GCSE

3445U20-1

MONDAY, 10 JUNE 2024 – MORNING

APPLIED SCIENCE (Double Award)

UNIT 2: Space, Health and Life
FOUNDATION TIER

1 hour 30 minutes plus you 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.

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.

INFORMATION FOR CANDIDATES

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

Question 8(b) 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 9 AND 10.

A Periodic Table is printed in the separate data booklet.

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

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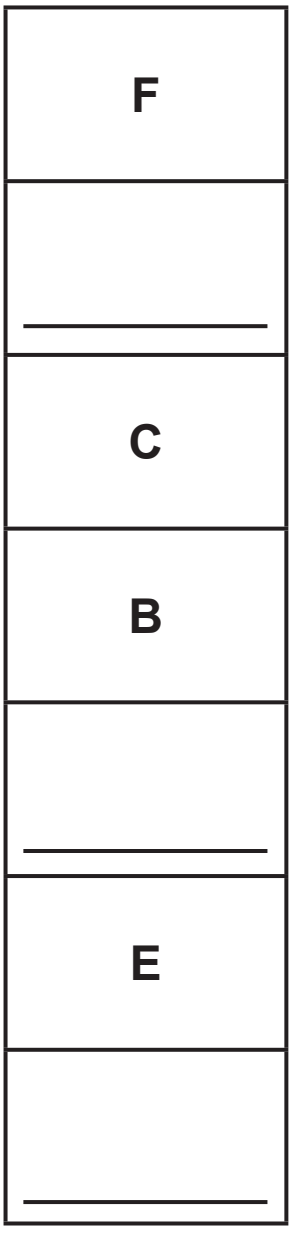
F
C
B
E

SECTION A

Answer ALL questions.

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

(a) The first division of living things is to place them into a kingdom. There are 5 kingdoms.

Complete the labelling of the kingdoms on DIAGRAM 1.1 in the separate diagram booklet. [3 marks]

(b) Linnaeus' system further ranked living things to a species level. This is illustrated in TABLE 1.2 in the separate diagram booklet. The levels are not in the correct order.

Place the letters representing the levels in the correct order in the column on the opposite page. Some have been done for you. [2 marks]

1 (c) The classification of a brown bear is shown in DIAGRAM 1.3 in the separate diagram booklet. Its scientific name is **Ursus arctos**.

A wolf has the scientific name **Canis lupus**. Complete the classification table below for a wolf. [3 marks]

Kingdom	Animalia
	_____
Class	_____
Order	Carnivora
	Canidae
Genus	_____
	lupus

8

2 (a) **On DIAGRAM 2.1 in the separate diagram booklet, label the carbon cycle. Use words from the box below. [3 marks]**

dissolving	evaporating	decay
respiration	combustion	

(b) **Complete the following sentences by UNDERLINING the correct word in the brackets. [2 marks]**

(i) **When plant and animal waste decomposes,**

(sulfates / nitrates / oxides) are added

to the soil.

(ii) **Plants use (sulfates / nitrates / oxides)**

in the soil to grow.

5

3 **Indicator species may be used in an investigation to monitor water pollution at three different locations along a stream.**

(a) **The method for an investigation to monitor water pollution in a stream is described below. However, some of the stages are missing.**

Complete the method by writing in the missing steps. [2 marks]

1. **Take a tray and a net to the first location.**

2. _____

_____

3. **Study the organisms in the tray.**

4. _____

_____

5. **Pour the invertebrates and the water gently back into the stream.**

6. **Repeat steps 1 – 5 at the second and third locations.**

3 (b) **CHART 3.1 in the separate diagram booklet is available to you.**

Results from the water sampling at each location are given in TABLE 3.2 in the separate diagram booklet.

(i) **Use the data in TABLE 3.2 to complete a bar chart on the grid in GRAPH 3.3 in the separate diagram booklet. [2 marks]**

(ii) **State which location is the cleanest. [1 mark]**

_____

(iii) **Give ONE reason for your answer. [1 mark]**

_____

_____

6

4 (a) **Theories about the Universe have changed over time.**

Tick (✓) the boxes next to the names of TWO of these theories. [2 marks]

- ☐ **Liquid State**
- ☐ **Steady State**
- ☐ **Loud Bang**
- ☐ **Big Bang**

(b) **Images of the Universe are taken using electromagnetic waves.**

Name TWO types of electromagnetic wave. [2 marks]

_____ **and**

_____

4 (c) **DIAGRAM 4.1 in the separate diagram booklet shows a spectrum from a star and four elements.**

Complete the table below by placing a tick (✓) if the element is present in the star. Hydrogen has been done for you. [1 mark]

Element	Element is present (✓)
hydrogen	✓
helium	
sodium	
lithium	

4 (d) **TABLE 4.2 in the separate diagram booklet gives information about the planets in our solar system.**

Use the information in TABLE 4.2 to answer the questions below.

(i) **Name the coldest ROCKY planet. [1 mark]**

(ii) **State how many ROCKY planets have moons. [1 mark]**

(iii) **Name the gas giant that orbits the Sun with the greatest SPEED. [1 mark]**

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4 (d)(iv)

Eris is a dwarf planet. Its orbit is 10 180 million km away from the Sun. Shaun says it is found in the asteroid belt between the orbits of Mars and Jupiter.

Explain whether you agree with Shaun. [1 mark]

(e) **On DIAGRAM 4.3 in the separate diagram booklet, tick (✓) the box next to the shape of the orbit of a comet around the Sun. [1 mark]**

10

5 Some students investigated the energy content of food. Their apparatus is shown in DIAGRAM 5.1 in the separate diagram booklet.

Their results are shown in TABLE 5.2 in the separate diagram booklet.

(a) Use the equation

energy released = 15 × 4.2 × temperature increase

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

energy released = _____ J

5 (b) **The students were asked to use their results to calculate the energy provided by a snack consisting of 15 g of oatie biscuits and 20 g of cheese.**
Complete the tables below to work out their answer. [3 marks]

Energy from 5 g of oatie biscuits (J)	Energy from 15 g of oatie biscuits (J)
441	

Energy from 4 g of cheese (J)	Energy from 20 g of cheese (J)
882	

Space for working

total energy from snack = _____ J

5

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Term	Description
Blind study	when only the researcher does not know if they are using the real drug
Double-blind study	when the patient and the researcher do not know if they are using the real drug
Placebo	an inactive substance made to look like the real drug
	when the patient does not know if they are given the real drug

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

The terms on the opposite page are used in drug development studies.

On the opposite page join each term to its description with a straight line. [3 marks]

3

7 **Some of the methods used in the treatment and diagnosis of disease are included in TABLE 7.1 in the separate diagram booklet.**

Place ONE tick (✓) in each row underneath the method used by each treatment or diagnosis. [4 marks]

4

8 Vaccines are used to protect against disease.

(a) Complete the following sentences about how the body reacts after infection or vaccination by UNDERLINING the correct term in the brackets.

(i) Vaccines contain molecules called

(antibodies / antigens / memory cells). [1 mark]

(ii) White blood cells respond to these molecules and produce

(antibodies / antigens / pathogens). [1 mark]

(iii) (Antibiotics / antigens / memory cells) are produced following infection or a vaccination. [1 mark]

8 (b) **GRAPH 8.1 in the separate diagram booklet shows the immune response over a 10-week period when a vaccine was given as two doses.**

Describe the changes in antibody concentration over 10 weeks using data from the graph. [6 marks QER]

continue your answer on next page

9

SECTION B

Refer to the separate Resource Folder to answer questions 9 and 10.

9 **Jake's heart rate, breathing rate and airflow were monitored during a training session.**

Use the information in TABLE 2 in the Resource Folder to answer the following questions.

(a) **State the value of the resting heart rate.**
[1 mark]

heart rate = _____ bpm

(b) **State the time at which the exercise stopped.**
[1 mark]

time = _____ min

(c) **Calculate the time the exercise lasted.**
[1 mark]

time = _____ min

9 (d)(i) Calculate the drop in heart rate between 14 and 15 minutes. [1 mark]

drop in heart rate = _____ bpm

(ii) Assuming that the heart rate drops at the same rate, calculate the heart rate after 16 minutes. [1 mark]

heart rate after 16 minutes = _____ bpm

(e) Estimate the breathing rate after 16 minutes. [1 mark]

breathing rate = _____ breaths per minute

6

10 (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]

10 (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]

10 (c) Use the information in TABLE 4 and equations from pages 4 to 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.

10 (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 10.1 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: _____

_____

10 (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/s^2

10 (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	

END OF PAPER

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

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APPLIED SCIENCE (Double Award)

UNIT 2: Space, Health and Life
FOUNDATION 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 _____

DIAGRAM 1.1

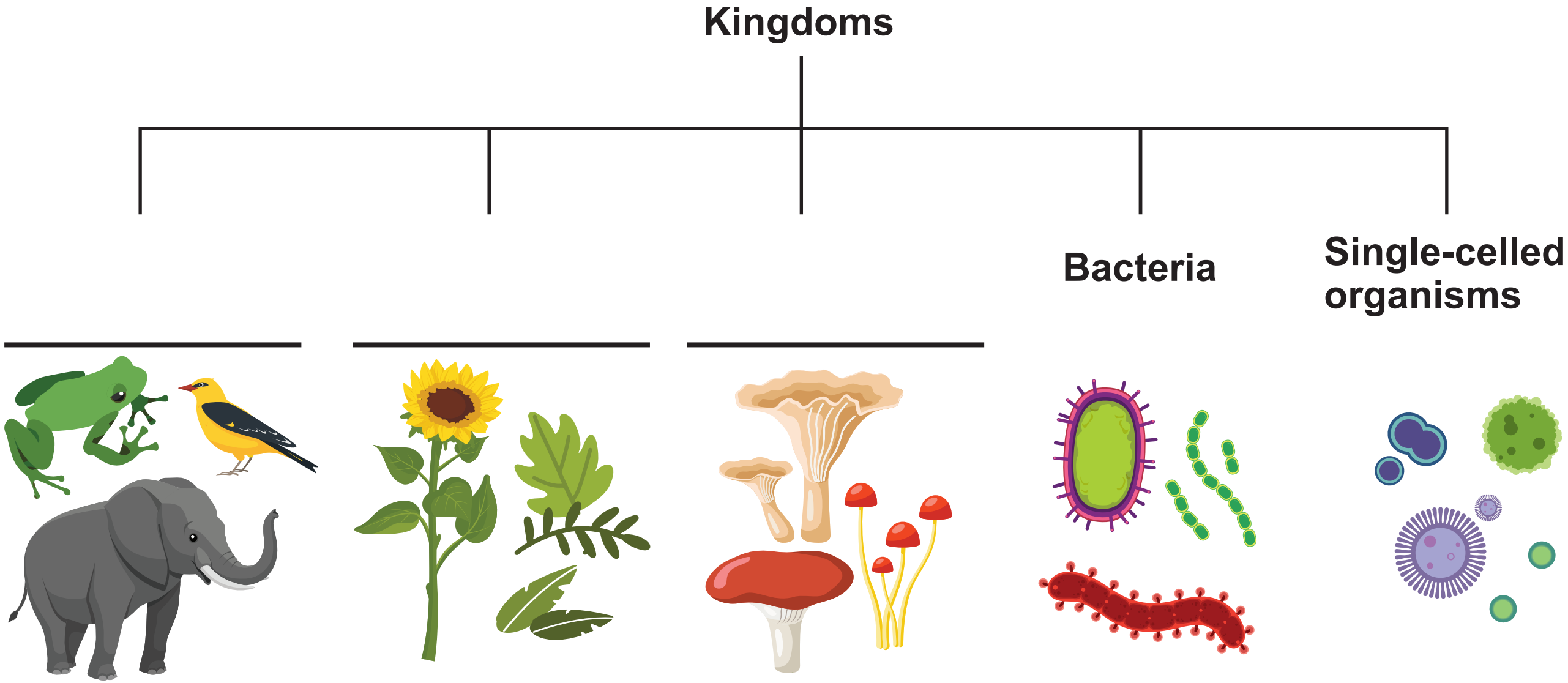

TABLE 1.2

A	B	C	D	E	F	G
species	order	class	phylum	genus	kingdom	family

DIAGRAM 1.3

Kingdom	Animalia
	Chordata
Class	Mammalia
Order	Carnivora
	Ursidae
Genus	Ursus
	arctos

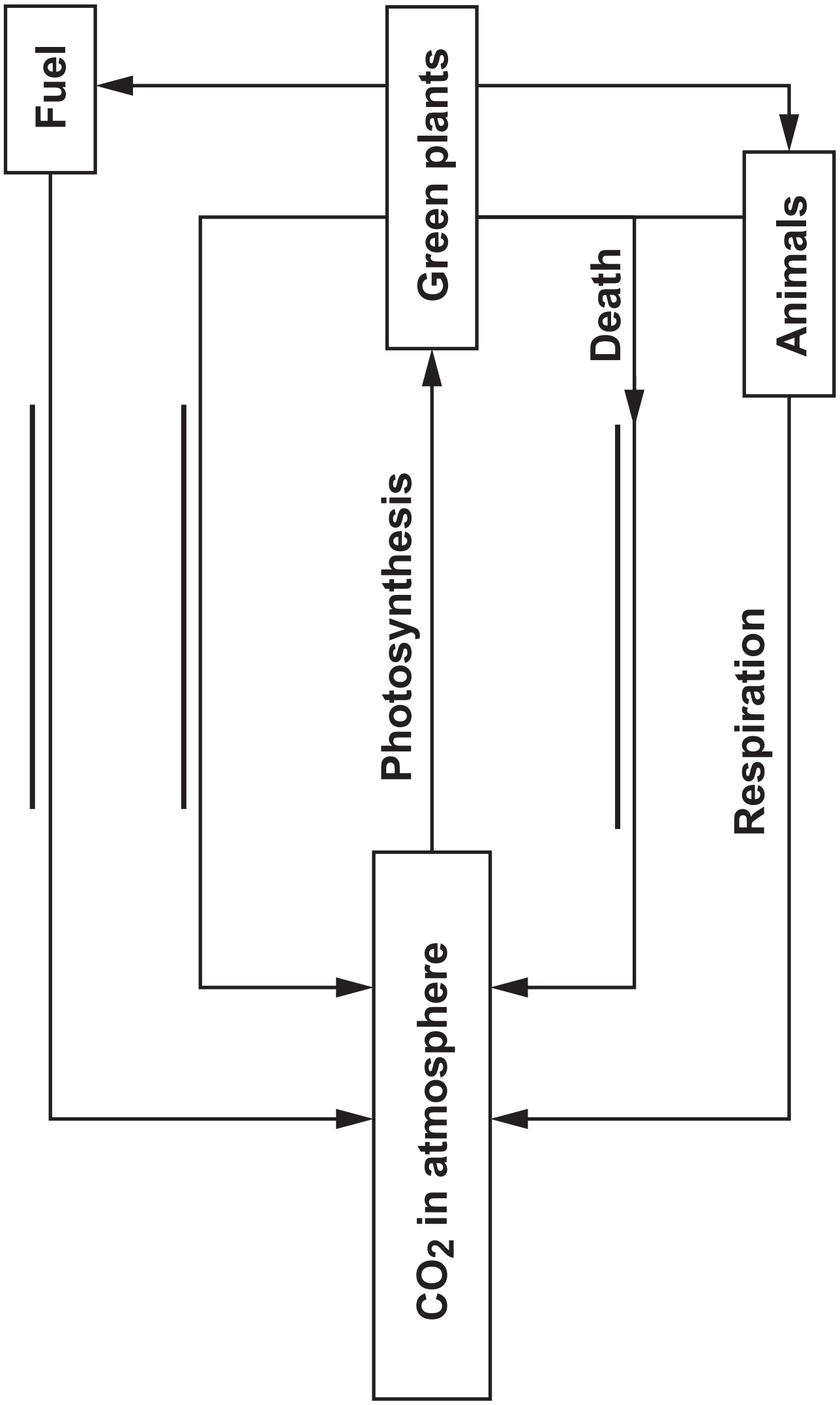
Fuel
Green plants
Death
Animals
Photosynthesis
Respiration
CO_2 in atmosphere

DIAGRAM 2.1

CHART 3.1

Pollution level	Indicator species	
A Clean water	 Stonefly nymph	 Mayfly nymph
B Some pollution	 Freshwater shrimp	 Caddis fly larva
C Moderate pollution	 Water louse	 Bloodworm
D High pollution	 Sludgeworm	 Rat-tailed maggot
E Very High pollution – no life		

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TABLE 3.2

Species	Total number in water sample		
	location 1	location 2	location 3
Stonefly nymph	0	0	31
Caddis fly larva	54	0	4
Water louse	2	5	3
Bloodworm	3	4	2
Sludgeworm	0	80	1
Rat-tailed maggot	1	65	1

GRAPH 3.3

Total number in water sample

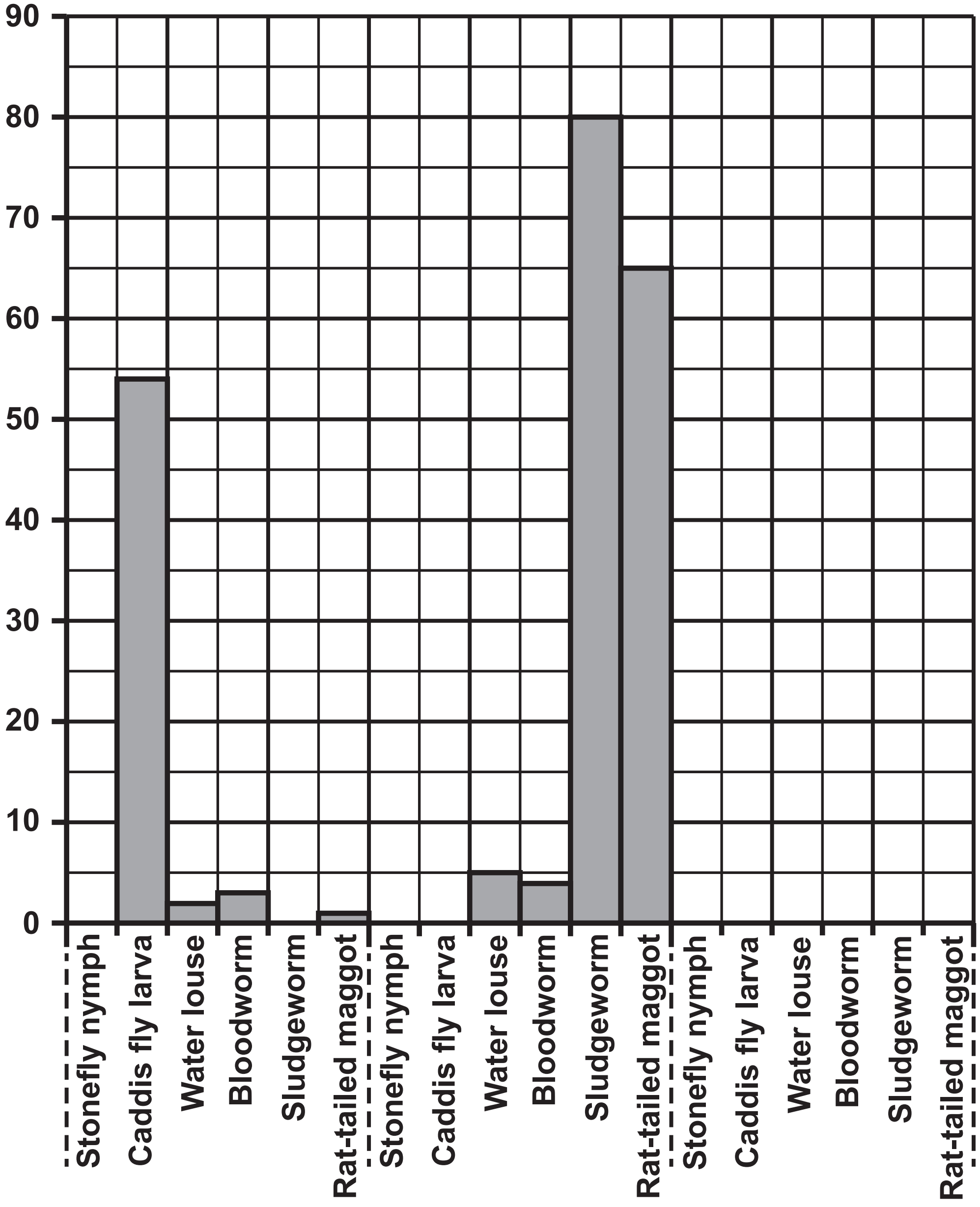


DIAGRAM 4.1

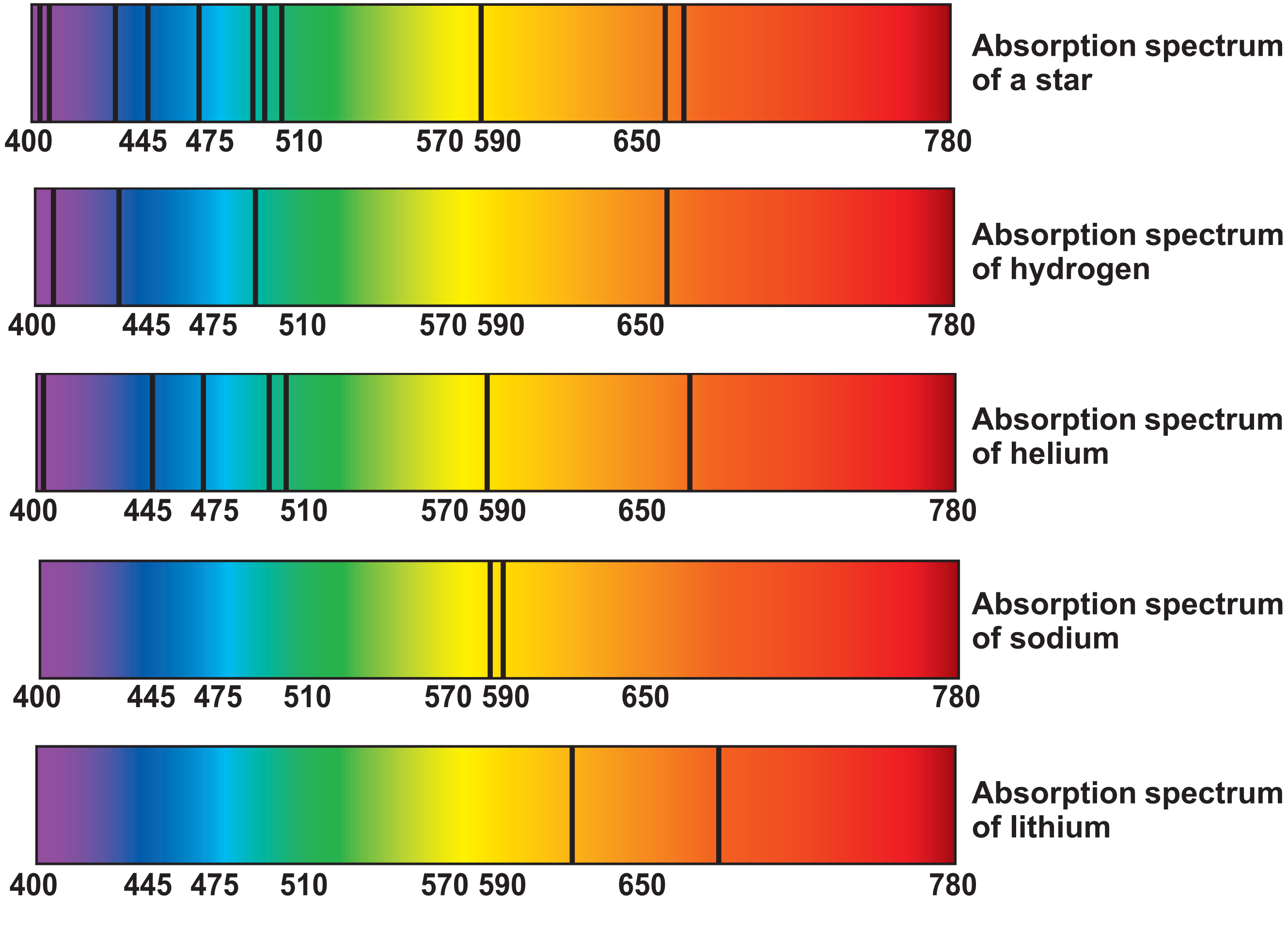
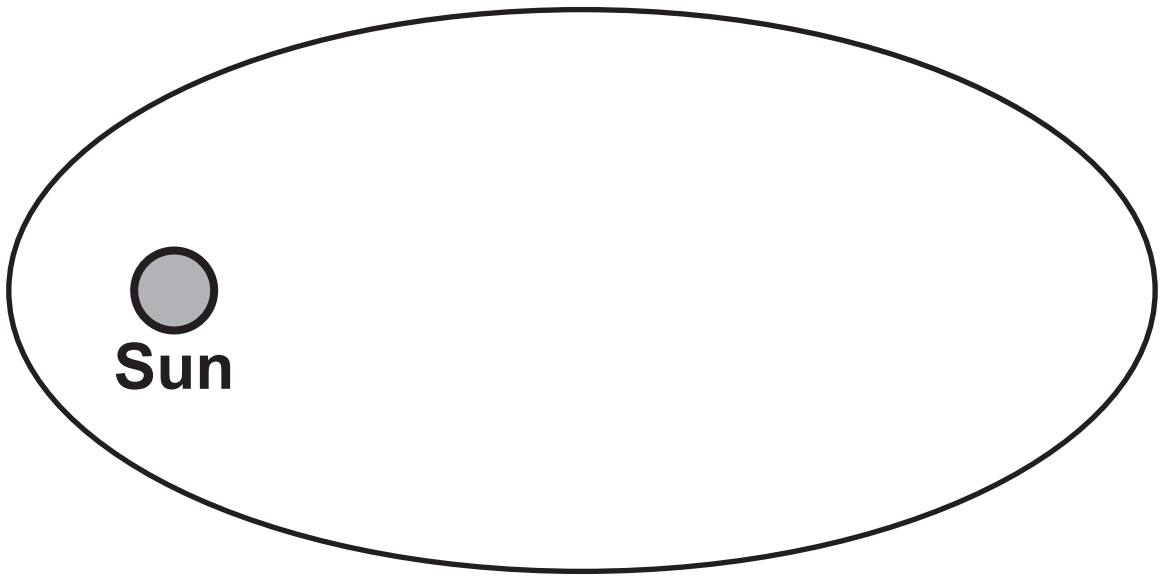

Absorption spectrum of a star
400 445 475 510 570 590 650 780
Absorption spectrum of hydrogen
400 445 475 510 570 590 650 780
Absorption spectrum of helium
400 445 475 510 570 590 650 780
Absorption spectrum of sodium
400 445 475 510 570 590 650 780
Absorption spectrum of lithium
400 445 475 510 570 590 650 780

TABLE 4.2

	Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune
density (kg/m^3)	5427	5243	5514	3933	1326	687	1271	1638
mean distance from the Sun (million km)	58	108	150	228	779	1434	2873	4495
mean speed of orbit (km/s)	47.4	35.0	29.8	24.1	13.1	9.7	6.8	5.4
mean temperature (°C)	167	464	15	−65	−110	−140	−195	−200
number of moons	0	0	1	2	79	82	27	14

DIAGRAM 4.3



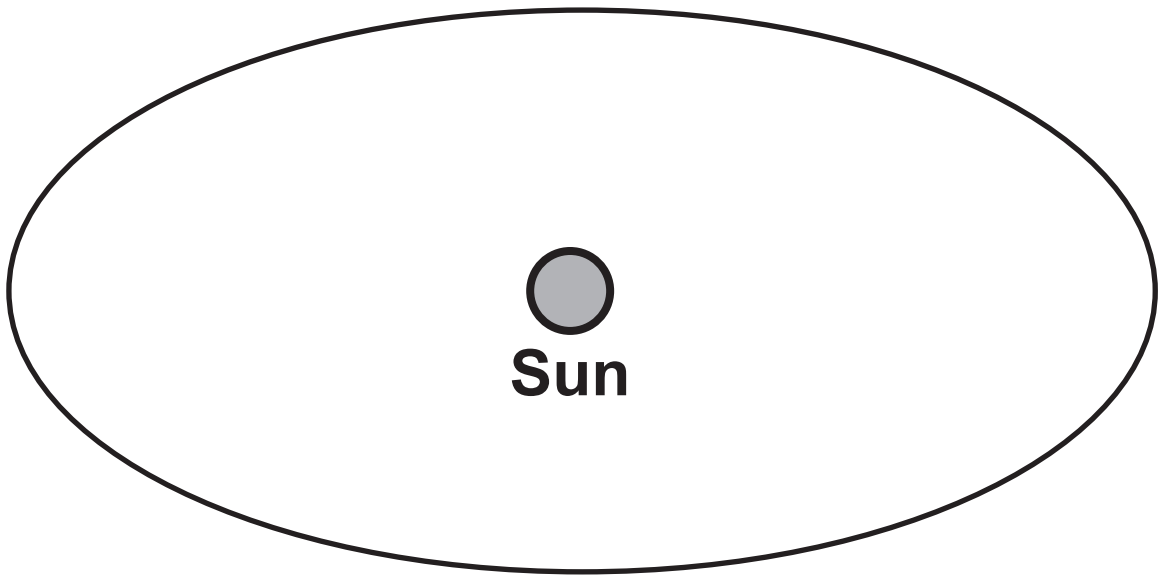


DIAGRAM 5.1

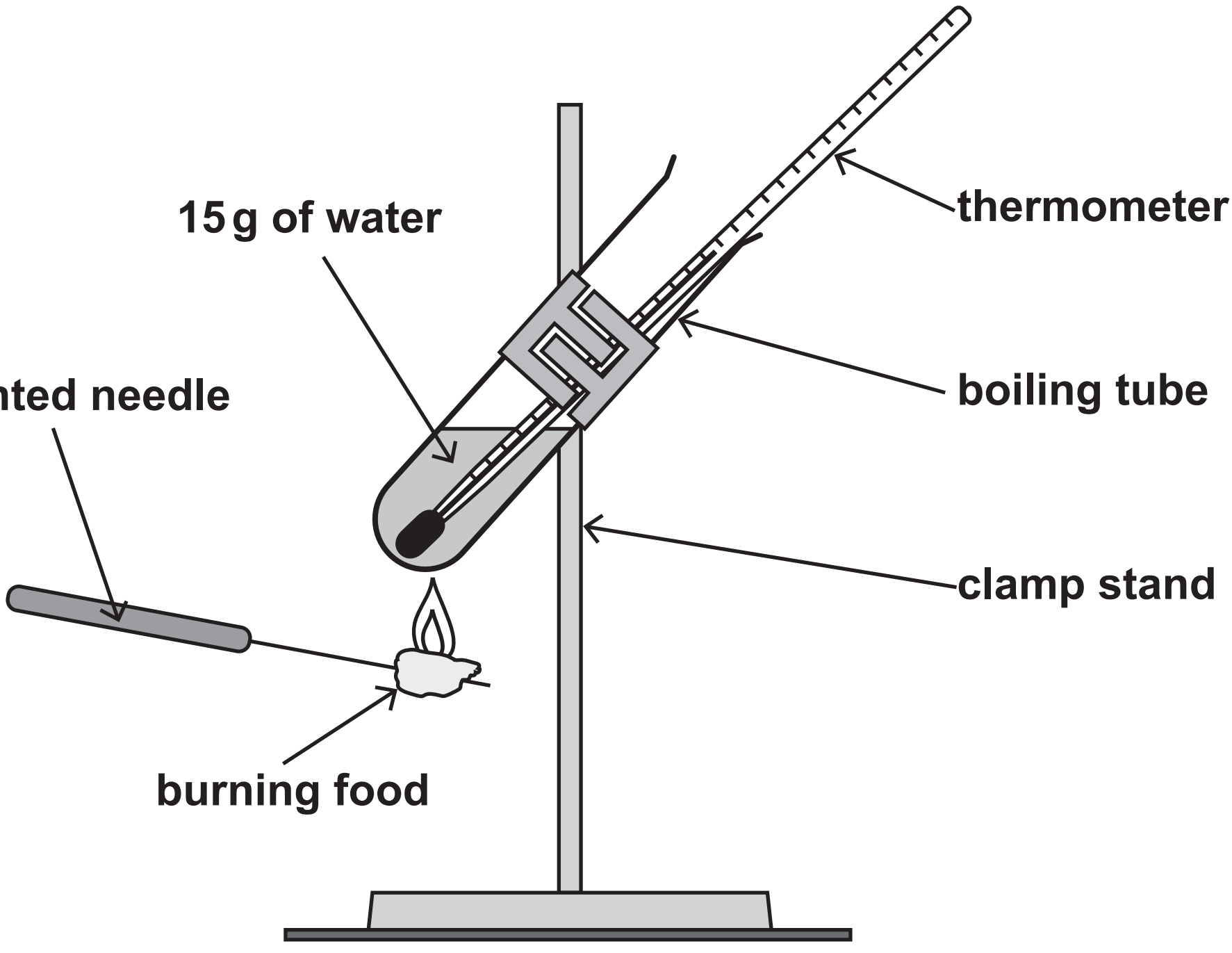

15 g of water
thermometer
mounted needle
boiling tube
clamp stand
burning food

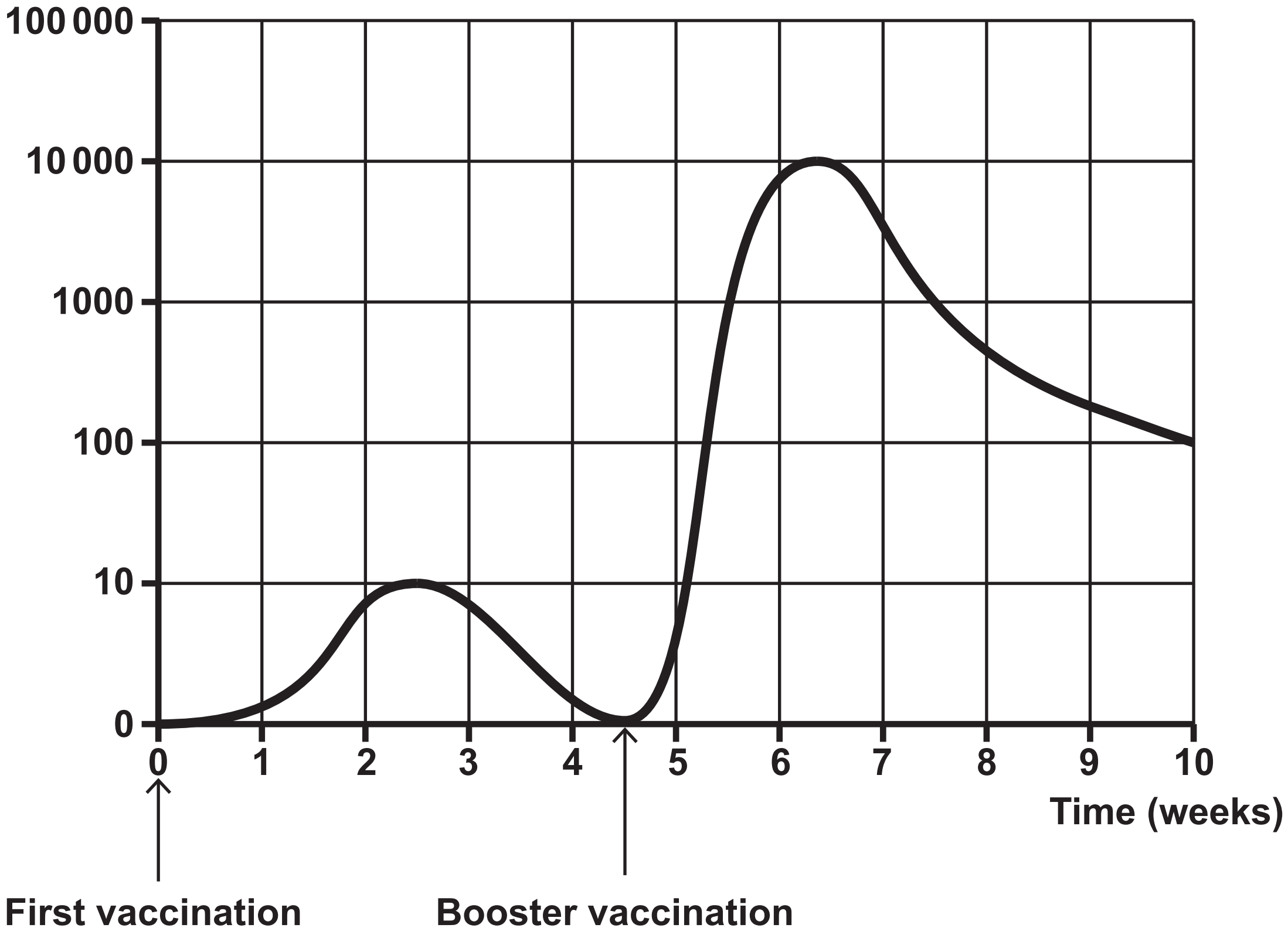
TABLE 5.2

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

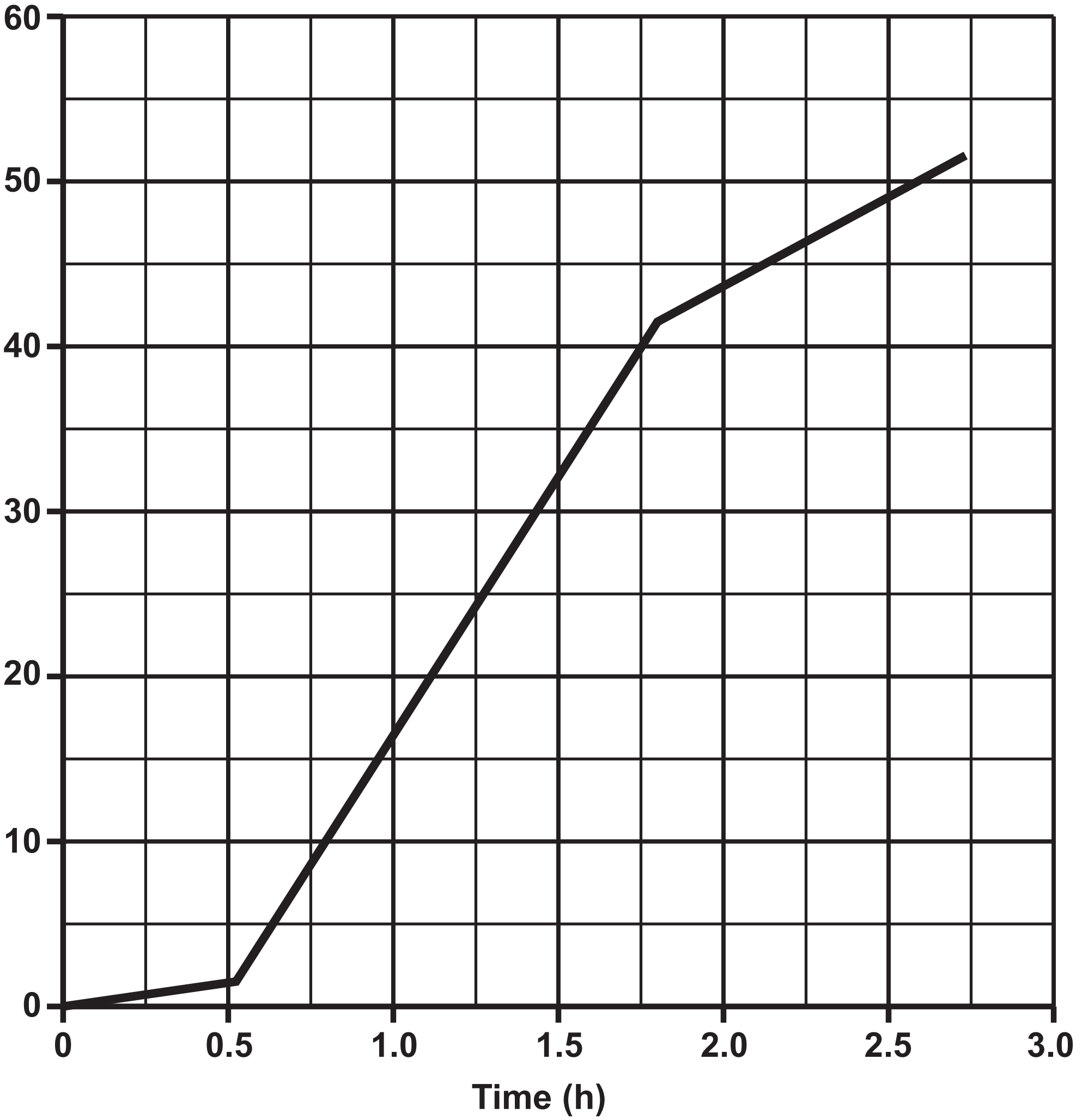
TABLE 7.1

Treatment or diagnosis	Uses high intensity light waves	Uses short wavelength electromagnetic waves	Uses high frequency sound waves	Uses strong magnetic fields	Uses drugs
chemotherapy					
ultrasound					
MRI scan					
CAT scan					

GRAPH 8.1


Antibody concentration (units)
100 000
10 000
1000
100
10
0
0
1
2
3
4
5
6
7
8
9
10
Time (weeks)
First vaccination
Booster vaccination

GRAPH 10.1



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MONDAY, 10 JUNE 2024 – MORNING

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

FOUNDATION TIER

Data Booklet

THE PERIODIC TABLE

KEY

A_r	relative atomic mass
Sym	symbol
Z	atomic number

1	2	GROUP										3	4	5	6	7	0
								1 H 1									4 He 2
7 Li 3	9 Be 4											11 B 5	12 C 6	14 N 7	16 O 8	19 F 9	20 Ne 10
23 Na 11	24 Mg 12											27 Al 13	28 Si 14	31 P 15	32 S 16	35.5 Cl 17	40 Ar 18
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	128 Te 52	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	222 Rn 86
223 Fr 87	226 Ra 88	227 Ac 89															

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