GCSE

3445U30-1

FRIDAY, 10 MAY 2024 – MORNING

APPLIED SCIENCE (Double Award)
UNIT 3: Food, Materials and Processes

FOUNDATION TIER

1 hour 30 minutes plus your additional time allowance

Surname _____

First name(s) _____

Centre Number _____

Candidate Number 0 _____

ADDITIONAL MATERIALS

In addition to this examination paper, you will require a calculator and a 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.

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.

The Periodic Table is printed in the separate data booklet.

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**5**	
2.	**10**	
3.	**11**	
4.	**12**	
5.	**12**	
6.	**6**	
7.	**9**	
8.	**10**	
Total	**75**	

Answer ALL questions.

1 **Supermarkets need to ensure that food products are safe to eat after purchase. They use different treatments for different foods.**

(a)(i) **Join each treatment below to the way it works with a straight line. [2 marks]**

TREATMENT	HOW IT WORKS
pickling	lowers the temperature to stop bacteria multiplying
freezing	lowers the pH to stop bacteria multiplying
drying	removes water so bacteria cannot digest and absorb the food source

(ii) **CIRCLE ONE other treatment method used to preserve food. [1 mark]**

adding oxygen **adding salt** **adding water**

1 (b) **Tick (✓) the boxes next to the TWO correct statements about precautions supermarkets take when dealing with raw and cooked meat. [2 marks]**

- ☐ **Keep raw and cooked meat apart.**
- ☐ **Use the same weighing scales for raw and cooked meat.**
- ☐ **Wash hands after handling raw meat.**
- ☐ **Keep raw and cooked meat at room temperature.**

5

THIS IS A BLANK PAGE

TURN OVER


glucose
ethanol
+ (carbon dioxide / oxygen / nitrogen)

2 **Brewing is an important industry in the UK.**

(a) **Complete the word equation on the opposite page for the fermentation of beer by <u>UNDERLINING</u> the correct word(s) in the brackets. [1 mark]**

THIS IS A BLANK PAGE

TURN OVER

A	**starch in the barley is converted to sugar, and water is added to make a brewing mixture**
B	**fermentation stops when all the sugar runs out**
C	**mixture is cooled and yeast is added**
D	**mixture is boiled**
E	**the beer is pasteurised, then stored in bottles or cans**
F	**hops are added for flavour**

2 (b) **The main stages of the beer making process are shown on the opposite page. However, the stages are not in the correct order. [2 marks]**

Put the statements in the correct order.

A
F
_____
_____
_____
E

2 (c) **A brewery tested different types of sugar in the fermentation process. These were glucose, maltose and fructose.**

The results are shown in GRAPH 2.1 in the separate diagram booklet.

Use information from GRAPH 2.1 and the numbers in the box below to answer the following questions.

2	3	6	40	50	70

(i) **State the concentration of ethanol formed from GLUCOSE at 30 HOURS. [1 mark]**

_____ **units**

(ii) **State the time at which the concentration of the ETHANOL was the same for all the sugars. [1 mark]**

time = _____ **hours**

(iii) **State the time at which fermentation stops for GLUCOSE. [1 mark]**

time = _____ **hours**

2 (c)(iv) Calculate the difference in ethanol concentration between 20 and 50 hours for maltose. [1 mark]

concentration difference = _____ units

(d)(i) Use your answer in (c)(iv) above and the equation:

$$\text{mean rate} = \frac{\text{concentration difference}}{\text{time difference}}$$

to calculate the mean rate of ethanol formation for MALTOSE between 20 and 50 hours. [2 marks]

mean rate = _____ units / hour

2 (d)(ii)

Charlie says that all sugars produce beer with the same ethanol concentration. State whether you agree AND give ONE reason for your answer. [1 mark]

10	

THIS IS A BLANK PAGE

TURN OVER


magnesium + hydrochloric acid ⟶ magnesium chloride + hydrogen

3 Magnesium alloys are used in the casings of tablet computers and mobile phones.

(a) Complete the sentence below by <u>UNDERLINING</u> the correct word in the brackets. [2 marks]

An alloy is a

(mixture / compound / solution)

of two or more elements. One of these must

be a (gas / metal / liquid).

(b) Magnesium reacts with hydrochloric acid producing hydrogen gas. The word equation for this reaction is shown on the opposite page.

A student investigated this reaction using the apparatus shown in DIAGRAM 3.1 in the separate diagram booklet.

A graph of the student's results is shown in GRAPH 3.2 in the separate diagram booklet.

DRAW a line on GRAPH 3.2 to show the results that you would expect if the experiment was repeated with a lower concentration of hydrochloric acid. [1 mark]

3 (c) **The student also investigated the reaction of hydrochloric acid and magnesium at different initial temperatures.**

The results are shown in TABLE 3.3 in the separate diagram booklet.

(i) **State THREE variables that need to be controlled in this experiment. [3 marks]**

1. _____

_____

2. _____

_____

3. _____

_____

3 (c)(ii)

I. The student thinks that every time the temperature doubles, the time taken halves. Explain whether you agree. [2 marks]

_____

_____

_____

_____

_____

_____

II. Predict the time it would take for the magnesium to disappear at 60 °C. [1 mark]

time = _____ s

3 (c)(iii)

Complete the following sentences by <u>UNDERLINING</u> the correct words in the brackets. [2 marks]

As the temperature increases, particles move

(faster / slower / at the same speed).

The particles collide

(more often / as often / less often)

in a given time.

11

4 **A laboratory technician tests THREE different food samples taken from a local restaurant by an Environmental Health Officer.**

The samples were spread onto sterile agar plates which were then incubated at 37 °C.

After 3 days the agar plates were examined. The results are shown in DIAGRAM 4.1 in the separate diagram booklet.

It is assumed that each colony was formed from one bacterium.

(a)(i) **The technician concludes that the food that produced Plate 1 was stored in the restaurant at 15 °C, the food that produced Plate 2 was stored at 25 °C, and the food that produced Plate 3 was stored at 5 °C. Explain whether you agree. [3 marks]**

continue your answer on the next page

4 (a)(ii) State why it is not possible to make a conclusion on the reproducibility of this analysis. [1 mark]

4 (b) **Agar plates can also be used in a school laboratory to investigate bacterial growth.**

(i) **State why the agar plate needs to be sterile. [1 mark]**

(ii) **State what should be done to the inoculating loop before it is used to transfer the food sample to the agar plate. [1 mark]**

(iii) **Give a reason why the students are only allowed to incubate their plates at 25 °C. [1 mark]**

(iv) **State why it is important the lid remains on the agar plate during incubation. [1 mark]**

4 (c) Two types of bacteria, **A** and **B**, were found on one of the plates. The plate has an area of 52 cm^2. Each square in the grid is 1 cm^2.

A section of the agar plate is shown in DIAGRAM **4.2** in the separate diagram booklet.

The results for four squares numbered **1** to **4** are shown in TABLE **4.3** in the separate diagram booklet. The students have completed the table for Bacteria **A**.

(i) Complete TABLE **4.3** for Bacteria **B**. [3 marks]

(ii) State how the results would be improved by counting the number of bacteria in 12 squares. [1 mark]

12

5 Hydrogen could be used to produce hydrogen chloride gas.

(a) DIAGRAM 5.1 in the separate diagram booklet represents the bonding in hydrogen. Complete the dot and cross diagram for a molecule of hydrogen.

(b) The reaction between hydrogen and chlorine can be represented by the following equation.

$$H-H + Cl-Cl \longrightarrow H-Cl + H-Cl$$

The bond energy values are shown in TABLE 5.2 in the separate diagram booklet.

Use the information in TABLE 5.2 to answer the following questions.

(i) Calculate the energy needed to break all the bonds in the reactants. [2 marks]

energy = _____ kJ

(ii) Calculate the energy given out when all the bonds in the product are formed. [2 marks]

energy = _____ kJ

5 (b)(iii)

Possible energy diagrams for this reaction are shown in DIAGRAM 5.3 in the separate diagram booklet.

I. Select the correct energy diagram for this reaction. [1 mark]

_____

II. Explain your choice. [2 marks]

_____

_____

_____

5 (c) **Use words from the box below to complete the sentences below about an ENDOTHERMIC reaction. [4 marks]**

more	less	taken in	given out
increase	decrease	thermal runaway	

In an endothermic reaction _____
energy is stored in the bonds AFTER the reaction than before. This means energy is

_____ from the surroundings.
This will cause the temperature to

_____ during the reaction.

This cannot lead to a _____
reaction.

12

6 Solutions can be acidic, alkaline or neutral. Analytical chemists use titrations to find the concentrations of solutions.

The concentration of solution A can be found by titrating against a standard solution B of known concentration. The apparatus used is shown in DIAGRAM 6.1 in the separate diagram booklet.

The titration curve is shown on GRAPH 6.2 in the separate diagram booklet.

Explain the pH changes during the titration.

Include in your answer:

- what can be deduced from the curve about solutions A and B
- the point at which the solution becomes neutral
- which solution is acid and which solution is alkaline. [6 marks QER]

continue your answer on the next page

6

7 Students are investigating how the stiffness of a wooden metre ruler depends on its length. They use the apparatus shown in DIAGRAM 7.1 in the separate diagram booklet. The weight, W, on the end of the ruler remains constant at 5 N.

The length, L, is varied. For each length, L, the depression, D, of the end of the ruler is measured.

Their results are shown in TABLE 7.2 in the separate diagram booklet.

(a) Plot the data in TABLE 7.2 on the grid in GRAPH 7.3 in the separate diagram booklet and draw a smooth curve. The point (0,0) has already been plotted for you. [4 marks]

(b) It was expected that depression, D, would be directly proportional to length, L.
Explain whether the graph shows a proportional relationship. [2 marks]

7 (c) Use information in the table and the equation:

$$\text{stiffness} = \frac{\text{weight}}{\text{depression}}$$

to calculate the stiffness of the ruler at a length of 50 cm. [3 marks]

stiffness = _____ N / cm

9

8 **Photosynthesis is the process by which plants make food from water and carbon dioxide.**

(a) **Stomata are an important part of the leaf. In many plants, stomata remain open during the day and closed at night.**

(i) **Label DIAGRAM 8.1 in the separate diagram booklet. [2 marks]**

(ii) **State TWO functions of stomata. [2 marks]**

1. _____

_____

2. _____

_____

8 (b) **Healthy plants require a supply of nutrients. Many farmers use artificial fertilisers to supply these nutrients to the soil.**

GRAPH 8.2 in the separate diagram booklet shows the mass of different nutrients applied to agricultural land between 1983 and 2017.

Use the data from the graph to answer the following questions.

(i) **It is claimed that the use of nitrate fertilisers halved between 1983 and 2017.**

Use GRAPH 8.2 to explain whether you agree. [3 marks]

8 (b)(ii)

The total land area of Wales is approximately 2 100 000 hectares.
60% of this land is used for farming.

I. Calculate the area of land used for farming in Wales. [1 mark]

area = _____ hectares

II. Calculate the total mass of phosphates used in farming in Wales in 1983. [2 marks]

mass = _____ kg

10

END OF PAPER

GCSE

3445U30-1

FRIDAY, 10 MAY 2024 – MORNING

APPLIED SCIENCE (Double Award)

UNIT 3: Food, Materials and Processes

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 _____

GRAPH 2.1

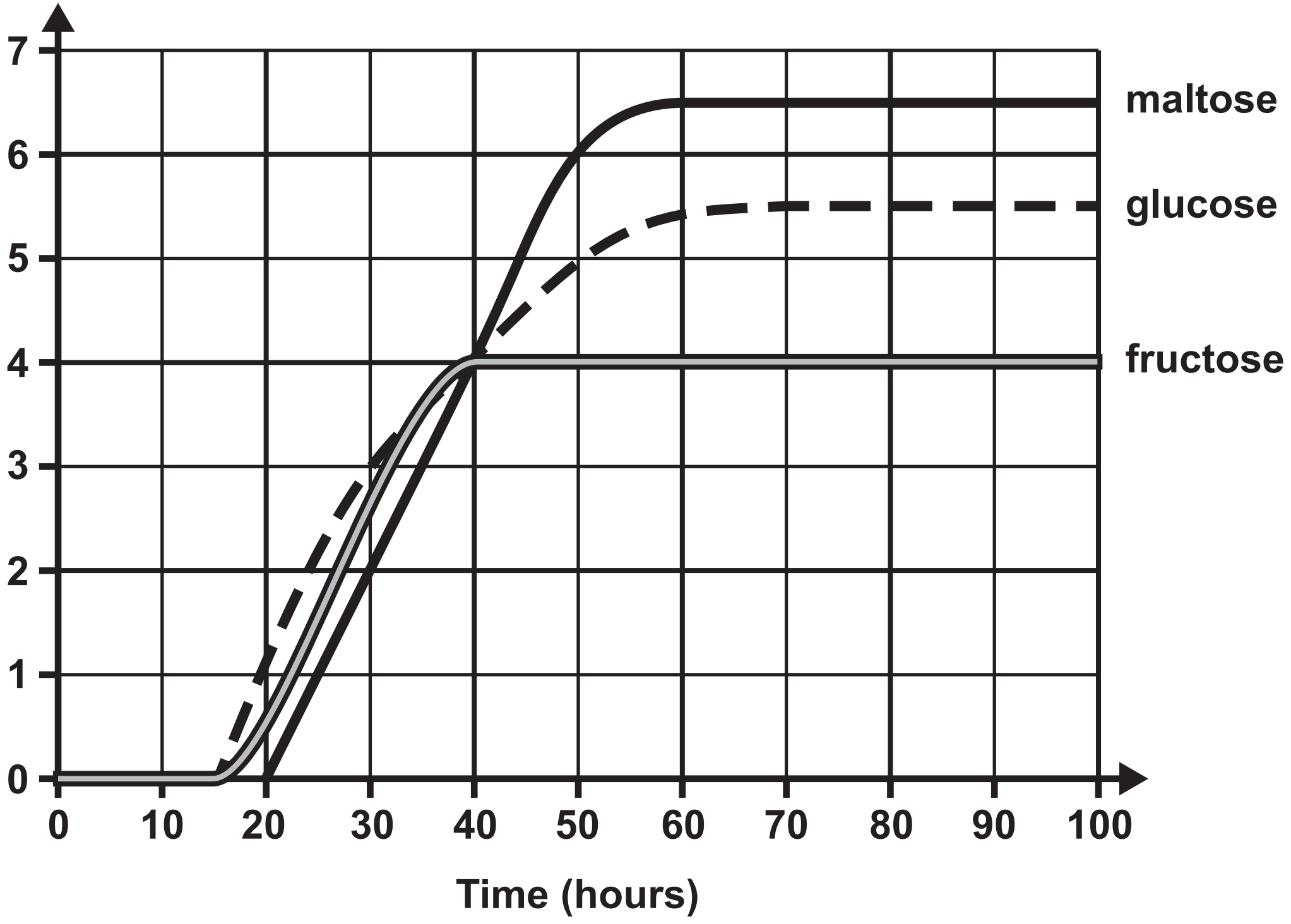
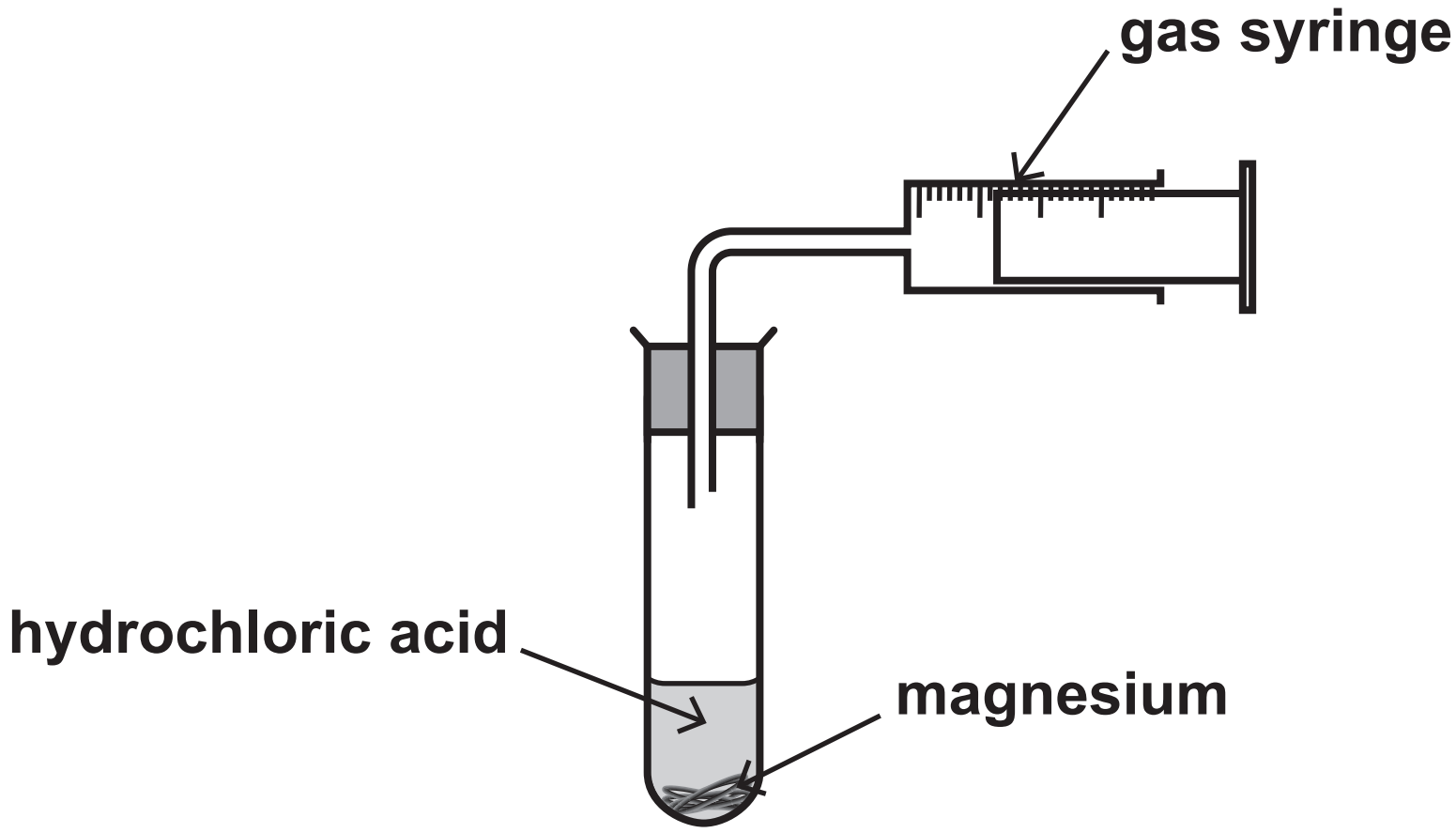

Ethanol concentration (units)
7
6
5
4
3
2
1
0
0
10
20
30
40
50
60
70
80
90
100
Time (hours)
maltose
glucose
fructose

DIAGRAM 3.1



GRAPH 3.2

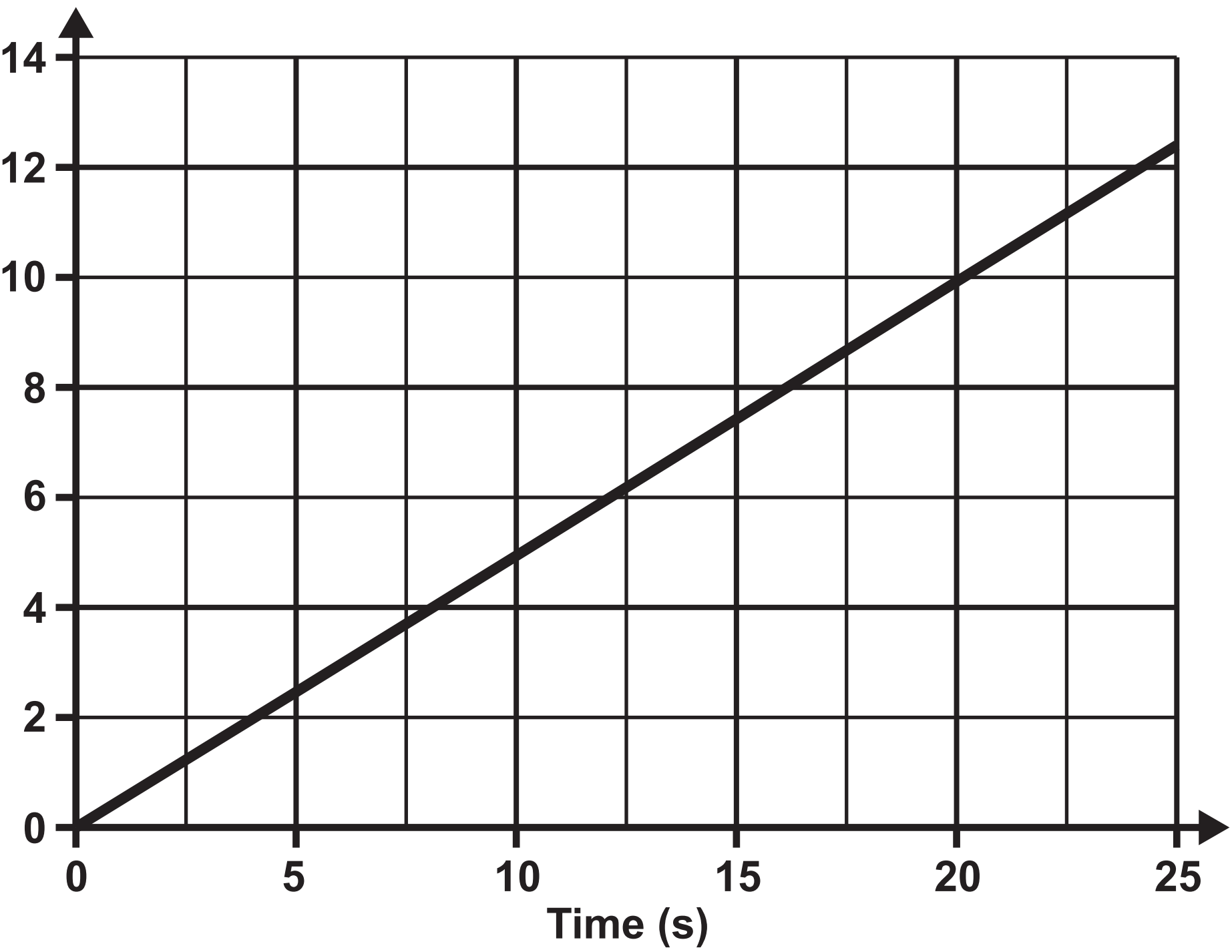


TABLE 3.3

Initial temperature (°C)	Time taken for magnesium to disappear (s)
10	80
20	40
30	20
40	10
50	5

DIAGRAM 4.1

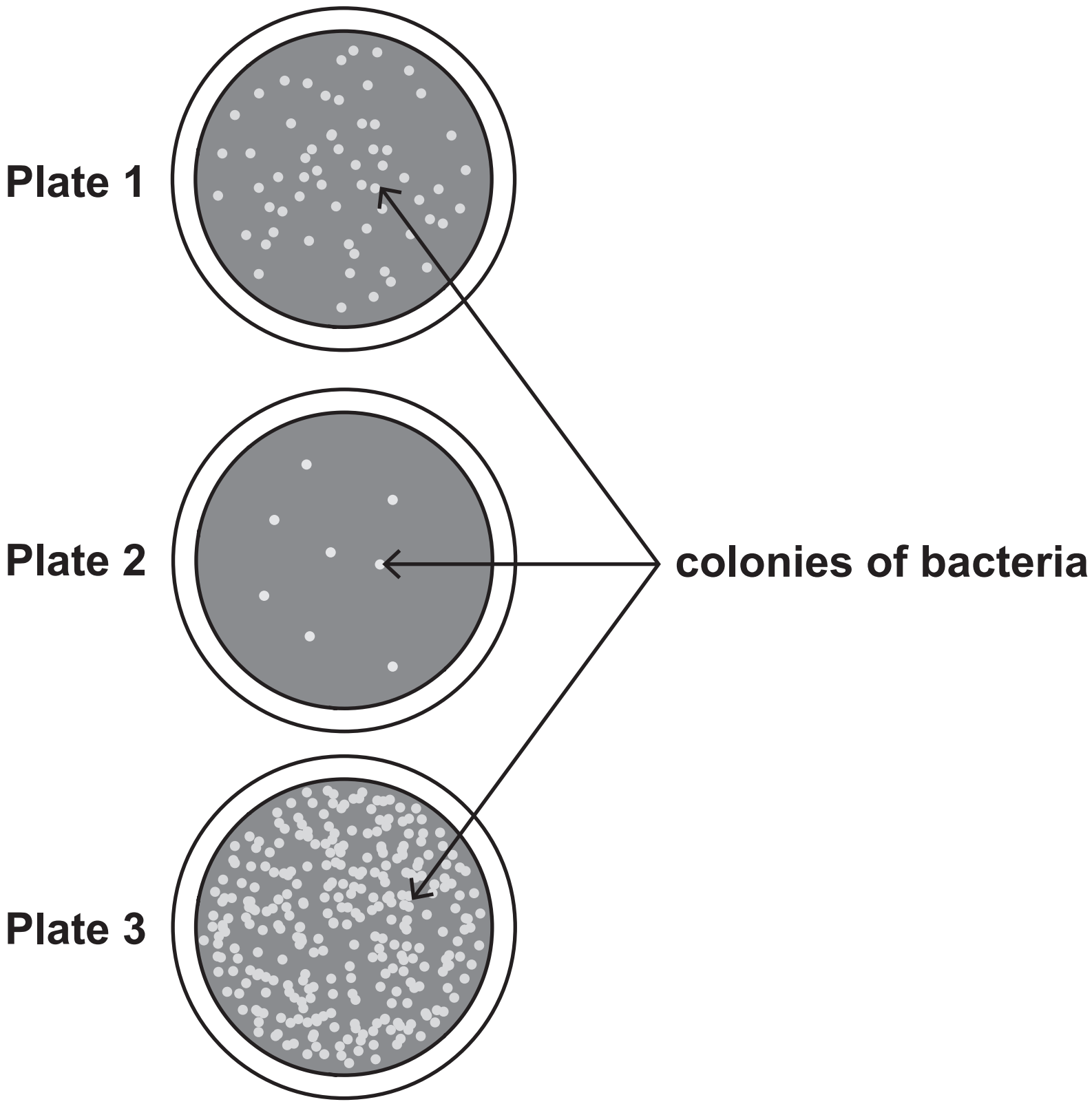


DIAGRAM 4.2

diagram NOT drawn to scale

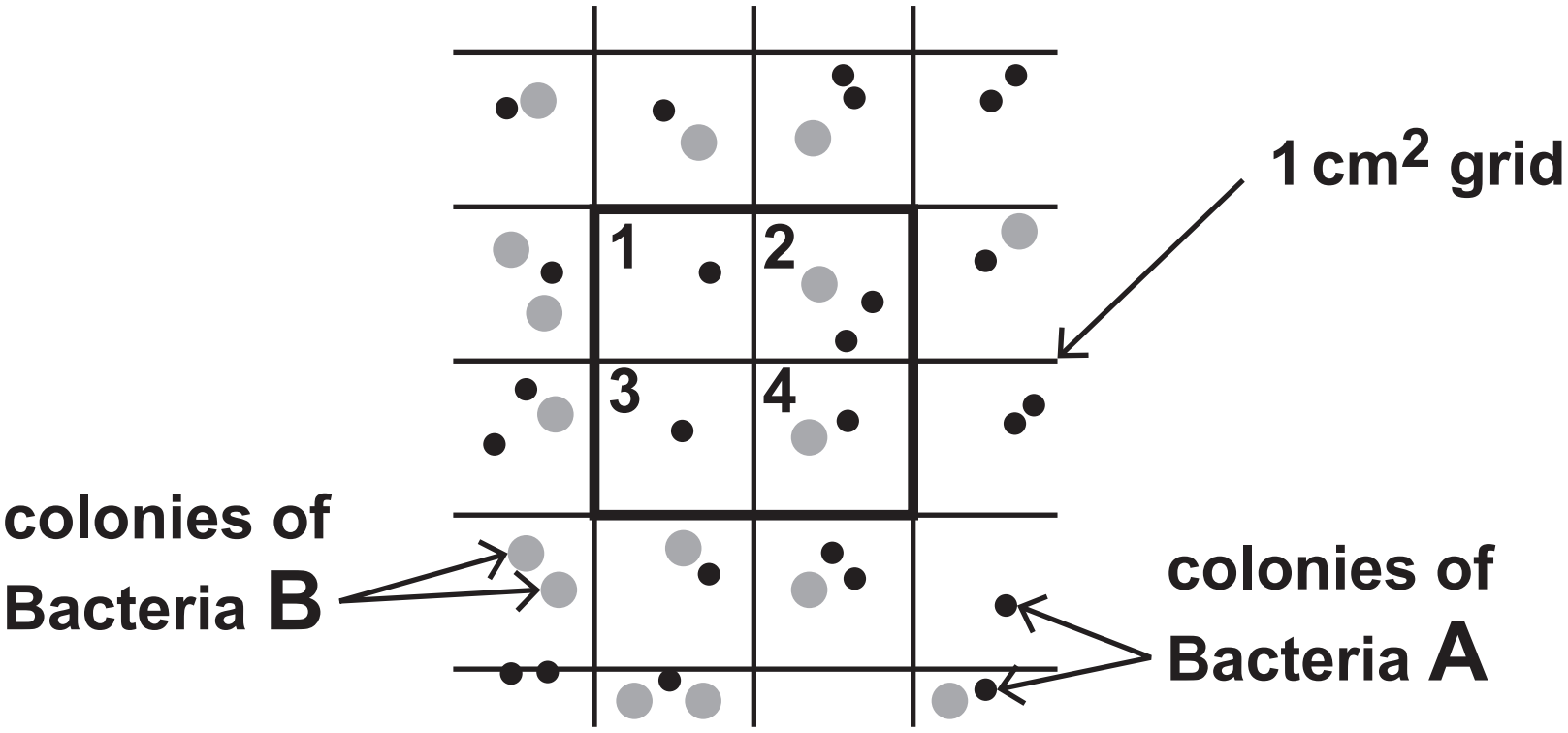
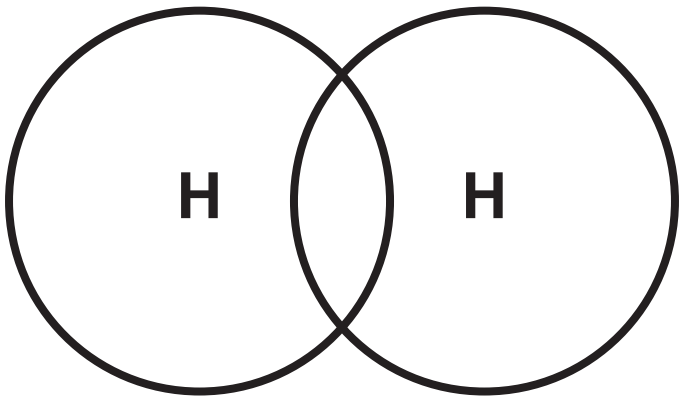


TABLE 4.3

Grid number	Number of bacteria in 1 cm²	
	Bacteria A	Bacteria B
1	1	0
2	2	1
3	1	0
4	1	
Mean colonies per cm²	1.25	
Mean colonies per 52 cm² plate	65	26
Total number of colonies in squares 1–4	5	

DIAGRAM 5.1



THIS IS A BLANK PAGE

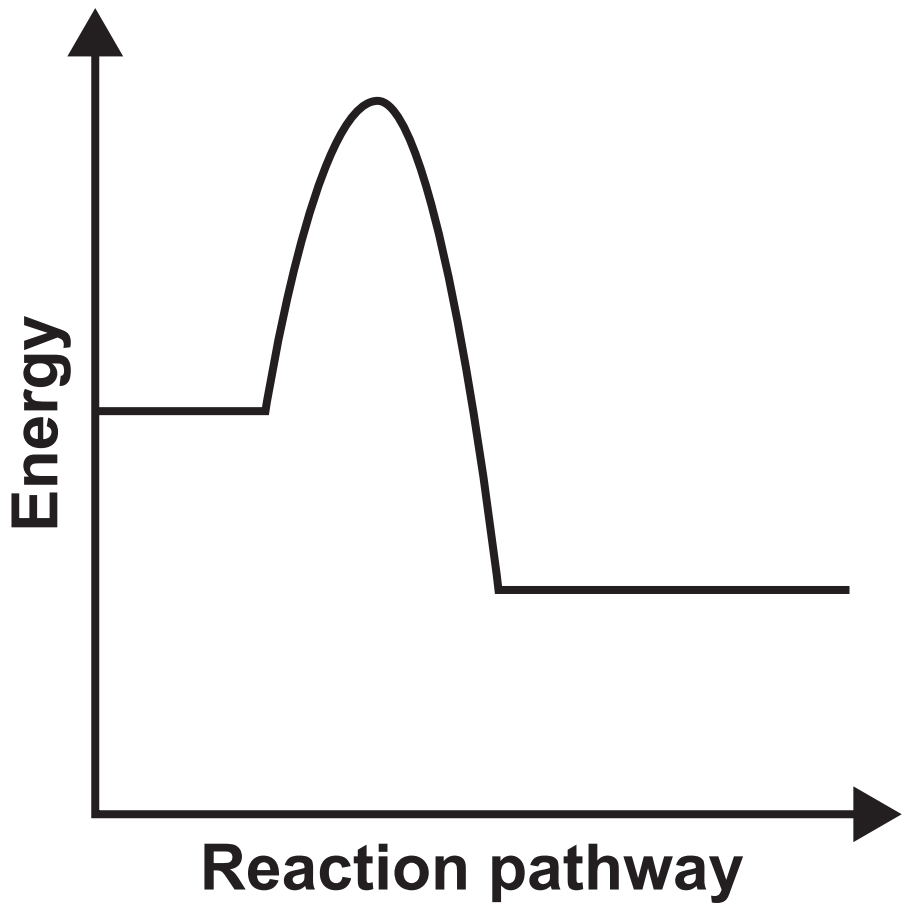
TURN OVER

TABLE 5.2

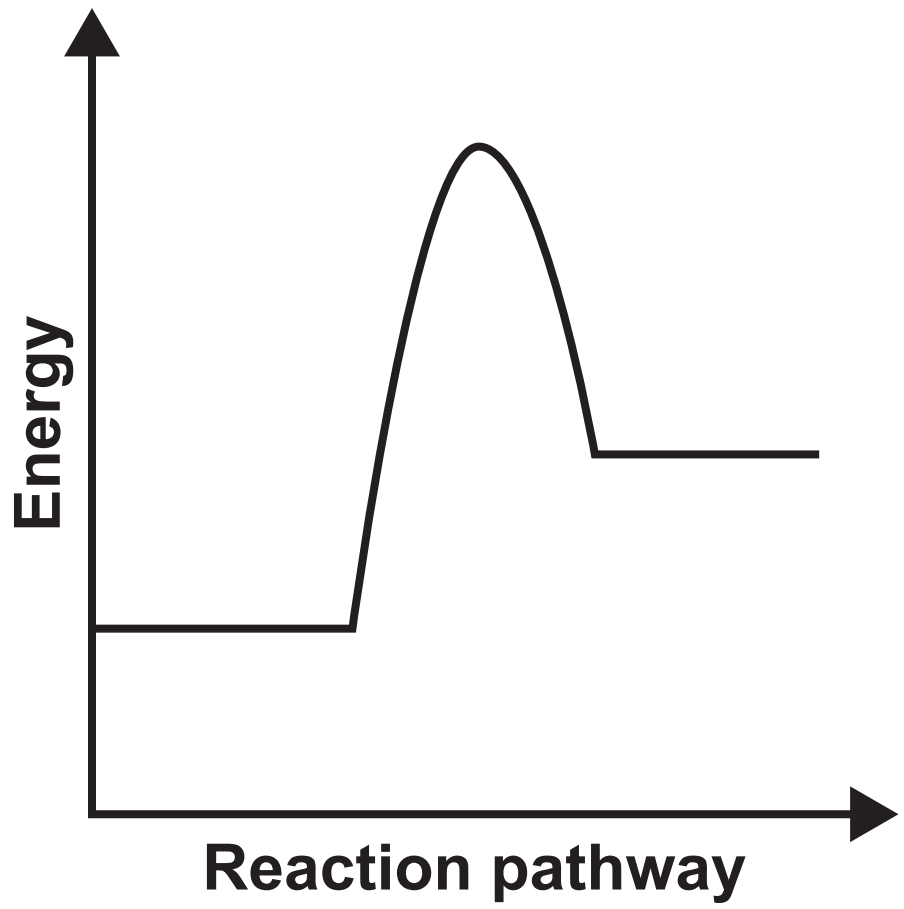
Bond	Energy needed to break or form the bond (kJ)
H–H	436
Cl–Cl	242
H–Cl	431

DIAGRAM 5.3

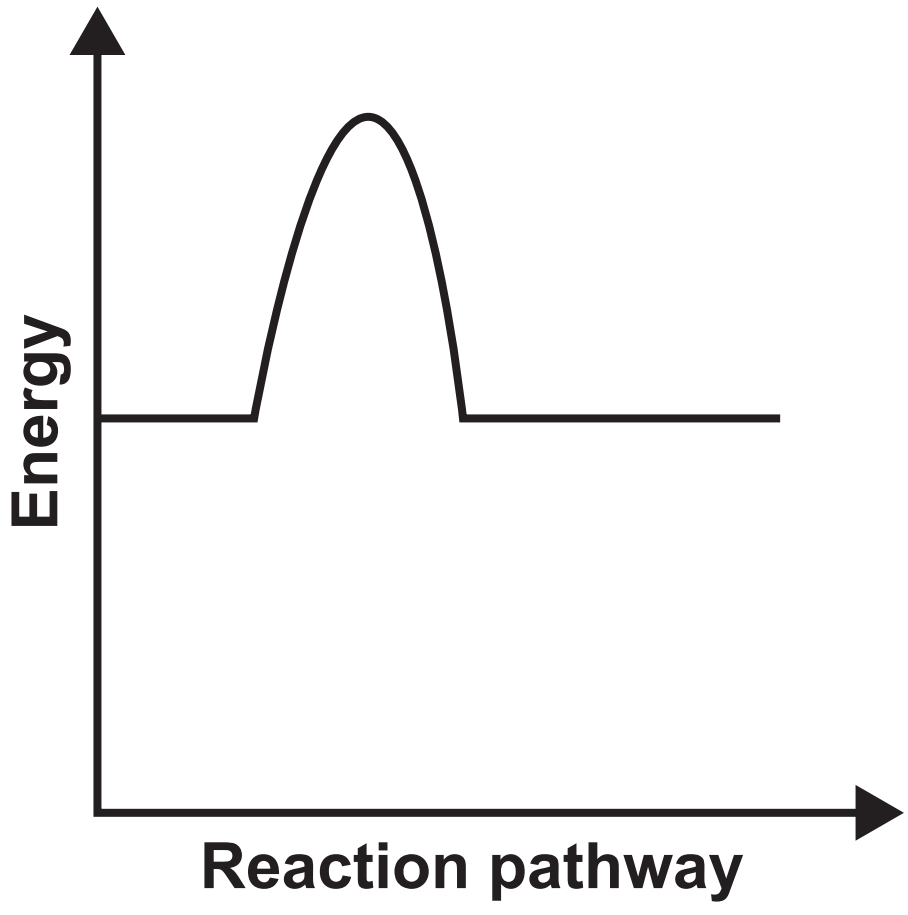
A



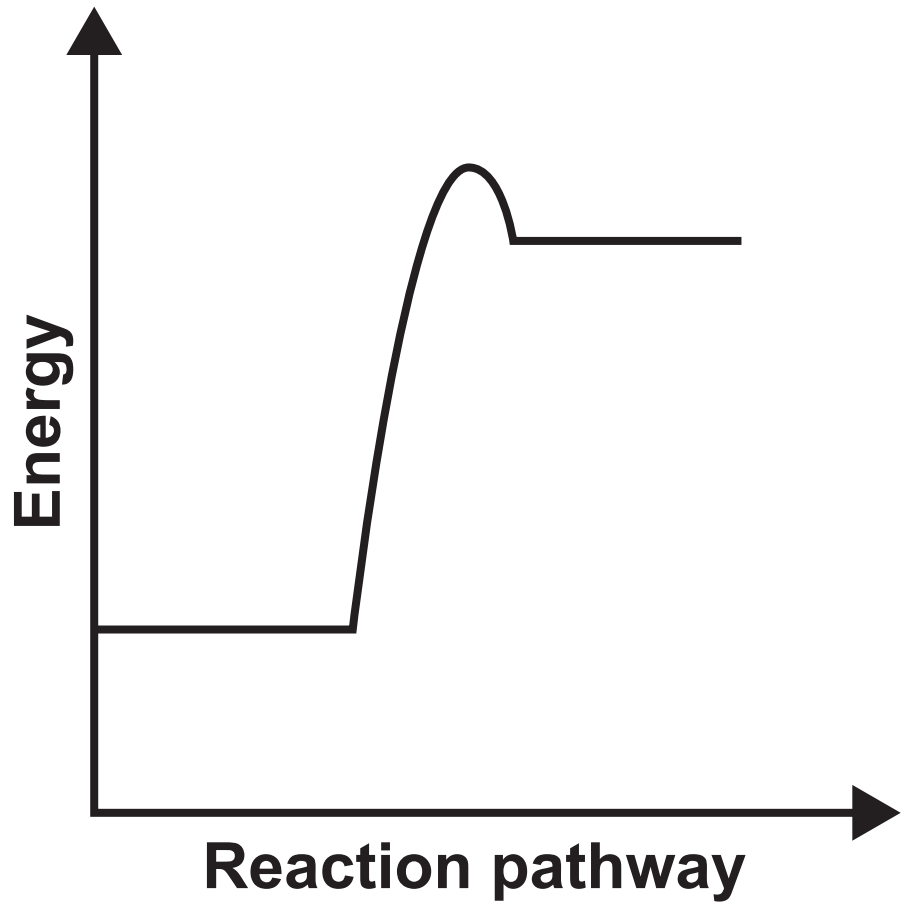
B



C



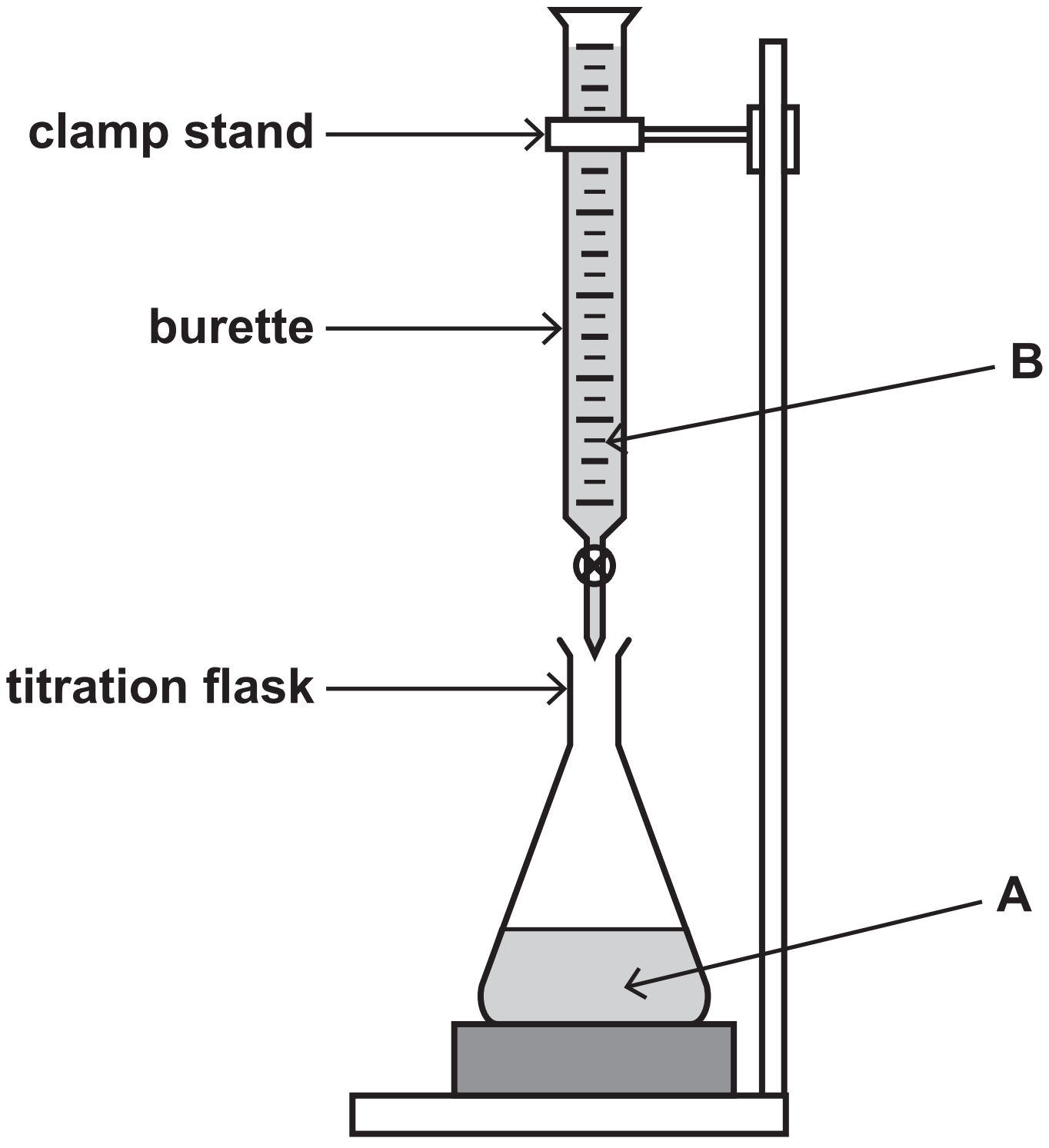
D



THIS IS A BLANK PAGE

TURN OVER

DIAGRAM 6.1



GRAPH 6.2

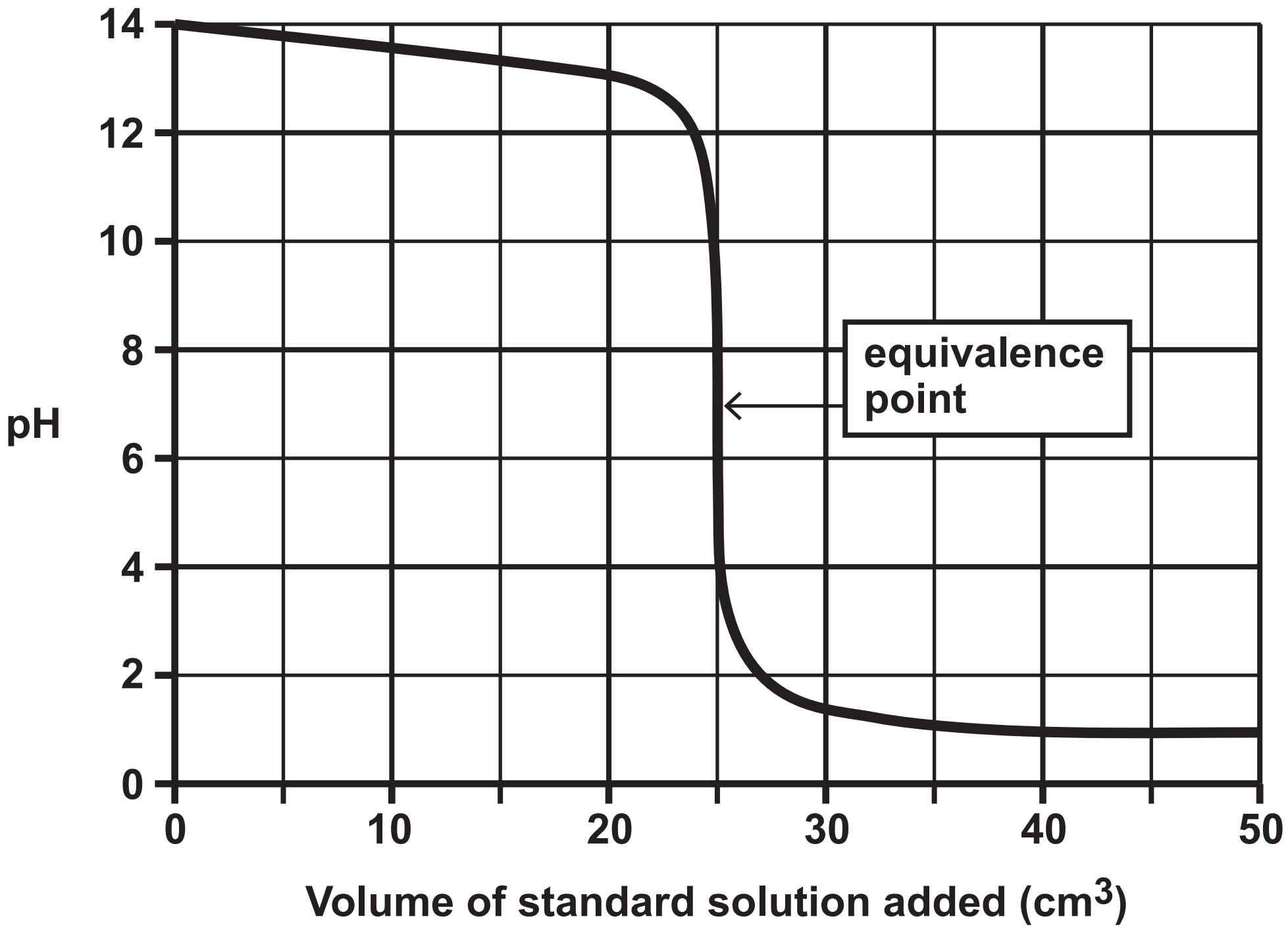
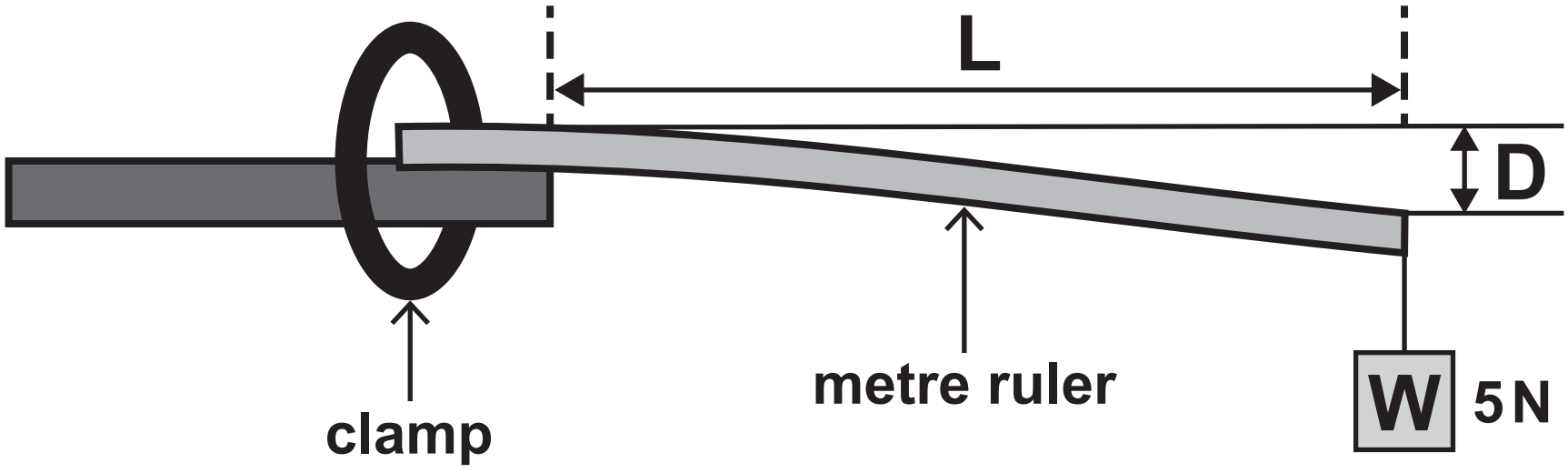

14
12
10
8
6
4
2
0
pH
equivalence point
0
10
20
30
40
50
Volume of standard solution added (cm3)

DIAGRAM 7.1



THIS IS A BLANK PAGE

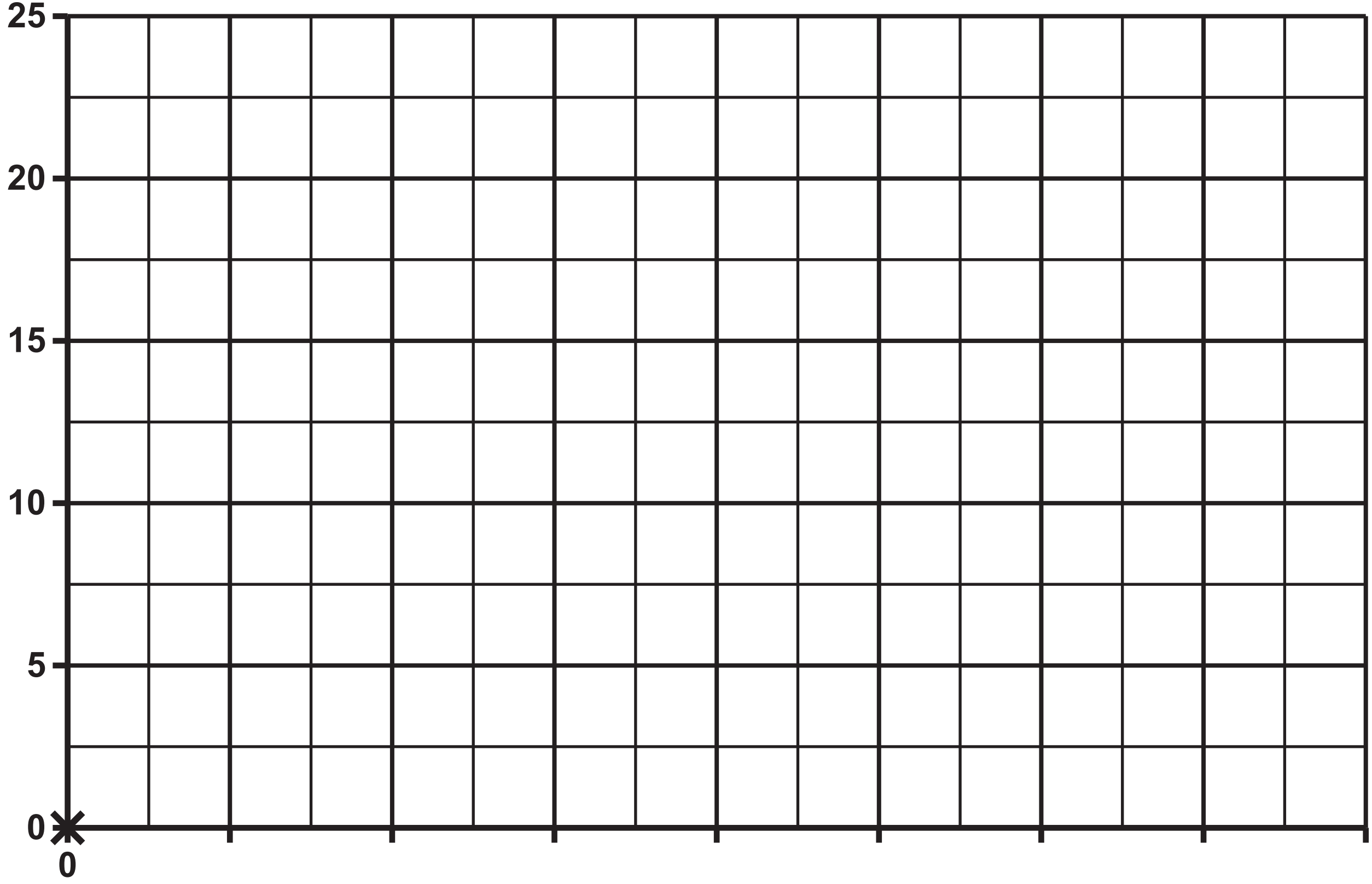
TURN OVER

TABLE 7.2

Length L (cm)	Depression D (cm)
0	0.0
30	1.0
40	3.0
50	6.0
60	10.0
70	15.0
80	22.0

GRAPH 7.3

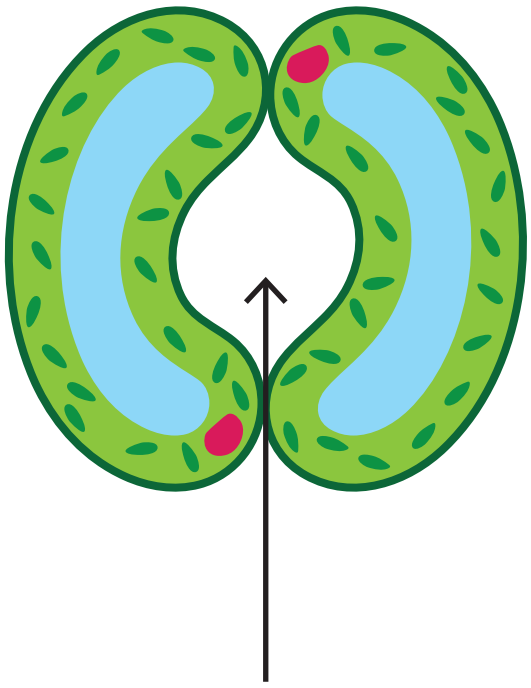
Depression (cm)



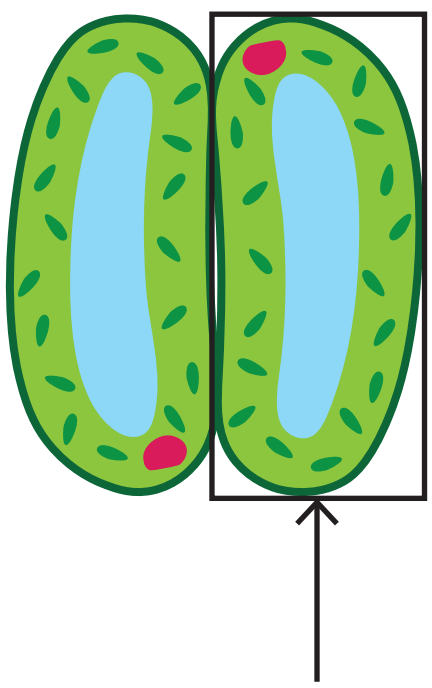
Length (cm)

DIAGRAM 8.1

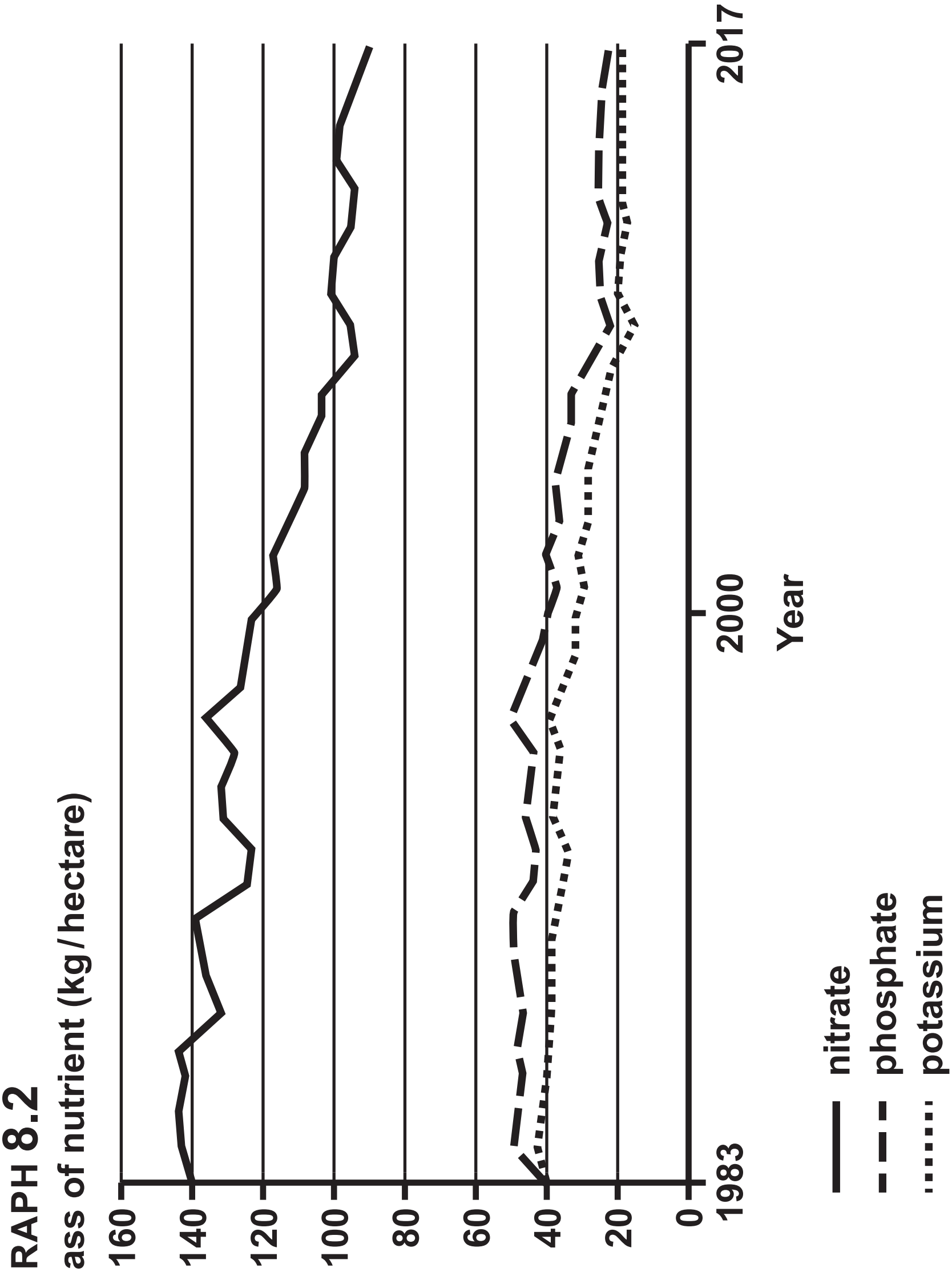
Open by day



Closed by night



GRAPH 8.2


Mass of nutrient (kg / hectare)
160
140
120
100
80
60
40
20
0
1983
2000
2017
Year
nitrate
phosphate
potassium

GCSE

3445U30-1

FRIDAY, 10 MAY 2024 – MORNING

APPLIED SCIENCE (Double Award)
UNIT 3: Food, Materials and Processes

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