Cambridge IGCSE
Topical Past Papers

CHEMISTRY

0620 P4

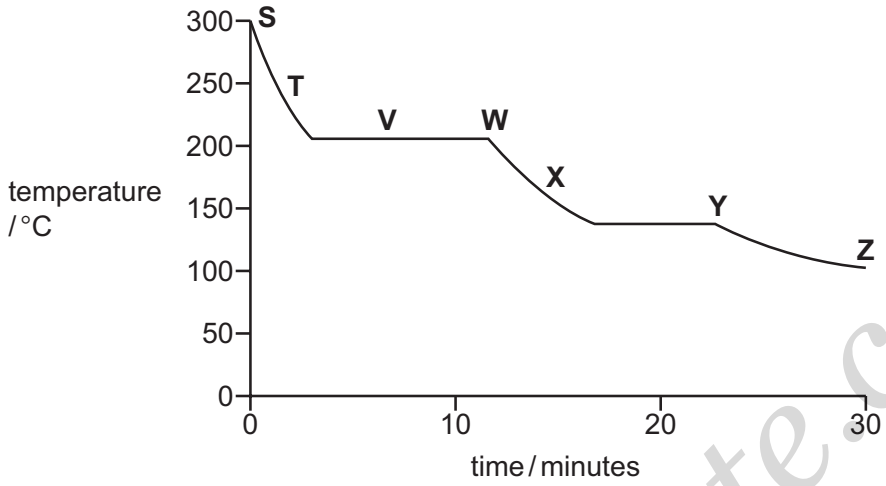
2017 — 2024

CHAPTER 1

STATES OF MATTER

1 - (0620/41_Winter_2017_Q2) ANSWER

The graph shows how the temperature of a substance changes as it is cooled over a period of 30 minutes. The substance is a gas at the start.



Each letter on the graph may be used once, more than once or not at all.

(a) Which letter, **S**, **T**, **V**, **W**, **X**, **Y** or **Z**, shows when

(i) the particles in the substance have the most kinetic energy,

..... [1]

(ii) the particles in the substance are furthest apart,

..... [1]

(iii) the substance exists as both a gas and a liquid?

..... [1]

(b) Use the graph to estimate the freezing point of the substance.

..... °C [1]

(c) Name the change of state directly from a solid to a gas.

..... [1]

(d) When smoke is viewed through a microscope, the smoke particles in the air appear to jump around.

(i) What term describes this movement of the smoke particles?

..... [1]

(ii) Explain why the smoke particles move in this way.

.....

.....

..... [2]

[Total: 8]

2 - (0620/42_Winter_2017_Q1) ANSWER

(a) Dust particles in the air move around in a random way.

(i) What term describes the random movement of the dust particles?

..... [1]

(ii) Identify the particles in the air which cause the random movement of the dust particles.

..... [2]

(iii) Explain why the dust particles move in this way.

.....

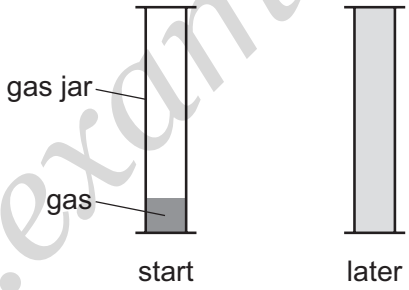
.....

..... [2]

(b) When chlorine gas, Cl_2, is put into a gas jar, it spreads out to fill the gas jar.

When bromine gas, Br_2, is put into a gas jar, it also spreads out to fill the gas jar.

The process takes longer for bromine gas than for chlorine gas.



(i) What term describes the way that the gas particles spread out?

..... [1]

(ii) Use **data** from the Periodic Table to explain why bromine gas takes longer to fill a gas jar than chlorine gas.

.....

.....

..... [2]

(iii) Explain why increasing the temperature increases the rate at which the gas particles spread out.

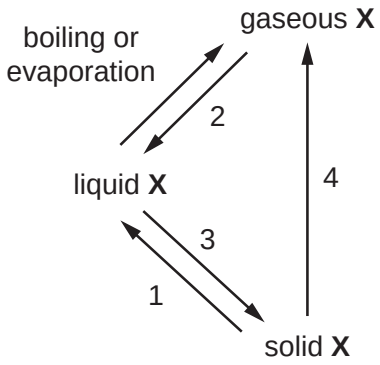
.....

..... [1]

[Total: 9]

3 - (0620/42_Winter_2018_Q1) ANSWER

Element **X** can undergo the following physical changes.



(a) (i) Give the scientific name for each of the numbered physical changes.

1 .....

2 .....

3 .....

4 .....

[4]

(ii) Explain why the changes shown are physical changes.

.....

..... [1]

(iii) One difference between boiling and evaporation is the rate at which the processes occur.

State **one** other difference between boiling and evaporation.

.....

..... [1]

(b) Describe the separation, arrangement and motion of particles of element **X** in the solid state.

separation .....

arrangement .....

motion .....

[3]

(c) Element **X** is a Group I metal. It burns in air to form an oxide $\mathbf{X}_2O$.

Write a chemical equation for this reaction.

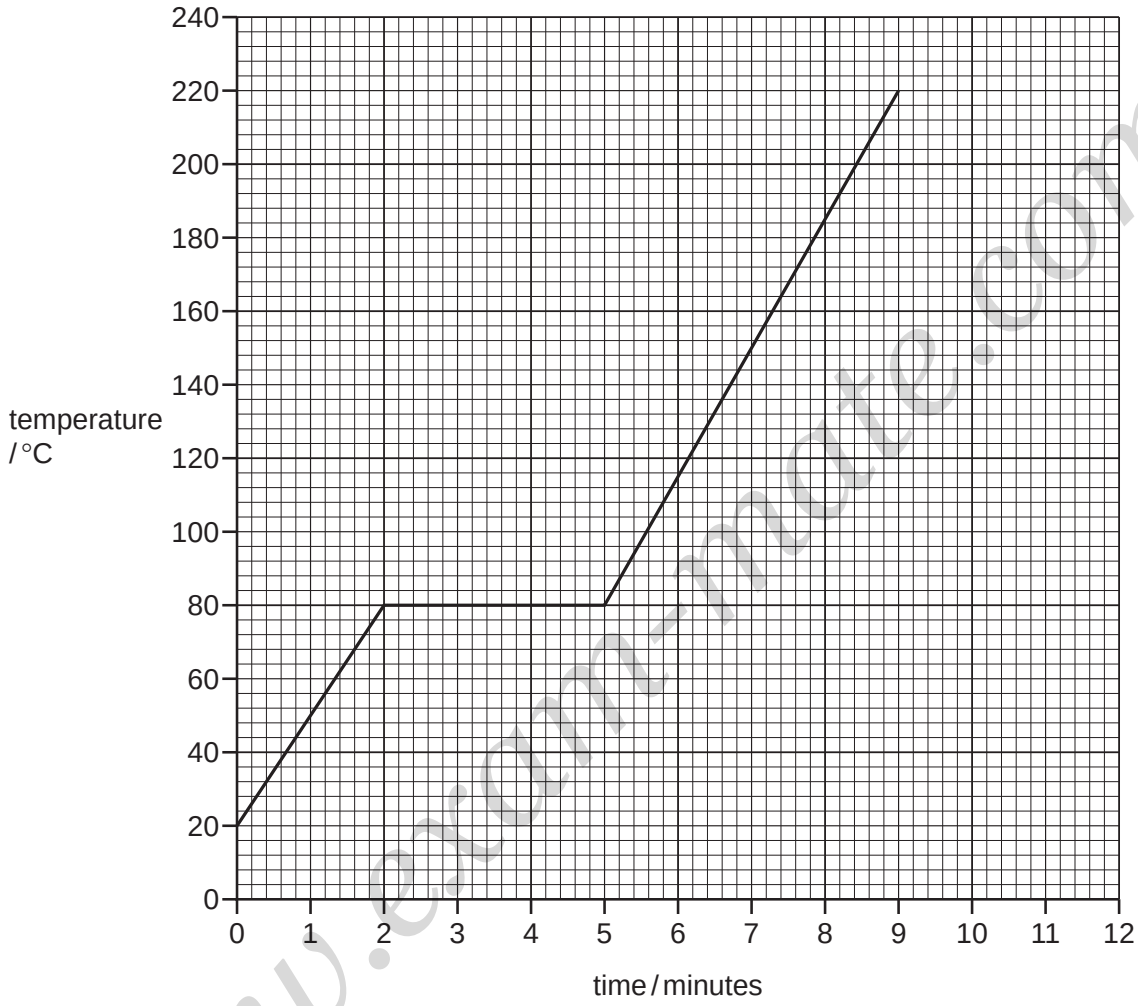
..... [2]

[Total: 11]

4 - (0620/41_Summer_2019_Q2) ANSWER

Z is a covalent substance. In an experiment, a sample of pure solid **Z** was continually heated for 11 minutes.

The graph shows how the temperature of the sample of pure **Z** changed during the first 9 minutes.



(a) What is the melting point of pure **Z**?

..... °C [1]

(b) The sample of pure **Z** began to boil at 9 minutes. It was boiled for 2 minutes.

Use this information to sketch on the grid how the temperature of the sample of pure **Z** changed between 9 minutes and 11 minutes. [1]

(c) The sample of pure **Z** was continually heated between 2 minutes and 5 minutes.

Explain, in terms of attractive forces, why there was no increase in the temperature of the sample of pure **Z** between 2 minutes and 5 minutes.

.....

.....

..... [2]

(d) Describe how the motion of particles of pure **Z** changed from 0 minutes to 2 minutes.

.....

..... [2]

(e) The experiment was repeated using a solid sample of **impure Z**.

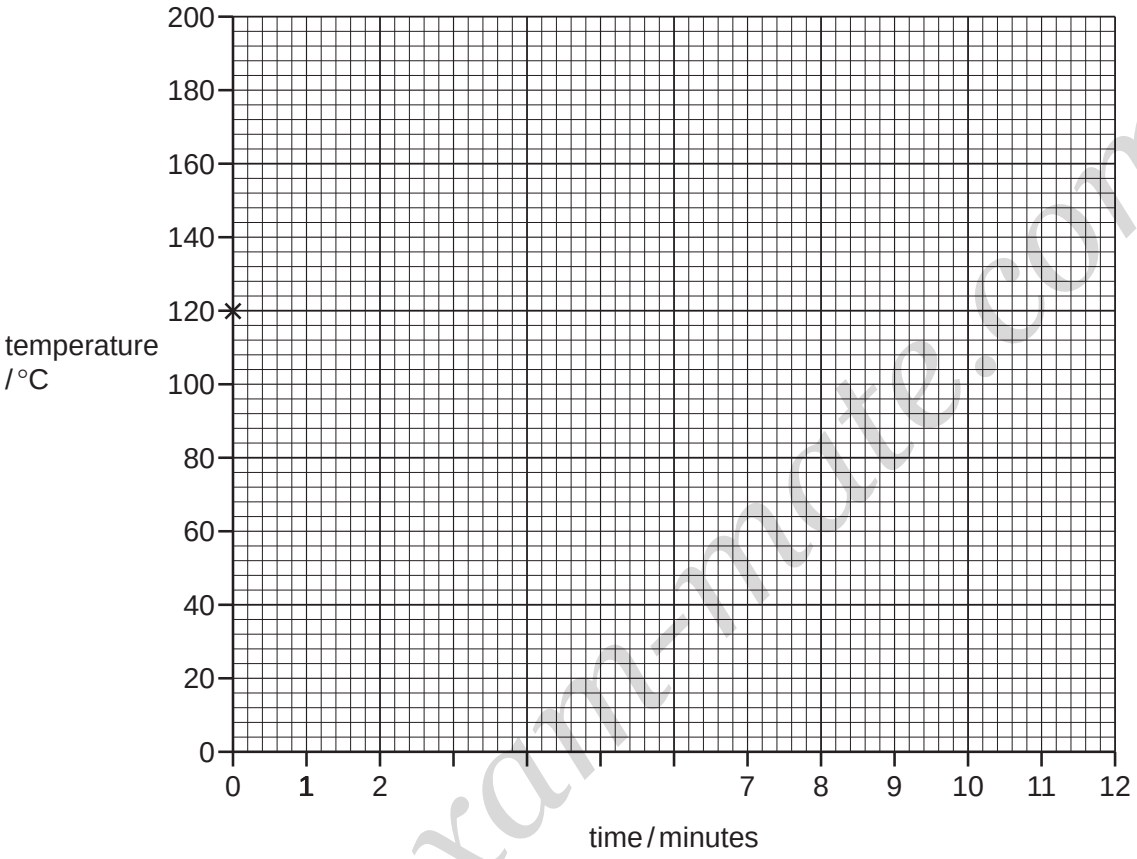
Suggest the differences, if any, in the melting point and boiling point of the sample of impure **Z** compared to the sample of pure **Z**.

melting point .....

boiling point .....
[2]

(f) A sample of pure **Z** was allowed to cool from 120 °C to 20 °C. The total time taken was 8 minutes.

Starting from point ×, sketch on the grid how the temperature of the sample of pure **Z** changed between 0 minutes and 8 minutes.



[2]

[Total: 10]

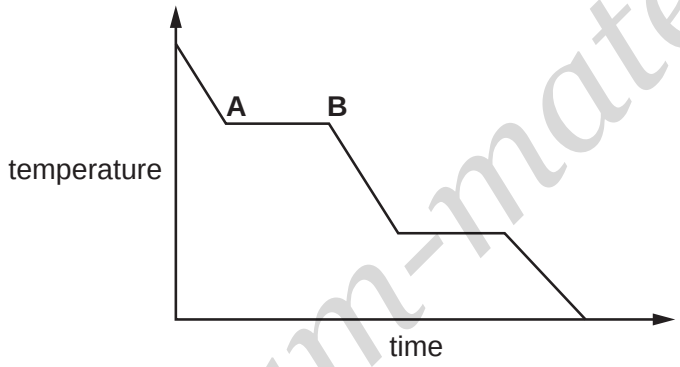
5 - (0620/43_Summer_2020_Q5) ANSWER

(a) Complete the table about solids, liquids and gases.

	particle separation	particle arrangement	type of motion
solid		regular	vibrate only
liquid	touching		random
gas	apart	random	

[3]

(b) The graph shows the change in temperature as a sample of a gas is cooled.



Name the change of state taking place between **A** and **B**.

..... [1]

(c) A bottle of liquid perfume is left open at the front of a room.

After some time, the perfume is smelt at the back of the room.

Name the **two** physical processes taking place.

1 .....

2 .....

[2]

[Total: 6]

6 - (0620/41_Winter_2020_Q3) ANSWER

(a) Aqueous ammonium sulfate, $(NH_4)_2SO_4$, is warmed with aqueous sodium hydroxide.

The pungent-smelling gas ammonia, NH_3, is produced.

Balance the equation for this reaction.

$(NH_4)_2SO_4$ + ...NaOH $\rightarrow$ .....NH_3 + ...H_2O + Na_2SO_4 [1]

(b) A 2.8 g sample of impure ammonium sulfate is found to contain 0.7 g of impurities.

Calculate the percentage of ammonium sulfate in this sample.

percentage of ammonium sulfate = ... % [1]

(c) Describe a test for ammonia gas.

test .....

result .....

[2]

(d) Ammonia gas is prepared at the front of a laboratory.

The pungent smell of ammonia spreads throughout the laboratory slowly.

(i) Name the process that occurs when ammonia gas spreads throughout the laboratory.

..... [1]

(ii) Explain, using ideas about particles, why ammonia gas spreads throughout the laboratory.

.....

.....

.....

..... [2]

(iii) Explain why carbon dioxide gas, CO_2, will spread throughout the laboratory at a slower rate than ammonia gas, NH_3.

.....

..... [1]

(e) Ammonia is produced in the Haber process.

The equation for the reaction is shown.

$$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$$

(i) In the Haber process, a temperature of 450 °C and a pressure of 200 atmospheres are used in the presence of finely-divided iron.

A larger equilibrium yield of ammonia would be produced if a lower temperature and a higher pressure are used.

Explain why a lower temperature and a higher pressure are **not** used.

lower temperature .....

.....

higher pressure .....

.....

[2]

(ii) State the role of iron in the Haber process.

..... [1]

(f) Ammonia is a weak base.

(i) Explain the meaning of the term *base*.

.....

..... [1]

(ii) Suggest the pH of aqueous ammonia.

..... [1]

[Total: 13]

7 - (0620/42_Winter_2021_Q1) ANSWER

This question is about states of matter.

(a) Complete the table, using ticks (✓) and crosses (✗), to describe the properties of gases, liquids and solids.

state of matter	particles are touching	particles have random movement	particles are regularly arranged
gas			
liquid			
solid			

[3]

(b) Substances can change state.

(i) Boiling and evaporation are two ways in which a liquid changes into a gas.

Describe **two** differences between boiling and evaporation.

1 .....

2 .....

[2]

(ii) Name the change of state when:

- a gas becomes a liquid .....
- a solid becomes a gas. .....

[2]

8 - (0620/43_Summer_2022_Q1) ANSWER

A list of substances is shown.

aluminium oxide	**carbon dioxide**	**carbon monoxide**	**chlorine**	**copper**
glucose	**iron(III) oxide**	**limestone**	**nitrogen**	**oxygen**

Answer the questions using the substances in the list.

Each substance may be used once, more than once or not at all.

State which substance is:

(a) a product of respiration

..... [1]

(b) the main constituent of hematite

..... [1]

(c) an element which has a sulfate that is used to test for water

..... [1]

(d) a colourless toxic gas

..... [1]

(e) a reactant in fermentation

..... [1]

(f) a reducing agent in the extraction of iron

..... [1]

(g) a conductor of electricity when solid

..... [1]

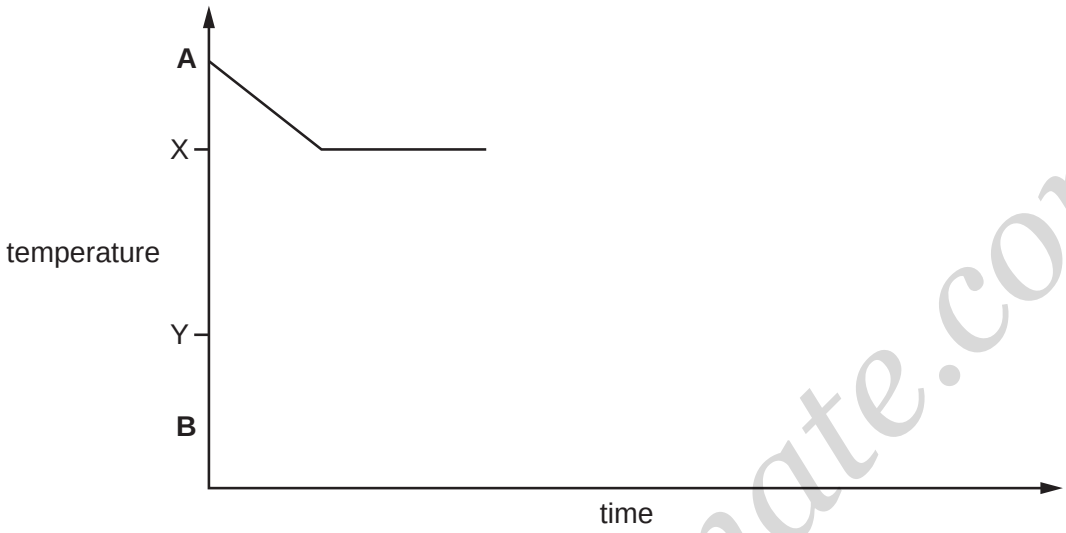
(h) a gas that is approximately 21% of clean, dry air.

..... [1]

[Total: 8]

(c) A substance boils at temperature X and melts at temperature Y.

Complete the graph to show the change in temperature over time as the substance cools from temperature **A** to temperature **B**.



[2]

(d) A solution is a mixture of a solute and a solvent.

(i) Name the process when a solid substance mixes with a solvent to form a solution.

..... [1]

(ii) Name the type of reaction when two solutions react to form an insoluble substance.

..... [1]

[Total: 11]

9 - (0620/41_Winter_2022_Q1) ANSWER

The names of the elements of Period 2 of the Periodic Table are shown.

lithium beryllium boron carbon nitrogen oxygen fluorine neon

Answer the following questions about these elements.
Each element may be used once, more than once or not at all.

Identify the element which:

(a) is a product of photosynthesis

..... [1]

(b) has an oxide found in clean, dry air

..... [1]

(c) forms a basic oxide with the formula X_2O

..... [1]

(d) is a main component of fertilisers used to improve crop growth

..... [1]

(e) has the highest rate of diffusion at room temperature

..... [1]

(f) produces a red flame in a flame test

..... [1]

(g) has only 5 electrons in each of its atoms

..... [1]

(h) has an oxide responsible for acid rain.

..... [1]

[Total: 8]

10 - (0620/41_Winter_2024_Q1) ANSWER

A list of chemical and physical processes, **A** to **H**, is shown.

A combustion
B diffusion
C melting
D neutralisation
E photosynthesis
F reversible reaction
G roasting
H thermal decomposition

Answer the following questions about processes **A** to **H**.
Each letter may be used once, more than once or not at all.

State which of the processes **A** to **H**:

(a) happens when an acid reacts with an alkali

..... [1]

(b) reaches a position of equilibrium

..... [1]

(c) involves particles changing from fixed positions to being mobile, but still touching

..... [1]

(d) are physical changes

..... and ..... [1]

(e) is caused by gas particles colliding with each other.

..... [1]

[Total: 5]

1 - (0620/41_Winter_2017_Q2)

(a)(i)	**S**	**1**
(a)(ii)	**S**	**1**
(a)(iii)	**V**	**1**
(b)	any value in the range 130–145 °C	**1**
(c)	sublimation	**1**
(d)(i)	Brownian motion	**1**
(d)(ii)	nitrogen / oxygen / carbon dioxide / air molecules hit / bombard the smoke particles	**1**
	(the bombarding particles) move randomly	**1**

2 - (0620/42_Winter_2017_Q1) QUESTION

(a)(i)	Brownian (motion)	**1**
(a)(ii)	molecules	**1**
	nitrogen / N_2 / N **OR** oxygen / O_2 / O	**1**
(a)(iii)	nitrogen **OR** oxygen (particles) collide with / bombard / hit the dust (particles)	**1**
	(the bombarding particles) move **randomly**	**1**
(b)(i)	diffusion	**1**
(b)(ii)	Br_2 has an M_r of 160 **AND** Cl_2 has an M_r of 71 / bromine has an A_r of 80 **AND** chlorine has an A_r of 35.5	**1**
	(heavier) bromine (molecules / particles) diffuses more slowly	**1**
(b)(iii)	particles have more energy / move faster	**1**

3 - (0620/42_Winter_2018_Q1) QUESTION

(a)(i)	M1 Melting M2 Condensing M3 Freezing M4 Sublimation	**4**
(a)(ii)	No new substances are made **or** The change can be reversed (by a physical process)	**1**
(a)(iii)	Boiling happens at a specific temperature **or** Evaporation happens over a range of temperatures	**1**
(b)	M1 Separation: Touching M2 Arrangement: Regular M3 Movement: Vibrate	**3**
(c)	$4X + O_2 \rightarrow 2X_2O$ M1 Species M2 Balance	**2**

4 - (0620/41_Summer_2019_Q2)

(a)	80(°C) (1)	**1**
(b)	horizontal line from end of graph at minute 9 to minute 11 (1)	**1**
(c)	energy is used to break bonds / overcome attraction (1) between molecules (1)	**2**
(d)	vibrations (1) increase (1)	**2**
(e)	melting point decreases (1) boiling point increases (1)	**2**
(f)	decrease from 120 °C to 80 °C and horizontal line at 80 °C (1) decrease from horizontal line to finish at 20 °C at 8 mins (1)	**2**

5 - (0620/43_Summer_2020_Q5)

(a)		particle separation	particle arrangement	type of motion	**3**
	solid	touching			
	liquid		random		
	gas			random	
(b)	condensing				**1**
(c)	evaporation diffusion				**2**

6 - (0620/41_Winter_2020_Q3) QUESTION

(a)(i)	$2 \rightarrow 2 + 2$	**1**
(b)	75(%)	**1**
(c)	test: (damp red) litmus paper (1) result: (litmus goes) blue (1)	**2**
(d)(i)	diffusion	**1**
(d)(ii)	particles move from an area of high to low concentration particles move randomly	**2**
(d)(iii)	CO_2 **molecules** are heavier (than NH_3)	**1**
(e)(i)	lower temperature: (rate of reaction) slower (1) higher pressure: expensive/specialist equipment	**2**
(e)(ii)	catalyst	**1**
(f)(i)	proton acceptor	**1**
(f)(ii)	any value greater than 7 up to 12	**1**

7 - (0620/42_Winter_2021_Q1) QUESTION

<table>
<tr><td>(a)</td><td>1 mark for each correct row
<table><tr><th>State</th><th>touching</th><th>random movement</th><th>regularly arranged</th></tr><tr><td>Gas</td><td></td><td>✔</td><td></td></tr><tr><td>Liquid</td><td>✔</td><td>✔</td><td></td></tr><tr><td>Solid</td><td>✔</td><td></td><td>✔</td></tr></table></td><td>3</td></tr>
<tr><td>(b)(i)</td><td>boiling happens at a specific temperature (1)
boiling has bubbles (1)</td><td>2</td></tr>
<tr><td>(b)(ii)</td><td>condensation (1)
sublimation (1)</td><td>2</td></tr>
<tr><td>(c)</td><td>one horizontal line level with Y (1)
two separate decreases before and after horizontal line (1)</td><td>2</td></tr>
<tr><td>(d)(i)</td><td>dissolving</td><td>1</td></tr>
<tr><td>(d)(ii)</td><td>precipitation</td><td>1</td></tr>
</table>

8 - (0620/43_Summer_2022_Q1)

(a)	carbon dioxide	**1**
(b)	iron(III) oxide	**1**
(c)	copper	**1**
(d)	carbon monoxide	**1**
(e)	glucose	**1**
(f)	carbon monoxide	**1**
(g)	copper	**1**
(h)	oxygen	**1**

9 - (0620/41_Winter_2022_Q1) QUESTION

(a)	oxygen	**1**
(b)	carbon	**1**
(c)	lithium	**1**
(d)	nitrogen	**1**
(e)	neon	**1**
(f)	lithium	**1**
(g)	boron	**1**
(h)	nitrogen	**1**

10 - (0620/41_Winter_2024_Q1)

(a)	D	**1**
(b)	F	**1**
(c)	C	**1**
(d)	B **AND** C	**1**
(e)	B	**1**