

Surname	Centre Number	Candidate Number
First name(s)		0



GCSE

3445U20-1



Z22-3445U20-1

WEDNESDAY, 15 JUNE 2022 – MORNING

APPLIED SCIENCE (Double Award)

UNIT 2: Space, Health and Life

FOUNDATION TIER

1 hour 30 minutes

Section A

ADDITIONAL MATERIALS

In addition to this examination paper, you will require a separate Resource Folder, calculator, pencil and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid.

You may use a pencil for graphs and diagrams only.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

Section B

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	4	
2.	5	
3.	7	
4.	8	
5.	10	
6.	6	
7.	10	
8.	25	
Total	75	

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

Question **6** is a quality of extended response (QER) question where your writing skills will be assessed.

You are reminded to show all your workings. Credit is given for correct workings even when the final answer given is incorrect.

You will need to refer to the separate Resource Folder to answer question **8**.

A Periodic Table is printed on page 20.



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Section A

Answer **all** questions in the spaces provided.

1. Len is responsible for monitoring the quality of water in Welsh rivers. He collects water samples from eight different sites along a river.

Diagram 1 shows the position of the collection sites.

Diagram 1

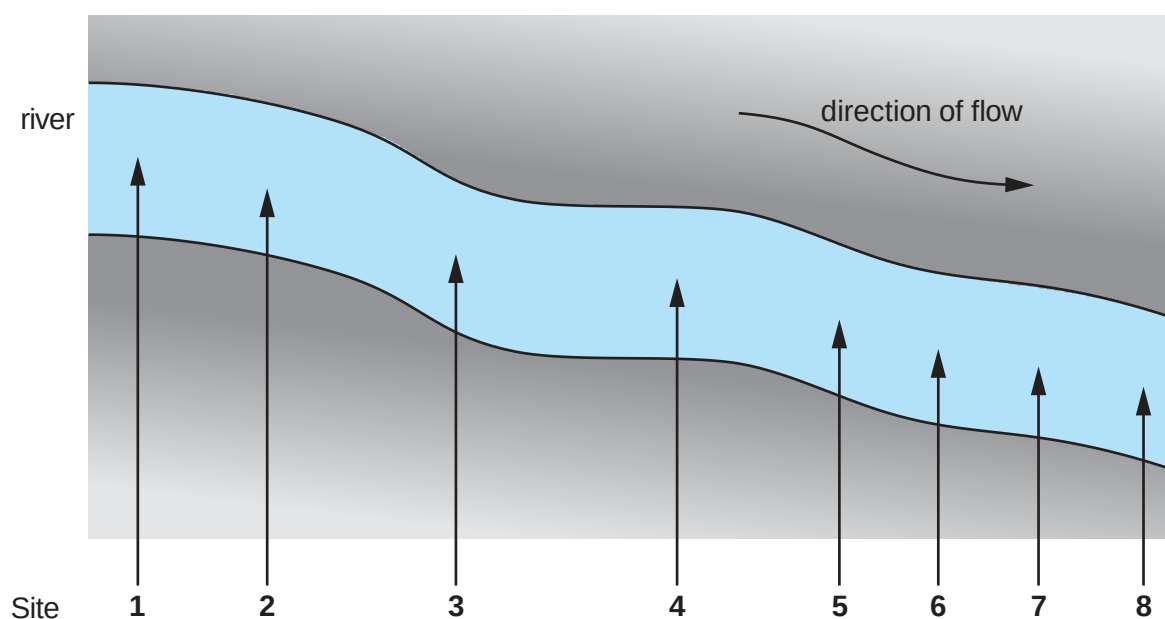
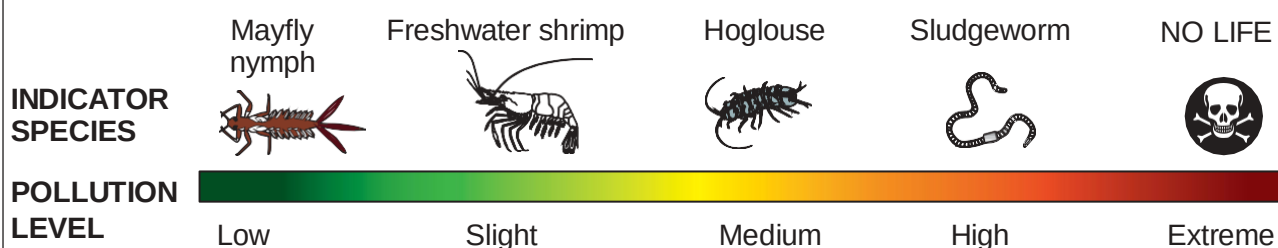


Diagram 2 shows different invertebrates and the level of water pollution in which they can live.

Diagram 2



Use the information in the diagrams to answer the following questions.

(a) Complete the table.

[3]

Site	Indicator species	Pollution level
1 & 2		low
3 & 4	No life	
5	Sludgeworm	high
6	Sludgeworm	high
7 & 8		medium

(b) Between which **two** sites did pollution enter the river?

[1]

..... and



2. Human activity is having an impact on our environment and its biodiversity.

(a) State why using more and more land for house building is reducing biodiversity. [1]

.....

(b) Protected areas such as nature reserves are an attempt to maintain biodiversity.

Tick (✓) two other methods being used to maintain biodiversity. [2]

seed banks

☐

captive breeding

☐

fishing

☐

photography

☐

(c) Explain why there need to be wildlife corridors between nature reserves. [2]

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.....

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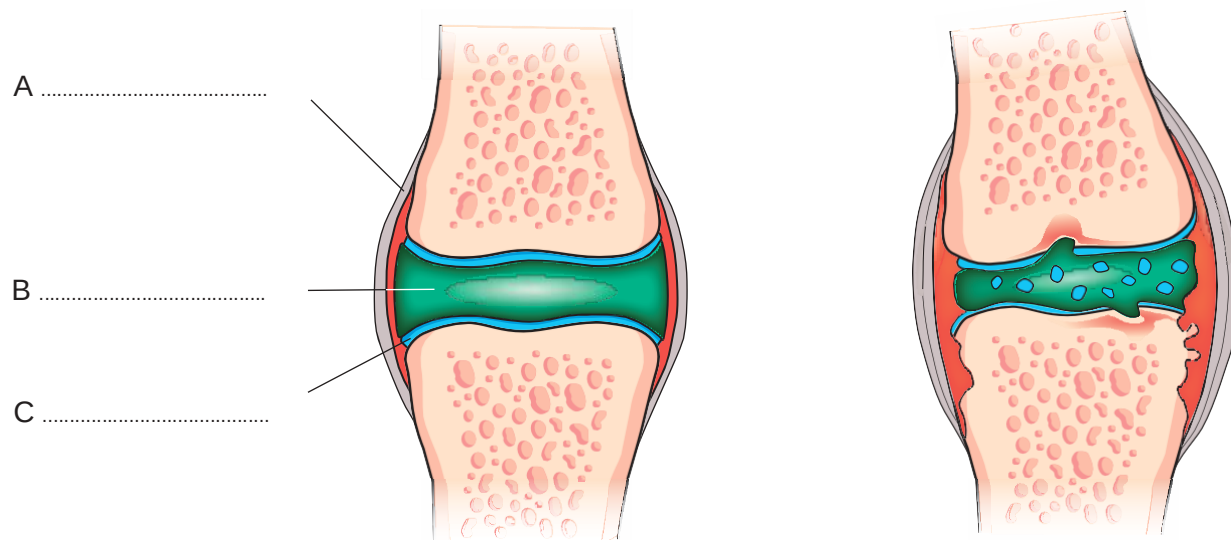
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3. The upper and lower leg are connected by the knee joint.

The lower leg is connected to the foot by the ankle joint.

- (a) The knee is a synovial hinge joint.
The diagram shows a healthy knee joint and one damaged by osteoarthritis.



- (i) Label the diagram using only the words from the box. [3]

synovial fluid

ligament

muscle

cartilage

- (ii) I. State **one** cause of osteoarthritis. [1]

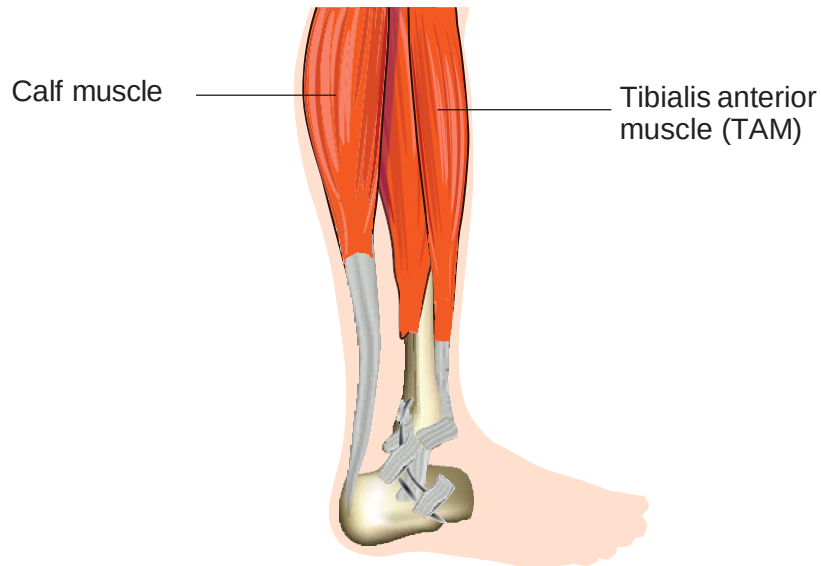
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- II. State why a person suffering from osteoarthritis has knee pain. [1]

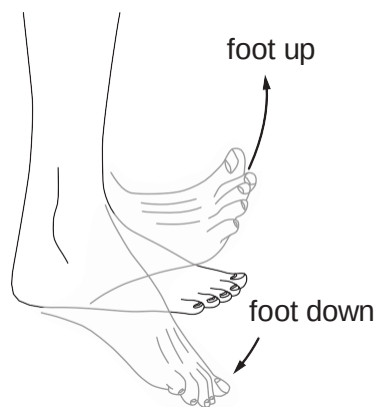
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- (b) The ankle joint is controlled by a pair of antagonistic muscles. These are the calf muscle and the tibialis anterior muscle (TAM).



Explain how these muscles work together to move the foot up and down as shown in the diagram. [2]



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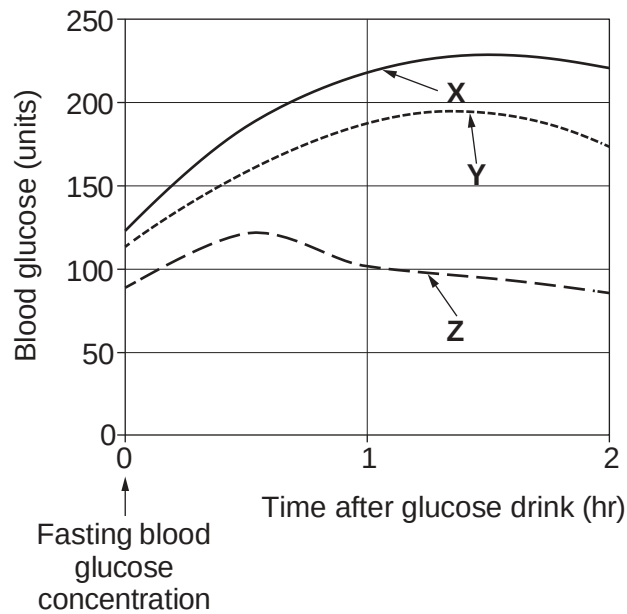
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4. Medical scientists have developed methods to diagnose, monitor and treat diseases.

- (a) For one type of diabetes test, you fast (don't eat) overnight, and the fasting blood glucose level is measured. Then you drink a glucose drink, and blood glucose levels are tested for the next two hours. A blood glucose level less than 140 units is normal. A reading of more than 200 units after two hours indicates diabetes. A reading between 140 and 199 units indicates prediabetes.



(i) State which line, **X**, **Y** or **Z** would show a person is diabetic..... [1]

(ii) State **one** method used to control diabetes. [1]

.....



- (b) Ionising radiation and ultrasound are used by medical scientists. Examples of imaging techniques are shown below. Complete the table. [4]

	Imaging technique	Example of its medical use
A		X-ray detects broken bones
B		
C		

- (c) Damage to DNA can lead to cancer.

- (i) Complete the sentence below to show the base pairs found in DNA. [1]

T pairs with and G pairs with

- (ii) Give **one** reason why imaging technique **A** could cause DNA damage. [1]

.....



5. Three images have been combined below to show colliding galaxy clusters 5 billion light years from Earth.

- The background is a Hubble Space Telescope image taken using visible light.
- The blue area is an X-ray image from the Chandra Space Observatory.
- The red area is an image from a radio telescope.



- (a) (i) State **one** advantage of using space-based telescopes to produce images of objects in space. [1]

.....

.....

- (ii) State **one** disadvantage of using space-based telescopes to produce images of objects in space. [1]

.....

.....

- (b) Complete the following sentence by underlining the correct word in the brackets.

It takes radio waves 5 billion (**seconds / hours / days / years**) to travel from the colliding galaxy clusters to reach the Earth. [1]



(c) The image is taken using X-rays, radio waves and visible light.

(i) Which of these waves has the highest frequency? [1]

(ii) Which of these waves has the longest wavelength? [1]

(iii) Name **two** other types of electromagnetic waves that could be used to take images of galaxies. [2]

..... and

(d) The speed of electromagnetic waves through space is 300 000 000 m/s. Some radio telescopes on Earth detect radio waves which have wavelengths between 2 and 10 m.

Use the equation

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

to calculate the **maximum** frequency of radio waves detected. [2]

frequency = Hz

(e) Images of the Universe can be used to support the current theory of the origin of the Universe.

State the name of this theory. [1]

.....



6. The table shows the quantities of nutrients in a balanced diet for the average adult and an actual diet for one particular adult. The balanced diet is based on guideline daily amounts (GDA).

Nutrient	Quantity per day	
	Balanced diet	Actual diet
Energy	2000 kcal	2500 kcal
Protein	50g	50g
Fat	70g	120g
Carbohydrates	310g	400g
Sugar	90g	180g
Sodium (salt)	2.3g	5.6g
Fibre	30g	9g

Compare the actual diet with the balanced diet and describe how the actual diet will affect the health of this adult. [6 QER]

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6



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7. Tom competes in a 400 m training race. His split times to travel each 100 m are measured. His pulse rate is also measured in beats per minute (bpm) before the race starts and at every 100 m interval. The measurements are shown in **Table 1** below.

Table 1

Distance (m)	0	100	200	300	400
Time (s)	0	13	27	43	58
Pulse rate (bpm)	78	133	132	134	133

Use the data in the table and your knowledge to answer the following questions.

- (a) (i) State Tom's resting pulse rate. bpm [1]
- (ii) One minute after the race ended, Tom's pulse rate had dropped to 122.

Calculate **how much longer** it will be for his pulse to return to his resting rate, assuming it continues to drop at the same rate. [3]

time = minutes

- (iii) Use the equation

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

and the information in **Table 1** to calculate Tom's mean speed over the race. [2]

mean speed = m/s



- (iv) Use the information in **Table 1** to complete **Table 2** to show the order of running each 100 m section from fastest to slowest. The fastest 100 m section has already been filled in. [2]

Table 2

Fastest section	0 to 100 m
↓	 to..... m
	 to..... m
Slowest section	 to..... m

- (b) Tom then trains for 6 months. **Complete Table 3** below by estimating Tom's pulse rate every 100 m in a 400 m race after training. [2]

Table 3

Distance (m)	0	100	200	300	400
Pulse rate (bpm)					



Section B

Refer to the separate Resource Folder to answer question 8.

8. (a) (i) The Red Admiral butterfly competes with greenfly for food. The scientific name for one type of greenfly is *Acyrtosiphon pisum*.

Complete the table below to show the scientific classification of greenfly. [3]

Kingdom:	
Phylum:	
Class:	Insecta
Order:	Hemiptera
Family:	Aphididae
Genus:	
Species:	
Scientific name:	<i>Acyrtosiphon pisum</i>

- (ii) Another butterfly is found in Africa. Its scientific name is *Vanessa abyssinica*.



- I. State **one** advantage of using scientific names. [1]

.....

.....

- II. State **one** piece of evidence, from its scientific name, that shows it is related to the Red Admiral. [1]

.....

.....



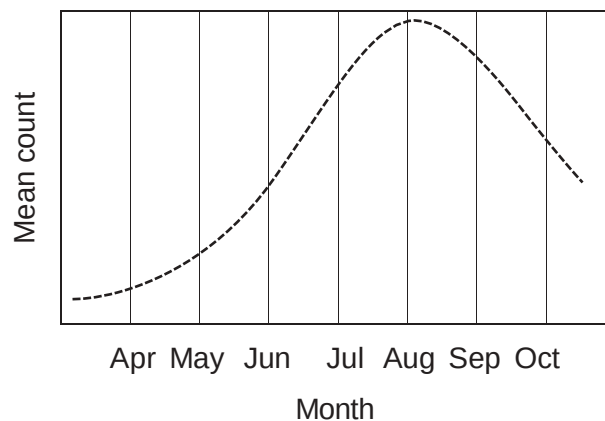
(b) The variation in population of adult Red Admirals is shown by the graph in **Figure 1**.

- (i) I. State the name of the seasonal movement of animals as seen in Red Admirals. [1]

- II. State **one** reason why this seasonal movement occurs. [1]

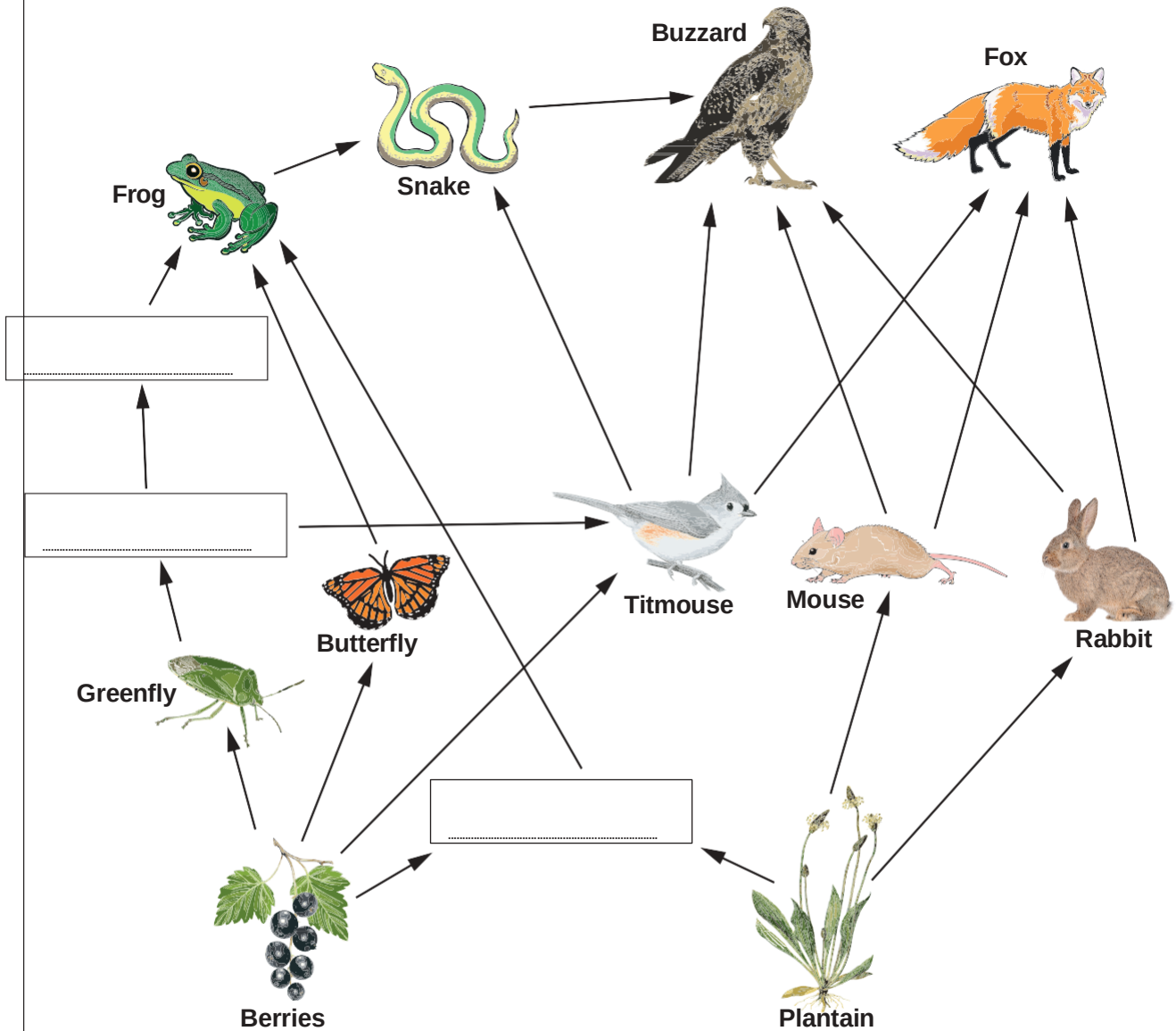
- (ii) Use the information in the graph in **Figure 1** to compare the variation of the Red Admiral population in 2019 with the mean change since 1976. [2]

- (iii) Red Admirals are a food source for frogs. **Add a line** to the graph below to show how the population of frogs changed between April and October in 2019. [2]



(c) **Table 2** gives information about the feeding relationships in one woodland habitat.

(i) Use the information in **Table 2** to **complete** the food web below. [3]



(ii) In this habitat, the fields containing plantain are cleared to make way for housing. Explain how this affects the foxes. [3]

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.....



(iii) Explain why the frog can be found at more than one trophic level. [2]

.....

.....

.....

(d) Refer to **Table 2** to construct a pyramid of biomass for a food chain of **five** trophic levels starting with berries and ending with buzzards. [3]

(e) Use the information in **Figure 2** to calculate the efficiency of energy transfer between the primary and secondary consumers. [3]

% efficiency =

END OF PAPER

8





THE PERIODIC TABLE

1

2

Group

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 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
86 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	99 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	179 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	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86
223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89															

Key

A_r

Symbol

Name

Z

relative atomic mass

Z

atomic number