AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 6.3.1.2

Changes of state

Past-paper questions

Tier	**Foundation**
Question groups	**6**
Available paper years	**2018–2025**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

6.3.1.2 Changes of state

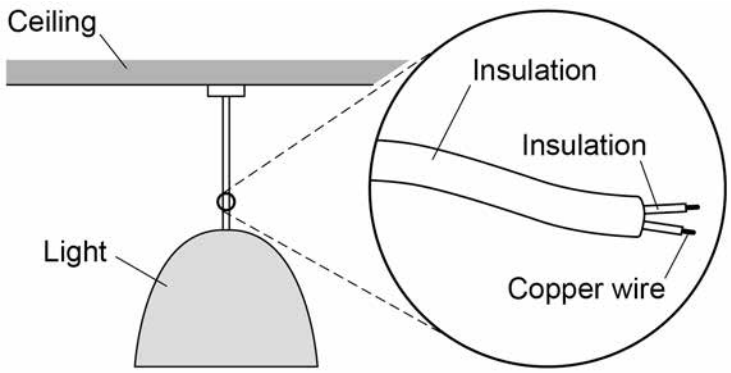
Question 01

June 2018 | 8464/P/1F | Original Q4

0 4 Some ceiling lights in the home are connected to the mains by a two-core cable.

Figure 6 shows a ceiling light.

Figure 6



0 4 . 1 Suggest why some ceiling lights do **not** have an earth wire.

[2 marks]

0 4 . 2 Write down the equation that links charge flow, current and time.

[1 mark]

0 4 . 3 There is a current of 2.95 A in one of the copper wires for 60 seconds.

Calculate the charge flow through the wire.

Use your equation from question **04.2**

[2 marks]

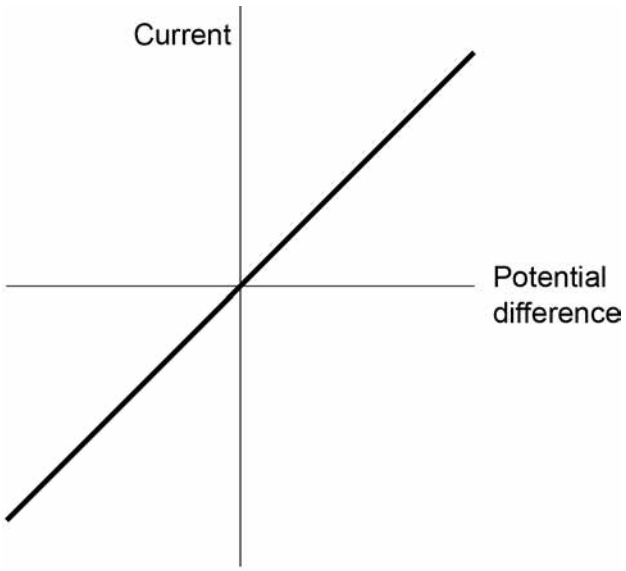
Charge flow = _____ C

6.3.1.2 Changes of state

Question 01 · continued

0 4 . 4 **Figure 7** shows a current potential difference graph for a piece of copper wire.

Figure 7



Draw another line on **Figure 7** for a wire with a different resistance.

[2 marks]

Question 4 continues on the next page

6.3.1.2 Changes of state

Question 01 · continued

Some fuses have a thin piece of copper that melts if the current is too large.

0 4 . 5 Draw the circuit symbol for a fuse.

[1 mark]

0 4 . 6 Describe how the movement of the copper particles in the wire changes when copper melts.

[2 marks]

0 4 . 7 Old copper wires are melted when they are recycled.

Calculate the energy needed to melt 500 kg of copper at its melting point.

Specific latent heat of fusion of copper = 200 kJ/kg

Use the Physics Equations Sheet.

[3 marks]

Energy = _____ J

13

6.3.1.2 Changes of state

Question 02

June 2018 | 8464/P/1F | Original Q5

0 5 Radioactive nuclei can emit alpha, beta or gamma radiation.

0 5 . 1 Which type of radiation is the most penetrating?

[1 mark]

Tick **one** box.

Alpha (α) ☐

Beta (β) ☐

Gamma (γ) ☐

0 5 . 2 Which type of radiation is the most ionising?

[1 mark]

Tick **one** box.

Alpha (α) ☐

Beta (β) ☐

Gamma (γ) ☐

0 5 . 3 Which type of radiation has the longest range in air?

[1 mark]

Tick **one** box.

Alpha (α) ☐

Beta (β) ☐

Gamma (γ) ☐

Question 5 continues on the next page

Question 02 · continued

When radioactive isotopes in the Earth's crust decay they release energy.

The decay causes the heating of rocks in the crust.

0 5 . 4 **Figure 8** shows the decay of uranium–238 (U–238) into thorium–234 (Th–234).

Figure 8

$$^{238}_{92}U \longrightarrow {}^{234}_{90}Th + {}^{4}_{2}He$$

Complete **Table 2** to show the number of neutrons and protons in the nuclei.

[2 marks]

Table 2

Isotope	Number of neutrons	Number of protons
uranium–238	146	
thorium–234		90

0 5 . 5 Geothermal power stations pump water through heated rocks.

The temperature of the water increases from 20 °C to its boiling point of 100 °C

Calculate the change in thermal energy when the mass of water heated is 150 kg

Specific heat capacity = 4 200 J/kg °C

Use the Physics Equations Sheet.

[3 marks]

Change in thermal energy = _____ J

8

6.3.1.2 Changes of state

Question 03

June 2019 | 8464/P/1F | Original Q3

0 3 In an experiment, a beam of alpha particles was directed at a thin sheet of gold foil.

0 3 . 1 Most of the alpha particles passed straight through the gold foil.

Alpha particles which passed close to the nucleus of a gold atom did **not** pass straight through.

What happened to the alpha particles which passed close to the nucleus of a gold atom?

[1 mark]

0 3 . 2 The results suggested that the diameter of the nucleus of a gold atom is $\frac{1}{6000}$ of the diameter of the atom.

The diameter of a gold atom is 0.18 nm

Calculate the diameter of a gold nucleus in nm

[2 marks]

Diameter = _____ nm

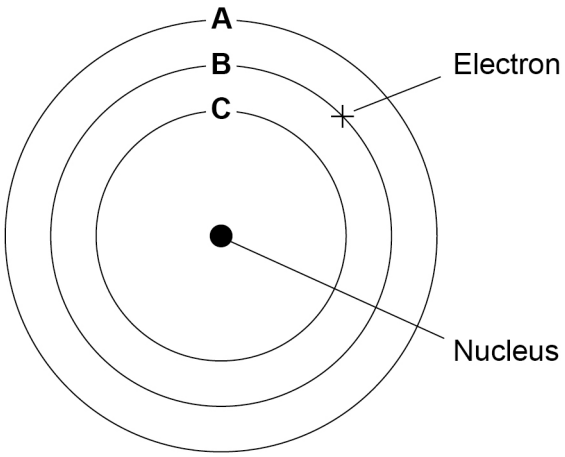
6.3.1.2 Changes of state

Question 03 · continued

0 3 . 3 Further experiments showed that gold nuclei are surrounded by electrons in different energy levels.

Figure 4 shows three of the energy levels around the nucleus of a gold atom.

Figure 4



The electron in energy level **B** absorbs electromagnetic radiation.

Which energy level will the electron be in after it has absorbed the electromagnetic radiation?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐

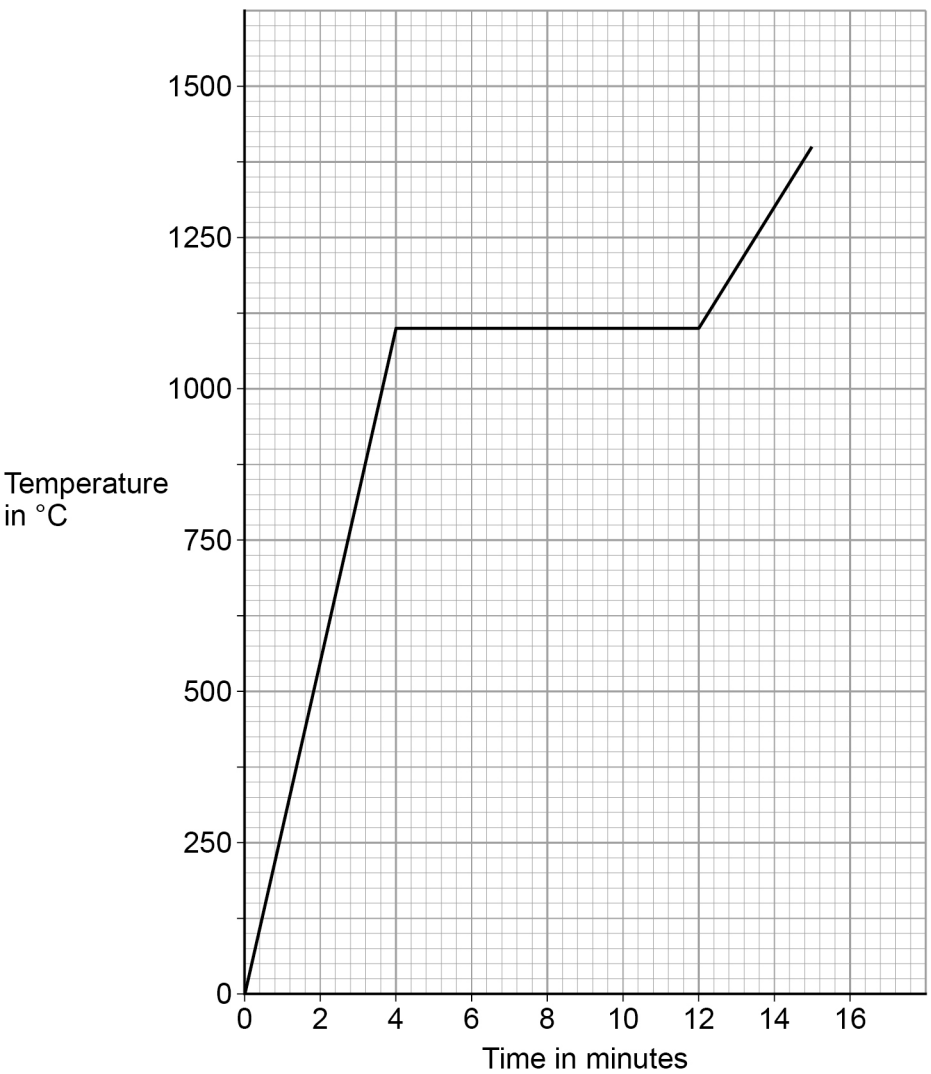
Question 3 continues on the next page

6.3.1.2 Changes of state

Question 03 · continued

Figure 5 shows how the temperature of a small sample of gold changes as it is heated from a solid to a liquid.

Figure 5



0 3 . 4 What is the melting point of the gold?

[1 mark]

Melting point = _____ °C

0 3 . 5 How many minutes did it take for all of the gold in the sample to change from solid to liquid?

[1 mark]

Time taken = _____ minutes

6.3.1.2 Changes of state

Question 03 · continued

0 3 . 6 What does the gradient of the graph in **Figure 5** represent?

[1 mark]

Tick (✓) **one** box.

- The internal energy of the gold ☐
- The rate of change of temperature of the gold ☐
- The specific heat capacity of the gold ☐

7

Turn over for the next question

6.3.1.2 Changes of state

Question 04

June 2019 | 8464/P/1F | Original Q7

0 7 A scientist cooled the air inside a container.

0 7 . 1 The temperature of the air changed from 20 °C to 0 °C

The volume of the container of air stayed the same.

Explain how the motion of the air molecules caused the pressure in the container to change as the temperature decreased.

[3 marks]

0 7 . 2 The air contained water that froze at 0 °C

The change in internal energy of the water as it froze was 0.70 kJ

The specific latent heat of fusion of water is 330 kJ/kg

Calculate the mass of ice produced.

Use the Physics Equations Sheet.

[3 marks]

Mass of ice = _____ kg

6.3.1.2 Changes of state

Question 04 · continued

0 7 . 3 The air also contained oxygen, nitrogen and carbon dioxide.

Oxygen boils at –183 °C and freezes at –218 °C
Nitrogen boils at –195 °C and freezes at –210 °C
Carbon dioxide sublimates at –78 °C

The scientist continued to cool the air to a temperature of –190 °C

What is the state of each substance at –190 °C?

[2 marks]

Tick (✓) **one** box for **each** row of the table.

Substance	Solid	Liquid	Gas
Oxygen			
Nitrogen			
Carbon dioxide			

Question 7 continues on the next page

6.3.1.2 Changes of state

Question 04 · continued

0 7 . 4 The air also contained a small amount of argon.

As the temperature of the air decreased from 20 °C to –190 °C the argon changed from a gas to a liquid to a solid.

Explain the changes in the arrangement and movement of the particles of the argon as the temperature of the air decreased.

[6 marks]

14

6.3.1.2 Changes of state

Question 05

June 2023 | 8464/P/1F | Original Q3

0 3 A piece of steel is heated until it has all melted.

0 3 . 1 Calculate the change in thermal energy when the temperature of the piece of steel is increased by 50 °C.

mass of steel = 4.0 kg

specific heat capacity of steel = 420 J/kg °C

Use the equation:

change in thermal energy = mass × specific heat capacity × temperature change

[2 marks]

Change in thermal energy = _____ J

0 3 . 2 The internal energy of the steel increases as the steel is heated.

What is meant by 'internal energy of the steel'?

[1 mark]

Tick (✓) **one** box.

- The change in energy of the steel particles as the steel melts. ☐
- The energy added to the steel particles as they are heated. ☐
- The total kinetic energy and potential energy of the steel particles. ☐

6.3.1.2 Changes of state

Question 05 · continued

0 3 . 3 Solid steel cannot be poured.

Which statement about the particles in a solid gives the reason why?

[1 mark]

Tick (✓) **one** box.

- The number of particles always stays the same. ☐
- The particles are close together. ☐
- The particles are in fixed positions. ☐
- The particles have a fixed size. ☐

0 3 . 4 Complete the sentence.

Choose the answer from the box.

[1 mark]

decreases	**stays the same**	**increases**

As the piece of solid steel melts, the mass of the steel _____.

Question 3 continues on the next page

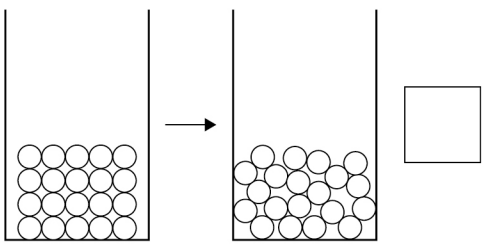
6.3.1.2 Changes of state

Question 05 · continued

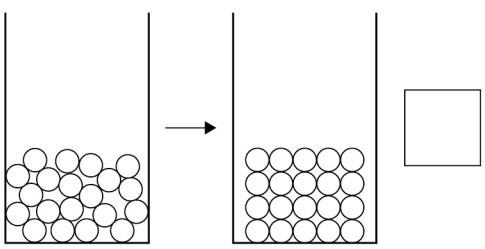
0 3 . 5 Which diagram shows how the arrangement of particles changes when a solid melts and becomes a liquid?

[1 mark]

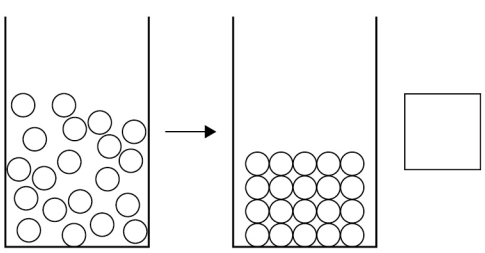
Tick (✓) **one** box.



☐



☐



☐

0 3 . 6 The density of steel decreases as it melts.

How does the spacing of the particles change as the steel melts?

[1 mark]

6.3.1.2 Changes of state

Question 05 · continued

0 3 . 7 Complete the sentence.

Choose the answer from the box.

[1 mark]

chemical	**permanent**	**physical**

Melting is an example of a _____ change.

0 3 . 8 Steel is a mixture of iron and a small amount of carbon.

Table 1 shows the mass of carbon in 1.0 kg of different types of steel.

Table 1

Type of steel	Mass of carbon in 1.0 kg of steel
Low carbon	2.0 g
Medium carbon	4.5 g
High carbon	7.0 g

A 4.0 kg piece of steel contains 18 grams of carbon.

Determine which type of steel the 4.0 kg piece is made from.

You should include a calculation in your answer.

[3 marks]

Type of steel _____

6.3.1.2 Changes of state

Question 05 · continued

0 3 . 9 The 4.0 kg piece of solid steel was heated until it reached its melting point.

The additional energy required to melt the piece of steel was 280 000 J.

Calculate the specific latent heat of fusion of the steel.

Use the Physics Equations Sheet.

[3 marks]

Specific latent heat of fusion of steel = _____ J/kg

14

6.3.1.2 Changes of state

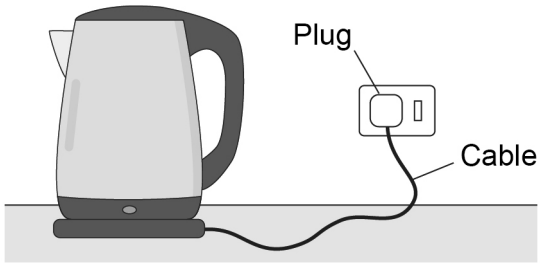
Question 06

June 2025 | 8464/P/1F | Original Q4

0 4 **Figure 5** shows a plastic kettle.

The kettle is connected to the mains electricity supply.

Figure 5



0 4 . 1 What is the frequency of the UK mains electricity supply?

[1 mark]

Tick (✓) **one** box.

25 Hz ☐

50 Hz ☐

75 Hz ☐

100 Hz ☐

Question 4 continues on the next page

6.3.1.2 Changes of state

Question 06 · continued

0 4 . 2 The cable that connects the kettle to the plug contains two insulated wires.

Draw **one** line from each wire to the colour of the insulation on the wire.

[2 marks]

Wire	Colour of insulation
Live	Blue
Neutral	Brown
	Green and yellow stripes

Use the Physics Equations Sheet to answer questions **04.3** and **04.4**.

0 4 . 3 Write down the equation that links current (I), potential difference (V) and power (P).

[1 mark]

6.3.1.2 Changes of state

Question 06 · continued

0 4 . 4 The power of the heating element in the kettle is 2100 W.

The potential difference across the heating element is 230 V.

Calculate the current in the heating element.

Give your answer to 2 significant figures.

[4 marks]

Current (2 significant figures) = _____ A

0 4 . 5 The kettle is designed to switch off when the water reaches boiling point.

Before the kettle switches off, 0.0080 kg of water changes state.

The energy transferred to change the state of the water is 18 000 J.

Calculate the specific latent heat of vaporisation of the water.

Use the Physics Equations Sheet.

[3 marks]

Specific latent heat of vaporisation = _____ J/kg

0 4 . 6 A different kettle is used to heat some water.

The useful output energy transferred to the water is 75 600 J.

The total input energy transferred by the kettle is 84 000 J.

Calculate the efficiency of the kettle.

Use the equation:

$$\text{efficiency} = \frac{\text{useful output energy transfer}}{\text{total input energy transfer}}$$

[2 marks]

Efficiency = _____

0 4 . 7 Explain **one** advantage of electrical appliances having a high efficiency.

[2 marks]

15