

3410U10-1

FRIDAY, 13 JUNE 2025 – MORNING

CHEMISTRY – Unit 1:
Chemical Substances, Reactions and
Essential Resources

FOUNDATION TIER

**1 hour 45 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 need 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. 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.

The Periodic Table and the formulae for some common ions are printed in the separate Data Booklet.

For Examiner’s use only		
Question	Maximum Mark	Mark Awarded
1.	6	
2.	8	
3.	7	
4.	14	
5.	10	
6.	5	
7.	10	
8.	5	
9.	6	
10.	9	
Total	80	

Answer ALL questions.

1 **DIAGRAM 1** in the separate diagram booklet shows part of the Periodic Table.

(a) Tick (✓) the box next to the number of the **GROUP** in the Periodic Table that contains the element chlorine, Cl. [1 mark]

☐

5

☐

6

☐

7

(Turn over)

1 (b) Tick (✓) the box next to the number of the PERIOD in the Periodic Table that contains the element chlorine, Cl. [1 mark]

☐**1**☐**2**☐**3**

(c) Tick (✓) the box next to the colour of chlorine gas. [1 mark]

☐**green**☐**orange**☐**blue**

(Turn over)

1 (d) Sodium metal reacts with chlorine gas to form sodium chloride.



(i) Tick (✓) the box next to the word that describes sodium chloride. [1 mark]

☐

element

☐

compound

☐

mixture

(Turn over)

1 (d)(ii)

Sodium ions in sodium chloride can be identified using a FLAME TEST.

Tick (✓) the box next to the colour of the flame produced by sodium ions in a flame test. [1 mark]

☐

red

☐

yellow

☐

green

(Turn over)

1 (e) Sodium reacts with bromine to form sodium bromide.

CIRCLE the correct formula of sodium bromide. [1 mark]

NaBr

SBr

nabr

NaB

6

(Turn over)

2 (a) Tick (✓) the box next to the name of the gas that is being identified by the test in DIAGRAM 2.1 and DIAGRAM 2.2 in the separate diagram booklet. [2 marks]

DIAGRAM 2.1

☐

carbon dioxide

☐

oxygen

☐

hydrogen

DIAGRAM 2.2

☐

carbon dioxide

☐

oxygen

☐

hydrogen

(Turn over)

2 (b) The gases in the early atmosphere came from volcanic eruptions.

TABLE 2.3 in the separate diagram booklet shows the percentages of some gases in the early atmosphere and today's atmosphere.

(i) USE ONLY THE INFORMATION IN TABLE 2.3 to complete the sentence. [2 marks]

Over geological time, the amount of _____ in the atmosphere has increased and the amounts of _____ and _____ have decreased.

(Turn over)

2 (b)(ii)

UNDERLINE the names of TWO processes which USE oxygen from the atmosphere. [2 marks]

photosynthesis sedimentation
respiration combustion

(Turn over)

2 (c) The symbols in DIAGRAM 2.4 in the separate diagram booklet represent atoms of hydrogen, carbon and oxygen.

A molecule of water, H_2O , can be represented by DIAGRAM 2.5 in the separate diagram booklet.

(i) Use the key to draw a molecule of carbon dioxide, CO_2 . [1 mark]

(Turn over)

2 (c)(ii)

Write the formula of the molecule shown in DIAGRAM 2.6 in the separate diagram booklet. [1 mark]

8

(Turn over)

3 Lithium, sodium, potassium and rubidium are all Group 1 elements.

**(a) Tick (✓) the box next to the name given to the Group 1 elements.
[1 mark]**

☐

halogens

☐

noble gases

☐

alkali metals

(Turn over)

3 (b) CHART 3.1 and CHART 3.2 in the separate diagram booklet show the densities and some of the melting points of the Group 1 elements.

USE ONLY THE INFORMATION IN CHARTS 3.1 AND 3.2 to answer the following questions.

(i) Name the element with the highest density. [1 mark]

(ii) Give the state (solid, liquid or gas) of sodium at 100°C. [1 mark]

(Turn over)

3 (b)(iii)

Tick (✓) the box next to the most likely melting point of potassium.
[1 mark]

☐

25°C

☐

64°C

☐

106°C

(c)(i) Potassium reacts with oxygen to produce potassium oxide.

Potassium oxide contains the ions K^+ and O^{2-} .

CIRCLE the correct formula of potassium oxide. [1 mark]

KO

KO₂

K₂O

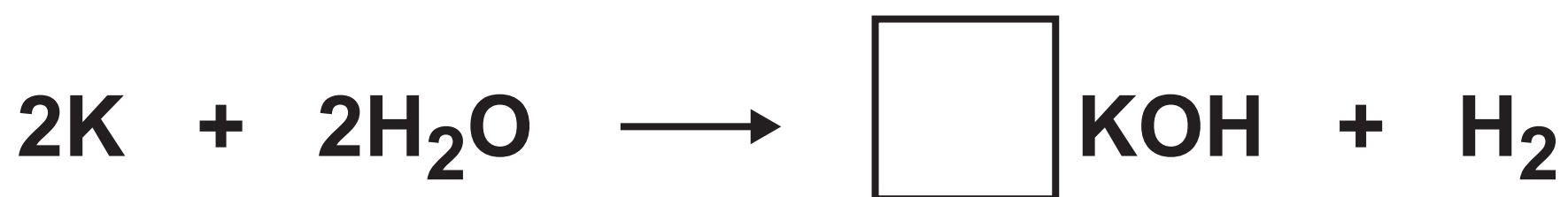
K₂O₂

(Turn over)

3 (c)(ii)

Potassium reacts with water to produce potassium hydroxide solution and hydrogen gas.

- I. Put a number in the box to balance the equation for this reaction.
[1 mark]**



(Turn over)

3 (c)(ii)

**II. Tick (✓) the box next to the observation which shows that a gas is formed during this reaction.
[1 mark]**

☐

potassium floats

☐

potassium melts

☐

fizzing

☐

potassium disappears

7

(Turn over)

4 (a) Calcium carbonate reacts with hydrochloric acid to produce a gas which can be collected and measured using the apparatus shown in DIAGRAM 4.1 in the separate diagram booklet.

(i) UNDERLINE the name of the apparatus labelled A. [1 mark]

test tube measuring cylinder

beaker evaporating dish

(ii) Use DIAGRAM 4.1 to give the volume of gas collected. [1 mark]

_____ cm³

(Turn over)

4 (a)(iii)

If the experiment is repeated using a higher concentration of acid, the rate of the reaction increases.

Choose words from the box to complete the sentence to explain why the rate increases. [2 marks]

energy particles collisions
gases solutions

When the concentration of the acid increases there are more

_____ in the same

volume and a higher chance of

successful _____ .

(Turn over)

4 (a)(iv)

Apart from increasing the concentration of the acid, give another change that will increase the rate of this reaction. [1 mark]

(Turn over)

4 (b) In a similar experiment, 48 cm³ of gas was collected in 2 minutes.

The mean rate of the reaction can be calculated using the following equation.

$$\text{mean rate} = \frac{\text{volume of gas}}{\text{time}}$$

**Use the equation to calculate the mean rate of the reaction in cm³/s.
[2 marks]**

Mean rate = _____ cm³/s

(Turn over)

4 (c) Calculate the relative formula mass, M_r , of calcium carbonate, CaCO_3 .
[2 marks]

$$A_r(\text{Ca}) = 40 \quad A_r(\text{C}) = 12 \quad A_r(\text{O}) = 16$$

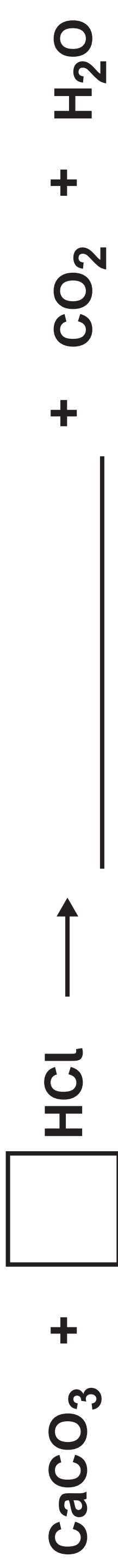
$$M_r = \underline{\hspace{4cm}}$$

(Turn over)

THIS IS A BLANK PAGE

TURN OVER

calcium carbonate + hydrochloric acid → calcium chloride + carbon dioxide + water



4 (d) The word equation for the reaction is shown on the opposite page.

Complete the symbol equation for the reaction on the opposite page by

- **giving the formula of calcium chloride**
- **putting a number in the box to balance the equation**
[2 marks]

(Turn over)

4 (e) Limestone is mainly composed of calcium carbonate. Limestone is quarried on Halkyn mountain in Flintshire.

There are benefits and drawbacks associated with limestone quarrying.

Benefits include the production of an important building material and employment for the local community.

Give ONE drawback of limestone quarrying. [1 mark]

4 (f) The limestone cycle is shown in DIAGRAM 4.2 in the separate diagram booklet.

(i) Give the chemical name of quicklime, CaO. [1 mark]

(ii) Give the name of the substance added to quicklime, CaO, to convert it to slaked lime, Ca(OH)₂. [1 mark]

5 The hardness of water can be measured by adding soap solution.

A class investigated the hardness of water from different locations in Wales.

They measured the volume of soap solution needed to create a permanent lather when it was shaken in a flask with samples of water from each location.

The results are shown in TABLE 5.1 in the separate diagram booklet.

(Turn over)

5 (a)(i)

Give the MISSING RESULT for Test 2 used to calculate the mean volume for the sample from Holyhead. [1 mark]

Missing result = _____ cm³

(Turn over)

5 (a)(ii)

**State TWO factors that must be controlled in this investigation.
[2 marks]**

Factor 1

Factor 2

(Turn over)

5 (a)(iii)

Complete CHART 5.2 in the separate diagram booklet to show the mean volume of soap solution needed to create a permanent lather for the water from each location.

**The first bar has been drawn for you.
[2 marks]**

(iv) Give the location with the hardest water. Explain your answer. [2 marks]

Location _____

(Turn over)

5 (b) Give the name of an ion which causes hard water. [1 mark]

(c) Tick (✓) the boxes next to the TWO benefits of hard water. [2 marks]

☐

makes boilers more efficient

☐

reduces the risk of heart disease

☐

strengthens bones

☐

less detergent is needed to wash dishes

☐

prevents limescale forming

6 (a) DIAGRAM 6.1 in the separate diagram booklet shows an atom of the element boron.

(i) Complete the sentence. [1 mark]

The nucleus of the boron atom contains

five _____

and six _____ .

(ii) Give the mass number of the boron atom. [1 mark]

(Turn over)

6 (a)(iii)

Explain why an atom of boron has no overall charge. [2 marks]

(Turn over)

6 (b) An atom of aluminium has 13 electrons.

Complete DIAGRAM 6.2 in the separate diagram booklet to show the electronic structure of an aluminium atom. [1 mark]

5

(Turn over)

7 (a) IMAGE 7.1 in the separate diagram booklet shows the chromatogram produced when the dyes in a purple ink were separated using water as the solvent.

DIAGRAMS 7.2A and 7.2B in the separate diagram booklet show two possible ways of setting up the apparatus to produce this chromatogram.

Explain why

- **chromatography can separate dyes in this way**
- **the set up in DIAGRAM 7.2A rather than DIAGRAM 7.2B would produce the chromatogram shown**
[6 marks QER]

answer on the next page

(Turn over)

(Turn over)

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

continue answer on the next page

(Turn over)

7 (b) DIAGRAM 7.3 in the separate diagram booklet shows a simplified chromatogram produced in another experiment.

The R_f value of a dye can be calculated using the equation

$$R_f = \frac{\text{distance travelled by dye}}{\text{distance travelled by solvent}}$$

Measure the distance travelled by dye X and use the equation to calculate its R_f value. [2 marks]

$R_f =$ _____

(Turn over)

7 (c) DIAGRAM 7.4 in the separate diagram booklet shows the apparatus used to separate a mixture of ethanol and water.

Explain why a mixture of ethanol and water is separated when it is heated in this apparatus. [2 marks]

continue answer on next page

(Turn over)

10

8 **DIAGRAM 8** in the separate diagram booklet represents part of the Periodic Table.

The letters shown are **NOT** the symbols of the elements.

(a) **USE LETTERS FROM DIAGRAM 8** to answer parts (i) and (ii).

(i) Give the letters of two elements that have atoms with three electrons in their outer shell. [1 mark]

_____ and _____

(ii) Give the letter of the element that has atoms with four electron shells. [1 mark]

(Turn over)

8 (b) Name the element represented by the letter F. Give ONE use of this element. [1 mark]

Name _____

Use _____

8 (c) State TWO properties that you would expect element **B to have. [2 marks]**

Property 1

Property 2

5

(Turn over)

9 (a) DIAGRAM 9.1 in the separate diagram booklet shows some of the Earth's tectonic plates and the directions in which they are moving.

(i) Give the numbers of two plates which share a CONSTRUCTIVE boundary. [1 mark]

_____ and _____

(Turn over)

9 (a)(ii)

**Describe what happens at a
DESTRUCTIVE plate boundary.
[2 marks]**

(Turn over)

9 (b) Alfred Wegener proposed that the Earth's continents had once all been joined together in a land mass he called Pangaea and that they had moved apart over time as shown in DIAGRAM 9.2 in the separate diagram booklet.

He called this the 'theory of continental drift'.

(Turn over)

9 (b)(i)

Give TWO pieces of evidence that Alfred Wegener used to support his theory of continental drift. [2 marks]

Evidence 1

Evidence 2

(Turn over)

9 (b)(ii)

State why Wegener's theory was not initially accepted. [1 mark]

6

(Turn over)

- 10 Groundwater is the water found underground in the cracks and spaces in soil, sand and rock. It is stored in and moves slowly through layers of soil, sand and rocks called aquifers.**

Groundwater provides 550 megalitres of the total water needed on average per day in Wales, approximately 5% of the total volume used. Some of the negative ions dissolved in groundwater include carbonate, chloride and sulfate ions.

Groundwater can also contain pollutants which can cause harm to humans if consumed. Many of these pollutants are natural, such as bacteria and viruses. However, there are now a number of man-made pollutants present in our water supplies, including fertilisers, pesticides and chemicals from industrial and household landfill waste.

(Turn over)

10 (a)(i)

Tick (✓) the box next to the approximate total volume of water used daily in Wales. [1 mark]

☐

110 megalitres

☐

550 megalitres

☐

11 000 megalitres

(ii) Suggest why recycling more industrial chemicals could improve the quality of groundwater. [1 mark]

(Turn over)

10 (a)(iii)

Tick (✓) the box next to the solution that could be used to identify one of the negative ions present in groundwater supplies. [1 mark]

☐

sodium hydroxide, NaOH

☐

silver nitrate, AgNO₃

☐

potassium nitrate, KNO₃

(Turn over)

10 (b)

DIAGRAM 10 in the separate diagram booklet shows the stages of treatment of the public water supply when it leaves reservoirs before being distributed to our homes.

The first stage of treatment of the public water supply is sedimentation.

The purpose of sedimentation is to remove large insoluble particles from the water.

Give the purpose of the filtration and chlorination stages of water treatment. [2 marks]

Filtration

continue answer on the next page

(Turn over)

Chlorination

(c)(i) In some areas, fluoride is added to water supplies.

Give the reason why fluoride is added to water supplies. [1 mark]

(Turn over)

10 (c)(ii)

Give ONE reason why some people disagree with the addition of fluoride to water supplies. [1 mark]

(Turn over)

10 (c)(iii)

Fluoride is added to water in compounds such as sodium fluorosilicate, Na_2SiF_6 .

The relative formula mass (M_r) of Na_2SiF_6 is 188.

Calculate the percentage by mass of sodium in Na_2SiF_6 . [2 marks]

$$A_r(\text{Na}) = 23$$

Percentage = _____ %

9

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

3410U10-1

FRIDAY, 13 JUNE 2025 – MORNING

**CHEMISTRY – Unit 1:
Chemical Substances, Reactions and
Essential Resources**

FOUNDATION TIER

**1 hour 45 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 _____

THIS IS A BLANK PAGE

TURN OVER

DIAGRAM 1

	1	2							
1									H
2	Li	Be							
3	Na	Mg							
4	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co
5	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh

DIAGRAM 1 continued

			3	4	5	6	7	0
								He
			B	C	N	O	F	Ne
			Al	Si	P	S	Cl	Ar
Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe

DIAGRAM 2.1

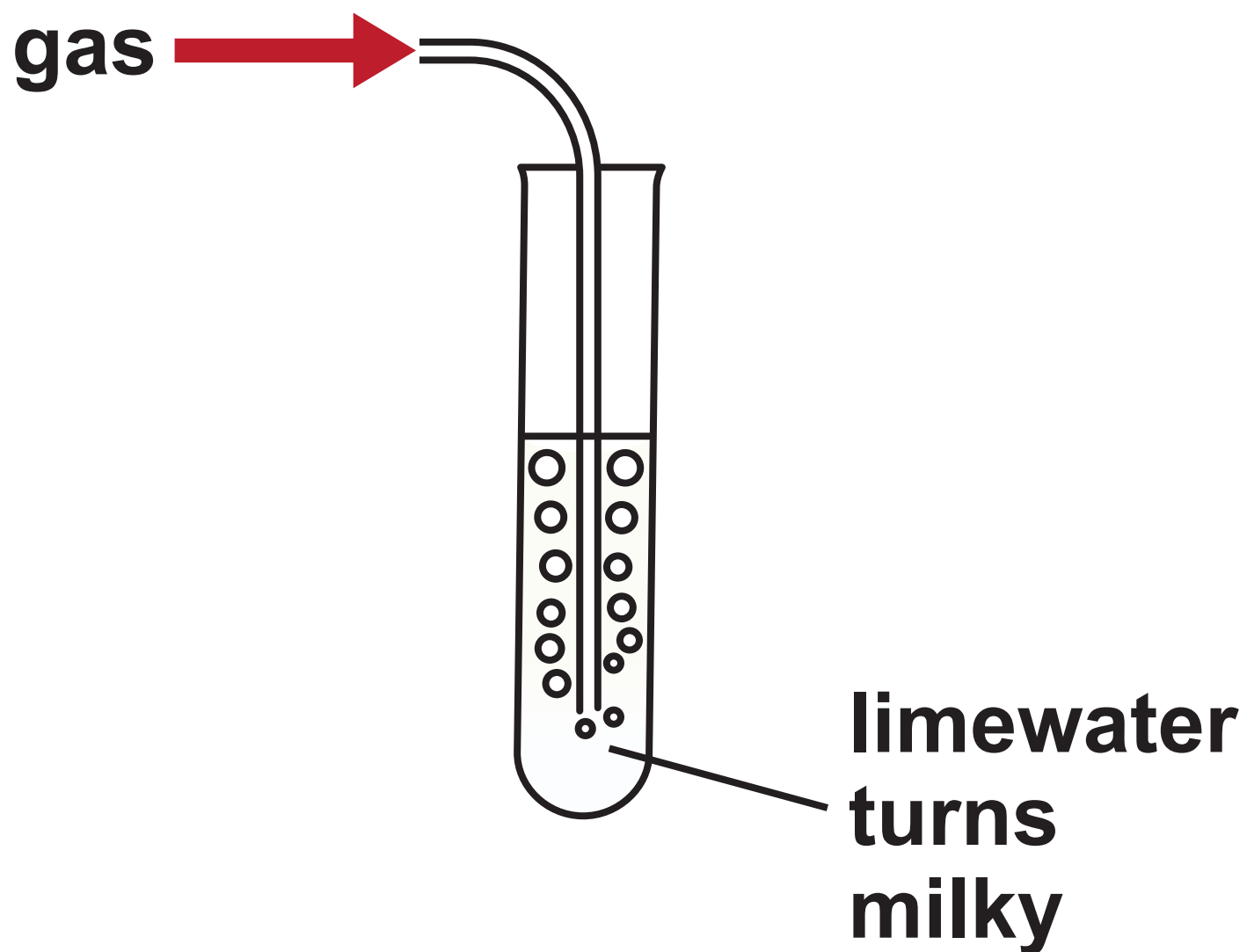


DIAGRAM 2.2

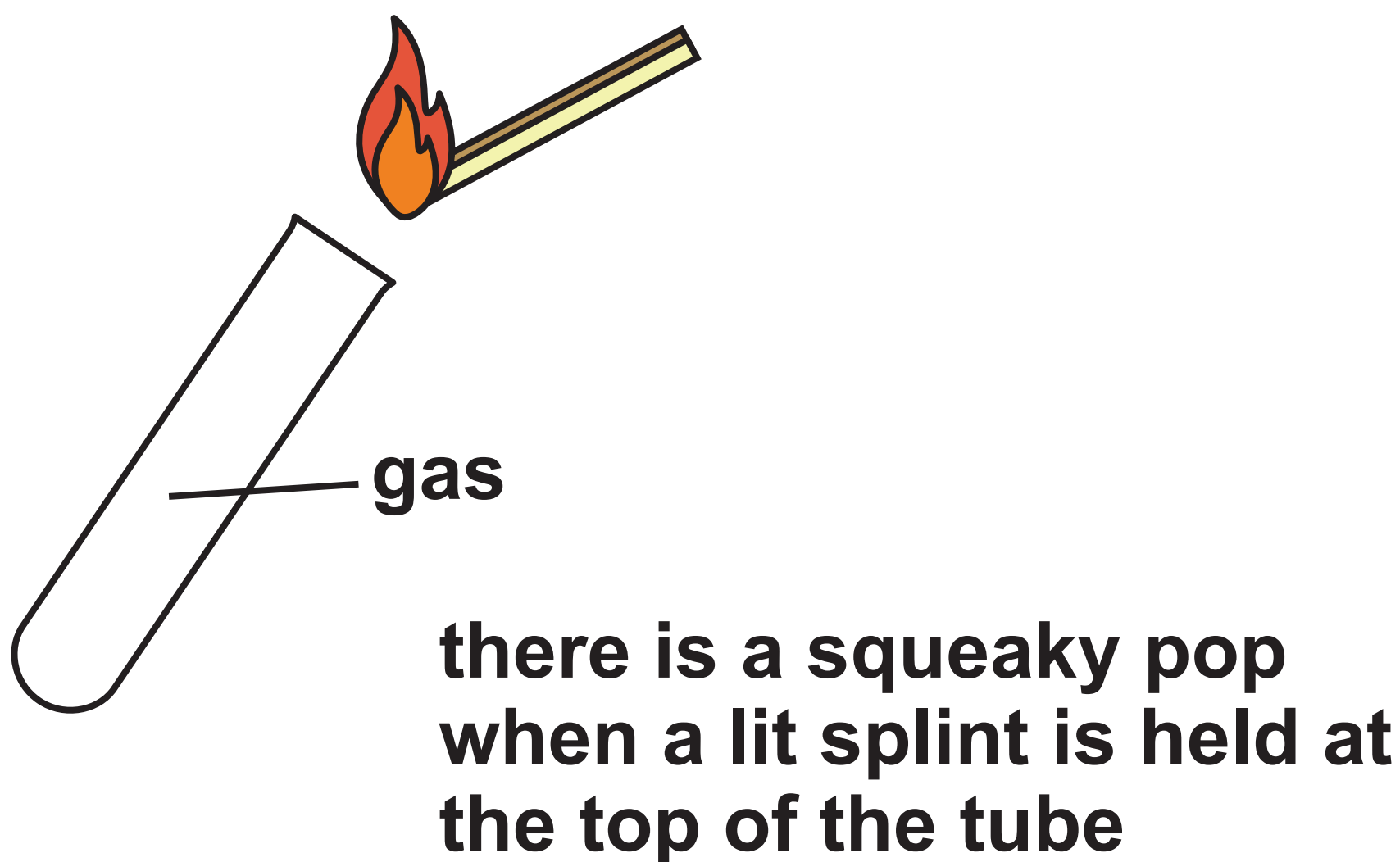
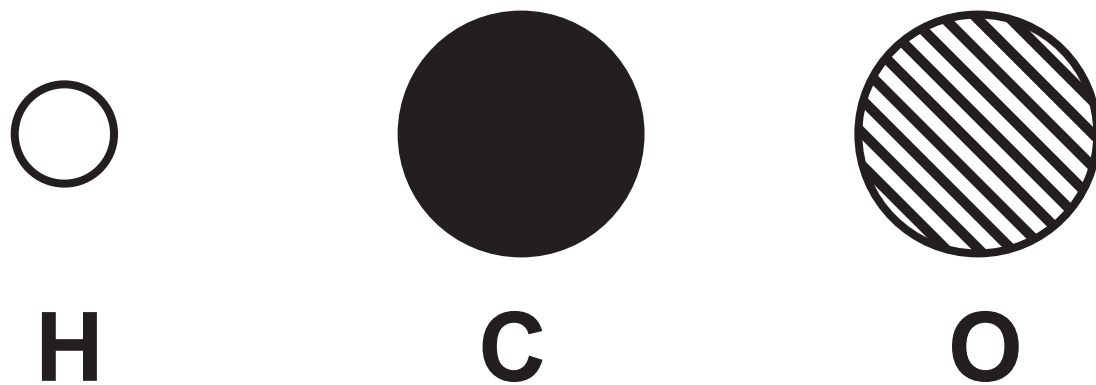
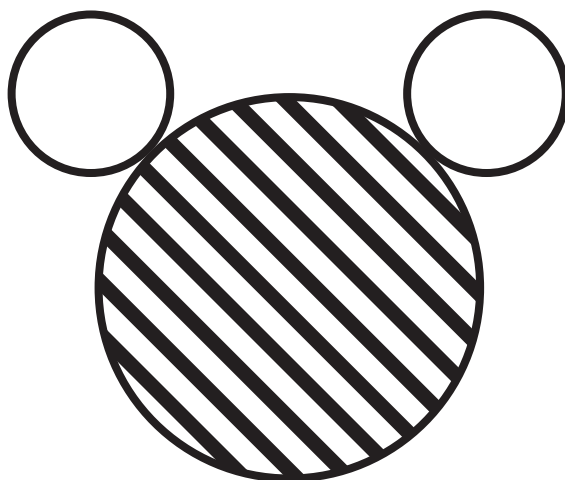
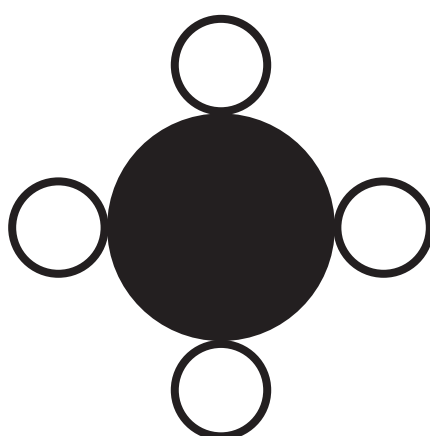


TABLE 2.3

Name of gas	Percentage of gas (%)	
	Early atmosphere	Today's atmosphere
oxygen	0	21
water vapour	20	0-3
carbon dioxide	35	0.04

DIAGRAM 2.4**DIAGRAM 2.5****DIAGRAM 2.6**

THIS IS A BLANK PAGE

TURN OVER

CHART 3.1

Density (g / cm³)

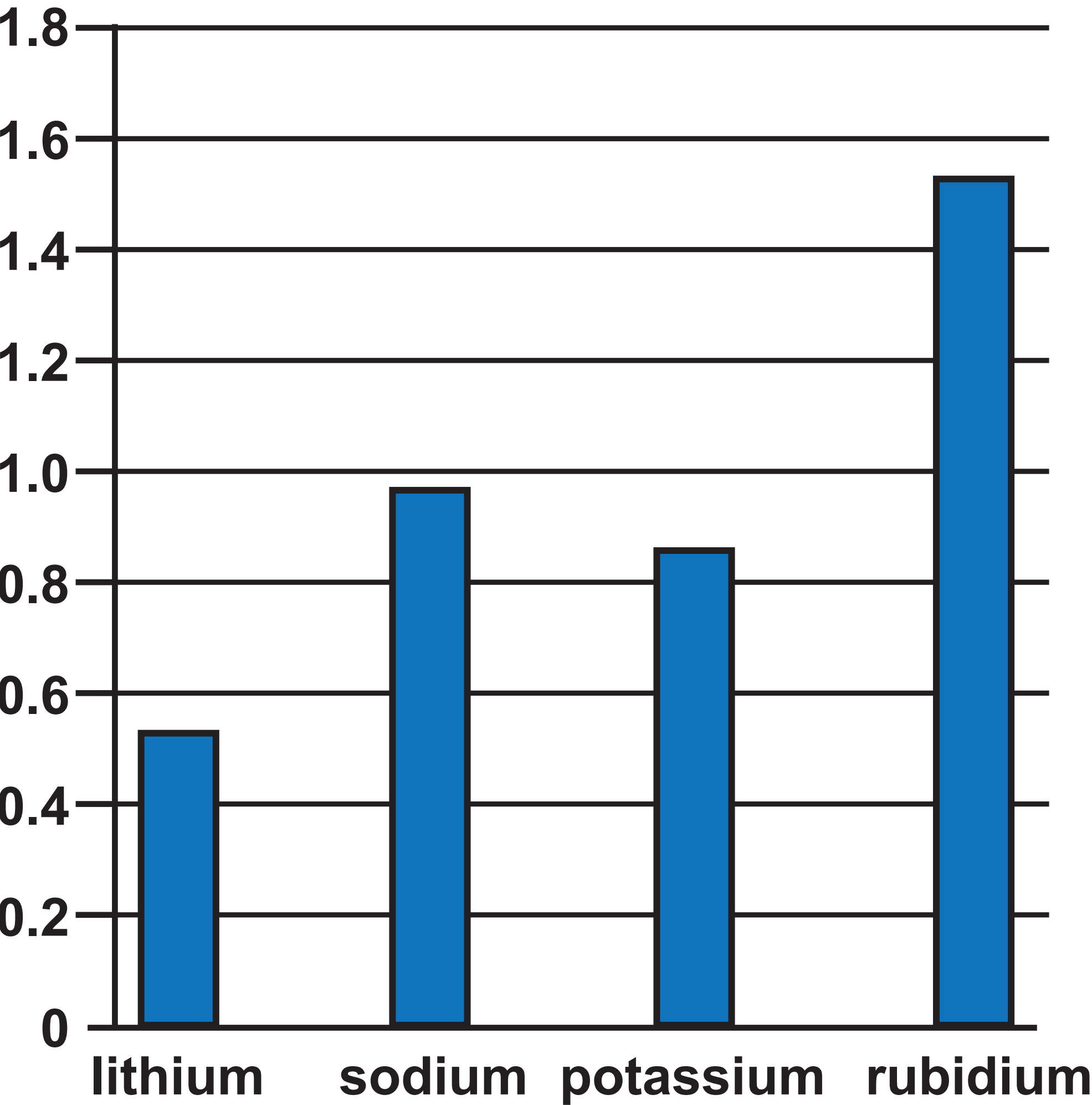


CHART 3.2

Melting point(°C)

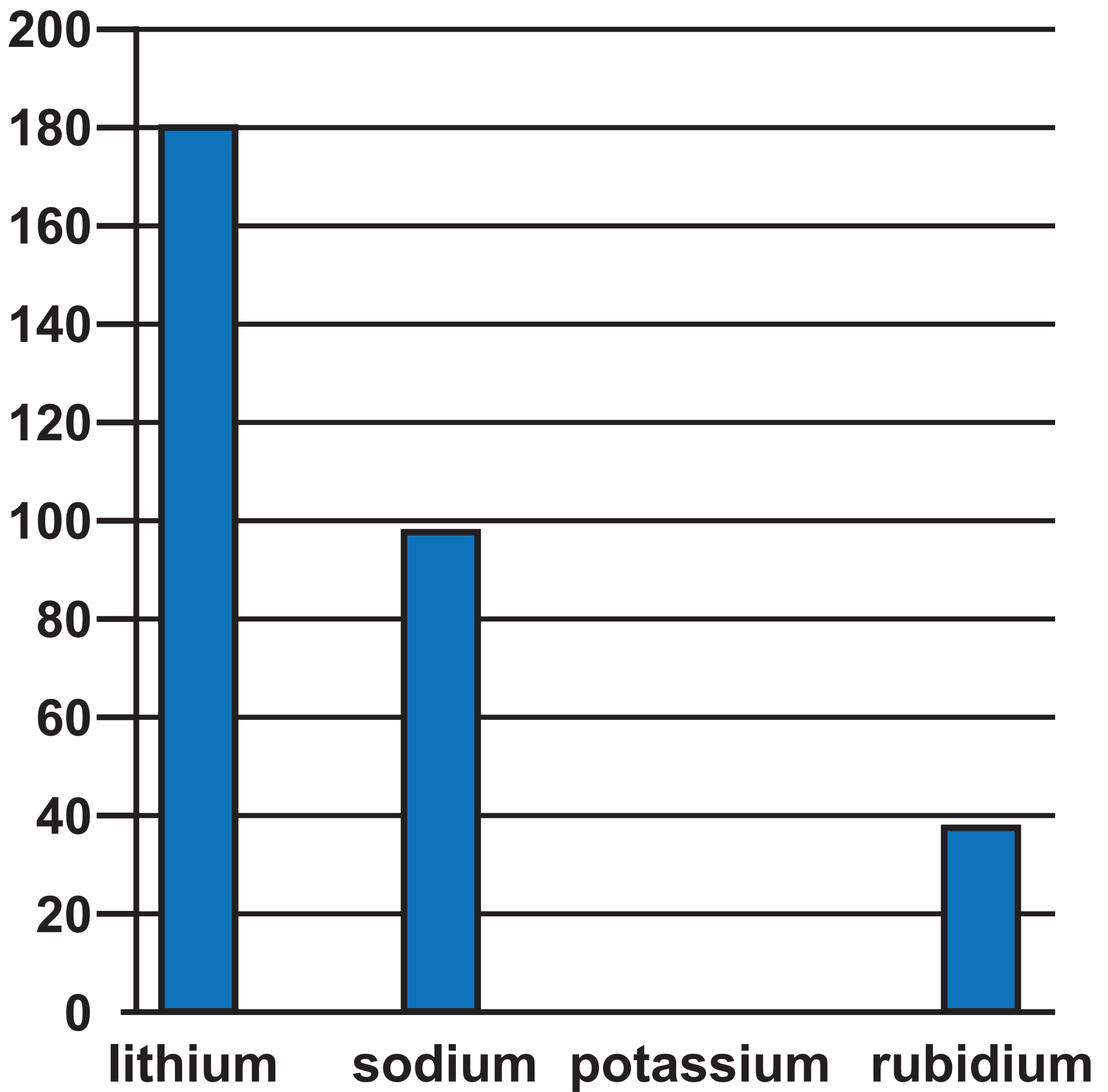


DIAGRAM 4.1

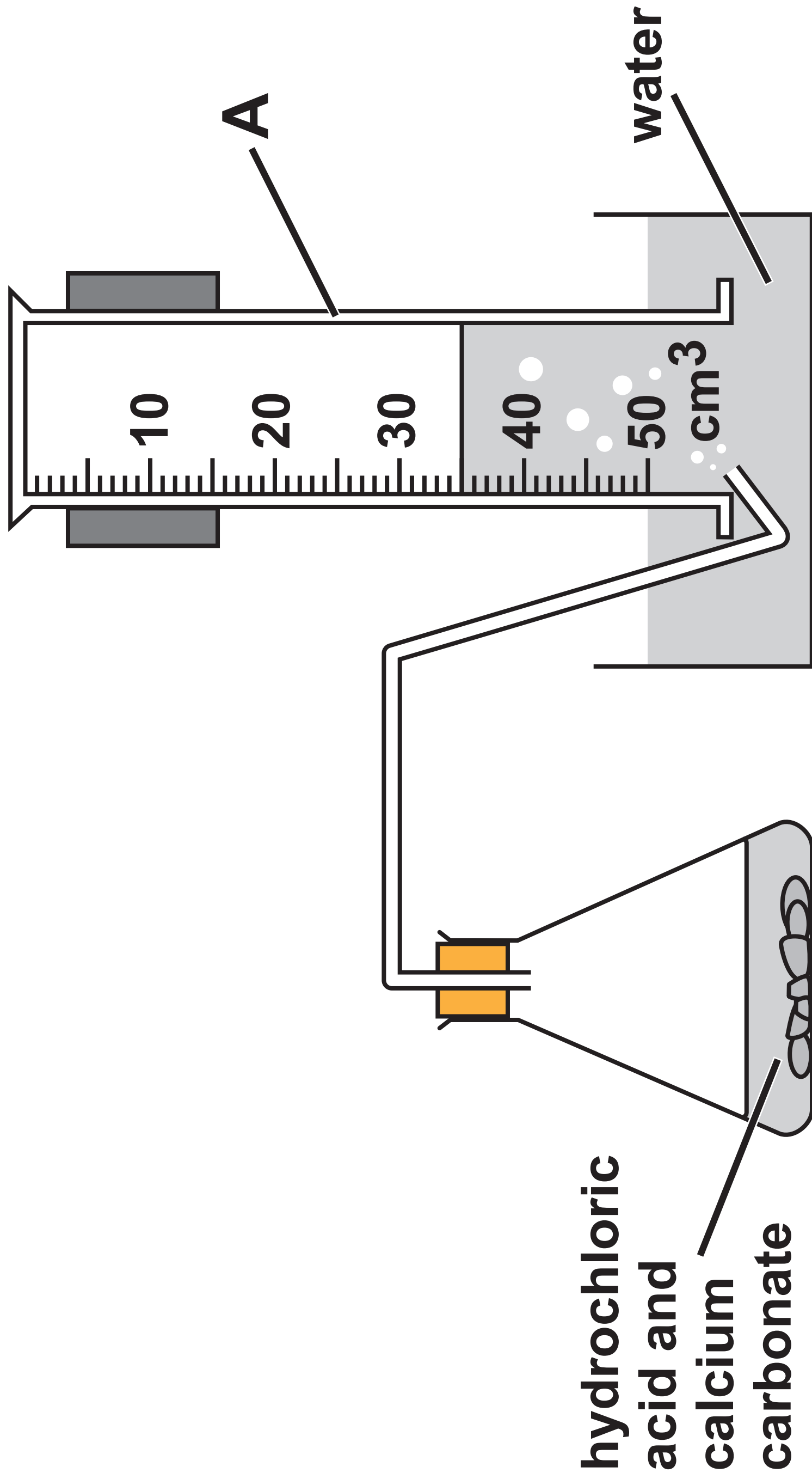
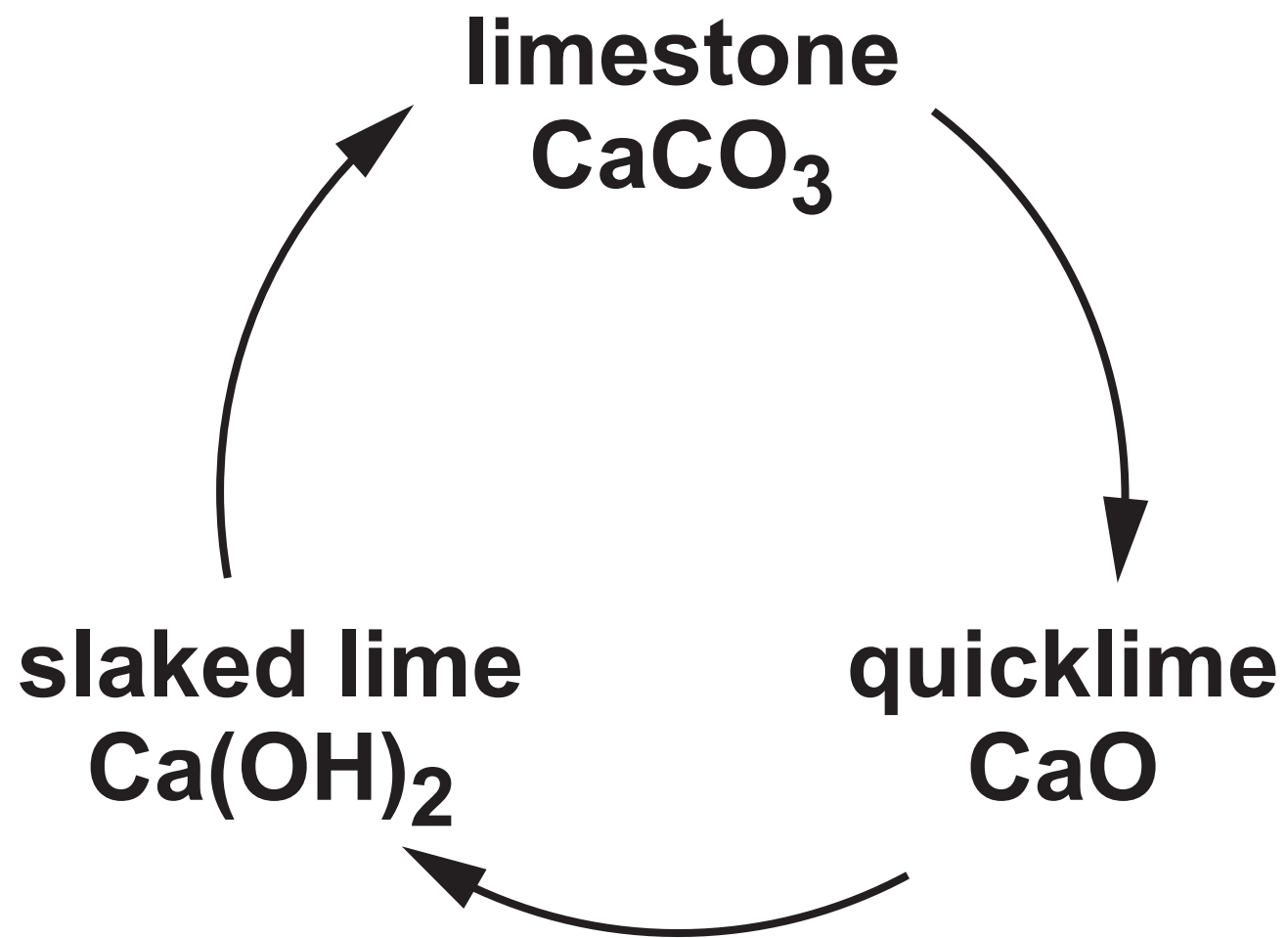


DIAGRAM 4.2

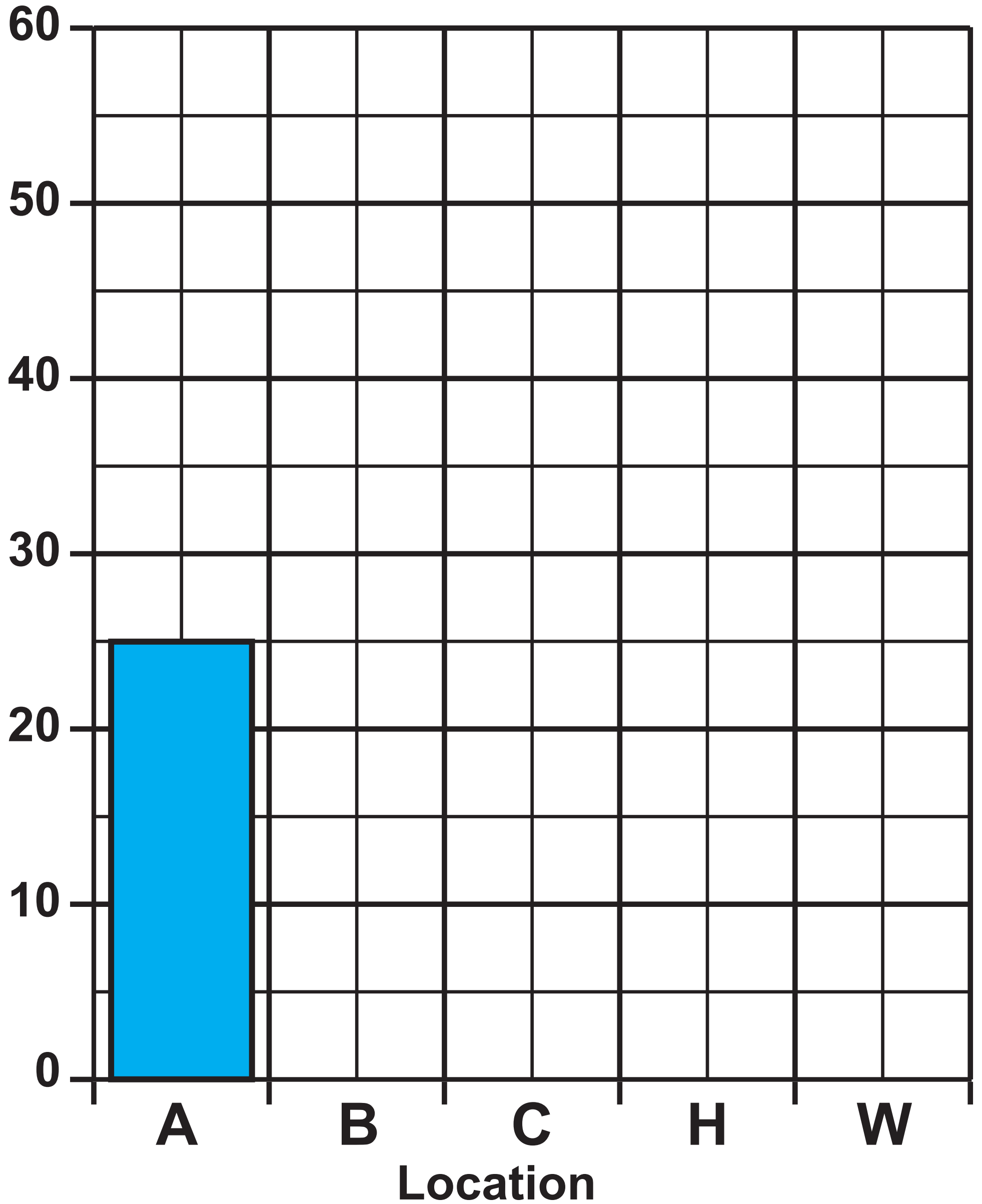
THIS IS A BLANK PAGE

TURN OVER

TABLE 5.1

Location	Volume of soap solution needed to create a permanent lather (cm³)		
	Test 1	Test 2	Mean
Abergavenny	23	27	25
Brecon	15	14	15
Carmarthen	52	55	54
Holyhead	37		35
Wrexham	59	57	58

CHART 5.2 KEY:
A - Abergavenny
B - Brecon
C - Carmarthen
H - Holyhead
W - Wrexham

CHART 5.2**Volume of soap solution (cm³)**

10

DIAGRAM 6.1

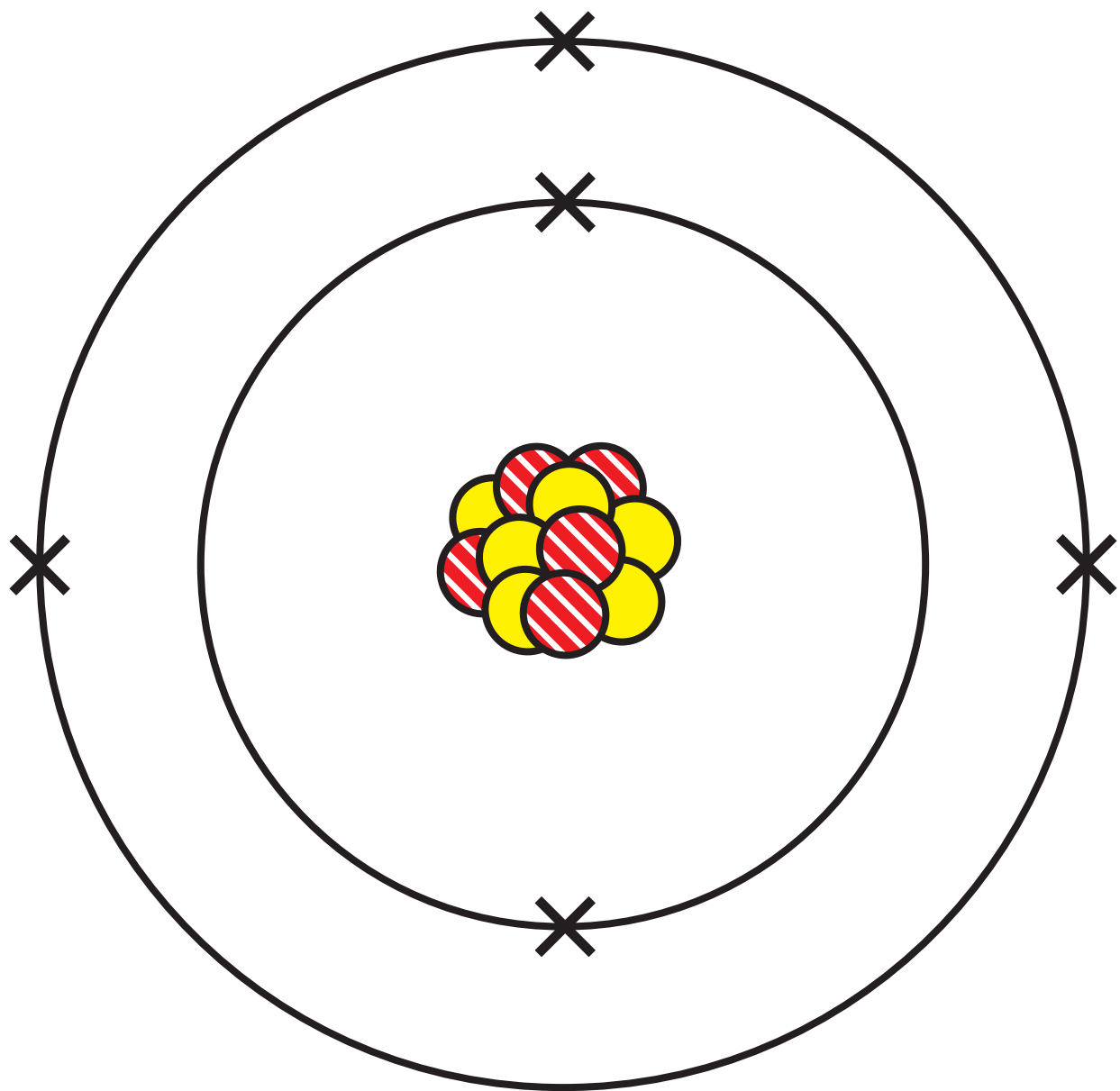
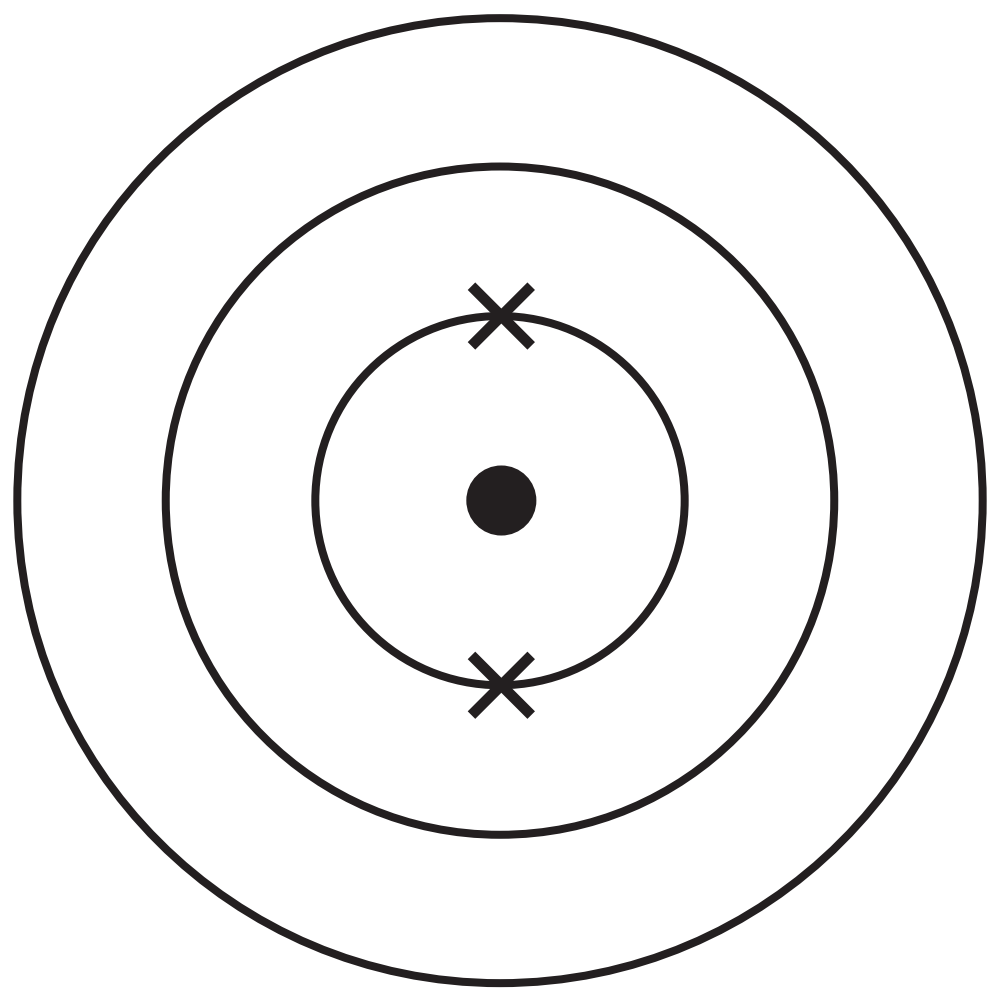


DIAGRAM 6.2



THIS IS A BLANK PAGE

TURN OVER

IMAGE 7.1



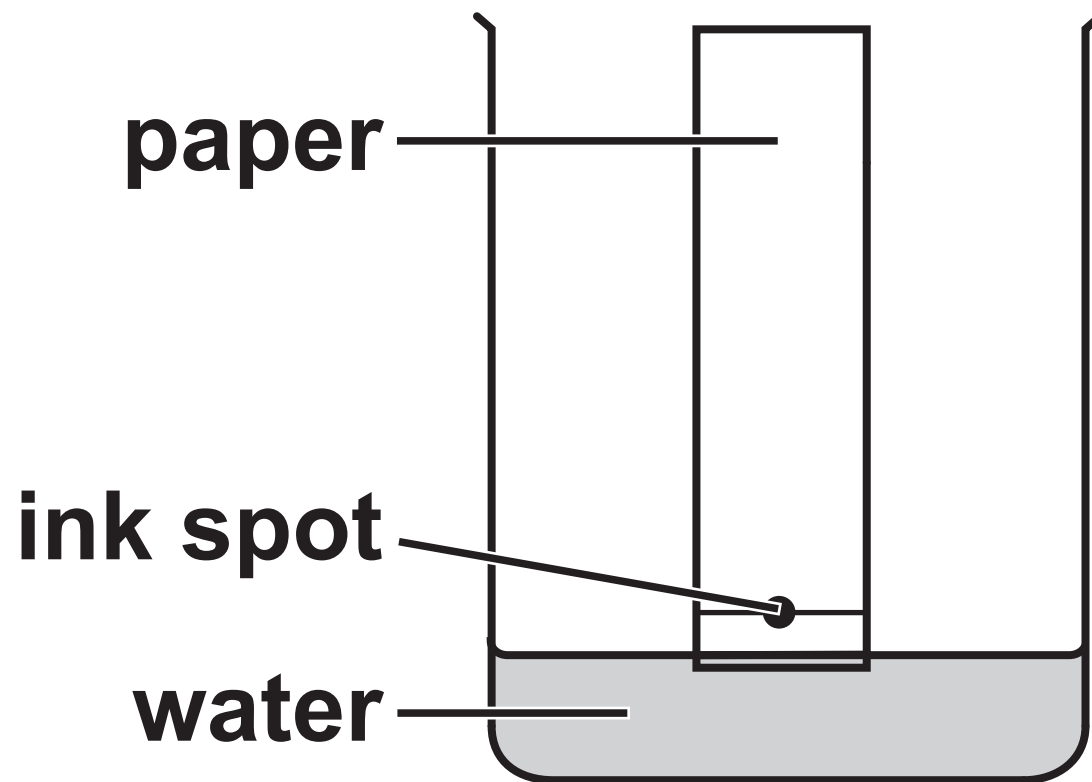
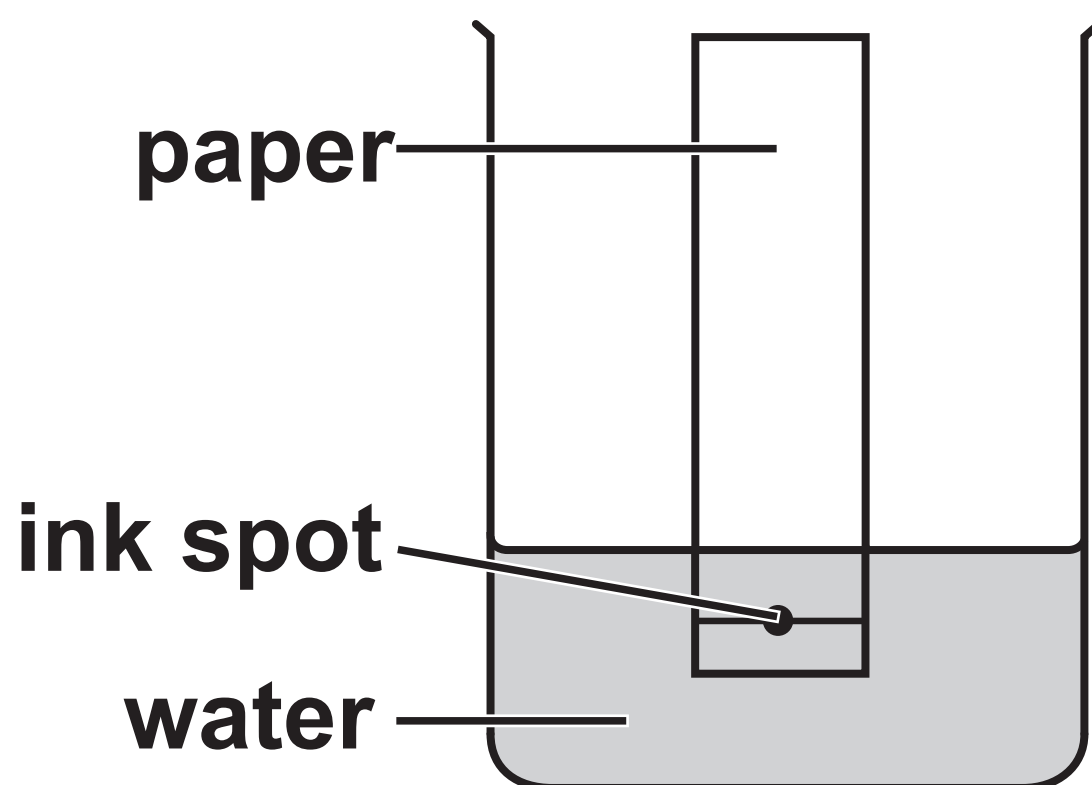
DIAGRAM 7.2A**DIAGRAM 7.2B**

DIAGRAM 7.3

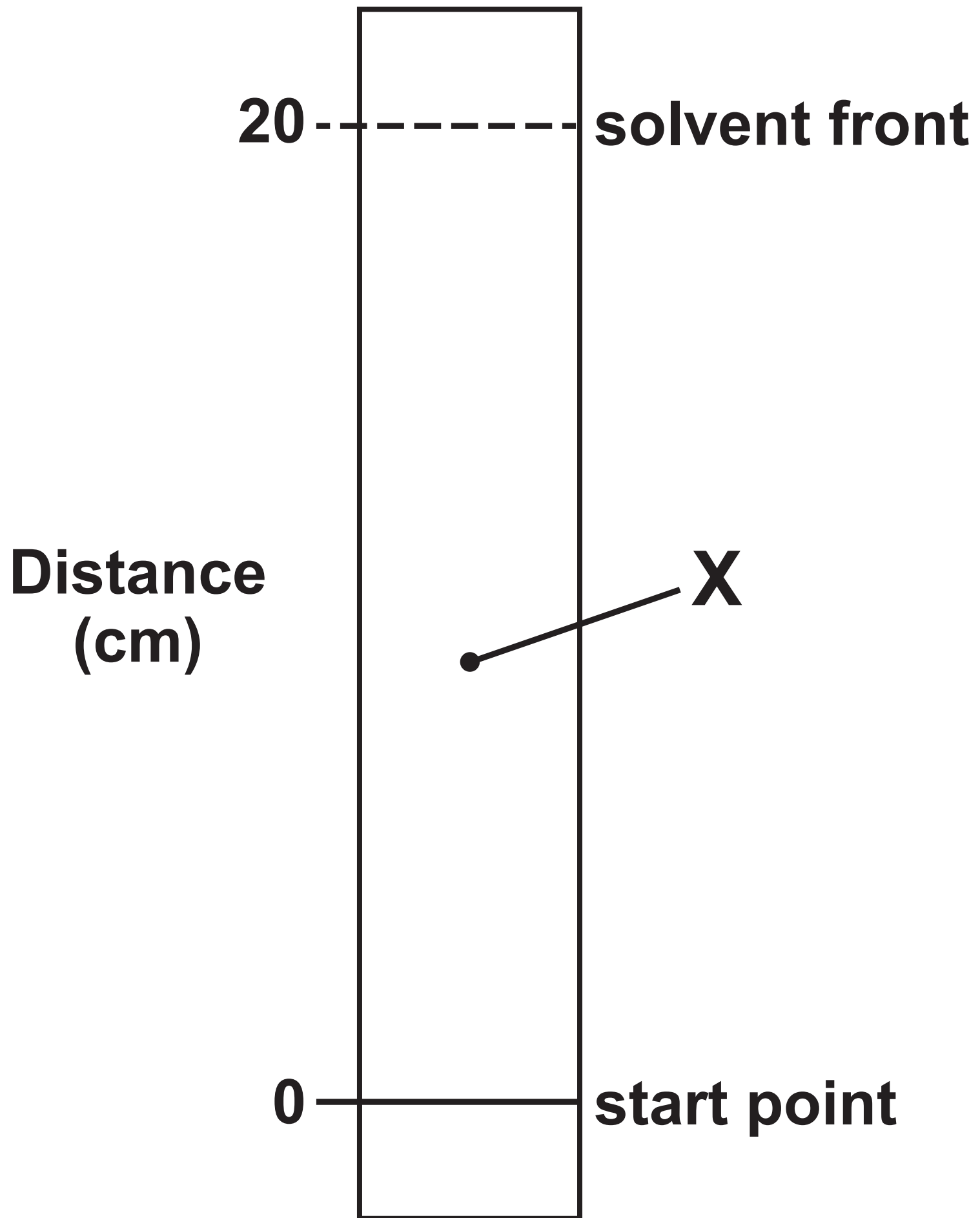


DIAGRAM 7.4

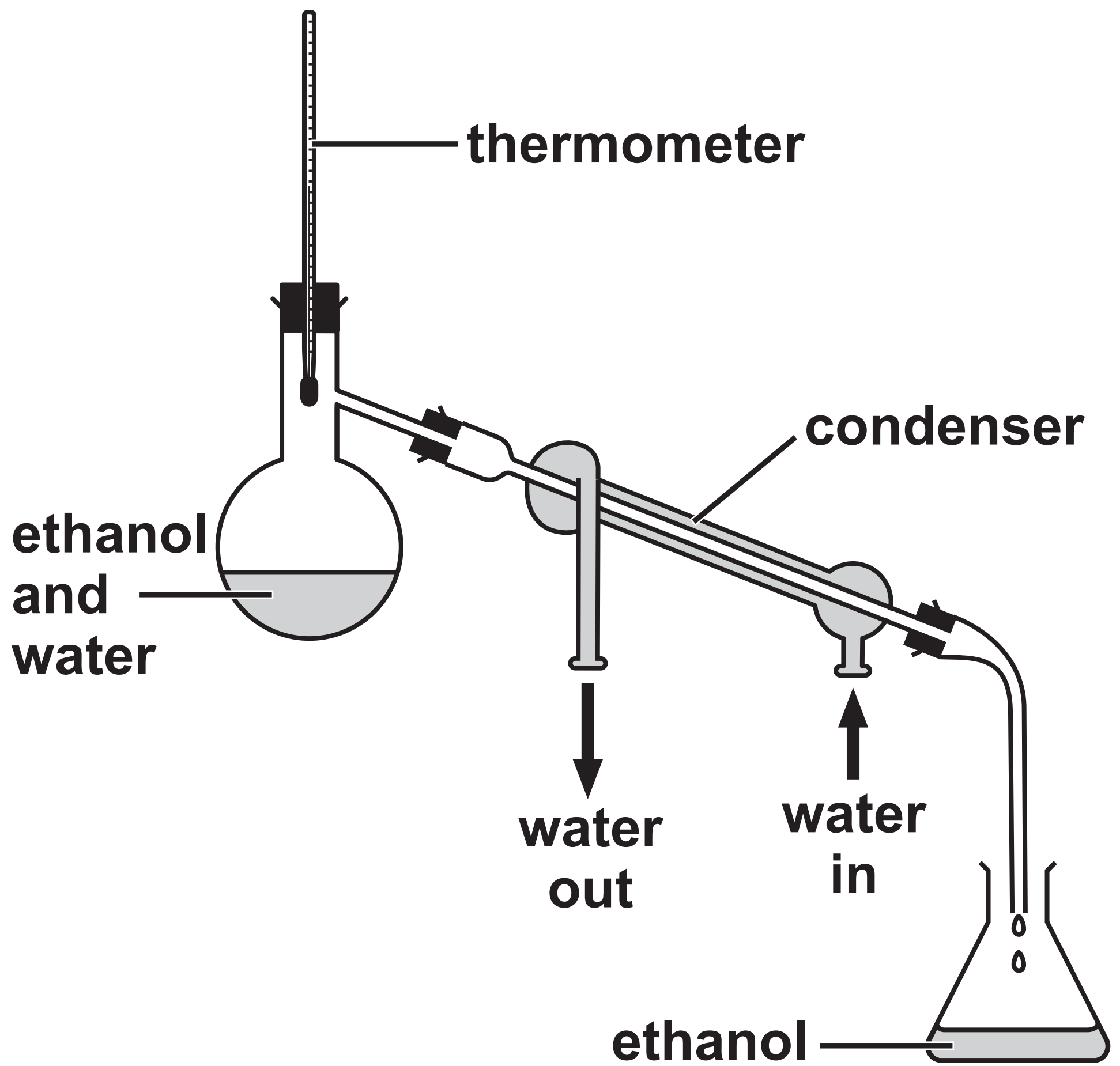


DIAGRAM 8

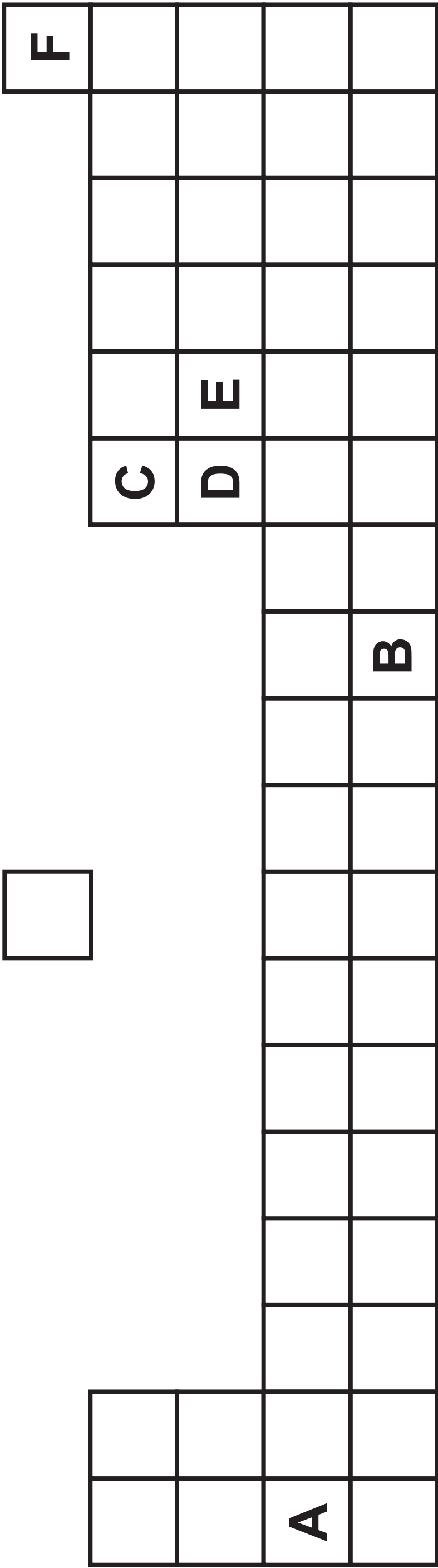
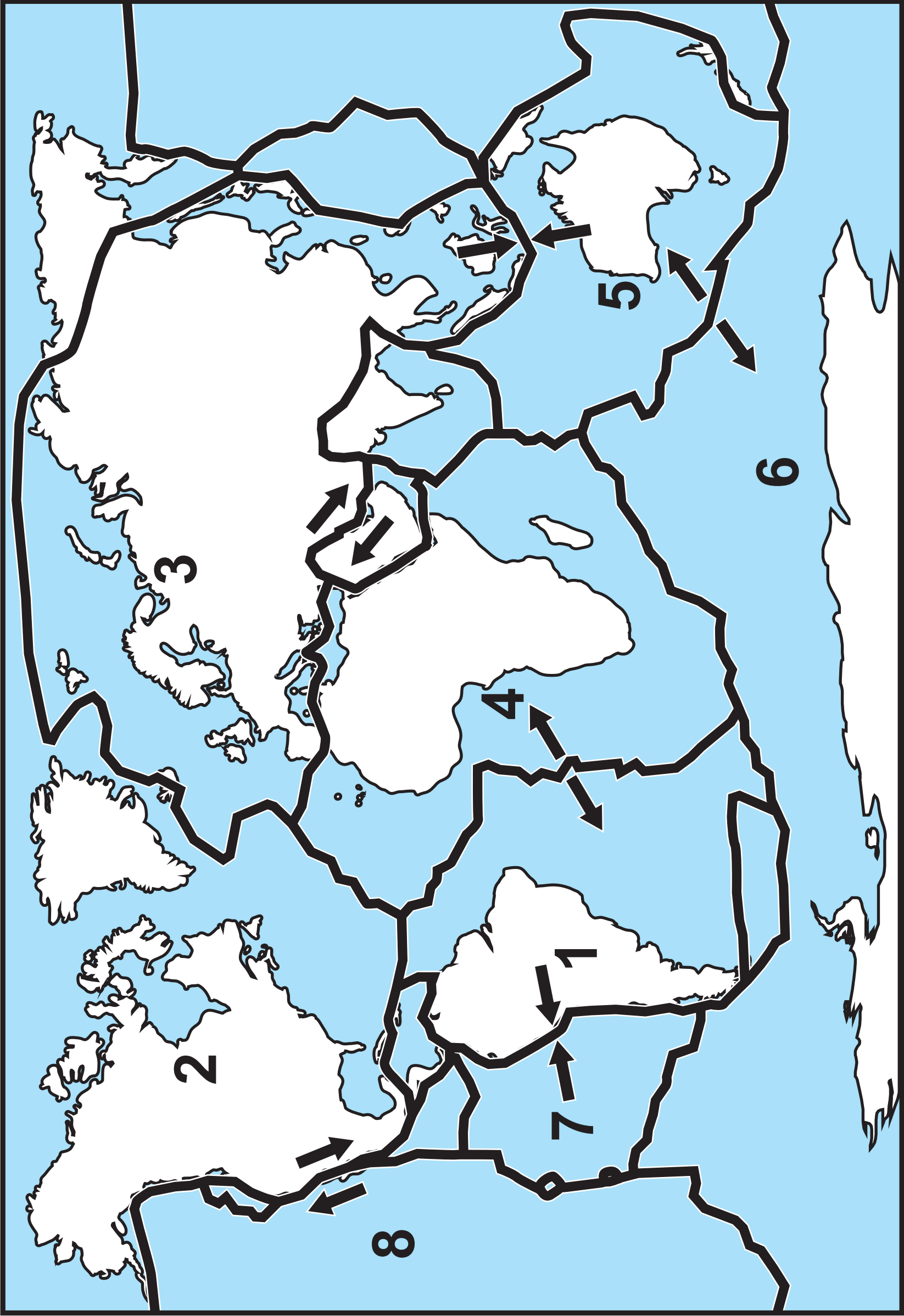


DIAGRAM 9.1



THIS IS A BLANK PAGE

TURN OVER

DIAGRAM 9.2

200 million years ago



DIAGRAM 9.2 continued

Present

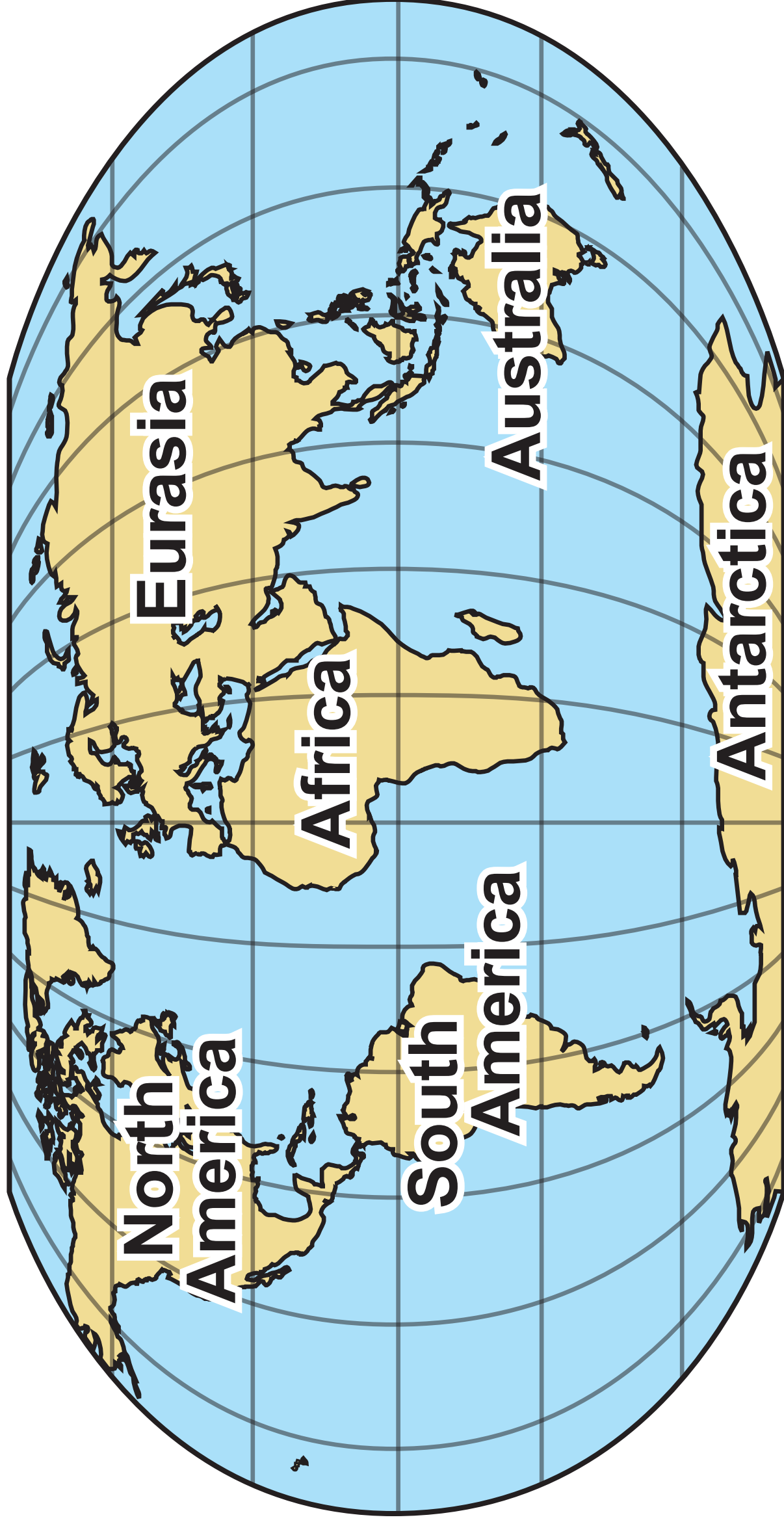
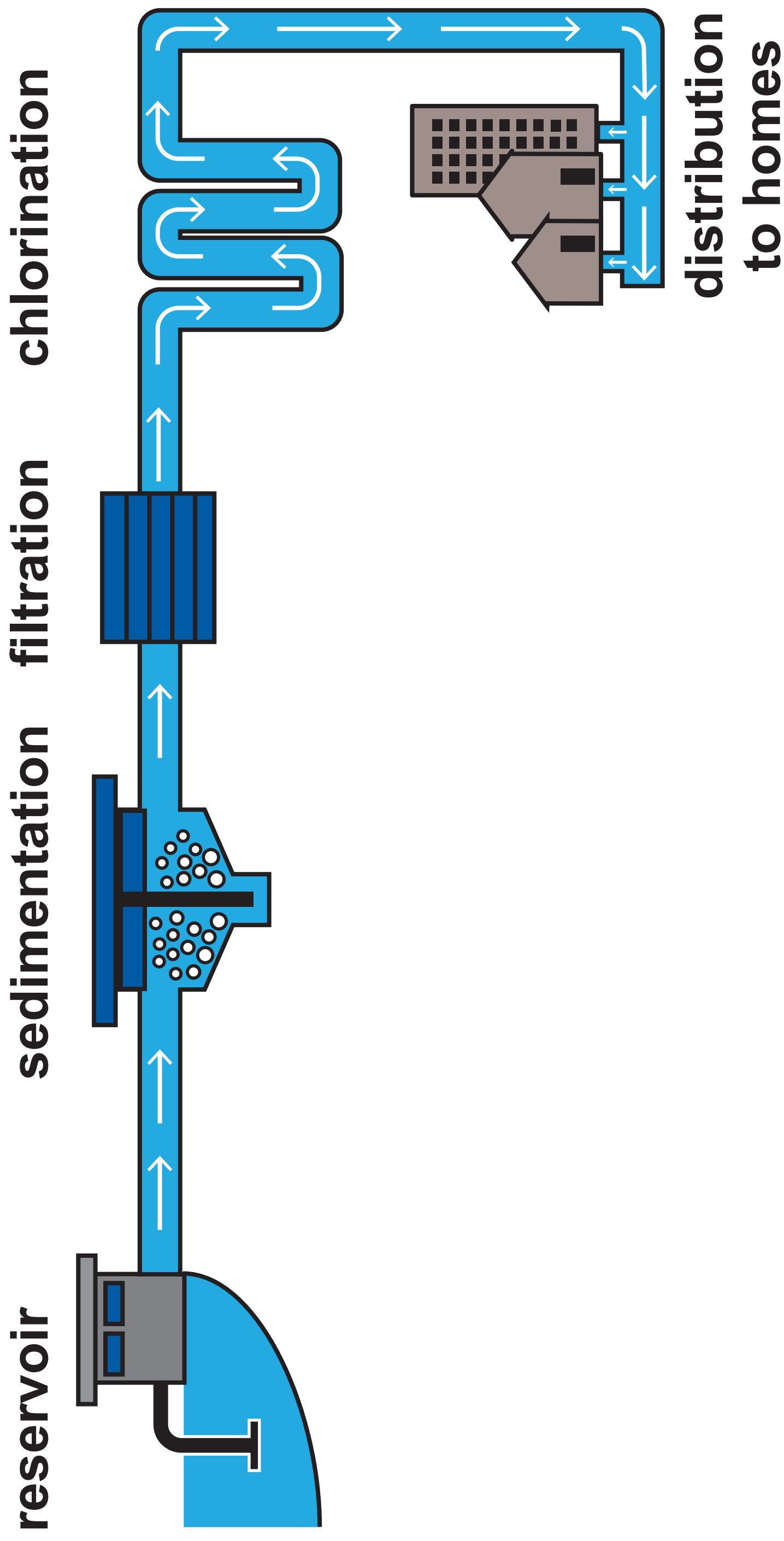


DIAGRAM 10





3410U10-1

FRIDAY, 13 JUNE 2025 – MORNING

CHEMISTRY – Unit 1:

**Chemical Substances, Reactions and
Essential Resources**

FOUNDATION TIER

Data Booklet

FORMULAE FOR SOME COMMON IONS

POSITIVE IONS	
Name	Formula
aluminium	Al^{3+}
ammonium	NH_4^+
barium	Ba^{2+}
calcium	Ca^{2+}
copper(II)	Cu^{2+}
hydrogen	H^+
iron(II)	Fe^{2+}
iron(III)	Fe^{3+}
lithium	Li^+
magnesium	Mg^{2+}
nickel	Ni^{2+}
potassium	K^+
silver	Ag^+
sodium	Na^+
zinc	Zn^{2+}

NEGATIVE IONS	
Name	Formula
bromide	Br^-
carbonate	CO_3^{2-}
chloride	Cl^-
fluoride	F^-
hydroxide	OH^-
iodide	I^-
nitrate	NO_3^-
oxide	O^{2-}
sulfate	SO_4^{2-}

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
86 Rb 37	88 Sr 38
133 Cs 55	137 Ba 56
223 Fr 87	226 Ra 88

KEY

Ar

Sym

Z

relative atomic mass

symbol

atomic number

45 Sc 21	48 Ti 22	51 V 23	52 Cr 24	55 Mn 25	56 Fe 26	59 Co 27
89 Y 39	91 Zr 40	93 Nb 41	96 Mo 42	99 Tc 43	101 Ru 44	103 Rh 45
139 La 57	179 Hf 72	181 Ta 73	184 W 74	186 Re 75	190 Os 76	192 Ir 77
227 Ac 89						

3

4

5

6

7

0

$${}^4_2\text{He}$$

**11
B
5**

12
C
6

14
N
7

16
0
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		