

Thursday 17 January 2013 – Afternoon

**GCSE GATEWAY SCIENCE
SCIENCE B**

B712/01 Science modules B2, C2, P2 (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 30 minutes



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 (✎).
- 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 **85**.
- This document consists of **32** pages. Any blank pages are indicated.

2

EQUATIONS

energy = mass $\times$ specific heat capacity $\times$ temperature change

energy = mass $\times$ specific latent heat

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

wave speed = frequency $\times$ wavelength

power = voltage $\times$ current

energy supplied = power $\times$ time

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

distance = average speed $\times$ time

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

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

force = mass $\times$ acceleration

weight = mass $\times$ gravitational field strength

work done = force $\times$ distance

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

power = force $\times$ speed

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

momentum = mass $\times$ velocity

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

GPE = mgh

$$mgh = \frac{1}{2}mv^2$$

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

3

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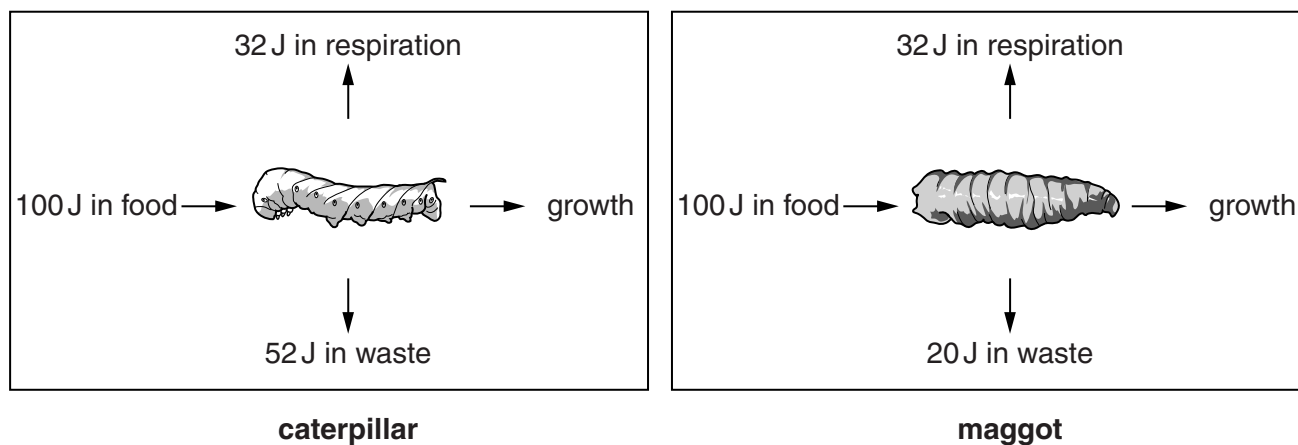
Question 1 begins on page 4

PLEASE DO NOT WRITE ON THIS PAGE

Answer **all** the questions.

SECTION A – Module B2

- 1 The diagram shows energy transfers through a caterpillar and a maggot.

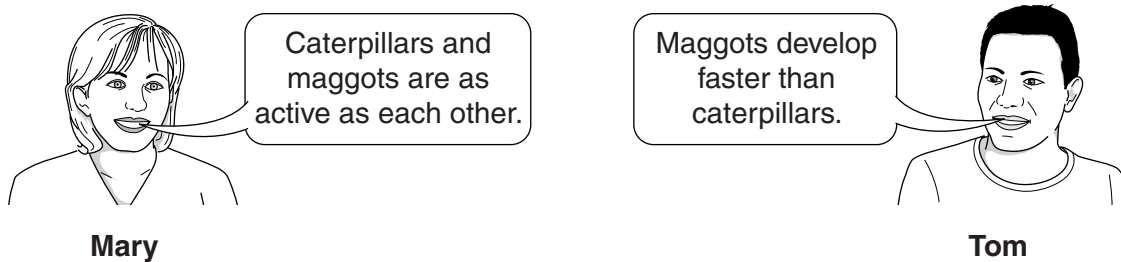


- (a) (i) Calculate the amounts of energy used for growth in the caterpillar and the maggot for every 100 J of energy in their food.

Show your working.

caterpillar = J maggot = J [2]

- (ii) Mary and Tom are talking about the two animals.



Use the data and your calculations to show how Mary and Tom are both correct.

.....

 [2]

5

- (b) Caterpillars and maggots are both the larvae (young) of adult insects.

Look at the diagrams.

How do caterpillars and maggots look different from **adult** insects?

.....

.....

..... [2]

- (c) Look at the list.

Which groups are insects in?

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

animal **arachnid** **arthropod** **crustacean** **protocista** [2]

[Total: 8]

Question 2 begins on page 6

- 2 *Waimanu manneringi* is the oldest known species of penguin.

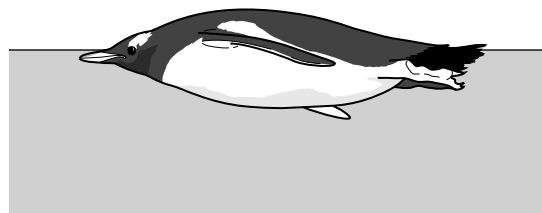
It lived around 62 million years ago in what is now New Zealand.

Scientists have used its fossils to reconstruct what they think it looked like.

The Gentoo penguin is a modern species of penguin that is alive today.



Waimanu manneringi



Gentoo penguin

Scientists think that *Waimanu manneringi* was a **less** efficient swimmer than modern species of penguin.

One reason for this is that *Waimanu manneringi* was **not** as streamlined as modern species of penguin.

- (a) Apply the theory of natural selection to explain how modern penguins could have evolved to become more streamlined than their ancestors.



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

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..... [6]

7

- (b) Paul says that because *Waimanu manneringi* is the oldest known species of penguin, then it must have been the **first** species of penguin.

Liz says that we can **not** be sure until we have looked for more fossils.

Kevin says that even if we find other fossils we will **never** be sure we have found the first species of penguin.

Who has made the best statement?

Explain your answer.

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

- (c) Look at the picture of the Gentoo penguin.

One way that it is adapted is its streamlined shape.

Describe and explain **other** ways that **you can see in the picture** that the Gentoo penguin is adapted.

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

[Total: 11]

3 This question is about gases in the atmosphere.

(a) Carbon dioxide is added to the atmosphere when fossil fuels are burnt.

(i) Describe how else carbon dioxide is added to the atmosphere.

.....

.....

..... [2]

(ii) How is carbon dioxide removed from the atmosphere?

.....

..... [2]

(b) Nitrogen is another gas in the atmosphere.

Plants and animals contain many nitrogen compounds but they can **not** use nitrogen gas to make them.

(i) Why can plants and animals **not** use nitrogen gas directly?

.....

..... [1]

(ii) What nitrogen compound do plants take in?

..... [1]

[Total: 6]

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Question 4 begins on page 10

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SECTION B – Module C2

- 4 David uses potassium sulfate, K_2SO_4 , as a fertiliser.



- (a) Fertilisers contain one or more of the three **essential elements** for plant growth.

- (i) Write down the **name** of the essential element in potassium sulfate.

..... [1]

- (ii) Sarah uses a mixture of potassium sulfate, K_2SO_4 , and ammonium phosphate, $(NH_4)_3PO_4$, as a fertiliser.

Suggest why Sarah's fertiliser is a better choice than David's.

.....

.....

..... [1]

- (b) Some people want to use more fertiliser and other people want to use less.

Write about the advantages and disadvantages of using fertilisers.

.....

.....

..... [2]

11

- (c) David wants to make some potassium sulfate solution.

He decides to neutralise an acid with potassium hydroxide.

- (i) Which **acid** should he use?

..... [1]

- (ii) David wants to check that a solution of potassium sulfate is neutral.

Write about how he could do this.

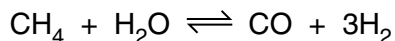
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..... [2]

[Total: 7]

Question 5 begins on page 12

- 5 Stowmarket Synthetics want to manufacture hydrogen from methane and water.

Look at the balanced symbol equation for this reaction.



- (a) What does the symbol $\rightleftharpoons$ mean?

..... [1]

- (b) Phil is a research chemist who works for Stowmarket Synthetics.

He investigates how the **percentage yield (%)** of this process changes with temperature and with pressure.

He does this with and without a catalyst.

Look at the percentage yield (%) **with** a catalyst.

	Temperature in °C	Pressure in atmospheres		
		20	30	40
With a catalyst	300	60%	42%	34%
	500	67%	49%	42%
	700	70%	64%	58%

Look at the percentage yield (%) **without** a catalyst.

	Temperature in °C	Pressure in atmospheres		
		20	30	40
Without a catalyst	300	60%	42%	34%
	500	67%	49%	42%
	700	70%	64%	58%

What conclusions can Phil make about the effect of:

- using the catalyst
- changing the temperature
- changing the pressure

on the percentage yield?

.....

.....

.....

.....

..... [3]

13

(c) Write about the **costs** of manufacturing hydrogen by this method.

.....

.....

..... [2]

[Total: 6]

Question 6 begins on page 14

- 6 The body of a railway carriage can be made from either aluminium or steel.



- (a) Steel is an alloy.

What is an alloy?

.....
 [1]

- (b) Look at the table. It shows some of the properties of aluminium and steel.

Property	Aluminium	Steel
corrosion in moist conditions	does not corrode	slowly rusts
density (1 = low, 10 = high)	3	8
magnetic attraction	not attracted	attracted
hardness (1 = soft, 10 = hard)	5	8
strength (1 = weak, 10 = strong)	4	9
electrical conductivity (1 = poor, 10 = good)	8	7
other properties	malleable and a good conductor of heat	malleable and a good conductor of heat

15

Suggest the properties needed by the metal used to make the body of a railway carriage.

Explain, with reasons, whether aluminium or steel is the best metal for this use.



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

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..... [6]

- (c) Old railway carriages are recycled in the same way as cars.

Write about the **advantages**, other than cost, of recycling metals.

.....

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..... [2]

[Total: 9]

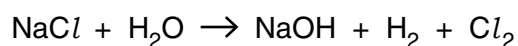
7 Sodium chloride is found in sea water.

It is an important raw material used in the chemical industry.

Sodium chloride solution can be chemically changed into:

- sodium hydroxide
- chlorine
- hydrogen.

(a) Look at the symbol equation for this reaction. It is **not** balanced.



Write down the **balanced symbol** equation for this reaction.

..... [1]

(b) Write down the name of a substance that can be made from hydrogen.

Choose from the list.

ammonia

cement

household bleach

soap

answer [1]

(c) Write down the name of a substance that can be made from chlorine.

Choose from the list.

ammonia

cement

household bleach

soap

answer [1]

[Total: 3]

17

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Question 8 begins on page 18

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SECTION C – Module P2

- 8 Paula fits solar panels to the roof of her house.



The panels contain photocells.

They transfer light energy to electricity.

- (a) What sort of electricity do photocells produce?

..... [1]

- (b) Paula wants to **double** the electrical power produced from sunlight.

What should she do to the **area** of her solar panels?

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

- (c) Paula wants to reduce her fuel bills by harnessing the Sun's energy in **another** way.

Describe a method she could use and explain how this method would reduce her fuel bills.

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

[Total: 4]

19

9 Producing electricity in power stations is not very efficient.

(a) In power station **A**, 800 joules of energy from coal produce 300 joules of electrical energy.

Calculate the efficiency of this power station.

.....

.....

.....

answer [2]

(b) In another power station, **B**, 800 joules of energy from coal produces 350 joules of electrical energy.

Comment on the efficiency of power stations **A** and **B**.

.....

..... [1]

[Total: 3]

Question 10 begins on page 20

10 This question is about dealing with radioactive materials safely.

(a) Radioactive waste is produced by some industries and hospitals.

Half-life is the time it takes for the waste to become half as radioactive.

Look at the information in the table.

Waste containing...	Level of radiation	Half-life	Type of radiation given out
uranium	very radioactive	700 000 000 years	alpha
iodine	very radioactive	8 days	beta and gamma
a mix of sources from hospitals	slightly radioactive	up to 20 years	alpha, beta and gamma

Suggest how each type of waste can be disposed of safely, giving reasons for your answer.



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

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..... [6]

21

- (b) Radioactive materials can be used by science teachers in classrooms.

There are risks involved in handling radioactive materials.

Write about how these risks can be reduced.

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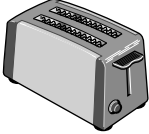
..... [2]

[Total: 8]

Question 11 begins on page 22

11 Tammy uses electrical appliances in her home.

Look at the information.

Appliance	Power in watts	Time used each day in hours
 kettle	2500	0.5
 lamp	60	8.0
 toaster	800	0.1
 washing machine	2500	1.0

(a) Which appliance costs the **least** to use for one hour?

Choose from the table.

answer

[1]

(b) The kettle and the washing machine have the same power rating.

The washing machine costs Tammy more to use each day than the kettle.

Explain why.

.....

..... [1]

23

- (c) Tammy has a television.

It is connected to the 230V mains.

The television takes a current of 0.8 A from the mains.

Calculate the power of the television.

.....
.....

answer W [2]

- (d) The toaster is also connected to the 230V mains.

Use information from the table to suggest why the toaster takes more current than the television.

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

[Total: 5]

Question 12 begins on page 24

- 12 (a) Stars give off their own light.

Explain why.

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

- (b) Spacecraft are used to explore space.

Some of them are manned, some are unmanned.

The distance from Earth to Mars is 200 million km.

It takes about 2 years for a spacecraft to reach Mars.

Look at the information about Neptune.

Distance from Earth 4500 million km

Diameter 49 600 km

Time to orbit Sun 165 years

Average temperature -225°C

A space exploration agency wants to send a spacecraft to Neptune.

They decide to use a **manned** spacecraft.

Is this a good decision?

.....

Explain your answer.

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

- (c) Large asteroids have collided with the Earth in the past.

What effect did these collisions have on the Earth?

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..... [2]

[Total: 5]

25

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Question 13 begins on page 26

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SECTION D

13 This question is about the greenhouse effect and global warming.

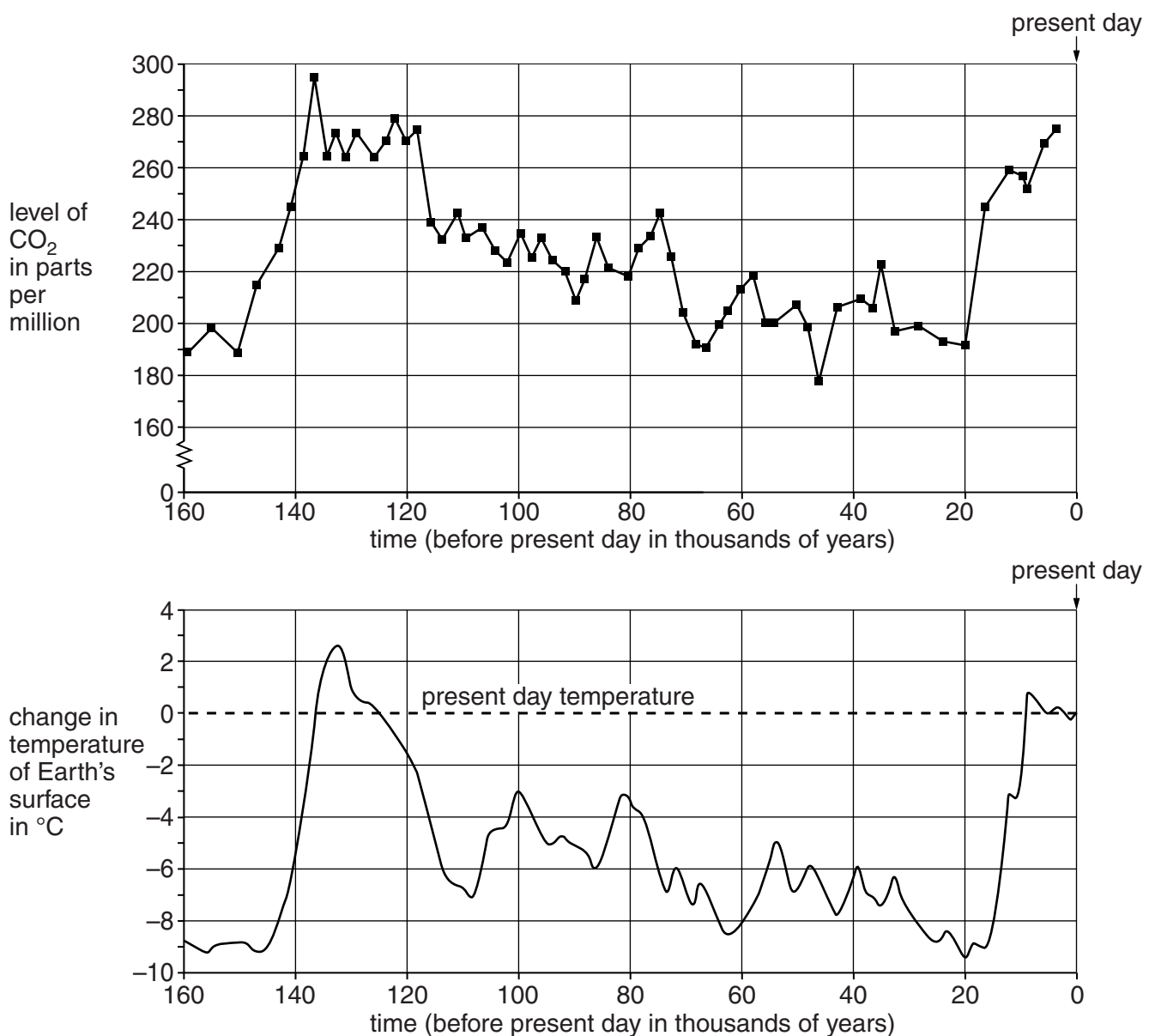
Some scientists say that an increase in global warming is part of a natural cycle.

Other scientists think that an increase in global warming will be disastrous for the world. They think that the surface temperature of the Earth is increasing and that this is because more fossil fuels are being burned.

Burning fossil fuels makes a lot of carbon dioxide.

Look at the graphs.

They show how the amount of carbon dioxide in the air and the temperature of the Earth have changed over the last 160 000 years.



- (a) (i) What is the **highest** level of carbon dioxide in the air during the last 160 000 years?

..... parts per million [1]

- (ii) Describe what has happened to the surface temperature of the Earth in the last 160 000 years.

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

- (iii) Is there a link between the surface temperature of the Earth and the level of carbon dioxide in the air?

Explain your answer. Use information from the graphs.

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

Question 13(b) begins on page 28

- (b) Look at the table. It shows the carbon dioxide emissions for some countries in 2003.

It also shows the population for these countries in 2003.

Country	Continent	Carbon dioxide emissions in million tonnes per year	Population in millions
Botswana	Africa	4	2
China	Asia	3762	1254
France	Europe	390	62
Germany	Europe	854	82
Ghana	Africa	7	23
India	Asia	1050	1064
Indonesia	Asia	318	215
Japan	Asia	1201	128
Mozambique	Africa	2	21
Russia	Asia	1527	143
UK	Europe	540	59
USA	America	5729	291
World		24 983	6268

- (i) Which **three** countries had the **lowest** carbon dioxide emissions in 2003?

.....

Suggest why.

.....

..... [2]

- (ii) Show that the percentage of the world emissions of carbon dioxide in 2003 made by the USA was 22.9%.

.....

..... [1]

29

(iii) In 2003, about 4.6% of the world's population lived in the USA.

22.9% of the world's emissions of carbon dioxide came from the USA.

Some other countries are concerned about the difference between these two percentages.

Suggest why.

.....

..... [2]

[Total: 10]

END OF QUESTION PAPER

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The Periodic Table of the Elements

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							