



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.

(Turn over)

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.

(Turn over)

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.

(Turn over)

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

(Turn over)

1 (a)(ii)

CIRCLE ONE other treatment method used to preserve food.
[1 mark]

adding oxygen adding salt

adding water

(Turn over)

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

(Turn over)

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(carbon dioxide /

**glucose → ethanol + 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 UNDERLINING the correct word(s) in the brackets. [1 mark]

(Turn over)

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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

(Turn over)

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

(Turn over)

2 (c)(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

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

concentration difference = _____ units

(Turn over)

2 (d)(i)

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

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

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

mean rate = _____ units / hour

(Turn over)

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

(Turn over)

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

(a) Complete the sentence below by UNDERLINING 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).**

(Turn over)

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3 (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]**

(Turn over)

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. _____

(Turn over)

3 (c)(ii)

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

3 (c)(ii)

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

time = _____ s

(Turn over)

3 (c)(iii)

Complete the following sentences by UNDERLINING 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.

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.

(Turn over)

4 (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 answer on next page

(Turn over)

(Turn over)

4 (a)(ii)

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

(Turn over)

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]

(Turn over)

4 (b)(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]**

(Turn over)

4 (c)(ii)

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

12

(Turn over)

- 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. [1 mark]**

(Turn over)

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



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

(Turn over)

5 (b)(ii)

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

energy = _____ kJ

(Turn over)

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]

(Turn over)

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more less taken in given out

increase decrease

thermal runaway

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

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

(Turn over)

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

The apparatus used is shown in DIAGRAM 6.1 in the separate diagram booklet.

The concentration of solution A can be found by titrating against a standard solution B of known concentration.

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**

6 continued

- **the point at which the solution becomes neutral**
- **which solution is acid and which solution is alkaline. [6 marks QER]**

continue answer on next page

(Turn over)

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]

(Turn over)

**7 (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

(Turn over)

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. _____

(Turn over)

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 GRAPH 8.2 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]

continue answer on next page

(Turn over)

(Turn over)

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

(Turn over)

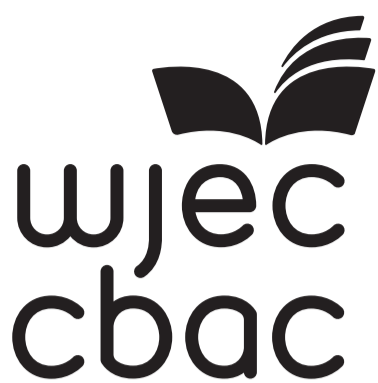
8 (b)(ii) continued

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

mass = _____ kg

10

END OF PAPER



GCSE

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**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)

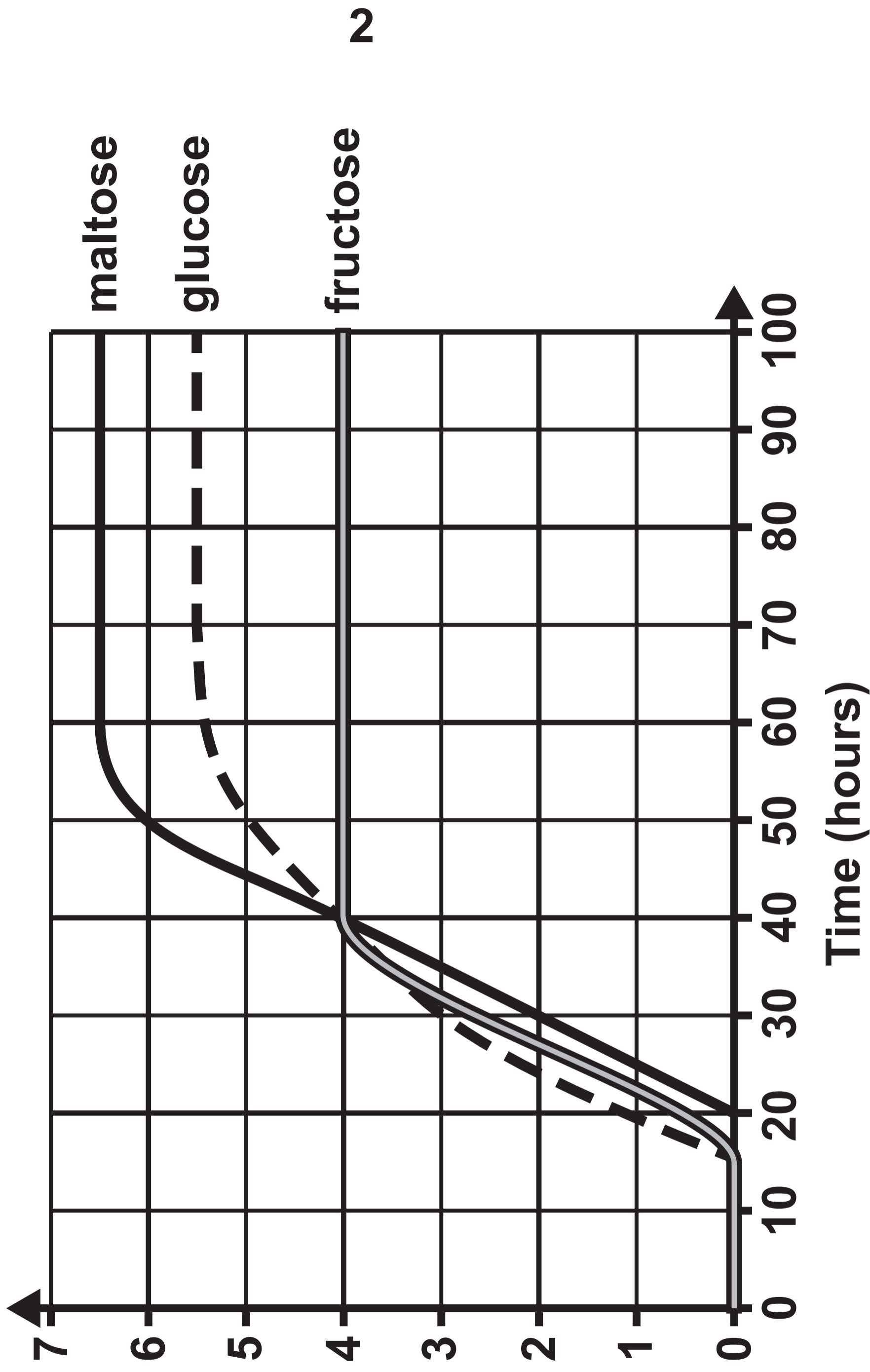
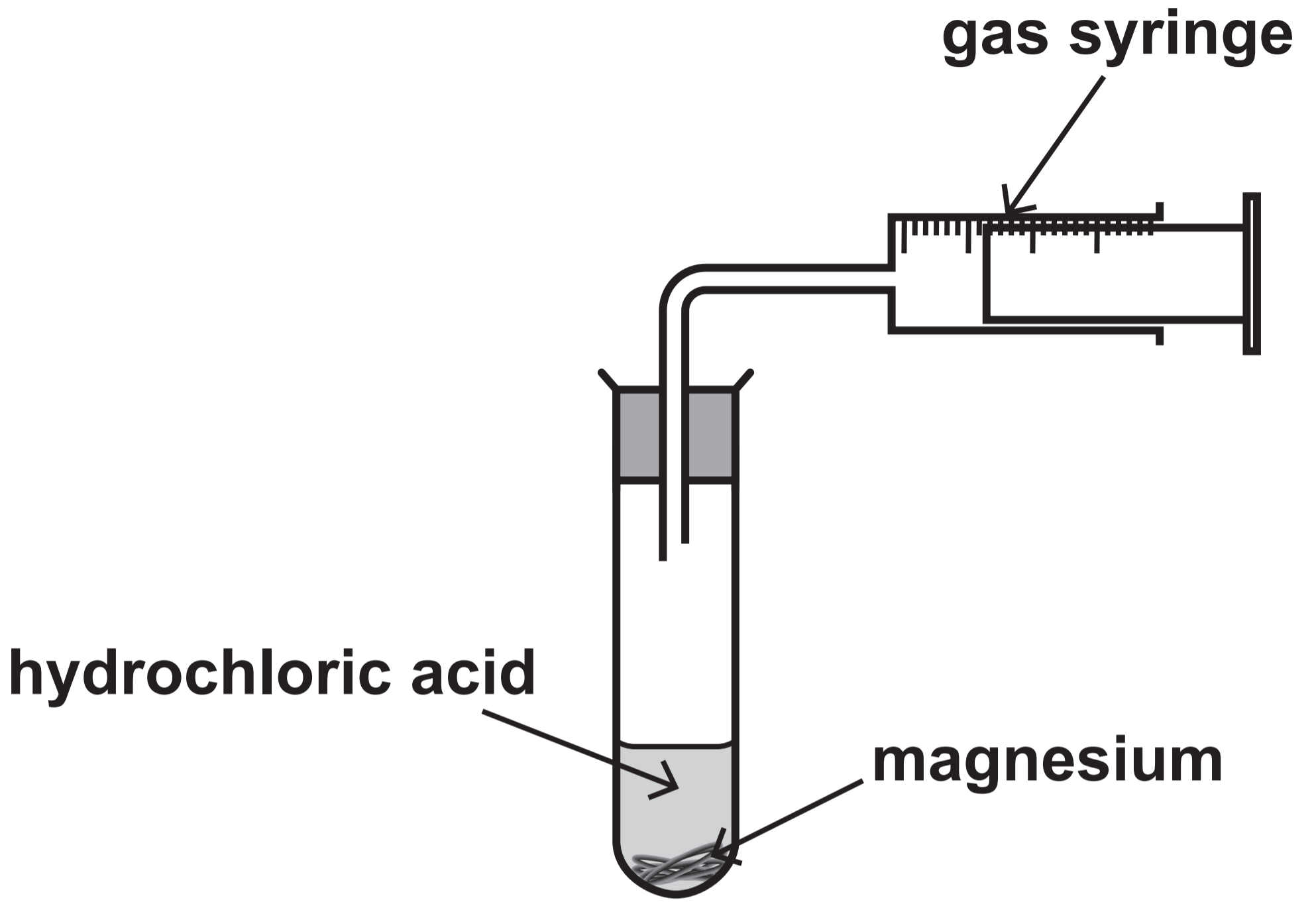


DIAGRAM 3.1



GRAPH 3.2

Volume of hydrogen gas (cm³)

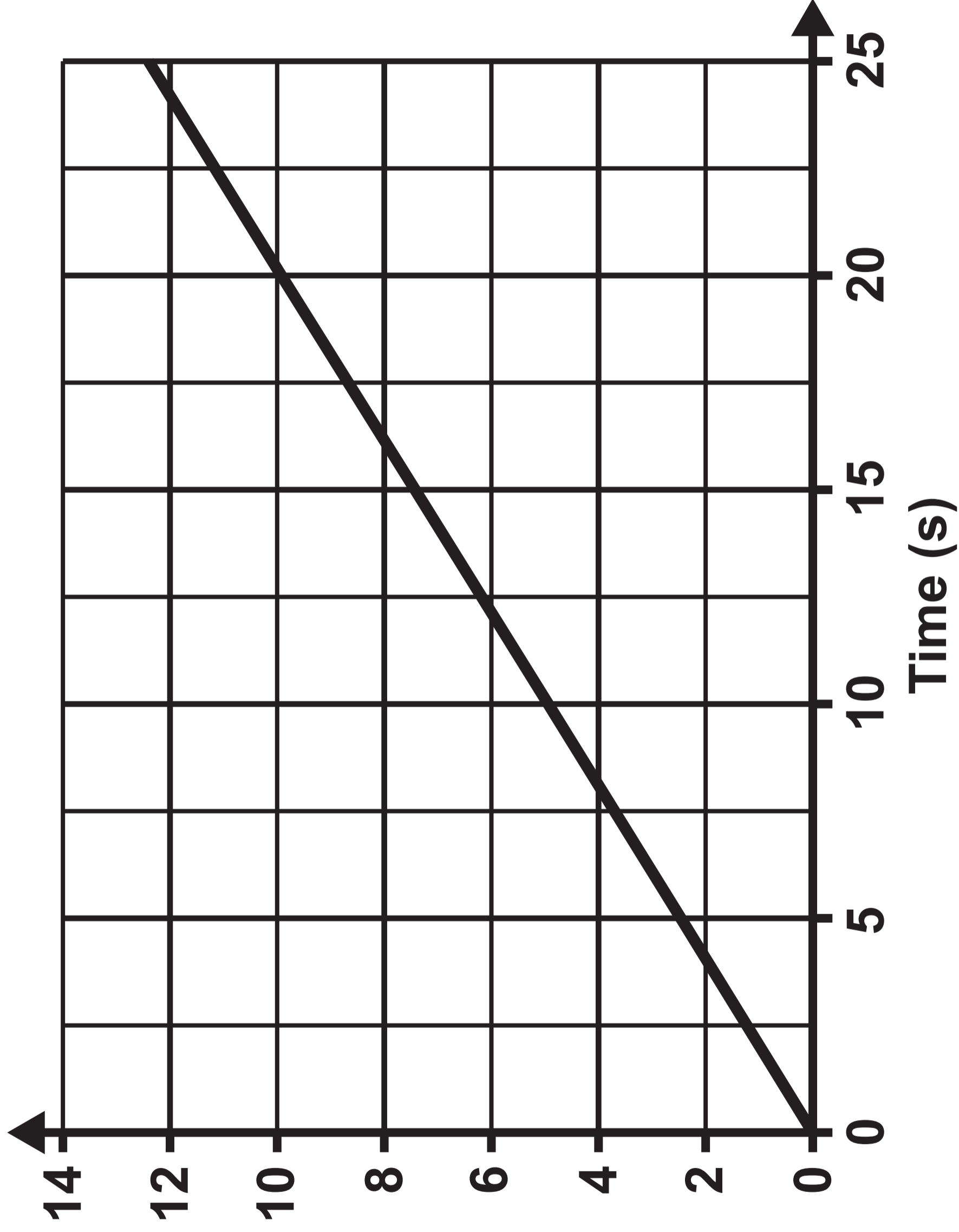


TABLE 3.3

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

DIAGRAM 4.1

Plate 1

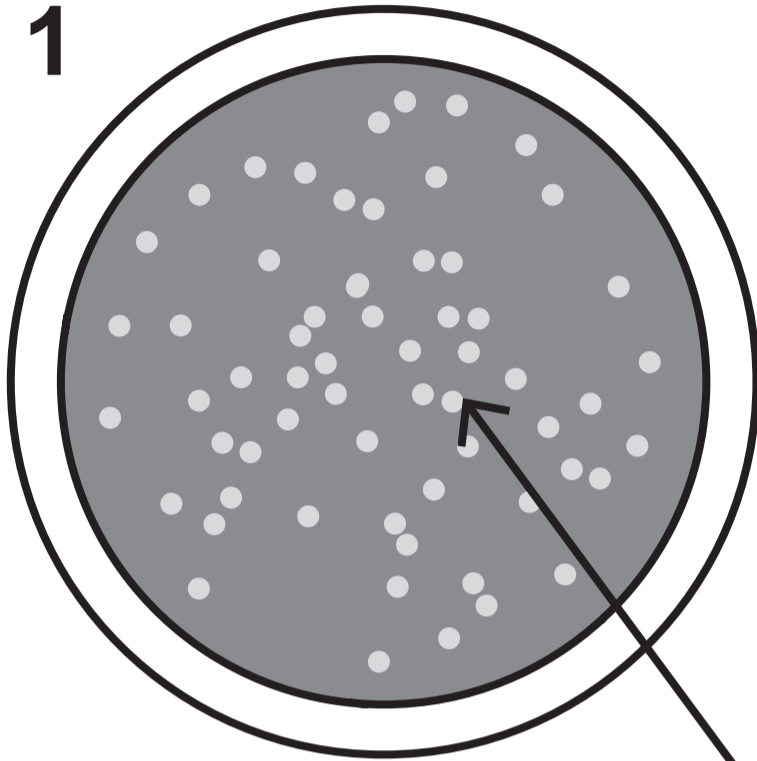


Plate 2

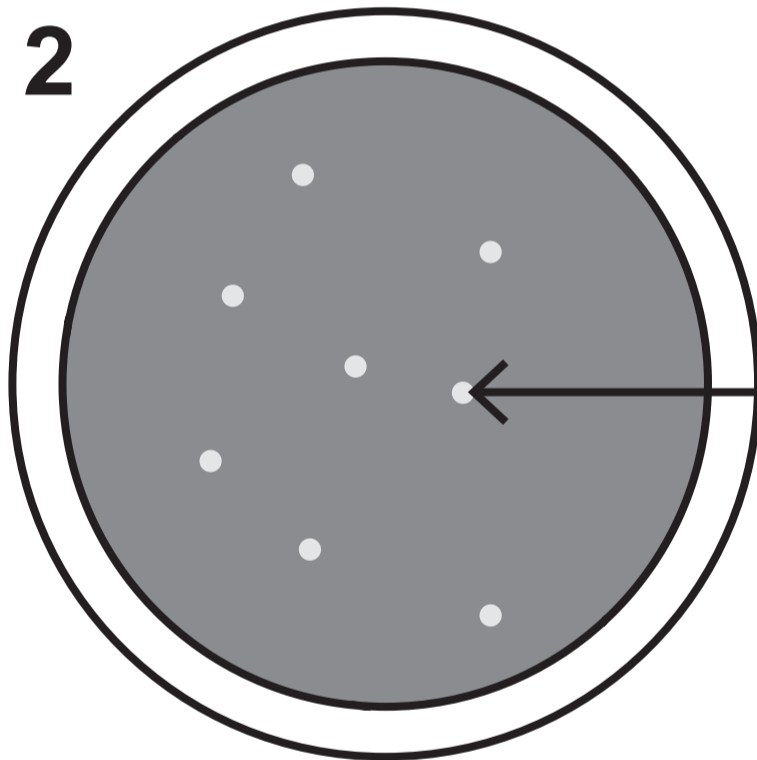
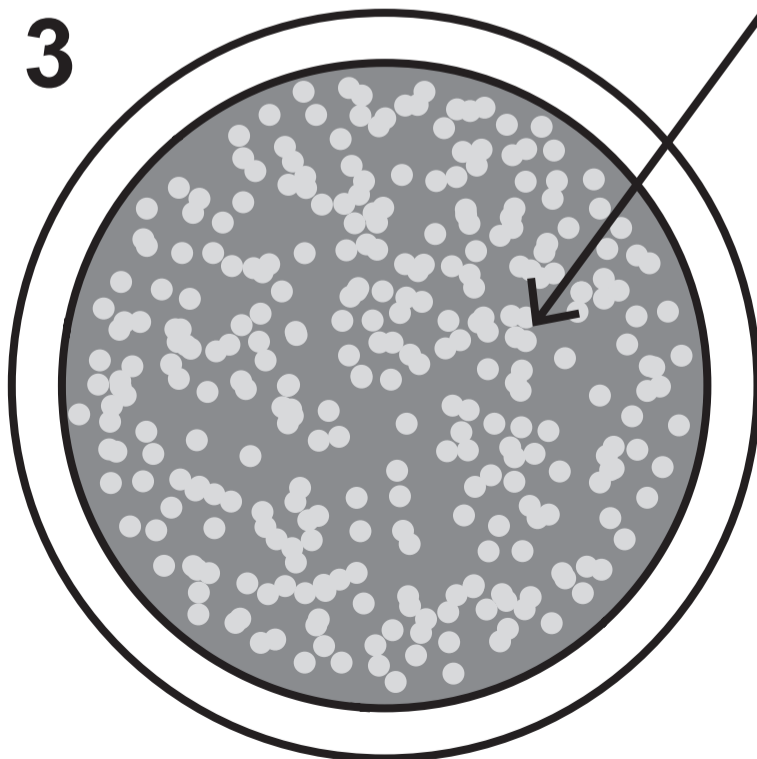


Plate 3



**colonies
of bacteria**

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DIAGRAM 4.2

diagram not drawn to scale

Section of agar plate

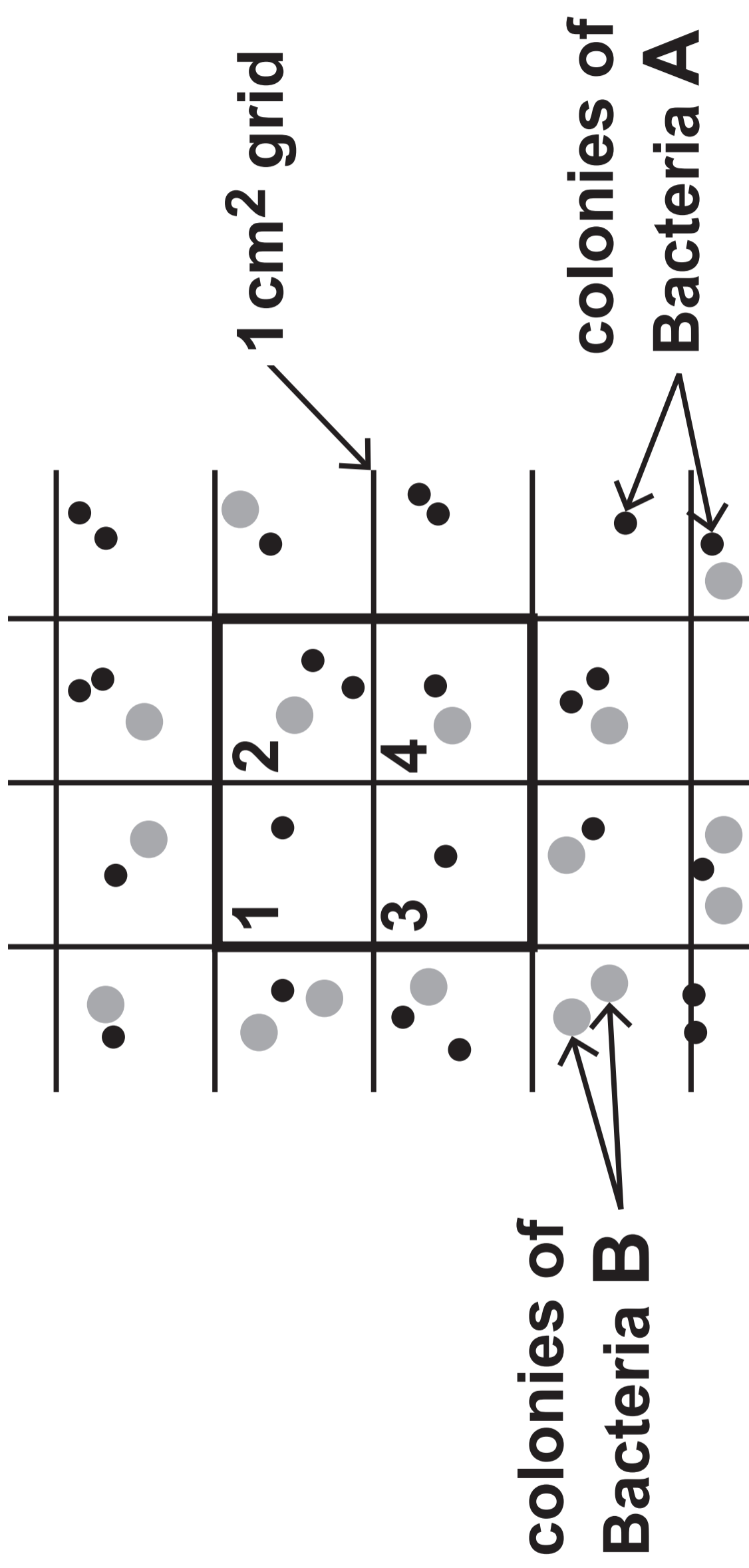
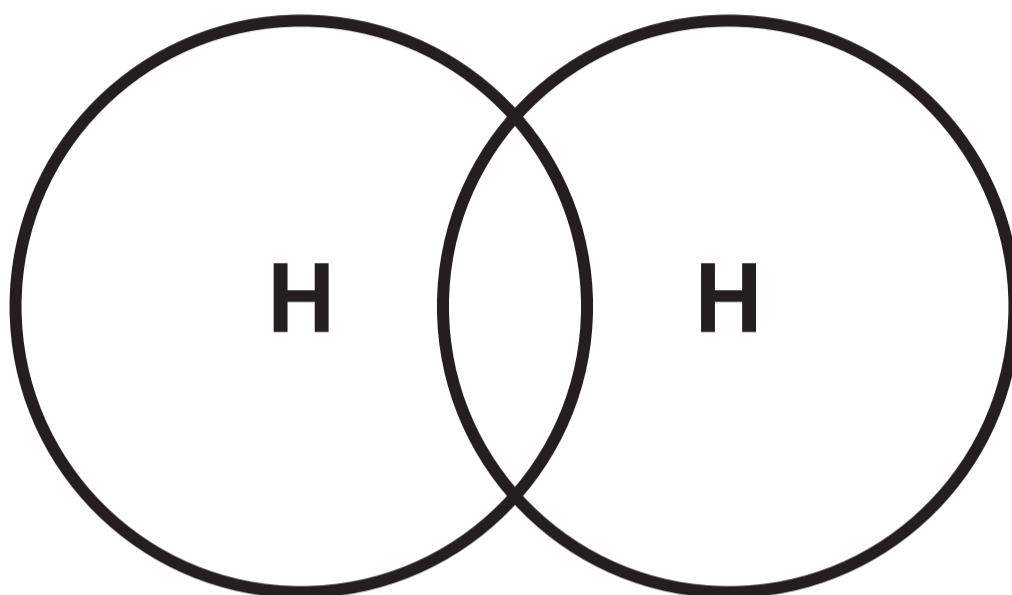


TABLE 4.3

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**TABLE 5.2**

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

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DIAGRAM 5.3

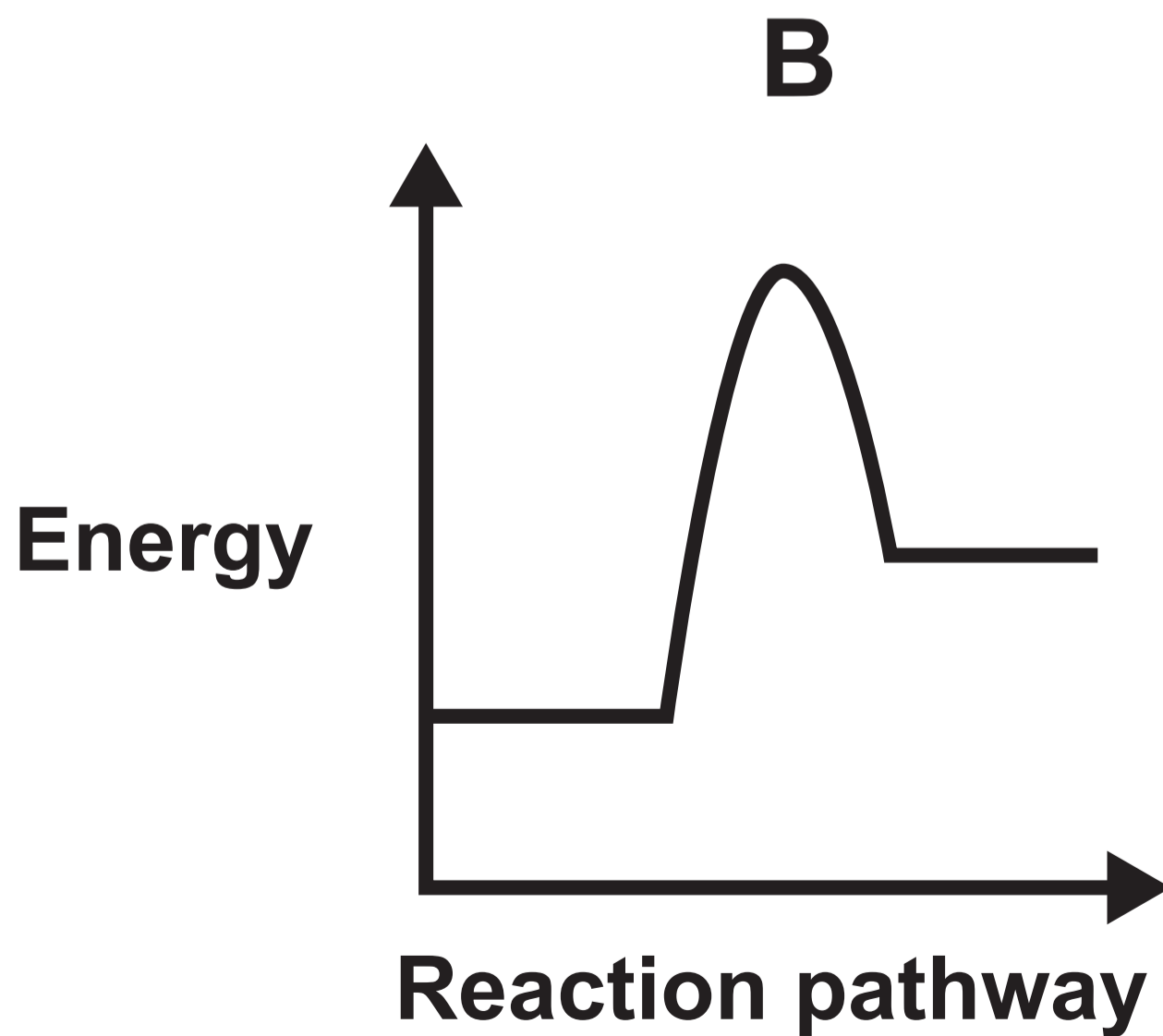
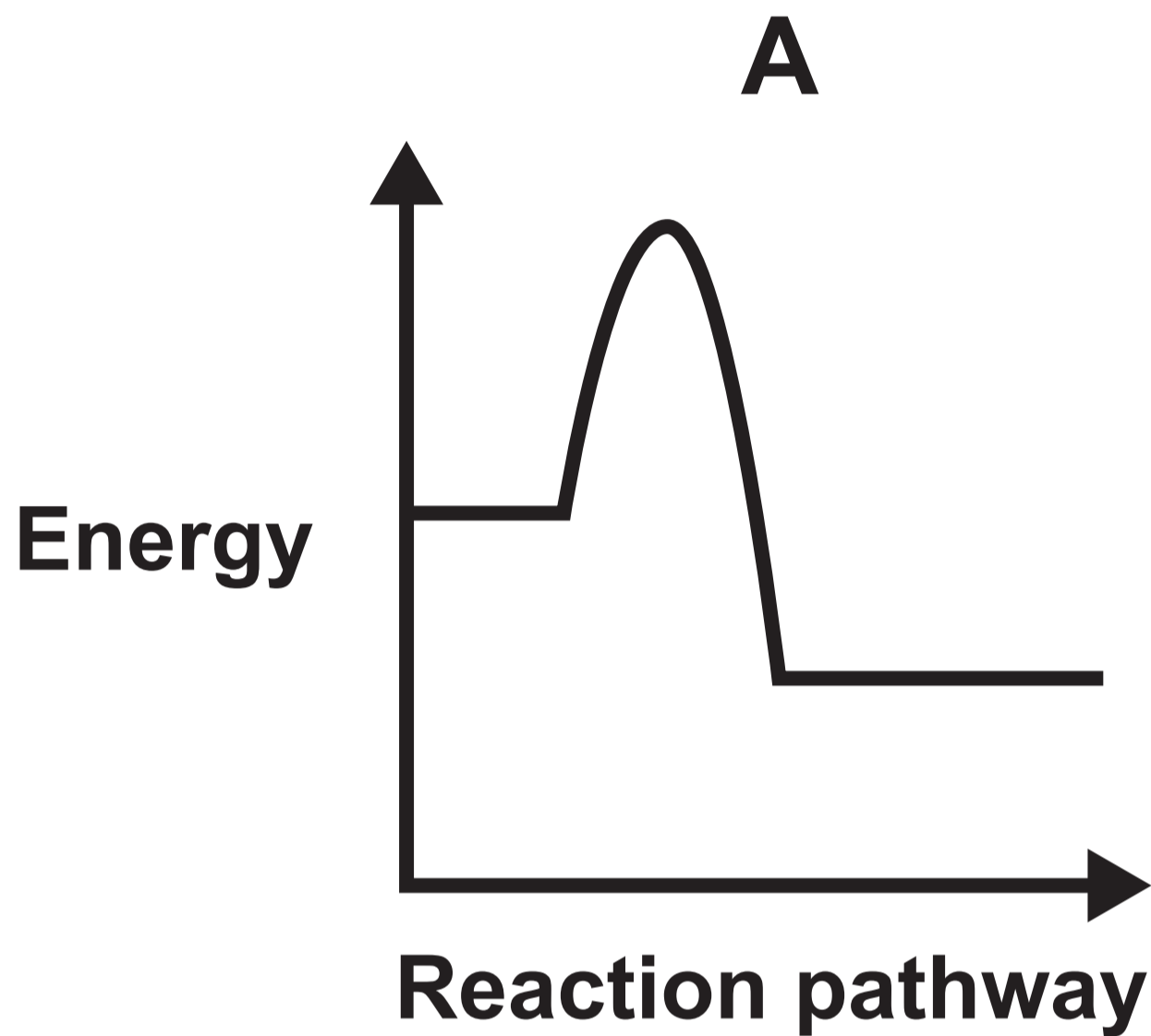


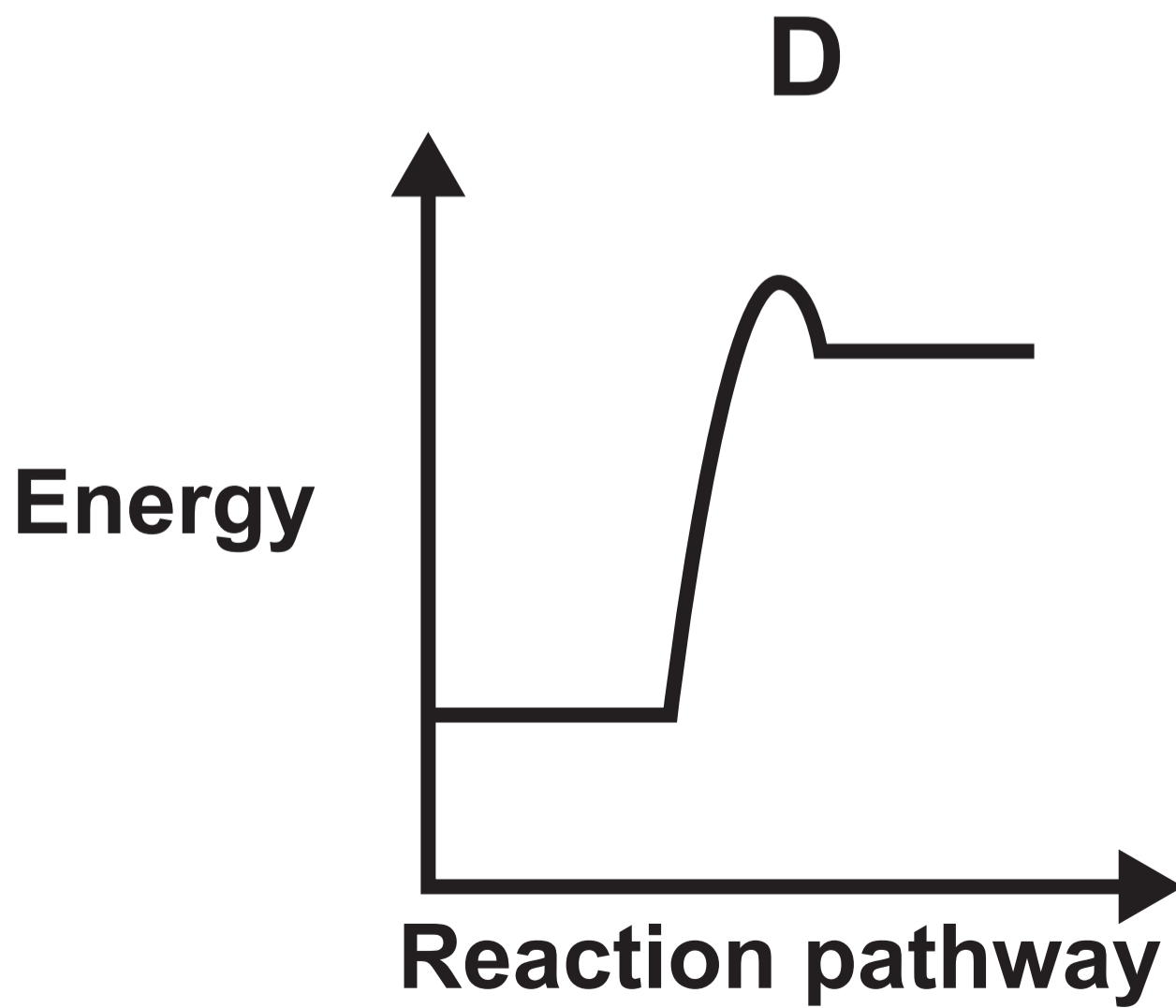
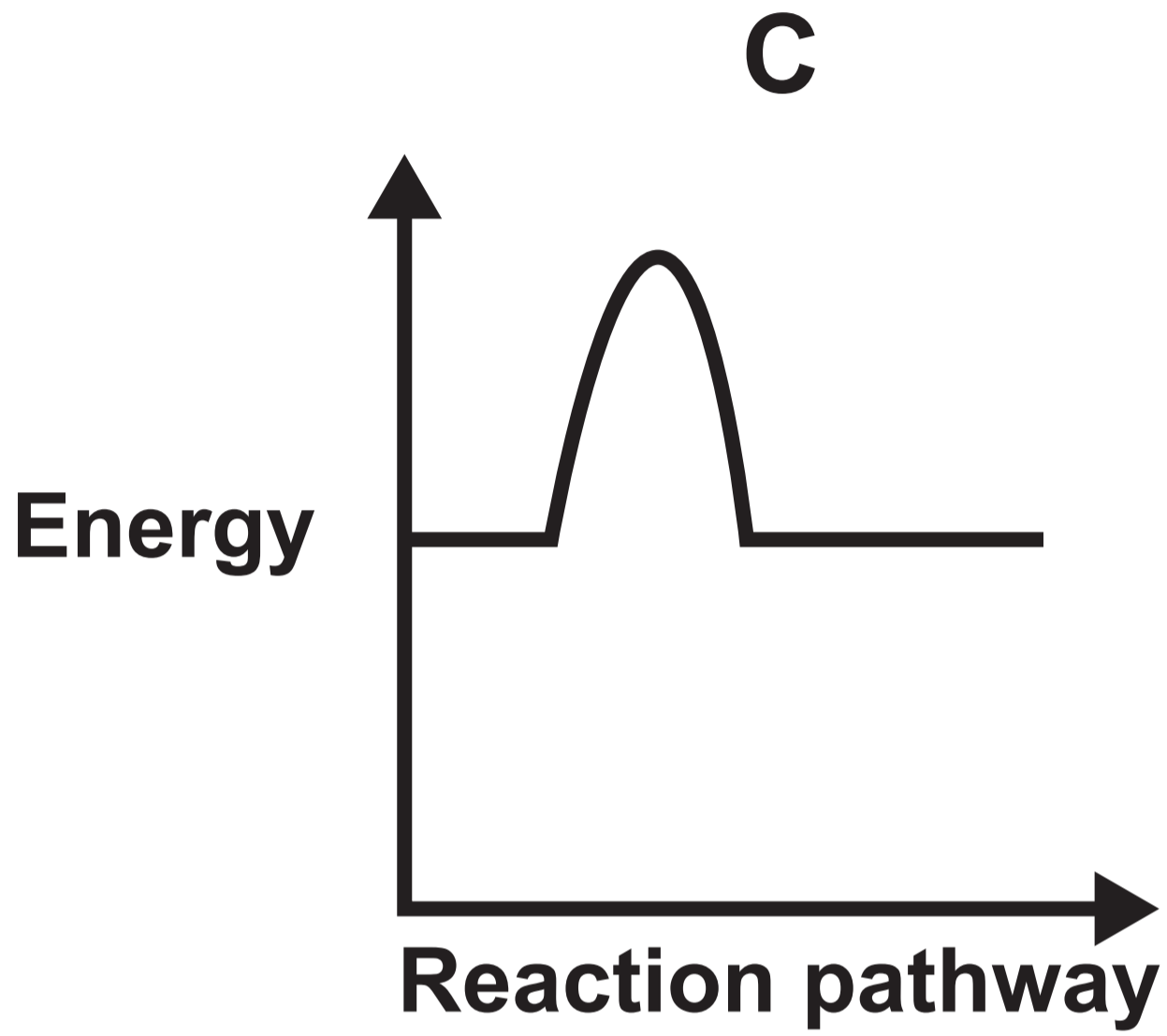
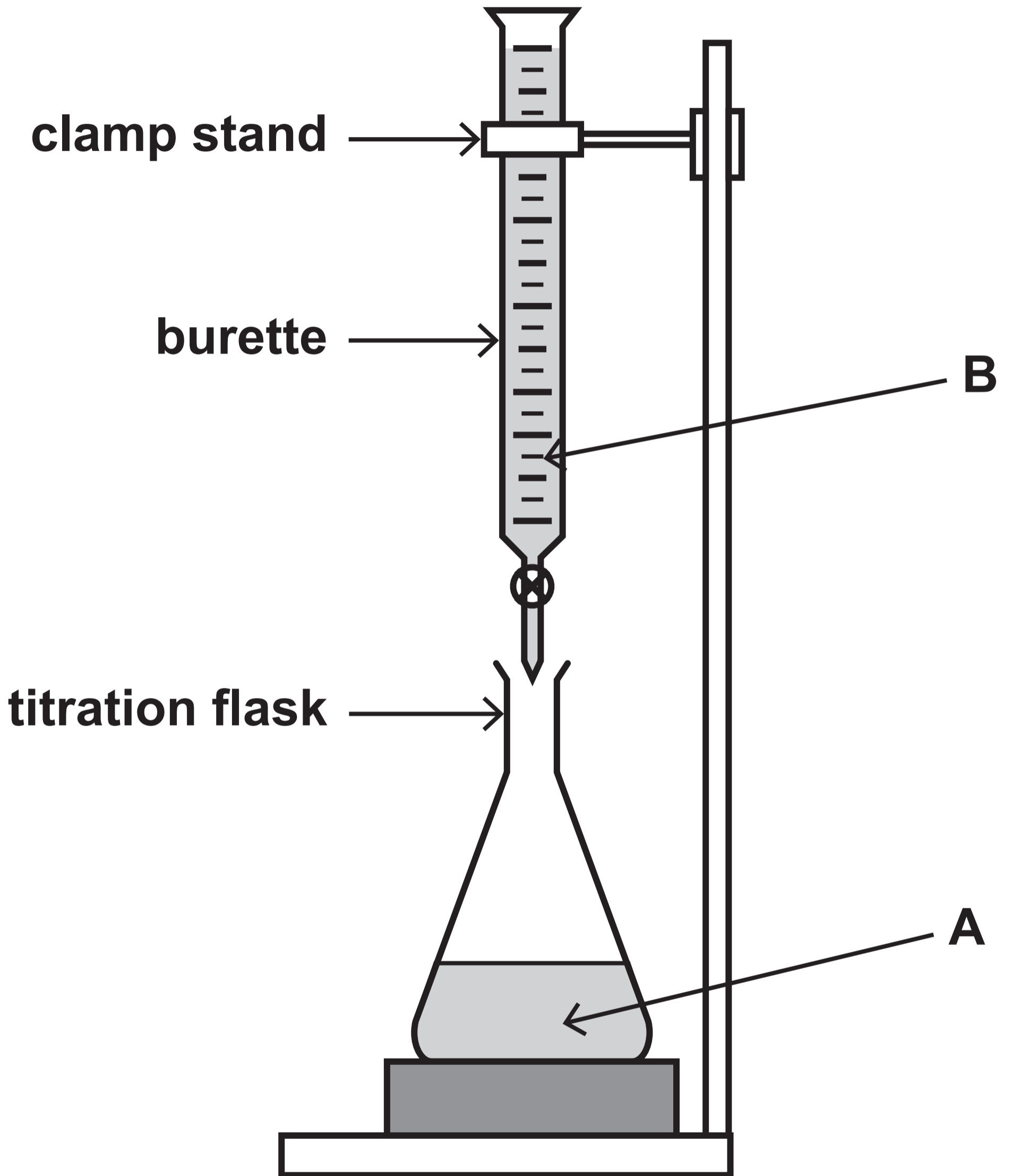
DIAGRAM 5.3 continued

DIAGRAM 6.1



GRAPH 6.2

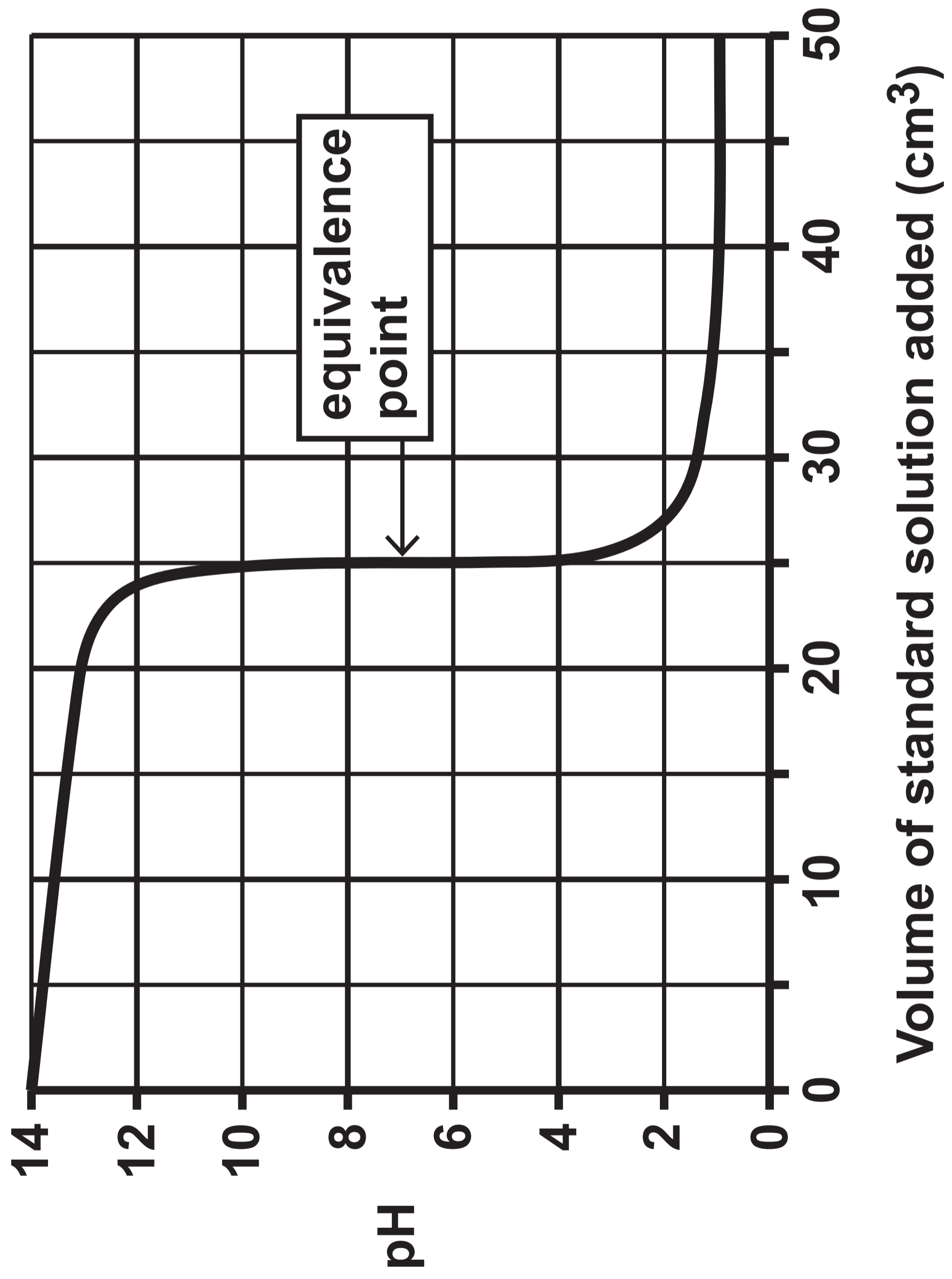
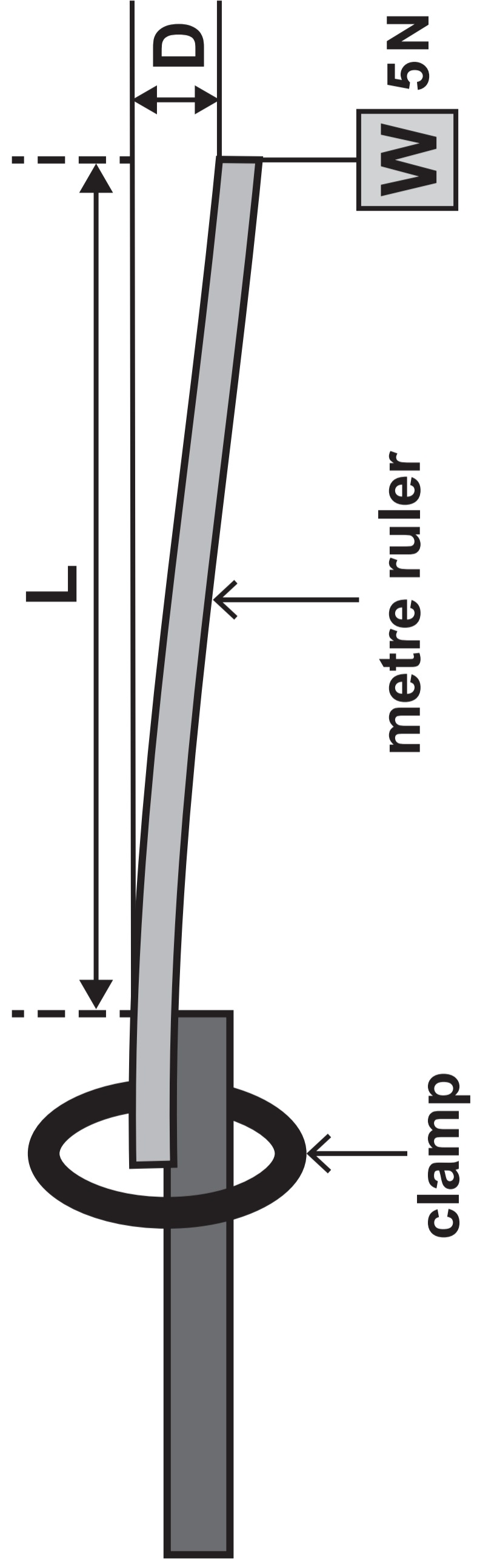


DIAGRAM 7.1



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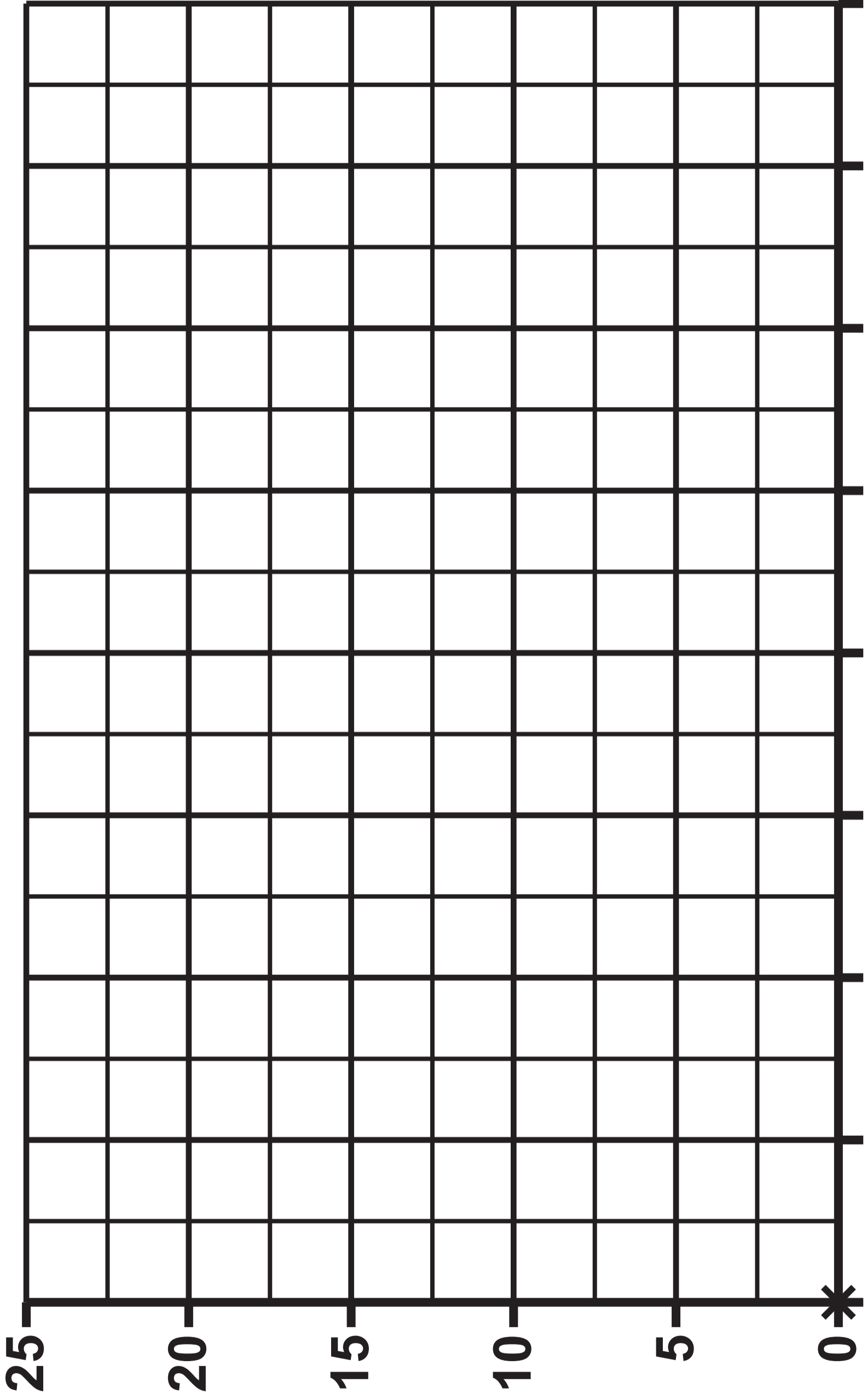
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TABLE 7.2

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)

25

20

15

10

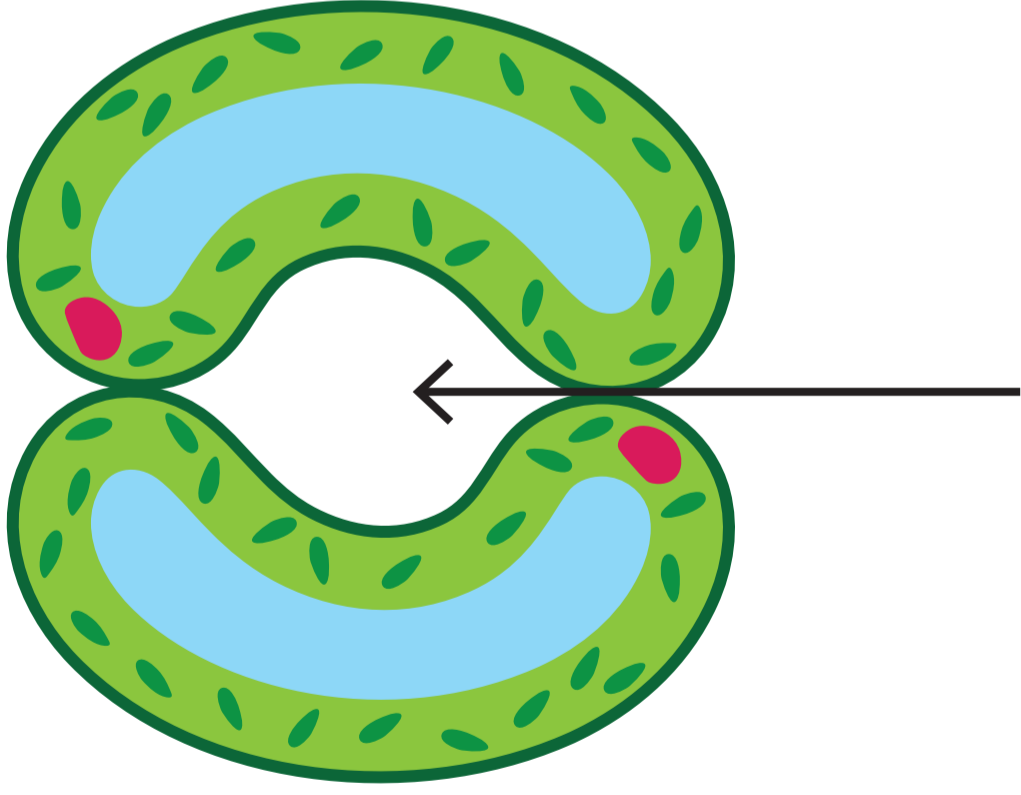
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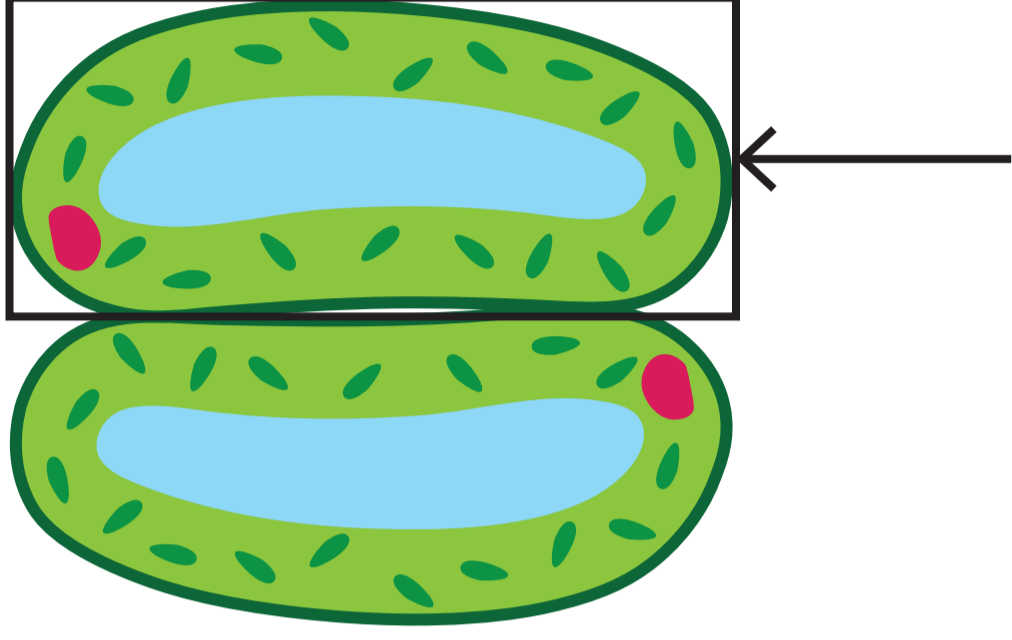
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DIAGRAM 8.1

Open by day



Closed by night

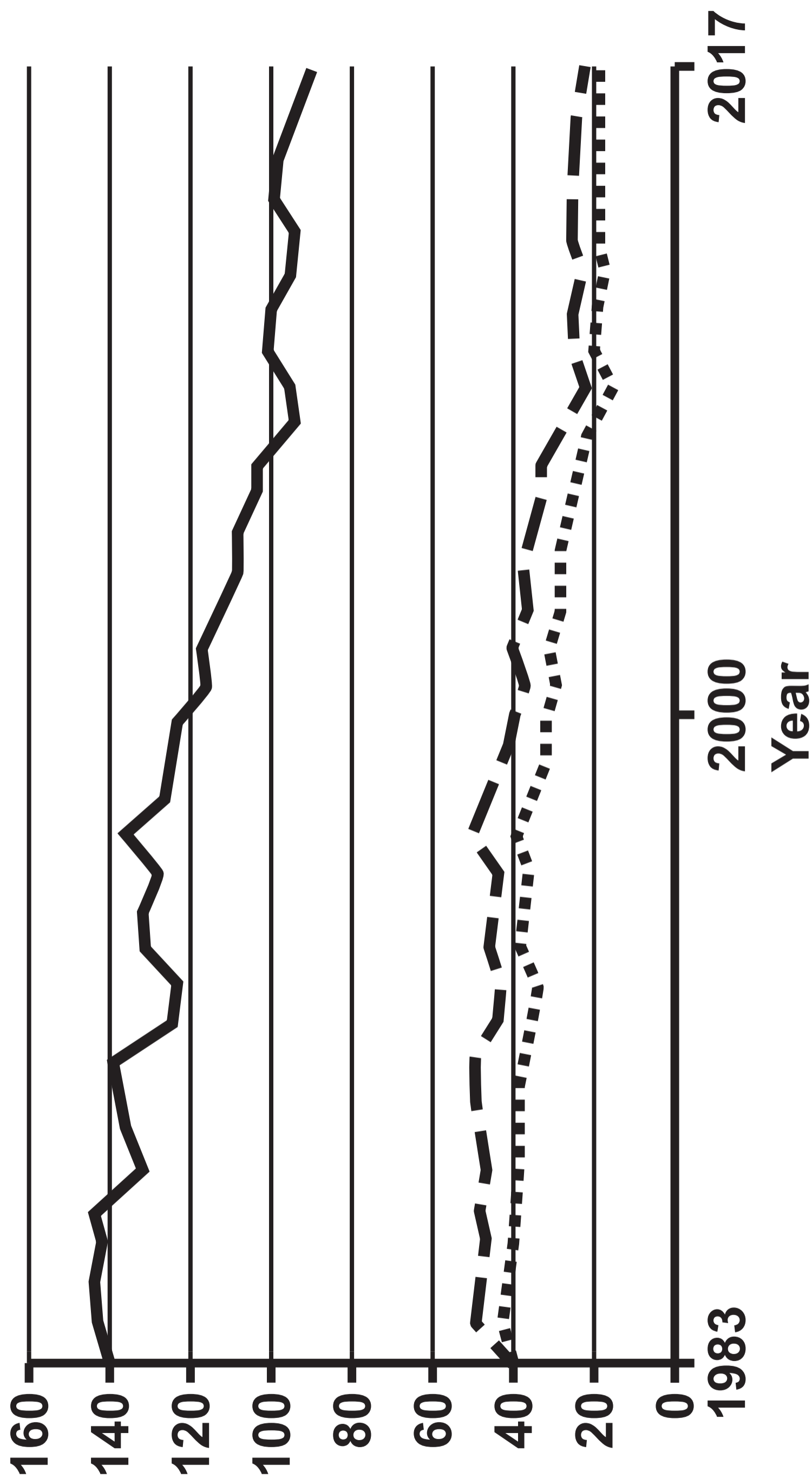


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GRAPH 8.2

Mass of nutrient (kg / hectare)



Key for GRAPH 8.2 opposite

— nitrate

- - - phosphate

..... potassium



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FRIDAY, 10 MAY 2024 – MORNING

APPLIED SCIENCE (Double Award)

UNIT 3: Food, Materials and Processes

FOUNDATION TIER

Data Booklet

THE PERIODIC TABLE

1 2 GROUP

1 H 1

7 Li 3	9 Be 4
23 Na 11	24 Mg 12

KEY	
A_r	relative atomic mass
Sym	symbol
Z	atomic number

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						

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		