



GCSE

3445UB0-1

MONDAY, 10 JUNE 2024 – MORNING

APPLIED SCIENCE (Double Award)

**UNIT 2: Space, Health and Life
HIGHER TIER**

1 hour 30 minutes plus your additional time allowance

Surname _____

First name(s) _____

Centre Number _____

Candidate Number 0 _____

ADDITIONAL MATERIALS

- **Separate Resource Folder**
- **Calculator**
- **Pencil**
- **Ruler.**

ITEMS INCLUDED WITH QUESTION PAPER

A separate Diagram Booklet.

A separate Data Booklet.

A separate Resource Folder.

The Diagram Booklet MUST be handed in to the invigilators and sent for marking.

INSTRUCTIONS TO CANDIDATES

Use black ink, black ball-point pen or your usual method.

Write your name, centre number and candidate number in the spaces provided on the front cover.

Answer ALL questions.

Write your answers in the spaces provided in this booklet. If you run out of space, use the additional pages at the back of the booklet, taking care to number the question(s) correctly.

(Turn over)

INFORMATION FOR CANDIDATES

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

Question 7(a) 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 questions 1 and 2.

A Periodic Table is printed in the separate data booklet.

| For Examiner's use only | | | |
|--------------------------------|-----------------|---------------------|---------------------|
| | Question | Maximum Mark | Mark Awarded |
| Section A | 1. | 19 | |
| | 2. | 6 | |
| Section B | 3. | 5 | |
| | 4. | 6 | |
| | 5. | 7 | |
| | 6. | 10 | |
| | 7. | 8 | |
| | 8. | 7 | |
| | 9. | 7 | |
| | Total | 75 | |

SECTION A

Answer ALL questions.

Refer to the separate Resource Folder to answer questions 1 and 2.

1 (a) Dave says the distances of each leg in a long-distance triathlon are all double those in a middle-distance triathlon.

Tom says the distances of each leg in an Olympic triathlon are double those in a sprint triathlon.

Use data from TABLE 1 in the Resource Folder to explain whether Dave or Tom is correct. [2 marks]

1 (b) Piera says Jake breathed in less air per minute at 4 minutes than at 3 minutes because his breathing rate was lower.

Petula disagrees because Jake's airflow per breath was greater at 4 minutes than at 3 minutes.

**Use data from TABLE 2, and the equation on page 3 in the Resource Folder, to explain whether you agree with Piera or Petula.
[2 marks]**

1 (c) Use the information in TABLE 4 and equations from pages 4 and 5 in the Resource Folder to answer the following questions.

(i) Calculate Malcolm's BMI. [2 marks]

BMI = _____

(ii) Calculate Malcolm's maximum heart rate.
[1 mark]

maximum heart rate = _____ bpm

(d) Karen wants to exercise in the aerobic zone. Use the information in TABLES 3 and 4 and on pages 4 and 5 in the Resource Folder to determine the range in heart rate she should aim for. [1 mark]

heart rate range is from

_____ bpm to _____ bpm.

1 (e) Data in the TRIATHLON TIMES section (page 6) and TABLE 1 in the Resource Folder was used to plot distance-time graphs for each of the triathlons described. There were three sections in each graph to show the swim, cycle and run legs. The graphs did not include transition times. One of the graphs is shown in GRAPH 1 in the separate diagram booklet.

Determine which type of triathlon is represented by the graph and give TWO reasons for your answer. [3 marks]

Type of triathlon: _____

Reason 1: _____

Reason 2: _____

- 1 (f) Use the information about Triathlon times on page 6, the information in TABLE 1 and an equation on page 7 in the Resource Folder to calculate the mean speed during an Ironman triathlon. [3 marks]

mean speed = _____ km/h

- (g) When a triathlete mounts their bike they are travelling at 1.5 m/s.
Use the information in TABLE 5 and an equation on page 7 in the Resource Folder to calculate the acceleration along level ground in a cycle leg. [3 marks]

acceleration = _____ m/s²

- 1 (h) It is thought that the higher the age group of the triathlete, the lower the mean speed in the cycle leg. Use data from GRAPH 1 in the Resource Folder to explain whether this statement is true for all age groups. [2 marks]**

| |
|-----------|
| |
| 19 |

- 2 Use the information in TABLE 2 in the Resource Folder to answer the following questions.**
- (a) Calculate the mean increase in heart rate per minute DURING EXERCISE. [3 marks]**

**mean increase in
heart rate per minute = _____ bpm**

- (b) Calculate the time at which the heart rate returns to its resting value after exercise. Assume that the heart rate drops at a constant rate after exercise. [3 marks]**

time = _____ minutes

| |
|----------|
| |
| 6 |

(Turn over)

THIS IS A BLANK PAGE

TURN OVER

kingdom → phylum → order → genus → species

→

→

→

→

SECTION B

Answer ALL questions.

3 Living things are classified using a system developed by Carl Linnaeus.

(a) There are 5 kingdoms. These include single-celled organisms and plants.

Name TWO other kingdoms. [2 marks]

_____ and _____

(b) Linnaeus' system further ranked living things to a species level. This is illustrated on the opposite page. Complete the sequence. [2 marks]

(c) *Panthera leo* is the scientific name for a lion.

State the advantage of using scientific names instead of common names. [1 mark]

| |
|----------|
| |
| 5 |

- 4 Students were investigating the energy content of food. They heated 15g of water with each sample of food, as shown in **DIAGRAM 4.1** in the separate diagram booklet.

Their results are shown in **TABLE 4.2** in the separate diagram booklet.

- (a) Complete the table. [1 mark]

- (b) Use the equation:

$$\begin{array}{l} \text{energy} \\ \text{released} \\ \text{(J)} \end{array} = \begin{array}{l} \text{mass of} \\ \text{water (g)} \end{array} \times 4.2 \times \begin{array}{l} \text{temperature} \\ \text{increase (}^\circ\text{C)} \end{array}$$

to calculate the energy released by the cheese. [2 marks]

energy released = _____ J

- 4 (c) Use the students' results to calculate the energy provided by a snack consisting of 20 g of cheese and 15 g of oatie biscuits. [3 marks]

energy = _____ J

| |
|---|
| |
| 6 |

5 All drugs can have side effects. New drugs undergo testing before they can be prescribed by doctors.

(a) State the meaning of each of the following terms used in drug development.

(i) Blind study [1 mark]

(ii) Double-blind study [1 mark]

(iii) Placebo [1 mark]

5 (b) Aspirin is a common treatment for patients suffering cardiovascular disease. State ONE positive and ONE negative effect of regularly taking aspirin. [2 marks]

Positive: _____

Negative: _____

- 5 (c) A painkiller has 196 possible side effects. The most common side effects and their occurrence are listed below.

| Side effect | Occurrence (%) |
|-------------|----------------|
| nausea | 12.5 |
| headache | 19.5 |
| insomnia | 20.7 |
| anxiety | 11.5 |

If there are 100 000 people being treated with this painkiller at any one time, calculate how many are likely to suffer from insomnia. [2 marks]

number of people = _____

| |
|---|
| |
| 7 |

6 (a) The spectrum from a star is crossed by dark lines. This is called an absorption spectrum.

(i) Explain how an absorption spectrum is produced. [2 marks]

6 (a)(ii)

An absorption spectrum from a star is shown in **DIAGRAM 6.1** in the separate diagram booklet.

Absorption spectra for different elements are shown in **DIAGRAM 6.2** in the separate diagram booklet.

Complete the table below to show whether each element is present in the star. [2 marks]

| Element | Present in the star (Yes or No) |
|---------|------------------------------------|
| 1 | _____ |
| 2 | _____ |
| 3 | _____ |
| 4 | _____ |

(Turn over)

6 (b) The table below gives information about some planets in our solar system.

| Planet | Distance to Sun (million km) | Mean temperature on side facing the Sun ($^{\circ}\text{C}$) |
|---------|---------------------------------|--|
| Mercury | 60 | 430 |
| Venus | 110 | 470 |
| Earth | 150 | 20 |
| Mars | 230 | -20 |
| Jupiter | 780 | -150 |

- (i) Plot the data on GRAPH 6.3 in the separate diagram booklet. [2 marks]
- (ii) **CIRCLE** the anomalous point on the grid. [1 mark]
- (iii) Join the points with a smooth curve. [1 mark]
- (iv) Determine the distance from the Sun at which a planet would have a mean temperature to be 0°C . [1 mark]

distance = _____ (million km)

(Turn over)

- 6 (c) Complete **DIAGRAM 6.4** in the separate diagram booklet to show the shape of the orbit of a comet around the Sun. [1 mark]

| |
|----|
| |
| 10 |

7 (b) CHART 7.1 in the separate diagram booklet is available to you.

Results from water sampling at two locations are given in TABLE 7.2 in the separate diagram booklet.

Use the data in TABLE 7.2 to compare the quality of water at the two locations. [2 marks]

| |
|----------|
| |
| 8 |

8 The greenhouse effect is important to stabilise the conditions on Earth needed for life.

(a) Describe how the greenhouse effect occurs. [3 marks]

8 (b) State TWO ways an enhanced greenhouse effect has an impact on Earth. [2 marks]

1. _____

2. _____

8 (c) State TWO ways humans can reduce their dependency on fossil fuels. [2 marks]

1. _____

2. _____

| |
|---|
| |
| 7 |

9 Vaccines protect against disease.

- (a) GRAPH 9.1 in the separate diagram booklet shows blood antibody levels following a first vaccination and a booster. Once antibody levels rise above a threshold value then there is immunity against the disease.**

Compare the immune response following the initial vaccination and the booster vaccination. [4 marks]

(b) Explain how a vaccine protects against specific illnesses. [3 marks]

| |
|---|
| |
| 7 |

END OF PAPER

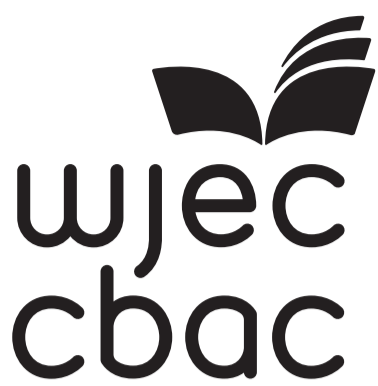
| Question number | Additional page, if required. Write the question numbers in the left-hand margin. |
|------------------------|--|
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |

| Question number | Additional page, if required. Write the question numbers in the left-hand margin. |
|------------------------|--|
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |

| Question number | Additional page, if required. Write the question numbers in the left-hand margin. |
|------------------------|--|
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |

| Question number | Additional page, if required. Write the question numbers in the left-hand margin. |
|------------------------|--|
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |

| Question number | Additional page, if required. Write the question numbers in the left-hand margin. |
|------------------------|--|
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |



GCSE

3445UB0-1

MONDAY, 10 JUNE 2024 – MORNING

APPLIED SCIENCE (Double Award)

**UNIT 2: Space, Health and Life
HIGHER TIER**

1 hour 30 minutes plus your additional time allowance

DIAGRAM BOOKLET

This Diagram Booklet MUST be handed in to the invigilators and sent for marking.

Surname _____

First name(s) _____

Centre Number _____

Candidate Number 0 _____

GRAPH 1

Distance (km)

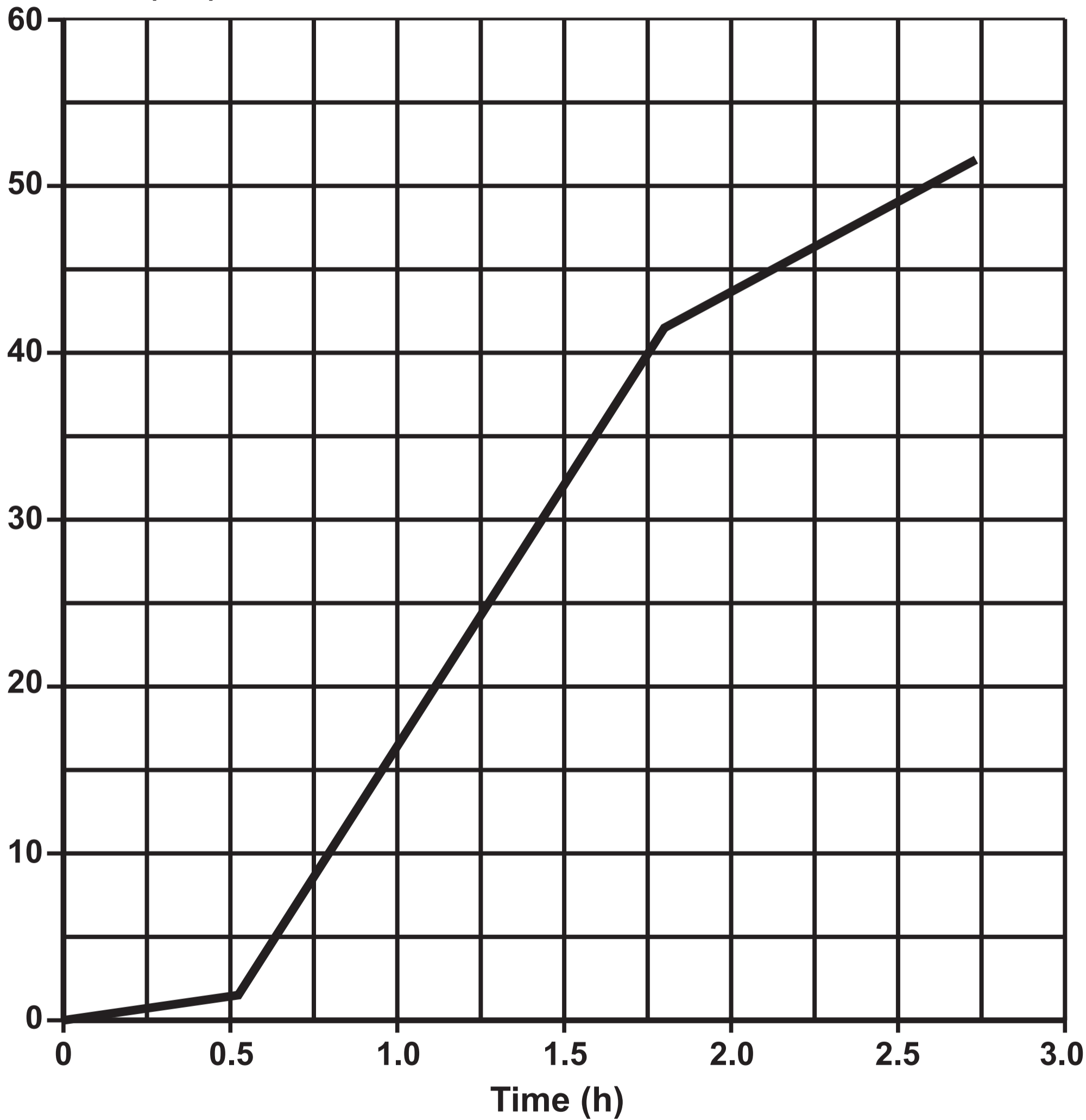


DIAGRAM 4.1

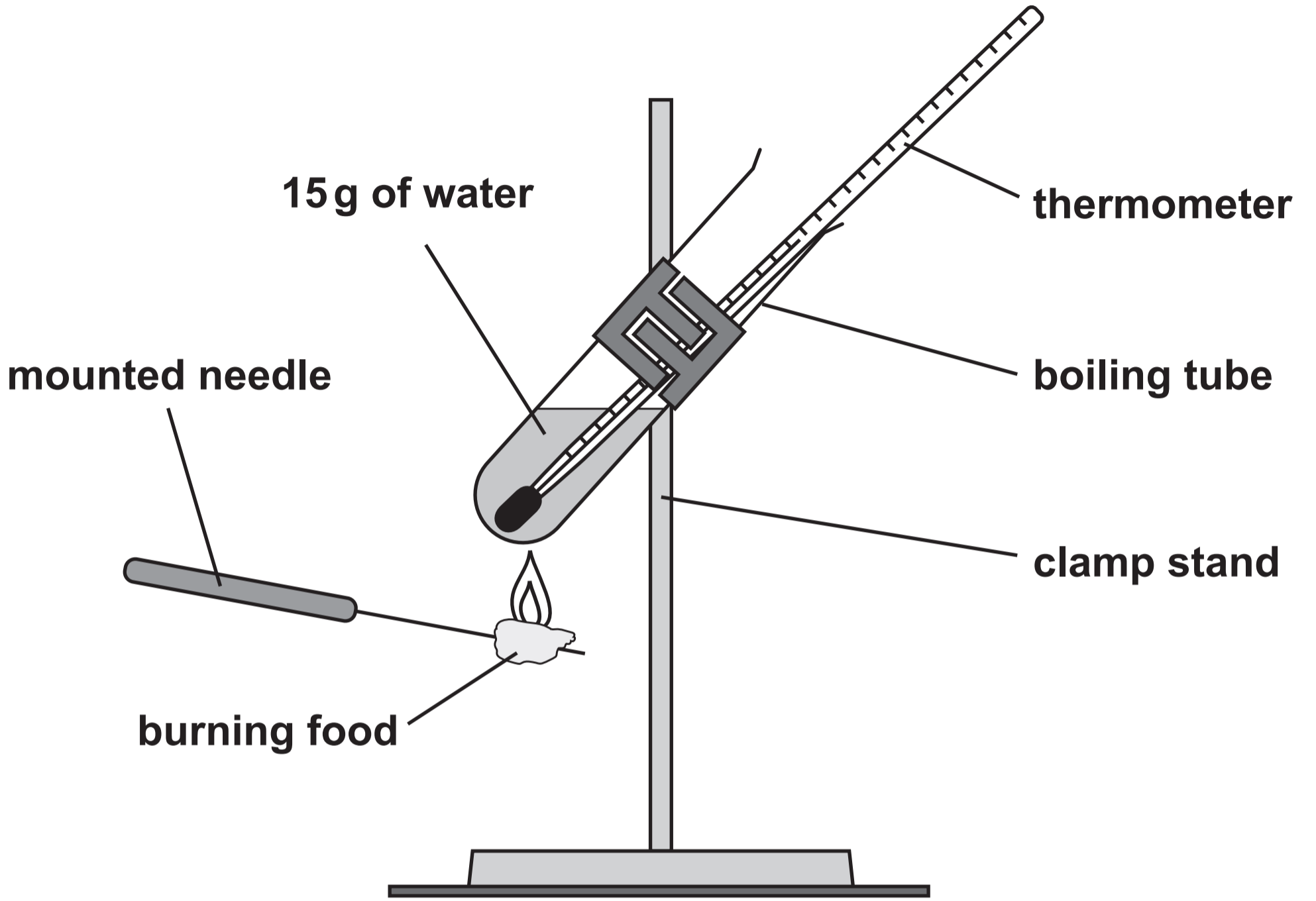


TABLE 4.2

| Food | Mass of food burnt (g) | Initial water temperature (°C) | Final water temperature (°C) | Rise in temperature of water (°C) |
|----------------------|-------------------------------|---------------------------------------|-------------------------------------|--|
| bread | 2.5 | 18 | 23 | 5 |
| cheese | 4.0 | — | 31 | 14 |
| cornflakes | 3.0 | 17 | 29 | 12 |
| oatie biscuit | 5.0 | 18 | 25 | 7 |

THIS IS A BLANK PAGE
TURN OVER

DIAGRAM 6.1

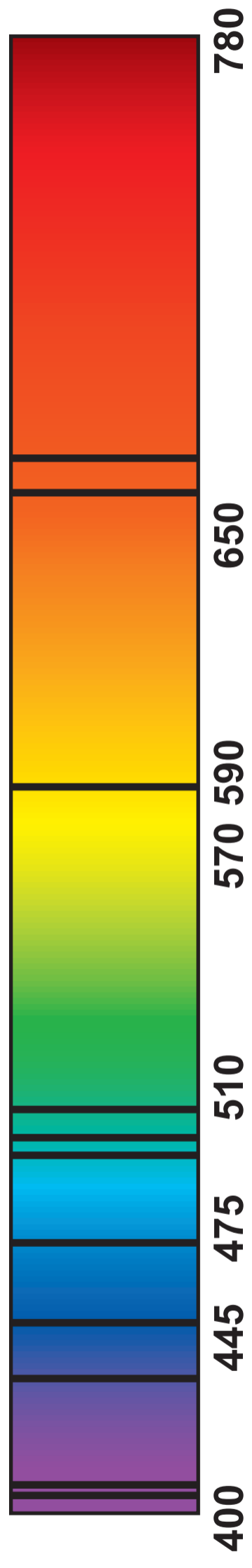
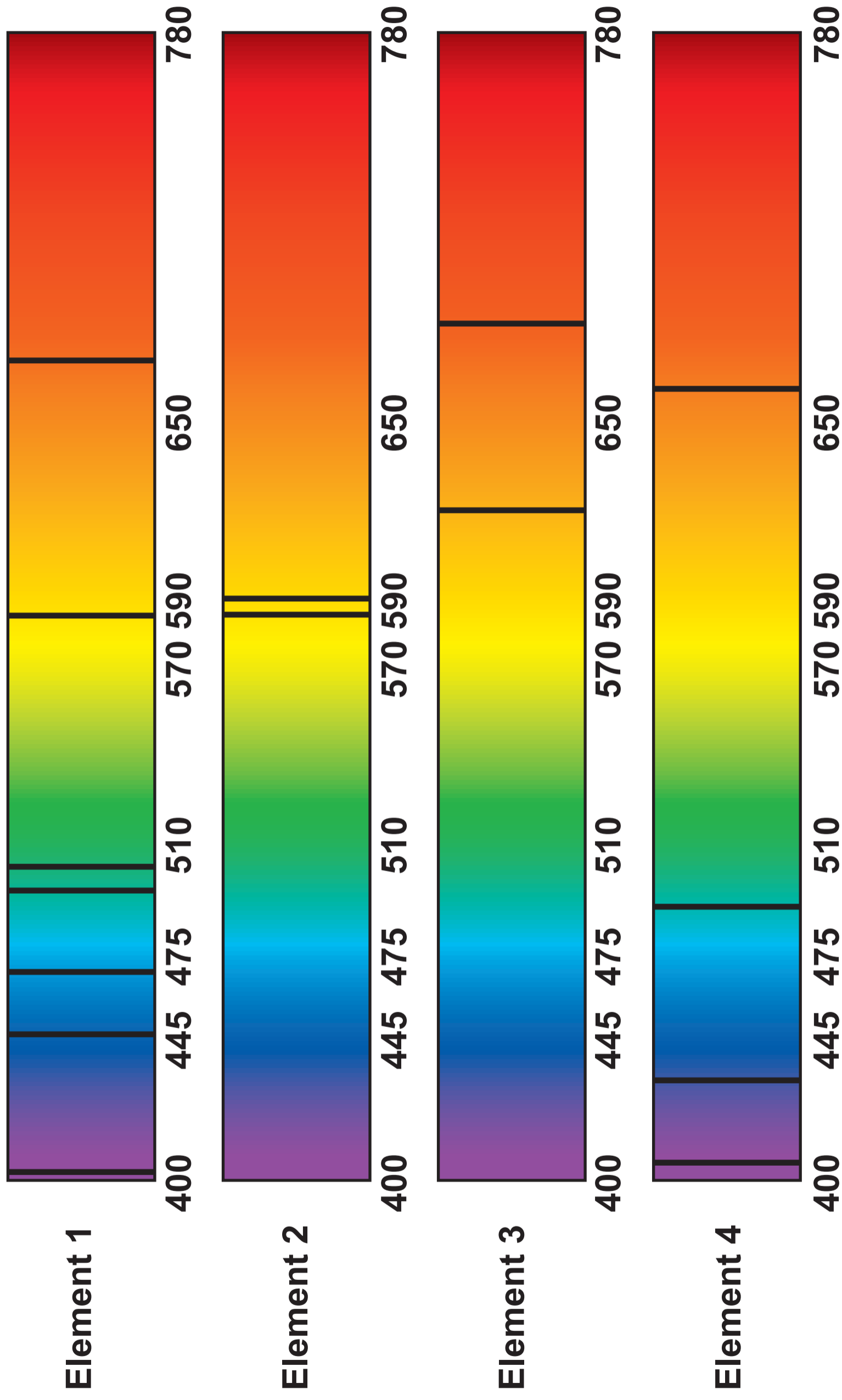
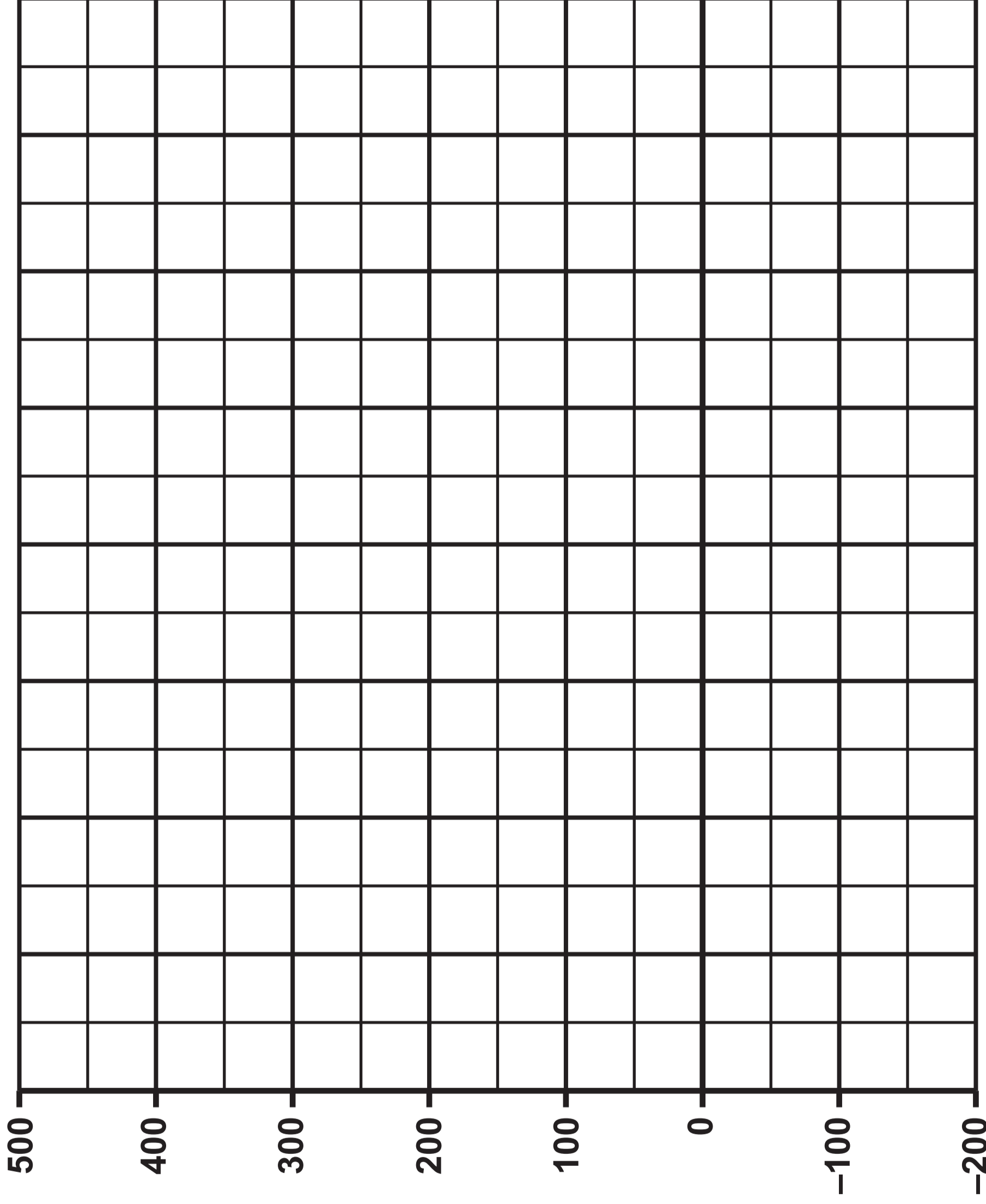


DIAGRAM 6.2



GRAPH 6.3

Mean temperature on side facing the Sun ($^{\circ}\text{C}$)



Distance to Sun (million km)

DIAGRAM 6.4



CHART 7.1









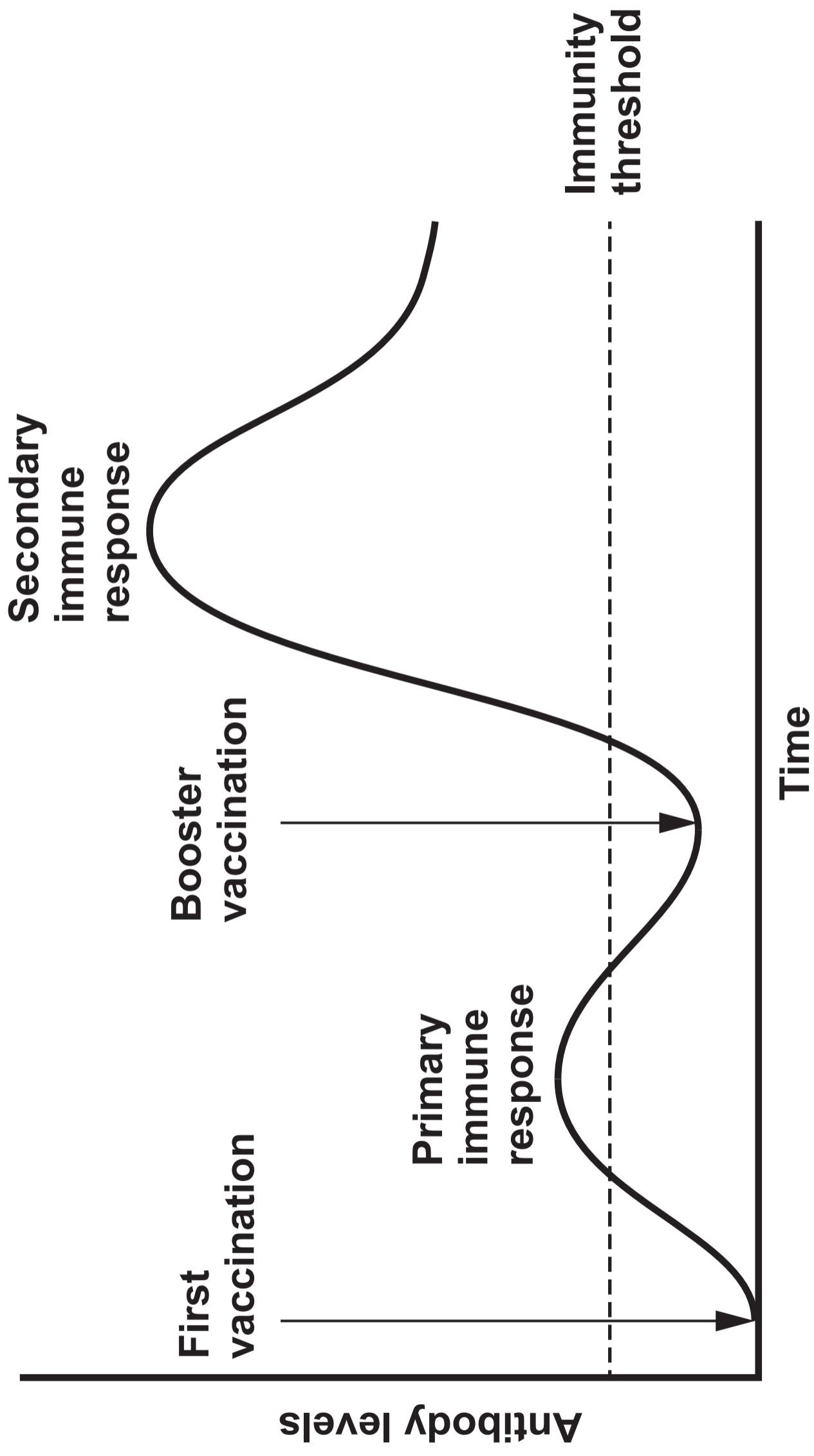
| Pollution level | Indicator species | |
|--|---|--|
| A Clean water |  Stonefly nymph (about 10 mm) |  Mayfly nymph (about 20 mm) |
| B Some pollution |  Freshwater shrimp (about 20 mm) |  Caddis fly larva (about 10 mm) |
| C Moderate pollution |  Water louse (about 10 mm) |  Bloodworm (about 20 mm) |
| D High pollution |  Sludgeworm (about 120 mm) |  Rat-tailed maggot (about 55 mm) |
| E Very High pollution – no life | | |

TABLE 7.2

| Species | Total in water sample | |
|--------------------------|------------------------------|-------------------|
| | location 1 | location 2 |
| Stonefly nymph | 0 | 0 |
| Caddis fly larva | 54 | 0 |
| Water louse | 2 | 0 |
| Bloodworm | 3 | 0 |
| Sludgeworm | 0 | 80 |
| Rat-tailed maggot | 1 | 65 |

GRAPH 9.1





GCSE

3445UB0-1

MONDAY, 10 JUNE 2024 – MORNING

APPLIED SCIENCE (Double Award)
UNIT 2: Space, Health and Life

HIGHER TIER

Data Booklet

THE PERIODIC TABLE

KEY

| | |
|-----|----------------------|
| Ar | relative atomic mass |
| Sym | symbol |
| Z | atomic number |

GROUP

1 2 3 4 5 6 7 0

| | | |
|---|---|---|
| 1 | H | 1 |
|---|---|---|

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|----|---|---|----|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|---|----|----|---|----|------|----|----|----|---|----|----|----|----|----|----|----|----|----|----|----|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|---|----|----|----|----|----|----|----|----|----|----|----|----|----|-----|----|----|-----|----|----|-----|----|----|-----|----|----|-----|----|----|-----|----|----|-----|----|----|-----|----|----|-----|---|----|-----|----|----|-----|----|----|-----|----|----|-----|----|----|-----|----|----|-----|----|----|-----|---|----|-----|----|----|-----|----|----|-----|----|----|-----|----|----|-----|----|----|-----|----|----|-----|----|----|-----|----|----|-----|----|----|-----|----|----|-----|----|----|-----|----|----|-----|----|----|-----|----|----|-----|----|----|
| 7 | Li | 3 | 9 | Be | 4 | 11 | Na | 11 | 23 | Na | 11 | 24 | Mg | 12 | 27 | Al | 13 | 28 | Si | 14 | 31 | P | 15 | 32 | S | 16 | 35.5 | Cl | 17 | 39 | K | 19 | 40 | Ca | 20 | 45 | Sc | 21 | 48 | Ti | 22 | 51 | V | 23 | 52 | Cr | 24 | 55 | Mn | 25 | 56 | Fe | 26 | 59 | Co | 27 | 59 | Ni | 28 | 63.5 | Cu | 29 | 65 | Zn | 30 | 70 | Ga | 31 | 73 | Ge | 32 | 75 | As | 33 | 79 | Se | 34 | 80 | Br | 35 | 84 | Kr | 36 | 86 | Rb | 37 | 88 | Sr | 38 | 89 | Y | 39 | 91 | Zr | 40 | 93 | Nb | 41 | 96 | Mo | 42 | 99 | Tc | 43 | 101 | Ru | 44 | 103 | Rh | 45 | 106 | Pd | 46 | 108 | Ag | 47 | 112 | Cd | 48 | 115 | In | 49 | 119 | Sn | 50 | 122 | Sb | 51 | 127 | I | 53 | 131 | Xe | 54 | 133 | Cs | 55 | 137 | Ba | 56 | 139 | La | 57 | 179 | Hf | 72 | 181 | Ta | 73 | 184 | W | 74 | 186 | Re | 75 | 190 | Os | 76 | 192 | Ir | 77 | 195 | Pt | 78 | 197 | Au | 79 | 201 | Hg | 80 | 204 | Tl | 81 | 207 | Pb | 82 | 209 | Bi | 83 | 210 | Po | 84 | 210 | At | 85 | 223 | Fr | 87 | 226 | Ra | 88 | 227 | Ac | 89 | 222 | Rn | 86 |
|---|----|---|---|----|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|---|----|----|---|----|------|----|----|----|---|----|----|----|----|----|----|----|----|----|----|----|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|---|----|----|----|----|----|----|----|----|----|----|----|----|----|-----|----|----|-----|----|----|-----|----|----|-----|----|----|-----|----|----|-----|----|----|-----|----|----|-----|----|----|-----|---|----|-----|----|----|-----|----|----|-----|----|----|-----|----|----|-----|----|----|-----|----|----|-----|---|----|-----|----|----|-----|----|----|-----|----|----|-----|----|----|-----|----|----|-----|----|----|-----|----|----|-----|----|----|-----|----|----|-----|----|----|-----|----|----|-----|----|----|-----|----|----|-----|----|----|-----|----|----|

THE PERIODIC TABLE

PERIODIC TABLE – KEY ATOMIC NUMBER – SYMBOL – NAME

| | |
|----|----------------|
| 1 | H – Hydrogen |
| 2 | He – Helium |
| 3 | Li – Lithium |
| 4 | Be – Beryllium |
| 5 | B – Boron |
| 6 | C – Carbon |
| 7 | N – Nitrogen |
| 8 | O – Oxygen |
| 9 | F – Fluorine |
| 10 | Ne – Neon |
| 11 | Na – Sodium |
| 12 | Mg – Magnesium |
| 13 | Al – Aluminium |
| 14 | Si – Silicon |
| 15 | P – Phosphorus |
| 16 | S – Sulfur |
| 17 | Cl – Chlorine |
| 18 | Ar – Argon |
| 19 | K – Potassium |
| 20 | Ca – Calcium |
| 21 | Sc – Scandium |
| 22 | Ti – Titanium |
| 23 | V – Vanadium |
| 24 | Cr – Chromium |
| 25 | Mn – Manganese |
| 26 | Fe – Iron |
| 27 | Co – Cobalt |
| 28 | Ni – Nickel |
| 29 | Cu – Copper |
| 30 | Zn – Zinc |
| 31 | Ga – Gallium |
| 32 | Ge – Germanium |
| 33 | As – Arsenic |

| | |
|----|-----------------|
| 34 | Se – Selenium |
| 35 | Br – Bromine |
| 36 | Kr – Krypton |
| 37 | Rb – Rubidium |
| 38 | Sr – Strontium |
| 39 | Y – Yttrium |
| 40 | Zr – Zirconium |
| 41 | Nb – Niobium |
| 42 | Mo – Molybdenum |
| 43 | Tc – Technetium |
| 44 | Ru – Ruthenium |
| 45 | Rh – Rhodium |
| 46 | Pd – Palladium |
| 47 | Ag – Silver |
| 48 | Cd – Cadmium |
| 49 | In – Indium |
| 50 | Sn – Tin |
| 51 | Sb – Antimony |
| 52 | Te – Tellurium |
| 53 | I – Iodine |
| 54 | Xe – Xenon |
| 55 | Cs – Caesium |
| 56 | Ba – Barium |
| 57 | La – Lanthanum |
| 72 | Hf – Hafnium |
| 73 | Ta – Tantalum |
| 74 | W – Tungsten |
| 75 | Re – Rhenium |
| 76 | Os – Osmium |
| 77 | Ir – Iridium |
| 78 | Pt – Platinum |
| 79 | Au – Gold |
| 80 | Hg – Mercury |

| | |
|-----------|----------------------|
| 81 | Tl – Thallium |
| 82 | Pb – Lead |
| 83 | Bi – Bismuth |
| 84 | Po – Polonium |
| 85 | At – Astatine |
| 86 | Rn – Radon |
| 87 | Fr – Francium |
| 88 | Ra – Radium |
| 89 | Ac – Actinium |