

GCSE Combined Science: Trilogy

Worksheet: Changes of state

TIME 35 min	TOTAL 32 marks	CALCULATOR Allowed	DIFFICULTY Easy, Medium
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Topics: Changes of state

NAME	CLASS	DATE
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- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Answer all questions in the spaces provided.
- In all calculations, show clearly how you work out your answer.
- The marks for questions are shown in brackets.

0 1

0 1 . 1

Solid carbon dioxide is sometimes called 'dry ice'. At room temperature, dry ice changes directly from a solid into a gas.

What is the name of this change of state?

.....

.....

.....

.....

[1 mark]

0 1 . 2

Which change of state happens when water vapour turns into liquid water?

Tick (✓) **one** box.

Boiling

☐

Condensing

☐

Freezing

☐

Melting

☐

[1 mark]

0 1 . 3

A student put 45 g of ice into a plastic bag and sealed the bag. After one hour, all of the ice had melted.
What was the mass of the water in the bag?

.....

.....

.....

Mass = g

[1 mark]

0 1 . 4

Give the reason for your answer.

.....

.....

[1 mark]

0 2

0 2 . 1

A pure substance melts at 63 °C.
At what temperature will the same substance freeze?

.....

.....

.....

Freezing point = °C

[1 mark]

0 2 . 2

Which statement is correct?

Tick (✓) **one** box.

Melting and boiling are both changes from a solid to a gas. ☐

Freezing and condensing both release energy to the surroundings. ☐

Evaporation can only happen at the boiling point of a liquid. ☐

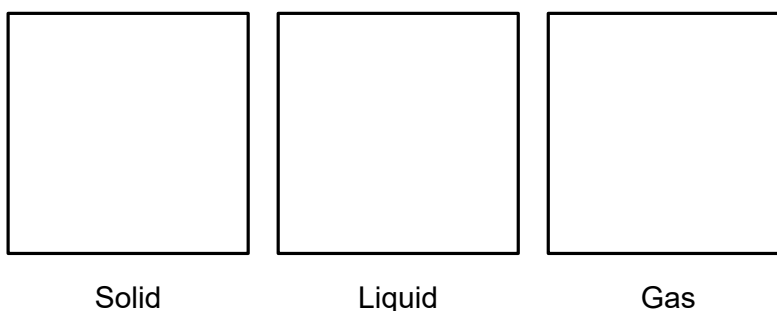
Sublimation is a two-step change: solid to liquid, then liquid to gas. ☐

[1 mark]

0 3

Figure 1 shows three empty boxes.

Figure 1



0 3 . 1

Complete the box labelled 'Solid' in Figure 1 to show the arrangement of the particles in a solid. Show at least nine particles.

[1 mark]

0 3 . 2

Complete the box labelled 'Liquid' in Figure 1 to show the arrangement of the particles in a liquid. Show at least nine particles.

[1 mark]

0 3 . 3

Complete the box labelled 'Gas' in Figure 1 to show the arrangement of the particles in a gas. Show at least nine particles.

[1 mark]

0 3 . 4

State one way in which the movement of the particles in a liquid is different from the movement of the particles in a gas.

.....

.....

[1 mark]

0 4

A pure substance is a solid at room temperature. It is heated at a constant rate until it has completely changed into a gas.

Figure 2 shows a pair of axes.

Figure 2



0 4 . 1

On Figure 2, sketch a graph to show how the temperature of the substance changes from when it starts being heated until it has completely turned into a gas.

Label the sections of your graph where the substance is melting and where it is boiling.

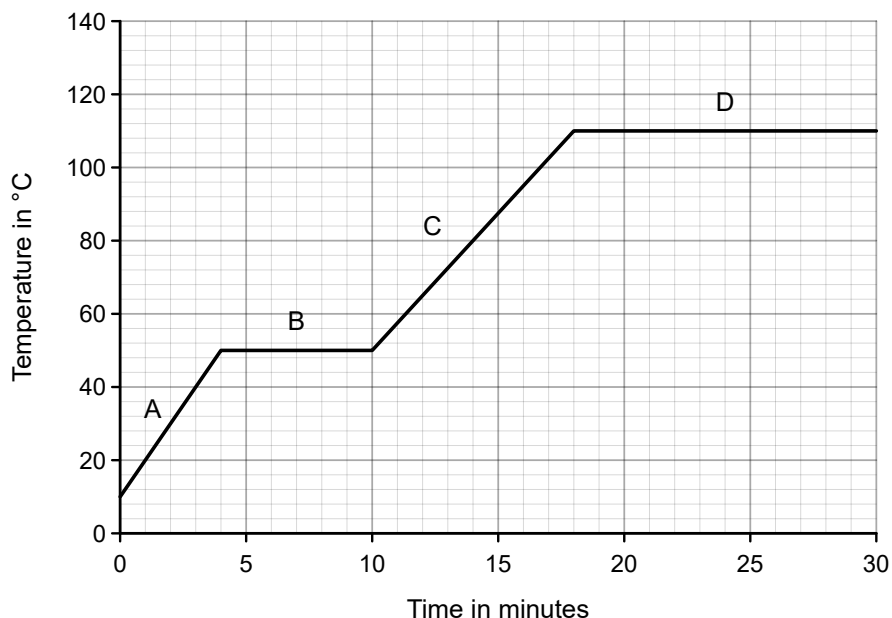
[4 marks]

.....

0 5

A student heated a solid substance in a container at a constant rate. Figure 3 shows how the temperature of the substance changed with time.

Figure 3



0 5 . 1

What is the melting point of the substance?

.....

.....

.....

Melting point = °C

[1 mark]

0 5 . 2

In which section of the graph, A, B, C or D, is the substance changing from a solid into a liquid?

.....

.....

[1 mark]

0 5 . 3

What state is the substance in during section C?

.....

.....

[1 mark]

0 5 . 4

Name the change of state that is happening during section D.

.....

.....

.....

.....

[1 mark]

0 5 . 5

Compare the movement of the particles in section A with the movement of the particles in the gas formed during section D.

.....

.....

.....

.....

[2 marks]

0 6

Melting, freezing, boiling, evaporating, condensing and sublimating are all changes of state.

0 6 . 1

Changes of state are physical changes.

Explain how a physical change is different from a chemical change.

.....

.....

.....

.....

[2 marks]

0 6 . 2

A student boiled 250 g of water in an open beaker. After 5 minutes, the mass of water in the beaker was 212 g.

The student said:

‘This shows that mass is not conserved when water boils.’

Explain why the student is wrong.

.....

.....

.....

.....

[2 marks]

0 6 . 3

Describe how the arrangement and the movement of the particles change when a solid melts.

.....

.....

.....

.....

[2 marks]

.....

0 7

When a candle is lit, energy from the flame melts some of the solid wax near the wick. Liquid wax travels up the wick and evaporates. The wax vapour then burns in the flame: it reacts with oxygen from the air to form carbon dioxide and water vapour.

When the candle is blown out, the pool of liquid wax around the wick turns back into solid wax.

0 7 . 1

Explain why the melting and the evaporation of the wax are described as physical changes, but the burning of the wax is not.

In your answer, refer to the particles of wax, to mass and to whether each change can be reversed.

.....

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.....

.....

[6 marks]

END OF QUESTIONS

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Mark scheme

GCSE Combined Science: Trilogy · Worksheet: Changes of state · 32 marks

Question 1 (4 marks)

01.1 [1 mark]

Answer: Sublimation

- sublimation / subliming / sublimating (1)
-

01.2 [1 mark]

Correct: Condensing

01.3 [1 mark]

Answer: 45 g

- 45 (g) (1)
-

01.4 [1 mark]

Answer: Mass is conserved in a change of state; the bag was sealed, so no particles could enter or leave.

- mass is conserved when a substance changes state / no particles were added or removed because the bag was sealed (1)
-
-

Question 2 (2 marks)

02.1 [1 mark]

Answer: 63 °C

- 63 (°C) (1)
-

02.2 [1 mark]

Correct: Freezing and condensing both release energy to the surroundings.

Question 3 (4 marks)

03.1 [1 mark]

- particles drawn touching, arranged in a regular, repeating pattern (e.g. rows and columns) (1)

03.2 [1 mark]

- particles drawn touching or almost touching, arranged randomly with no regular pattern (1)

03.3 [1 mark]

- particles drawn well separated, with gaps much bigger than a particle, arranged randomly (1)

03.4 [1 mark]

Answer: Liquid particles stay close together and slide past each other; gas particles move freely and randomly in all directions, travelling much further between collisions.

- liquid particles stay close together and move around / slide past each other, whereas gas particles move freely and randomly in all directions, travelling much further between collisions (1)

Notes: Allow 'gas particles move faster' or 'gas particles move more freely'.

Question 4 (4 marks)

04.1 [4 marks]

- temperature rises (while the substance is a solid), then becomes flat while it melts (1)
 - temperature rises again (while the substance is a liquid), then becomes flat again while it boils (1)
 - temperature rises once more after boiling is complete (while the substance is a gas) (1)
 - the two flat sections are correctly labelled 'melting' and 'boiling' (1)
-

Question 5 (6 marks)

05.1 [1 mark]

Answer: 50 °C

- 50 (°C) (1)
-

05.2 [1 mark]

Answer: B

- B (1)
-

05.3 [1 mark]

Answer: Liquid

- liquid (1)
-

05.4 [1 mark]

Answer: Boiling

- boiling (1)

Notes: Do not accept evaporating or melting.

05.5 [2 marks]

Answer: In A the particles only vibrate about fixed positions; in the gas they move randomly and freely in all directions.

- in section A (a solid) the particles vibrate about fixed positions (1)
 - in the gas the particles move freely / randomly in all directions (at high speed) (1)
-

Question 6 (6 marks)

06.1 [2 marks]

Answer: If a physical change is reversed, the material recovers its original properties; a chemical change produces a new substance with different properties.

- in a physical change the material recovers its original properties if the change is reversed (1)
- in a chemical change a new substance (with different properties) is made (1)

Notes: A statement and its converse on their own (e.g. 'a physical change makes no new substance but a chemical change does') score 1 mark only.

06.2 [2 marks]

Answer: The missing 38 g became steam that escaped into the air; the total mass of water plus water vapour is unchanged.

- 38 g of water turned into water vapour / steam which escaped from the open beaker (into the air) (1)
- the total mass of the water and the water vapour did not change / no particles were destroyed (1)

06.3 [2 marks]

Answer: The particles go from a regular arrangement, vibrating about fixed positions, to a random arrangement in which they are still close together but can move past each other.

- the arrangement changes from regular to random / irregular (the particles stay close together) (1)
 - the particles change from vibrating about fixed positions to moving around / sliding past each other (1)
-

Question 7 (6 marks)

07.1 [6 marks]

Answer: Melting and evaporating are changes of state: the same wax particles are only rearranged (their spacing and movement change), mass is conserved, and the change is reversed by cooling, giving wax with its original properties. Burning is a chemical change: the wax reacts with oxygen to form new substances (carbon dioxide and water) that do not turn back into wax when they are cooled.

Levels of response

- **Level 3 (5–6)** A detailed, coherent answer. Relevant points are accurate, linked in a logical sequence and use correct scientific terms.
- **Level 2 (3–4)** Several relevant points with some linking, but the answer has gaps, errors or lacks detail.
- **Level 1 (1–2)** Simple statements making one or two relevant points, with little or no linking.
- **No marks (0)** Nothing relevant or worthy of credit.

Indicative content

- melting and evaporating are changes of state: the wax particles themselves do not change — only their arrangement, spacing and movement change
- when the wax melts, its particles are no longer held in fixed positions and can move past each other; when it evaporates, the particles move far apart as a gas
- mass is conserved in a change of state: the mass of liquid wax formed equals the mass of solid wax that melted, because the number of particles does not change
- the changes of state can be reversed: when the candle is blown out, the liquid wax freezes and becomes solid wax again, with its original properties
- burning is a chemical change: the wax reacts with oxygen to form new substances, carbon dioxide and water, which have different properties
- cooling the carbon dioxide and water does not turn them back into wax, so the material does not recover its original properties when the change is reversed
- the candle loses mass as it burns because the products are gases that escape into the air

Notes: Level 3 (5–6 marks): explains that melting and evaporation change only the arrangement and movement of the same particles, that mass is conserved and that cooling reverses them, and contrasts this with burning, which forms new substances that do not become wax again when cooled.

Level 2 (3–4 marks): identifies melting and evaporation as reversible changes of state and burning as forming new substances, with some explanation.

Level 1 (1–2 marks): simple statements, e.g. 'melting can be reversed' or 'burning makes carbon dioxide'.
