Marshall Cavendish Education

Cambridge Assessment International Education

Endorsed for learner support

Cambridge IGCSE™ Chemistry

THEORY WORKBOOK

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How to Use This Book

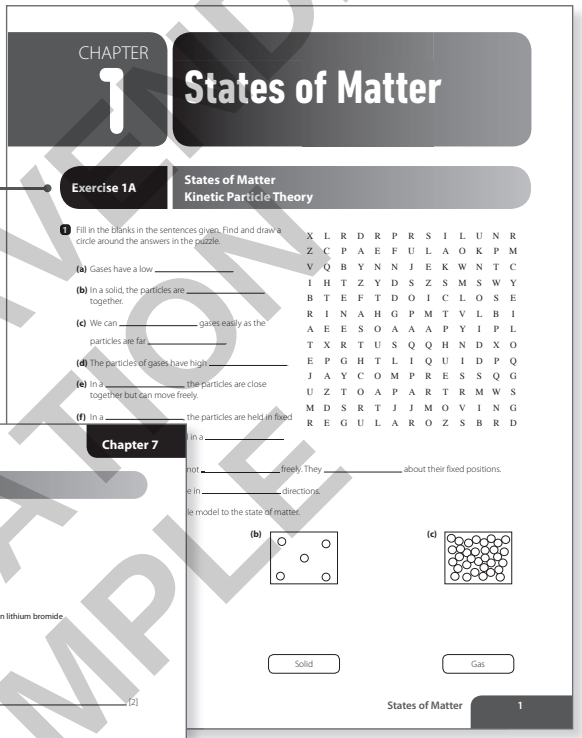
For further learner support, alongside the Student's Book, the Theory Workbook offers a range of exercises to reinforce and consolidate key terms and concepts learnt from each chapter.

This Theory Workbook is part of the Marshall Cavendish Education suite of resources that will support you as you follow the Cambridge IGCSE™ Chemistry (0620/0971) syllabuses and prepare for your examinations.

Formative Exercises

These exercises are meant to evaluate how well you are learning each section in a chapter.

The questions in the exercises are set using a variety of formats, which include word searches, crosswords, fill-in-the-blanks, completing sentences, matching and labelling. They are intended to help build your subject literacy and boost your confidence in using English to understand and respond to science questions. For example, word searches can help to increase your familiarity with key words, and reinforce and improve spelling of those words.


CHAPTER 1 States of Matter

Exercise 1A — States of Matter, Kinetic Particle Theory

1 Fill in the blanks in the sentences given. Find and draw a circle around the answers in the puzzle.

(a) Gases have a low _____

(b) In a solid, the particles are _____ together.

(c) We can _____ gases easily as the particles are far _____

(d) The particles of gases have high _____

(e) In a _____ the particles are close together but can move freely.

(f) In a _____ the particles are held in fixed ... in a _____

... not _____ freely. They _____ about their fixed positions.

... e in _____ directions.

... le model to the state of matter.

X L R D R P R S I L U N R
Z C P A E F U L A O K P M
V Q B Y N N J E K W N T C
I H T Z Y D S Z S M S W Y
B T E F T D O I C L O S E
R I N A H G P M T V L B I
A E E S O A A A P Y I P L
T X R T U S Q Q H N D X O
E P G H T L I Q U I D P Q
J A Y C O M P R E S S Q G
U Z T O A P A R T R M W S
M D S R T J J M O V I N G
R E G U L A R O Z S B R D

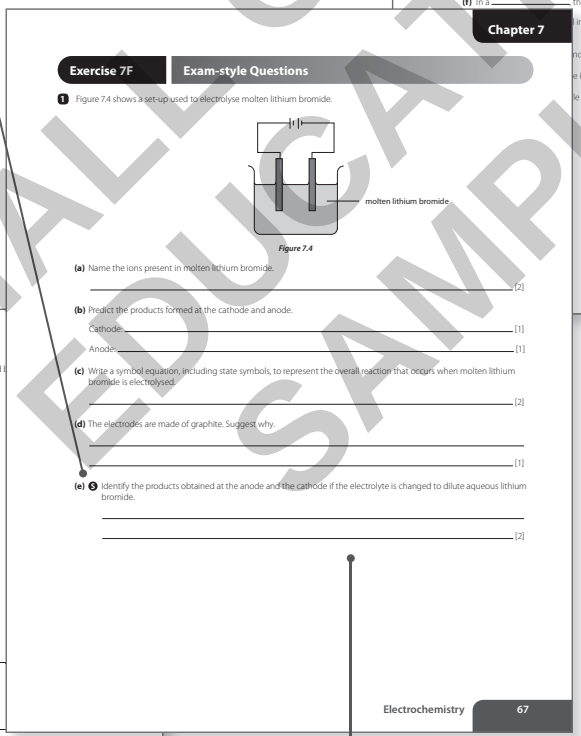
(b) (c)

Solid Gas

States of Matter 1

S

Supplement content is clearly marked for those studying the extended syllabus.


Chapter 7

Exercise 7F — Exam-style Questions

1 Figure 7.4 shows a set-up used to electrolyse molten lithium bromide.

molten lithium bromide

Figure 7.4

(a) Name the ions present in molten lithium bromide.

_____ [2]

(b) Predict the products formed at the cathode and anode.

Cathode: _____ [1]

Anode: _____ [1]

(c) Write a symbol equation, including state symbols, to represent the overall reaction that occurs when molten lithium bromide is electrolysed.

_____ [2]

(d) The electrodes are made of graphite. Suggest why.

_____ [1]

(e) **S** Identify the products obtained at the anode and the cathode if the electrolyte is changed to dilute aqueous lithium bromide.

_____ [2]

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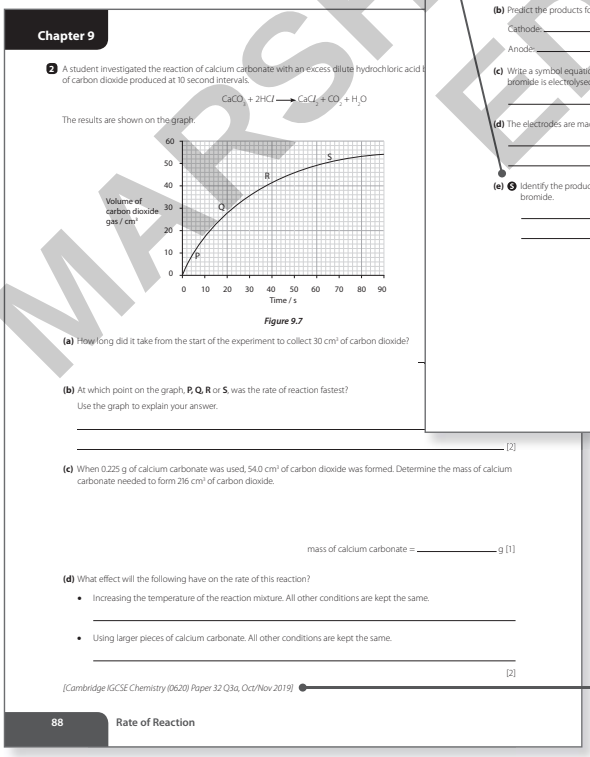

Chapter 9

2 A student investigated the reaction of calcium carbonate with an excess dilute hydrochloric acid ... of carbon dioxide produced at 10 second intervals.

$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$

The results are shown on the graph.

Volume of carbon dioxide gas / cm³

Time / s

Figure 9.7

(a) How long did it take from the start of the experiment to collect 30 cm³ of carbon dioxide?

(b) At which point on the graph, **P, Q, R** or **S**, was the rate of reaction fastest? Use the graph to explain your answer.

_____ [2]

(c) When 0.225 g of calcium carbonate was used, 54.0 cm³ of carbon dioxide was formed. Determine the mass of calcium carbonate needed to form 216 cm³ of carbon dioxide.

mass of calcium carbonate = _____ g [1]

(d) What effect will the following have on the rate of this reaction?

- Increasing the temperature of the reaction mixture. All other conditions are kept the same.

_____

- Using larger pieces of calcium carbonate. All other conditions are kept the same.

_____ [2]

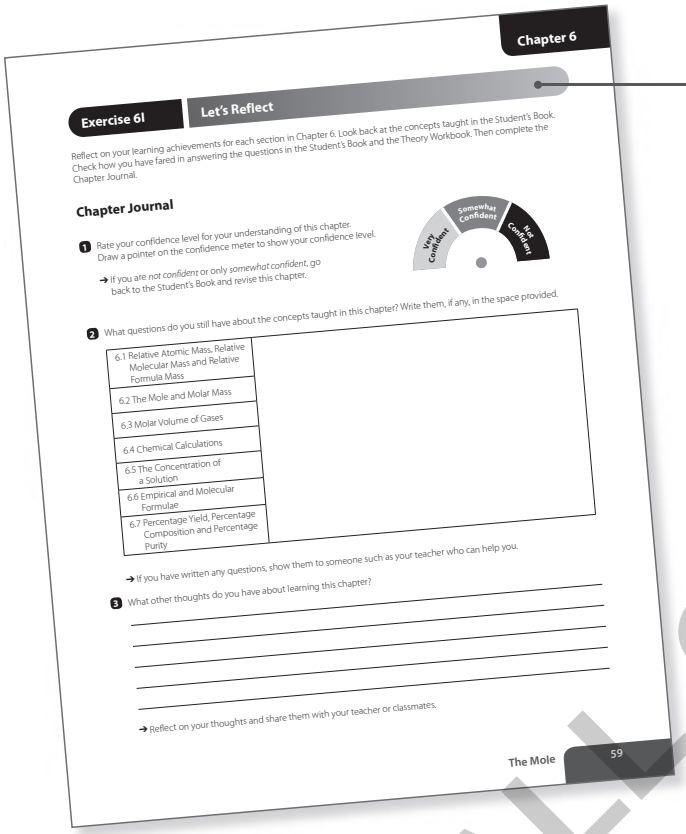
[Cambridge IGCSE Chemistry (0620) Paper 32 Q3a, Oct/Nov 2019]

88 Rate of Reaction

Exam-style Questions

Each chapter includes an exercise consisting of exam-style questions that are written by the author and/or taken from Cambridge IGCSE past papers.

The questions serve as a summative assessment to evaluate what you have learnt. They also help you to be familiar with the format of the questions in the exam.


Chapter 6

Exercise 6I — Let's Reflect

Reflect on your learning achievements for each section in Chapter 6. Look back at the concepts taught in the Student's Book. Check how you have fared in answering the questions in the Student's Book and the Theory Workbook. Then complete the Chapter Journal.

Chapter Journal

1 Rate your confidence level for your understanding of this chapter. Draw a pointer on the confidence meter to show your confidence level.

→ If you are *not confident* or only *somewhat confident*, go back to the Student's Book and revise this chapter.

Not Confident | Somewhat Confident | Very Confident

2 What questions do you still have about the concepts taught in this chapter? Write them, if any, in the space provided.

6.1 Relative Atomic Mass, Relative Molecular Mass and Relative Formula Mass	
6.2 The Mole and Molar Mass	
6.3 Molar Volume of Gases	
6.4 Chemical Calculations	
6.5 The Concentration of a Solution	
6.6 Empirical and Molecular Formulae	
6.7 Percentage Yield, Percentage Composition and Percentage Purity	

→ If you have written any questions, show them to someone such as your teacher who can help you.

3 What other thoughts do you have about learning this chapter?

→ Reflect on your thoughts and share them with your teacher or classmates.

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Let's Reflect

This exercise is included at the end of each chapter to help you identify knowledge gaps. It is designed for you to pause and reflect on your learning experience by evaluating your understanding of the concepts taught and completing the **Chapter Journal**.

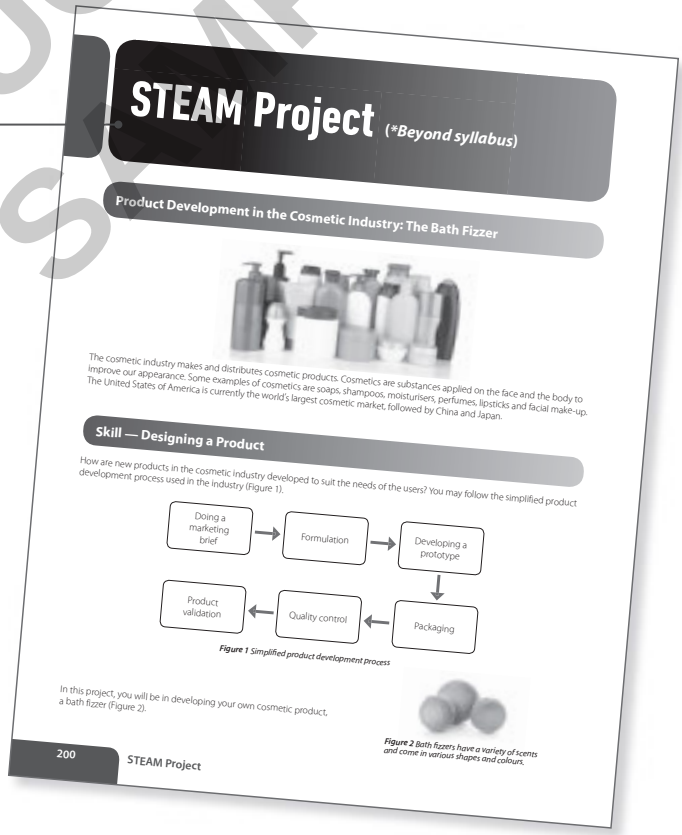
The use of a **confidence meter** to rate your level of confidence is a simple tool for you to recognise your level of understanding of a chapter.

To make your self-reflection visible to yourself and others, you can pose new questions about the key areas of the chapter that you are still unsure. You are also encouraged to write down your personal thoughts about the chapter.

From what you have reflected, you can then address any areas that require a follow-up. For example, you may revise the chapter on your own or ask your teacher to further explain a concept or correct a misconception.

Quotable quote on the importance of reflection:

"We do not learn from experience... we learn from reflecting on experience." – John Dewey


STEAM Project (**Beyond syllabus*)

Product Development in the Cosmetic Industry: The Bath Fizzer

The cosmetic industry makes and distributes cosmetic products. Cosmetics are substances applied on the face and the body to improve our appearance. Some examples of cosmetics are soaps, shampoos, moisturisers, perfumes, lipsticks and facial make-up. The United States of America is currently the world's largest cosmetic market, followed by China and Japan.

Skill — Designing a Product

How are new products in the cosmetic industry developed to suit the needs of the users? You may follow the simplified product development process used in the industry (Figure 1).

Doing a marketing brief → Formulation → Developing a prototype → Packaging → Quality control → Product validation

Figure 1 Simplified product development process

In this project, you will be in developing your own cosmetic product, a bath fizzer (Figure 2).

Figure 2 Bath fizzers have a variety of scents and come in various shapes and colours.

200 STEAM Project

STEAM Project (Beyond syllabus*)**

At the end of the Theory Workbook, there is a STEAM project for you and your classmates to undertake. STEAM stands for **S**cience, **T**echnology, **E**ngineering, the **A**rts and **M**athematics. This project allows you to work on a real-world application by using concepts across different areas that are interrelated. It helps to reinforce 21st century skills such as critical thinking, collaboration, communication, problem-solving and creativity. The STEAM project also provides you with the opportunity to develop as a confident, responsible, reflective, innovative and engaged learner. Find out more about the Cambridge Learner attributes at https://www.cambridgeinternational.org/why-choose-us/parents-and-students/in-class/the-cambridge-learner-attributes/ or check the syllabus.

Contents

CHAPTER

1 States of Matter

Exercise 1A

States of Matter
Kinetic Particle Theory

1 Fill in the blanks in the sentences given. Find and draw a circle around the answers in the puzzle.

(a) Gases have a low _____.

(b) In a solid, the particles are _____ together.

(c) We can _____ gases easily as the particles are far _____.

(d) The particles of gases have high _____.

(e) In a _____, the particles are close together but can move freely.

(f) In a _____, the particles are held in fixed positions and are arranged in a _____ arrangement.

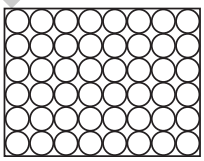
(g) In a solid, the particles are not _____ freely. They _____ about their fixed positions.

(h) The particles of gases move in _____ directions.

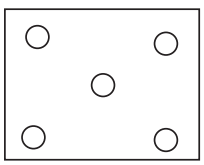
X	L	R	D	R	P	R	S	I	L	U	N	R
Z	C	P	A	E	F	U	L	A	O	K	P	M
V	Q	B	Y	N	N	J	E	K	W	N	T	C
I	H	T	Z	Y	D	S	Z	S	M	S	W	Y
B	T	E	F	T	D	O	I	C	L	O	S	E
R	I	N	A	H	G	P	M	T	V	L	B	I
A	E	E	S	O	A	A	A	P	Y	I	P	L
T	X	R	T	U	S	Q	Q	H	N	D	X	O
E	P	G	H	T	L	I	Q	U	I	D	P	Q
J	A	Y	C	O	M	P	R	E	S	S	Q	G
U	Z	T	O	A	P	A	R	T	R	M	W	S
M	D	S	R	T	J	J	M	O	V	I	N	G
R	E	G	U	L	A	R	O	Z	S	B	R	D

2 Draw lines to match the particle model to the state of matter.

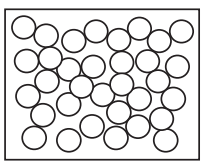
(a)



(b)



(c)



Liquid

Solid

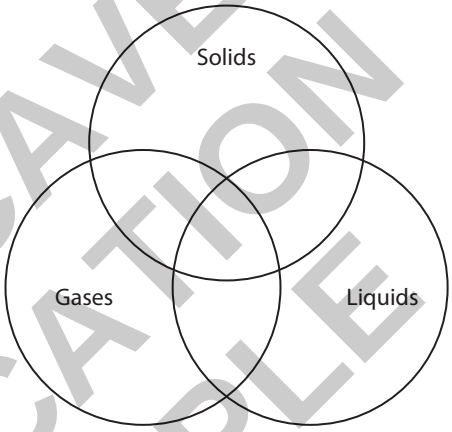
Gas

3 Complete the table showing the properties of solids, liquids and gases.

	Solid	Liquid	Gas
How close are the particles?	Very close together		
How are the particles arranged?		Irregular arrangement	
How do the particles move?			Move very fast in any direction
Is the energy of the particles low or high?	Very low		

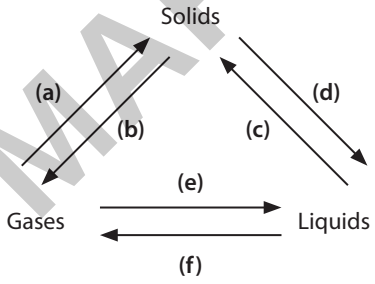
4 Complete the Venn diagram by writing the letters, A to I, to show the properties of solids, liquids and gases.

A: Can flow
B: Cannot be compressed
C: Definite shape
D: Definite volume
E: Made up of particles
F: Particles are close together
G: Particles move randomly
H: Particles vibrate in fixed positions
I: Particles are far apart



Exercise 1B Changes of State of Matter and the Kinetic Particle Theory

1 Name the changes of state in **(c)** to **(f)**. **(a)** and **(b)** have been done for you.



(a) Deposition

(b) Sublimation

(c) _____

(d) _____

(e) _____

(f) _____

2 State **three** differences between boiling and evaporation.

_____

_____

_____

3 **S** Describe, using the kinetic particle theory, the change of state of a substance from the solid state to the liquid state and to the gaseous state.
Use the following to help you explain. Arrange the sentences in the correct order by writing the numbers 1 to 7 in the boxes.

(a) This is known as melting

(b) The liquid continues to be heated and the particles gain more kinetic energy.

(c) The particles break away from their fixed positions and are able to move around each other. The solid has changed to a liquid.

(d) This is known as evaporation.

(e) The particles at the surface eventually gain enough energy to overcome the forces of attraction between them and escape as gas particles.

(f) As more energy is supplied, the particles have enough energy to overcome the forces of attraction between them.

(g) When a solid is heated, the particles that vibrate about fixed positions gain energy and vibrate more vigorously.

4 **S** Figure 1.1 shows a heating curve for substance X.

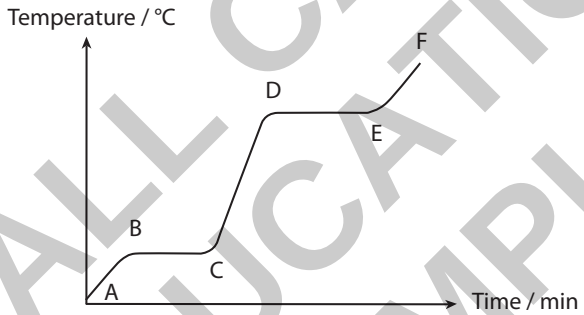


Figure 1.1

(a) Which state of matter is X in at
(i) part A; _____
(ii) part F? _____

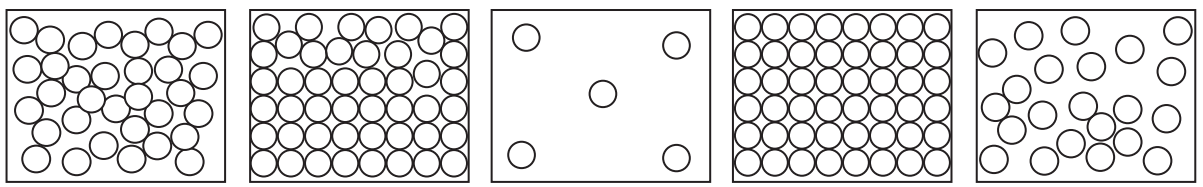
(b) Name the process that occurs from
(i) parts B to C; _____
(ii) parts D to E. _____

(c) What is happening to the particles in X from parts C to D?

_____

_____

(d) The following shows the different arrangements of particles at parts A, B to C, C to D, D to E and F. State the parts of the curve that each arrangement of particles represent.



(i) _____	**(ii)** _____	**(iii)** _____	**(iv)** _____	**(v)** _____

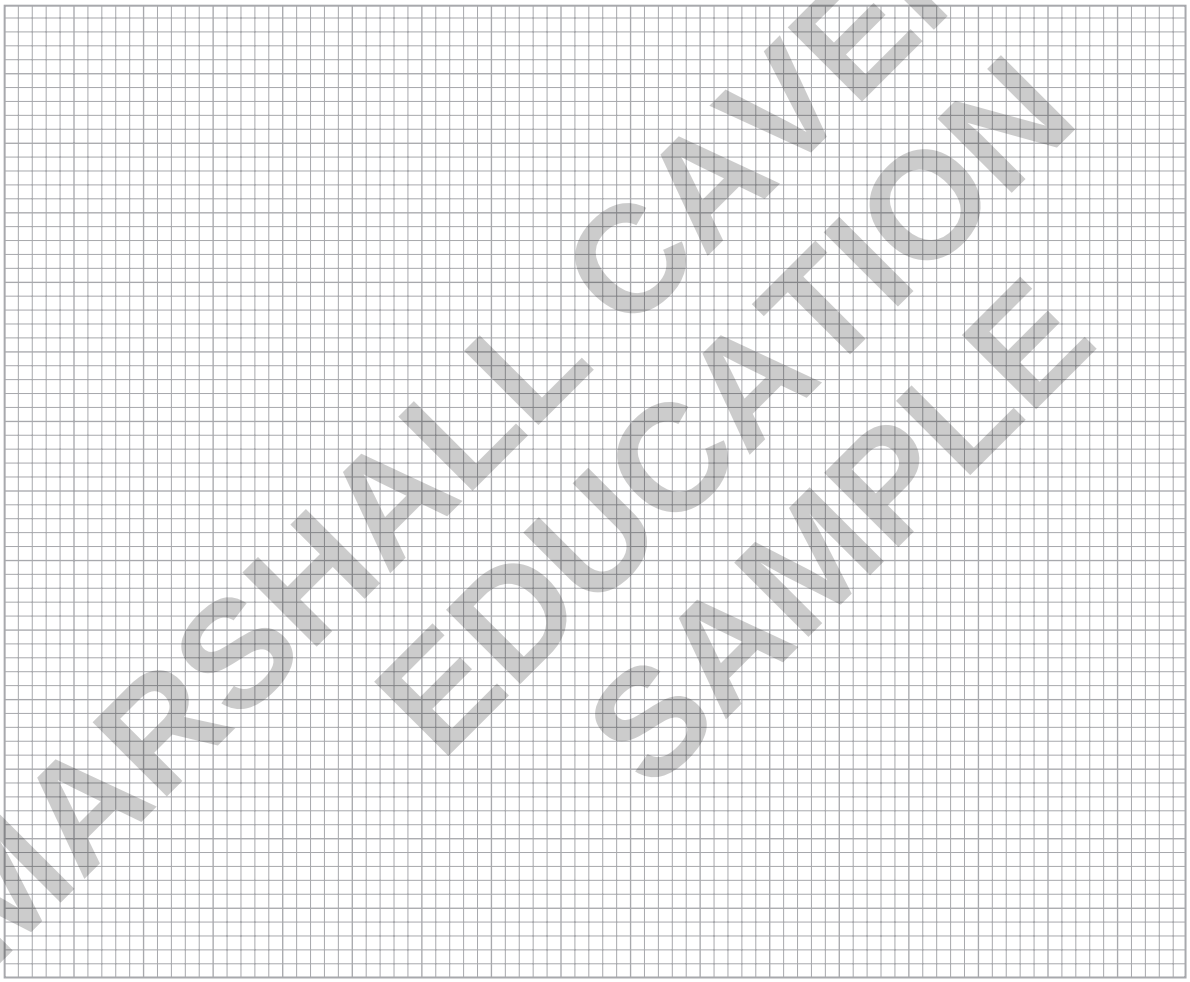
5 **S** Heating and cooling curves can be used to show what happens to the temperature of a substance as it is heated or cooled. Stearic acid was allowed to cool in a room with a temperature of 49°C. The temperature of the acid was measured every ten seconds.

The results are shown in Table 1.1.

Table 1.1

Time / s	10	20	30	40	50	60	70	80	90	100
Temperature / °C	89	84	80	75	71	70	70	70	69	67
Time / s	110	120	130	140	150	160	170	180	190	200
Temperature / °C	65	63	61	59	57	55	53	51	49	49

(a) Plot a graph of temperature against time.



(b) What happens to the temperature of the stearic acid over time?

_____

(c) Label the point on the graph where stearic acid is

(i) a liquid; **(ii)** a solid.

(d) Suggest the melting point of stearic acid.

_____

Exercise 1C Effects of Temperature and Pressure on the Volume of a Gas

1 Which of the following shows the correct changes in the volume of a gas when temperature and pressure are increased? Choose the correct answer and write your choice in the brackets.

	Changes in the volume of a gas	
	when temperature increases	**when pressure increases**
A	Decreases	Decreases
B	Decreases	Increases
C	Increases	Decreases
D	Increases	Increases

( )

2 **S** Three gases in sealed round-bottomed flasks were placed in water-baths of different temperatures (Figure 1.2).

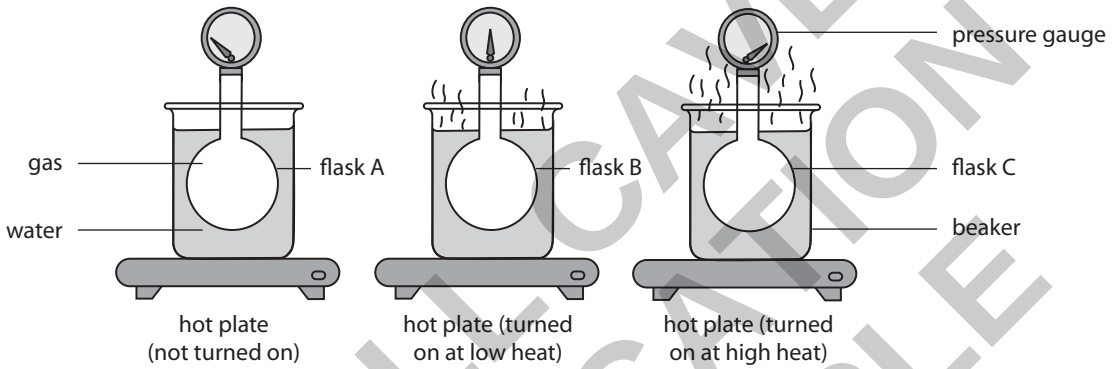


Figure 1.2

Explain, using kinetic particle theory, why the gas in flask A has the lowest pressure.

_____

_____

_____

_____

Exercise 1D Diffusion

1 Fill in the blanks in the sentence. Each term can be used once, more than once or not at all.

random	collision	gas	particles	energy	lower	higher

Diffusion is the movement of **(a)** _____ in a liquid or a **(b)** _____ as they move from a region of **(c)** _____ concentration to a region of **(d)** _____ concentration.

2 **S** Figure 1.3 shows a set-up that is used to investigate the rate of diffusion of different gases. When ammonia gas from ammonia solution and hydrogen chloride gas from hydrochloric acid react, a white ring of ammonium chloride is formed. Choose the correct answer and write your choice in the brackets.

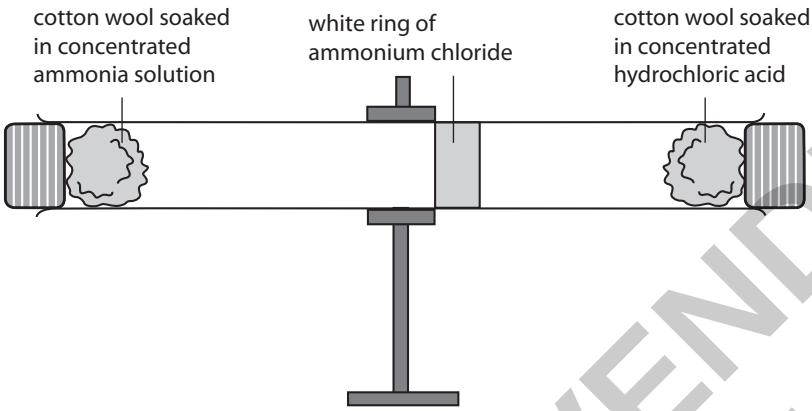


Figure 1.3

Which statement explains why the white ring was formed nearer the end with hydrogen chloride?

A Ammonia gas has a higher relative molecular mass than hydrogen chloride gas, so it diffuses more quickly.

B Ammonia gas has a lower relative molecular mass than hydrogen chloride gas, so it diffuses more quickly.

C Both gases diffuse at the same rate.

D Hydrogen chloride gas has a lower relative molecular mass than ammonia gas, so it diffuses more quickly. ( )

3 A gas jar of air was inverted on top of a gas jar containing bromine vapour. A glass plate was used to separate the gas jars. Figure 1.4 shows the gas jars before and after the glass plate was removed.

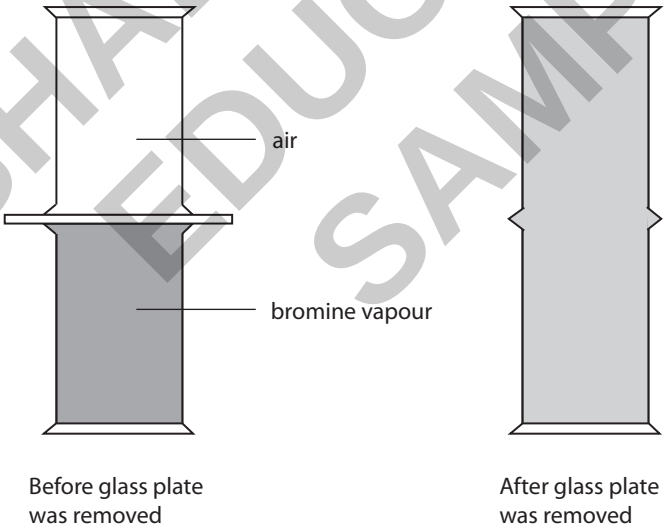


Figure 1.4

Explain, using kinetic particle theory, the colour inside the gas jars after the glass plate was removed.

Exercise 1E — Exam-style Questions

1 **S** Figure 1.5 shows the heating curve of substance X.

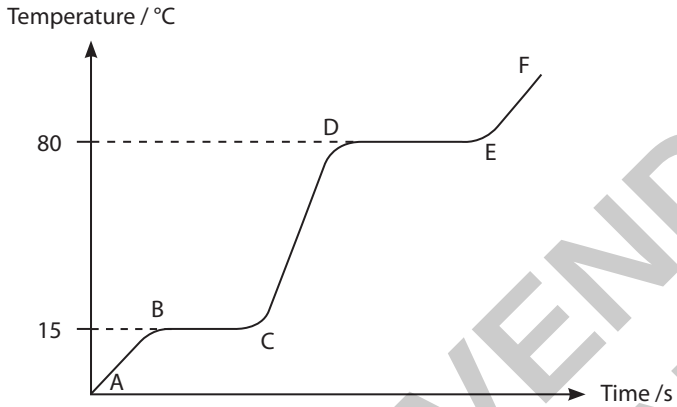


Figure 1.5

(a) What is the melting point of substance X? _____ [1]

(b) Is substance X a solid, a liquid or a gas at room temperature (25°C)? _____ [1]

(c) Name the process taking place at part DE of the heating curve. _____ [1]

2 This question is about bromine and compounds of bromine.

(a) Use the kinetic particle model to describe the arrangement and type of motion of the molecules in:

- liquid bromine _____

_____

- bromine gas _____

_____ [4]

(b) The graph shows how the volume of bromine gas changes with temperature. The pressure is kept constant.

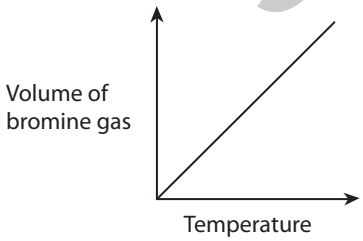


Figure 1.6

Describe how the volume of the bromine gas changes with temperature.

_____

_____ [1]

[Cambridge IGCSE Chemistry (0620) Paper 32 Q4a, b, May/Jun 2019]

3 Carbon dioxide is a colourless gas at room temperature. It freezes and forms solid carbon dioxide at a low temperature.

(a) Compare the movement and arrangement of the particles of carbon dioxide in the solid and gaseous forms.

_____

_____

_____ [3]

(b) **S** A sealed container contains carbon dioxide gas. The pressure of the gas is due to the gas particles hitting the wall of the container. Use the kinetic theory to explain why the pressure inside the container increases when the temperature is increased.

_____

_____ [2]

4 Table 1.2 shows the rate of diffusion of nitrogen and chlorine at room temperature.

Table 1.2

Gas	Relative molecular mass
Nitrogen	28
Chlorine	71

(a) What is diffusion?

_____ [1]

(b) **S** Which gas, nitrogen or chlorine, diffuses more quickly? Explain your answer.

_____

_____ [2]

(c) **S** Explain, using kinetic particle theory, why the rate of diffusion of nitrogen would be higher with increasing temperature.

_____ [1]

Exercise 1F Let's Reflect

Reflect on your learning achievements for each section in Chapter 1. Look back at the concepts taught in the Student's Book. Check how you have fared in answering the questions in the Student's Book and the Theory Workbook. Then complete the Chapter Journal.

Chapter Journal

1 Rate your confidence level for your understanding of this chapter.
Draw a pointer on the confidence meter to show your confidence level.

➔ If you are *not confident* or only *somewhat confident*, go back to the Student's Book and revise this chapter.

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1.1 States of Matter	
1.2 Kinetic Particle Theory	
1.3 Changes of State of Matter and the Kinetic Particle Theory	
1.4 Effects of Temperature and Pressure on the Volume of a Gas	
1.5 Diffusion	

➔ If you have written any questions, show them to someone such as your teacher who can help you.

3 What other thoughts do you have about learning this chapter?

_____

_____

_____

_____

_____

➔ Reflect on your thoughts and share them with your teacher or classmates.

For over 60 years Marshall Cavendish Education has been empowering educators and students in over 80 countries with high-quality, research-based, Pre-K-12 educational solutions. We nurture world-ready global citizens by equipping students with crucial 21st century skills through our resources for schools and education centres worldwide, including Cambridge schools, catering to national and international curricula.

The *Marshall Cavendish Education Cambridge IGCSE™ Chemistry* series is designed for students preparing for the 0620/0971 syllabuses. The series translates insights from educational psychology classic "How People Learn" into highly effective learner-centred classroom practices.

TWB The **Theory Workbook** provides meaningful reinforcement of concepts covered in the Student's Book. Each chapter contains formative questions to assess topical understanding, exam-style questions to build exam readiness and a Chapter Journal to encourage self-reflection. The formative questions include multiple-choice questions, word jumbles, crosswords, and short-answer and structured questions – all of which are intended to foster subject literacy. A STEAM project offers the opportunity for group work, to encourage critical thinking and inquiry-based knowledge building.

This resource is endorsed by Cambridge Assessment International Education

- ✓ Provides learner support for the Cambridge IGCSE and IGCSE (9–1) Chemistry syllabuses (0620/0971) for examination from 2023
- ✓ Has passed Cambridge International's rigorous quality-assurance process
- ✓ Developed by subject experts
- ✓ For Cambridge schools worldwide

Series architecture

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- Teacher's Guide
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