wjec cbac 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.

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 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]

continue answer on next page

(Turn over)

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 4 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 5 to 8 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

1 (d) Karen wants to exercise in the aerobic zone. Use the information in TABLES 3 and 4 and on pages 5 to 6 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 (pages 7 to 8) 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: _____

_____

_____

_____

(Turn over)

1 (f) Use the information about Triathlon times on pages 7 to 8, the information in TABLE 1 and an equation on page 10 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 10 in the Resource Folder to calculate the acceleration along level ground in a cycle leg. [3 marks]

acceleration = _____ m/s^2

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]

(Turn over)

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

2 (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

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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]

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

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

5

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TURN OVER

$$\text{energy released (J)} = \text{mass of water (g)} \times 4.2 \times \text{temperature increase (°C)}$$

4 Students were investigating the energy content of food. They heated 15 g 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 TABLE 4.2. [1 mark]

(b) Use the equation on the opposite page 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]

5 (a)(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 in TABLE 5 in the separate diagram booklet.

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.

Absorbtion 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	

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TURN OVER

Planet	Distance to Sun (million km)	Mean temperature on side facing the Sun (°C)
Mercury	60	430
Venus	110	470
Earth	150	20
Mars	230	−20
Jupiter	780	−150

6 (b) The table on the opposite page gives information about some planets in our solar system.

(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)

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 Indicator species may be used in an investigation to monitor water pollution.

(a) Describe how you would investigate water pollution at different points along a stream using indicator species. [6 marks QER]

continue answer on next page

continue answer on next page

(Turn over)

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

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

continue answer on next page

(Turn over)

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]

continue answer on next page

(Turn over)

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

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

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

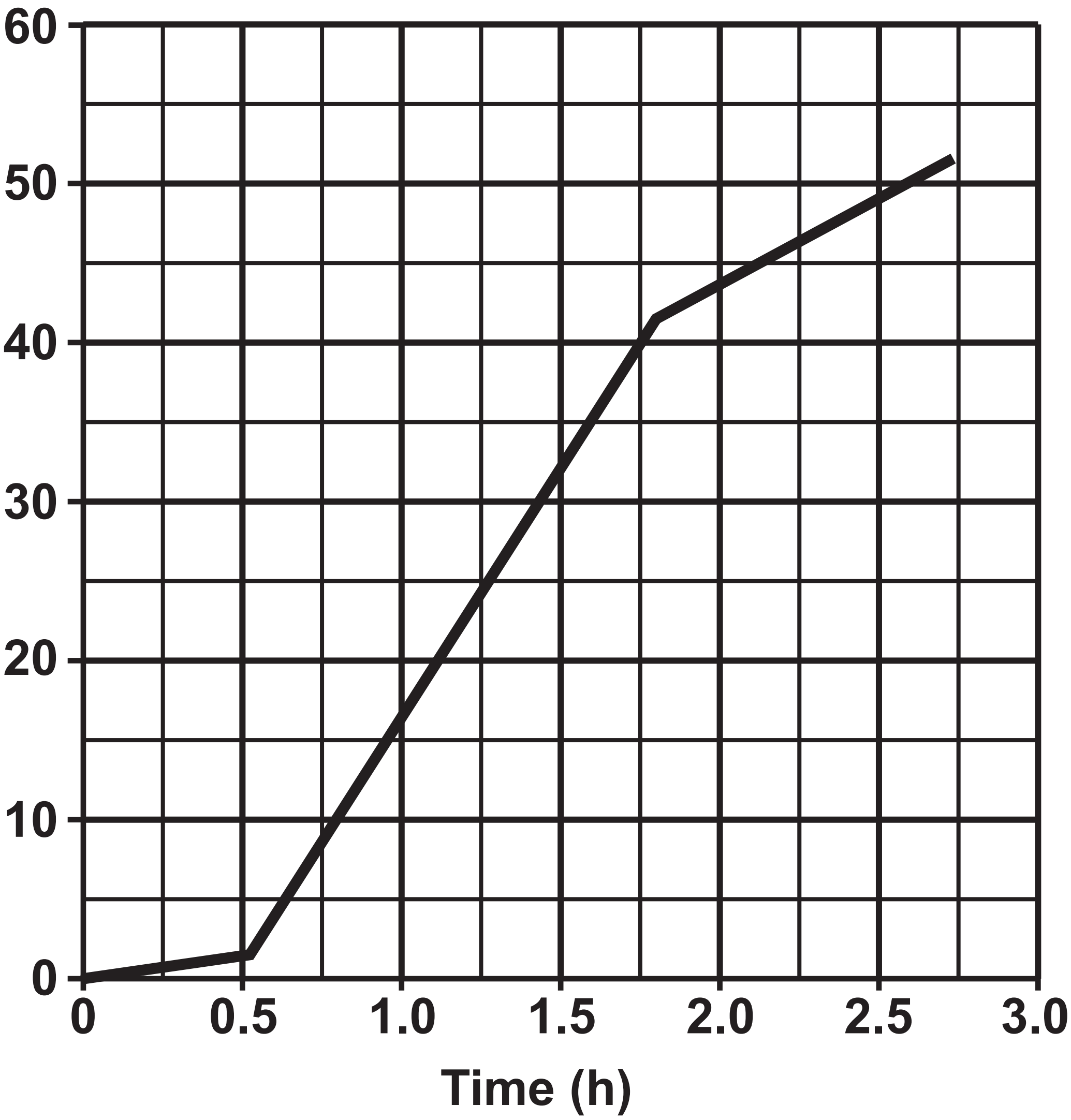

DIAGRAM 4.1

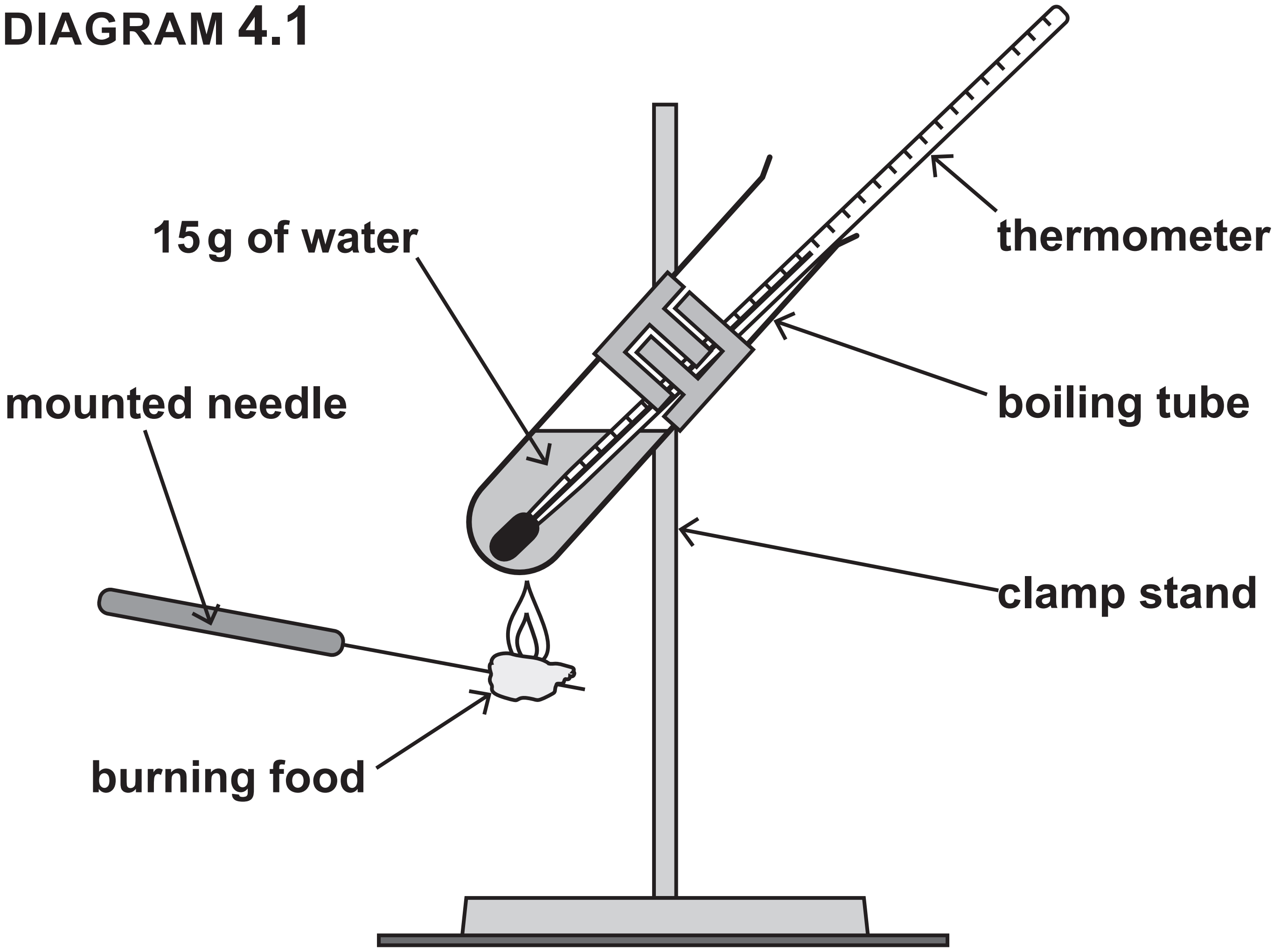
15 g of water
thermometer
mounted needle
boiling tube
clamp stand
burning food

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

TABLE 5

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

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DIAGRAM 6.1

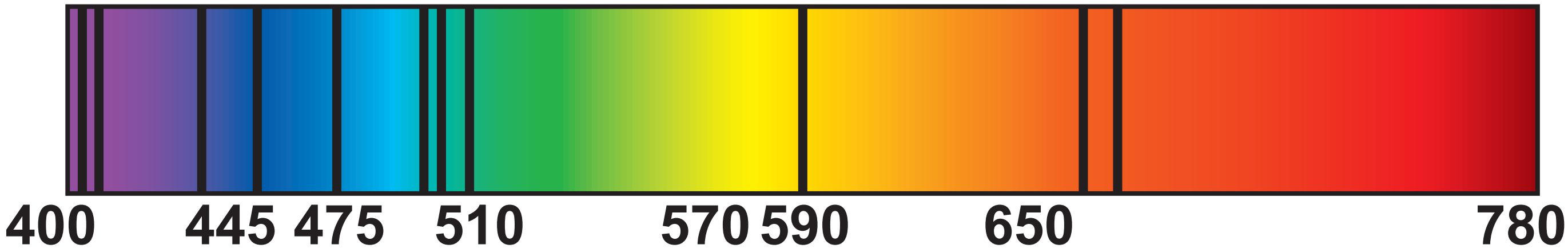
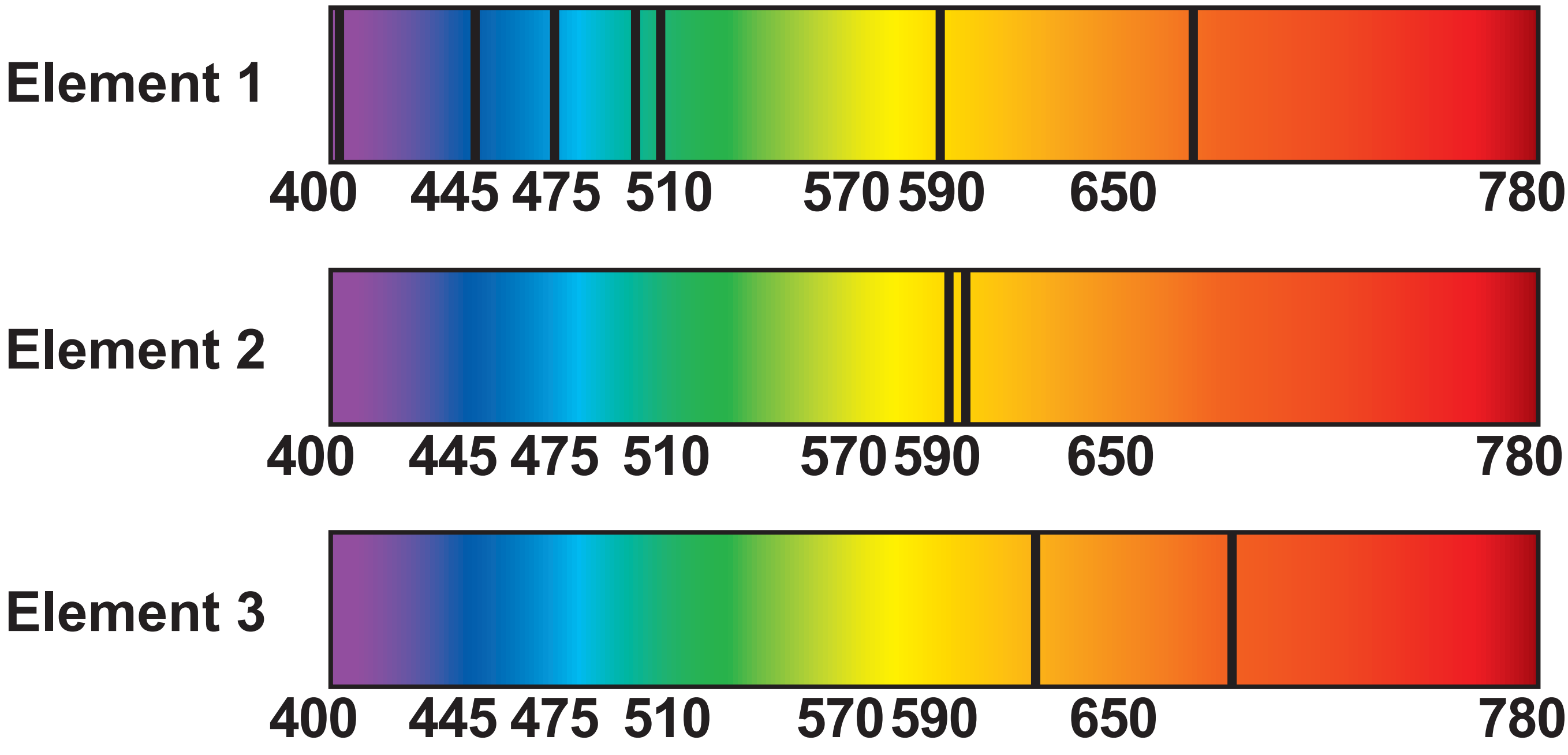


DIAGRAM 6.2


Element 1
400
445
475
510
570
590
650
780
Element 2
400
445
475
510
570
590
650
780
Element 3
400
445
475
510
570
590
650
780
Element 4
400
445
475
510
570
590
650
780

GRAPH 6.3

Mean temperature on side facing the Sun (°C)

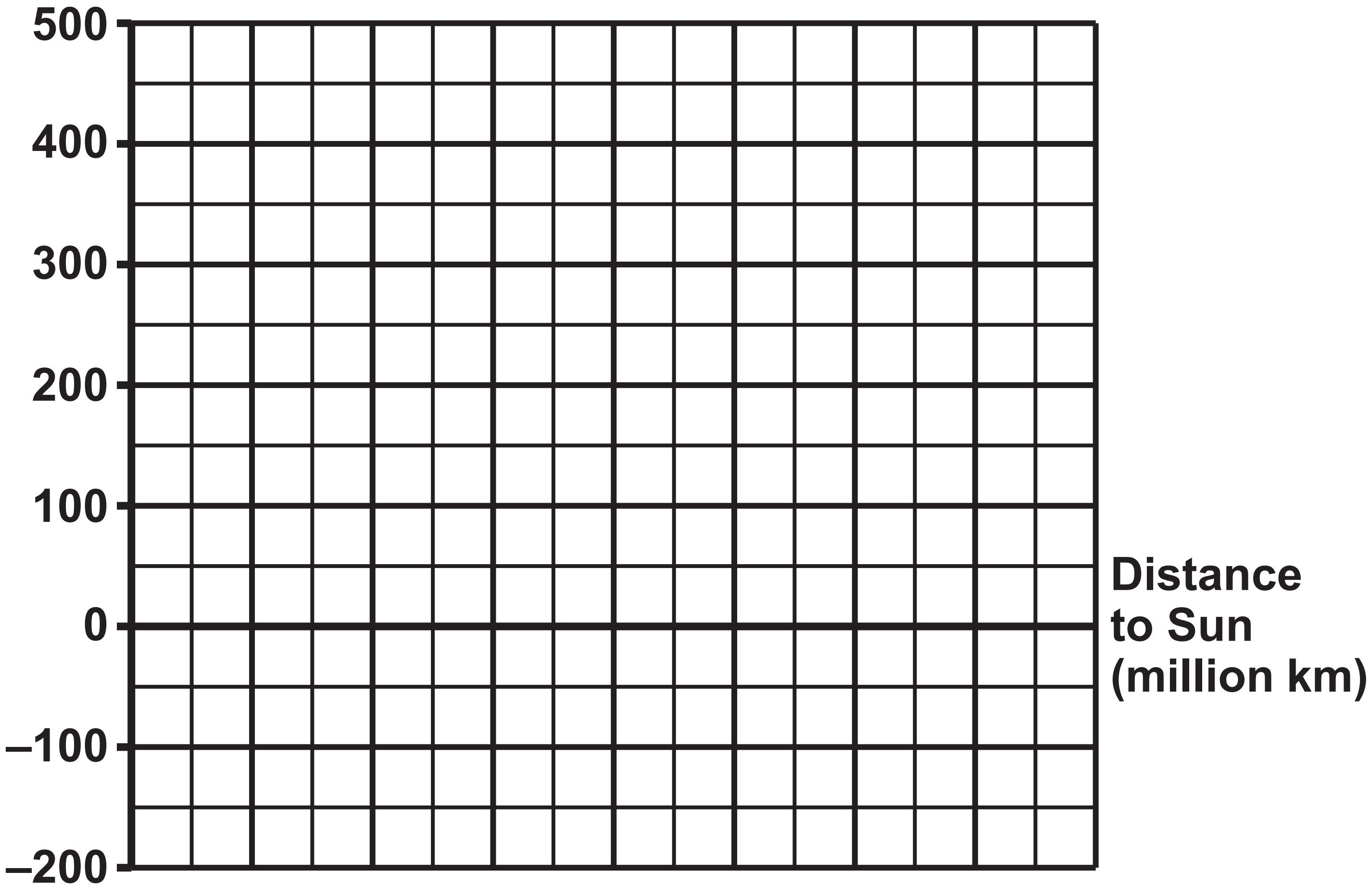


DIAGRAM 6.4

Sun

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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)**

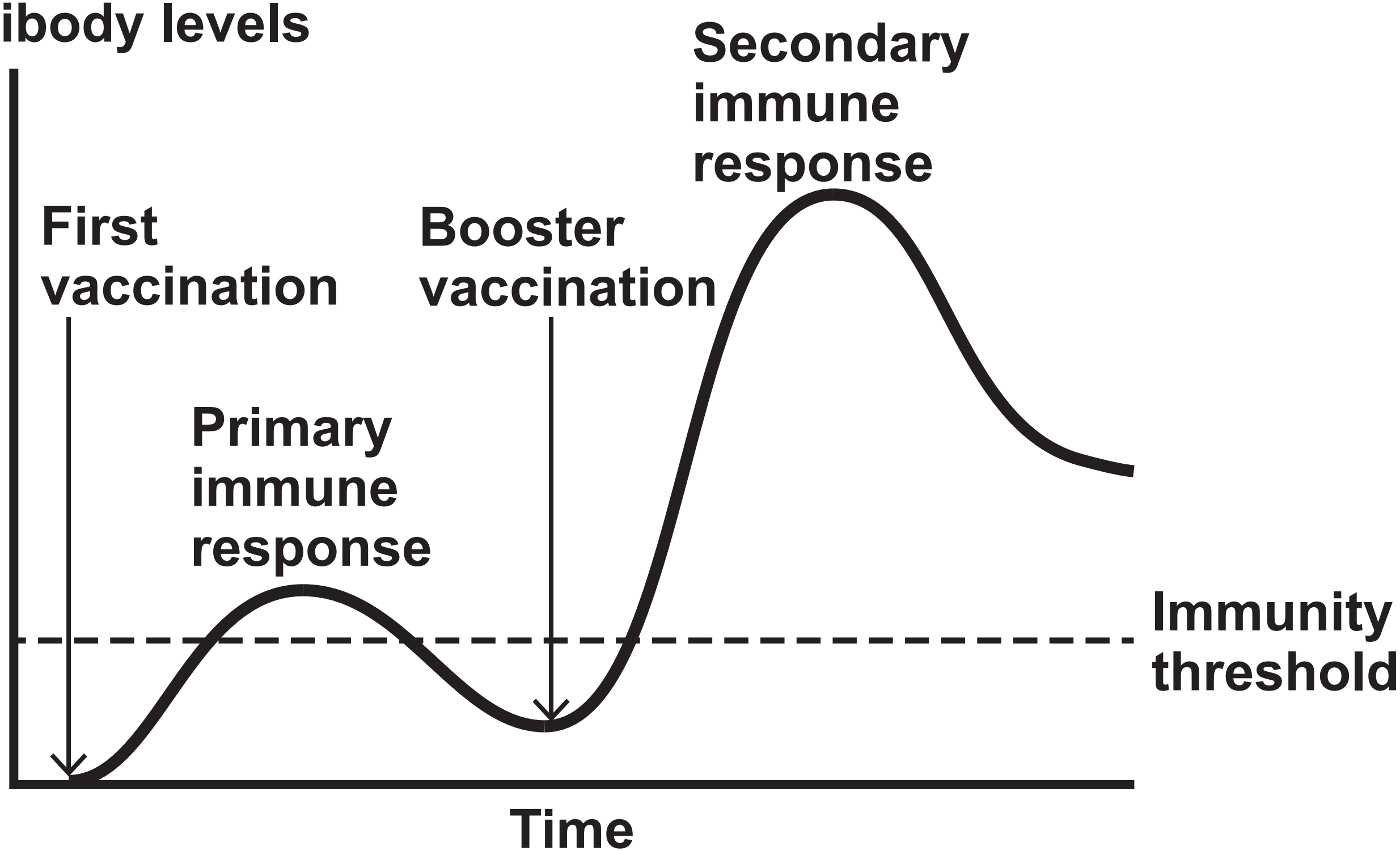
CHART 7.1 continued

POLLUTION LEVEL	INDICATOR SPECIES	
D High pollution	 Sludgeworm (about 120 mm)	 Red-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


Antibody levels
First vaccination
Booster vaccination
Secondary immune response
Primary immune response
Immunity threshold
Time

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

HIGHER TIER

Data Booklet

THE PERIODIC TABLE

1	2	GROUP						
								1 H 1
7 Li 3	9 Be 4							
23 Na 11	24 Mg 12							
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
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
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
223 Fr 87	226 Ra 88	227 Ac 89						

KEY

A_r	relative atomic mass
Sym	symbol
Z	atomic number

3	4	5	6	7	0
					4 He 2
11 B 5	12 C 6	14 N 7	16 O 8	19 F 9	20 Ne 10
27 Al 13	28 Si 14	31 P 15	32 S 16	35.5 Cl 17	40 Ar 18
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
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
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

THE PERIODIC TABLE

PERIODIC TABLE – KEY
ATOMIC NUMBER – SYMBOL – NAME

1	H – Hydrogen	19	K – Potassium
2	He – Helium	20	Ca – Calcium
3	Li – Lithium	21	Sc – Scandium
4	Be – Beryllium	22	Ti – Titanium
5	B – Boron	23	V – Vanadium
6	C – Carbon	24	Cr – Chromium
7	N – Nitrogen	25	Mn – Manganese
8	O – Oxygen	26	Fe – Iron
9	F – Fluorine	27	Co – Cobalt
10	Ne – Neon	28	Ni – Nickel
11	Na – Sodium	29	Cu – Copper
12	Mg – Magnesium	30	Zn – Zinc
13	Al – Aluminium	31	Ga – Gallium
14	Si – Silicon	32	Ge – Germanium
15	P – Phosphorus	33	As – Arsenic
16	S – Sulfur	34	Se – Selenium
17	Cl – Chlorine	35	Br – Bromine
18	Ar – Argon	36	Kr – Krypton

37	Rb – Rubidium	57	La – Lanthanum
38	Sr – Strontium	72	Hf – Hafnium
39	Y – Yttrium	73	Ta – Tantalum
40	Zr – Zirconium	74	W – Tungsten
41	Nb – Niobium	75	Re – Rhenium
42	Mo – Molybdenum	76	Os – Osmium
43	Tc – Technetium	77	Ir – Iridium
44	Ru – Ruthenium	78	Pt – Platinum
45	Rh – Rhodium	79	Au – Gold
46	Pd – Palladium	80	Hg – Mercury
47	Ag – Silver	81	Tl – Thallium
48	Cd – Cadmium	82	Pb – Lead
49	In – Indium	83	Bi – Bismuth
50	Sn – Tin	84	Po – Polonium
51	Sb – Antimony	85	At – Astatine
52	Te – Tellurium	86	Rn – Radon
53	I – Iodine	87	Fr – Francium
54	Xe – Xenon	88	Ra – Radium
55	Cs – Caesium	89	Ac – Actinium
56	Ba – Barium		