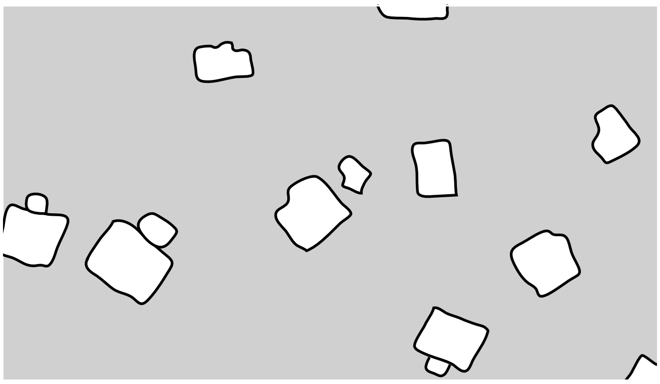
Sodium chloride and iodine are made.

Write a word equation for this reaction.

.... **[1]**

[Total: 3]

5 Joe evaporates some seawater.
Crystals of sodium chloride (salt) begin to form.



(a) Joe writes down the colour of the salt crystals.

What colour are they?

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

blue ☐

brown ☐

green ☐

colourless ☐

[1]

(b) Joe knows that salt is sodium chloride.
He does a flame test to show that there is sodium in his salt crystals.
He can tell that the flame contains sodium just by looking at it.
When he uses a spectroscope to look at the flame he finds out even more.

How does the flame show that sodium is present?

....

....

....

.... **[3]**

(c) Sodium chloride can be made by reacting sodium atoms with chlorine atoms.
It is the arrangement of electrons and protons in the atom which makes sodium atoms react in the way they do.

(i) There are 11 electrons in a sodium atom.

How many **protons** are there in a sodium atom?

Put a ring around the correct answer.

2 **8** **11** **23** **[1]**

(ii) The electron arrangement of a sodium **atom** is 2.8.1

A sodium atom loses one electron to make a sodium ion.

What is the electron arrangement of a sodium **ion**?

Put a ring around the correct answer.

2.8 **2.7.1** **1.8.1** **2.8.1** **[1]**

(iii) Sodium chloride is an ionic solid.

Two of these statements about sodium chloride are true.

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

Solid sodium chloride always conducts electricity. ☐

Solid sodium chloride often conducts electricity. ☐

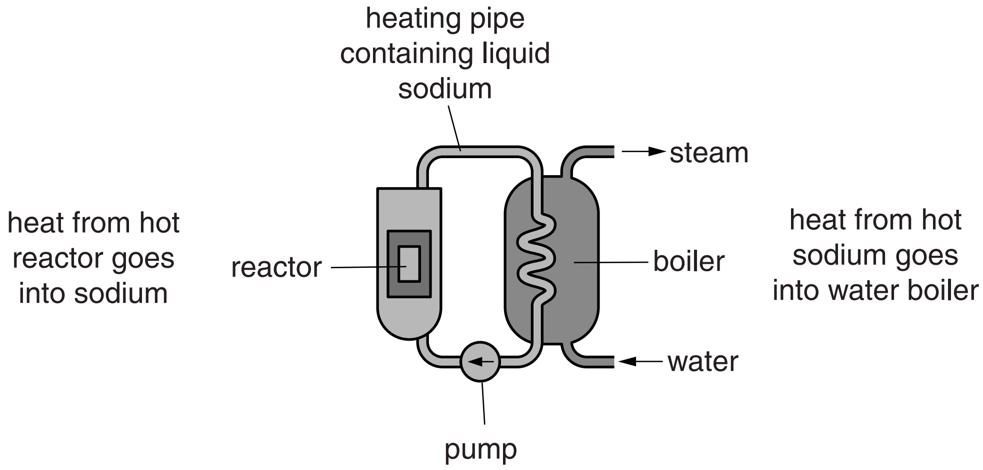
Melted sodium chloride conducts electricity. ☐

Sodium chloride solution conducts electricity. ☐

[1]

[Total: 7]

6 In some nuclear power stations sodium is used to carry the heat from the reactor to the boiler. Heat from the hot sodium turns the water in the boiler into steam.



The sodium must be melted so that it can flow through the pipes.

Sodium is a Group 1 metal.
Here is some information about Group 1 metals.

	Melting point	**Boiling point**
Lithium	180 °C	1342 °C
Sodium		883 °C
Potassium	63 °C	760 °C

(a) Estimate the melting point of sodium.

Put a (ring) around the best answer.

43 °C **98 °C** **183 °C** **883 °C** **[1]**

(b) A student thinks that using sodium in a nuclear power station might cause problems.

He has two **reasons**
- the melting point makes it difficult to use sodium in pipes
- the sodium might be dangerous if the pipes leak inside the boilers.

Suggest and explain what these problems might be.

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....

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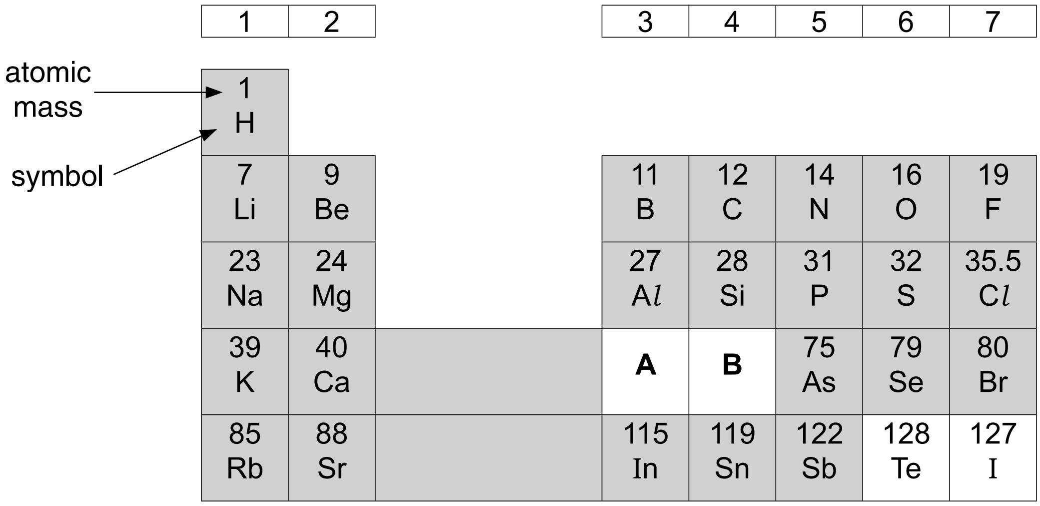
.... **[3]**

[Total: 4]

7 Mendeleev put all the elements that he knew about into a Periodic Table.
He used increasing atomic mass as the basis for his table.

Here is part of Mendeleev's table.



1	2		3	4	5	6	7
1 H							
7 Li	9 Be		11 B	12 C	14 N	16 O	19 F
23 Na	24 Mg		27 Al	28 Si	31 P	32 S	35.5 Cl
39 K	40 Ca		**A**	**B**	75 As	79 Se	80 Br
85 Rb	88 Sr		115 In	119 Sn	122 Sb	128 Te	127 I

Two important features of Mendeleev's table were
- leaving spaces at **A** and **B**
- the arrangement of Te and I.

Explain why these features were so important.

The quality of written communication will be assessed in your answer.

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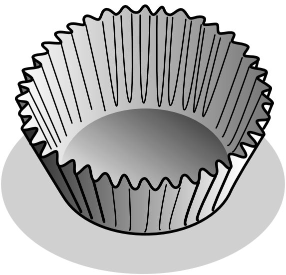
[Total: 6]

8 Jim investigates how paper cake cases fall through the air.
He thinks that they fall at a steady speed.



Jim releases the same cake case at different heights above the floor.
He times how long it takes for it to reach the floor.
Here are some of his results.

Height of drop in m	Time of fall in s	Speed in m/s	Average speed in m/s
1.00	2.00	0.500	....
1.00	2.05	0.488	
1.00	1.90	0.526	
0.50	1.07	0.467	0.489
0.50	0.98	....	
0.50	1.02	0.490	

(a) **(i)** Complete the **two** gaps in the table. **[2]**

(ii) Use the data in the table to comment on Jim's idea that the cake cases fall at a steady speed.

....

.... **[1]**

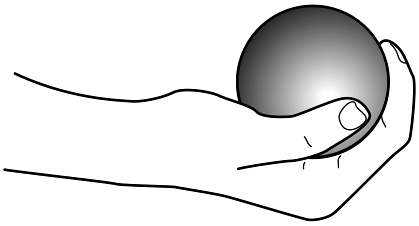
(b) Draw straight lines to link each **feature** of Jim's experiment to its correct **name**.

feature	**name**
speed of the cake case as it falls	controlled factor
weight and size of the cake case	changed factor
height of release above the floor	outcome variable

[2]

[Total: 5]

9 Jill throws a ball into the air.
She catches it when it comes down again.



Use ideas about force and momentum to explain how the speed of the ball changes while it is in the air.

The quality of written communication will be assessed in your answer.

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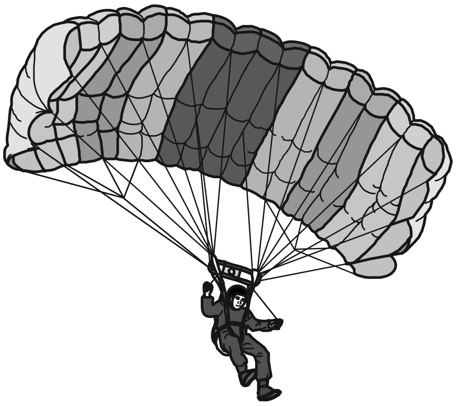
.... **[6]**

[Total: 6]

10 Ben uses a parachute to fall to the ground at a safe, steady speed.



(a) Here are some statements about the energy transfers which happen while he falls at a steady speed.

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

Ben loses kinetic energy. ☐

Ben gains kinetic energy. ☐

Ben has a constant kinetic energy. ☐

Ben loses gravitational potential energy. ☐

Ben gains gravitational potential energy. ☐

Ben has a constant gravitational potential energy. ☐

[2]

(b) Ben lands on the ground.
His weight is 800 N.
For a safe landing, the force on his feet must be less than 3200 N.
The impact with the ground lasts for 0.2 s.

(i) Calculate his maximum safe change of momentum during landing.

maximum safe momentum = ... kg m/s **[2]**

(ii) His speed just before he hits the ground is 5 m/s.
His mass is 80 kg.

Does he make a safe landing? Justify your answer.

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.... **[2]**

[Total: 6]

11 Mike is walking forwards across level ground.

Describe all the forces acting on Mike.

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.... **[3]**

[Total: 3]

END OF QUESTION PAPER

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The Periodic Table of the Elements

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										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 **A*l*** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **C*l*** 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 **T*l*** 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.