AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 6.2.3.2

Mains electricity

Past-paper questions

Tier	**Higher**
Question groups	**8**
Available paper years	**2019–2025**

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.

6.2.3.2 Mains electricity

Question 01

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

0 3 A hybrid car has an electric motor and a petrol engine.

0 3 . 1 Petrol is a non-renewable energy resource.

What is meant by a non-renewable energy resource?

[1 mark]

0 3 . 2 The electric motor in the car is powered by a battery.

To charge the battery, the car is plugged into the mains supply at 230 V

The power used to charge the battery is 6.9 kW

Calculate the current used to charge the battery.

[4 marks]

Current = _____ A

0 3 . 3 Mains electricity is an ac supply.

Explain the difference between direct and alternating potential difference.

[2 marks]

6.2.3.2 Mains electricity

Question 01 · continued

0 3 . 4 The cable used to connect the car to the mains electricity supply has a low resistance.

Explain why it is better to use a cable with a low resistance than to use a cable with a high resistance.

[2 marks]

9

6.2.3.2 Mains electricity

Question 02

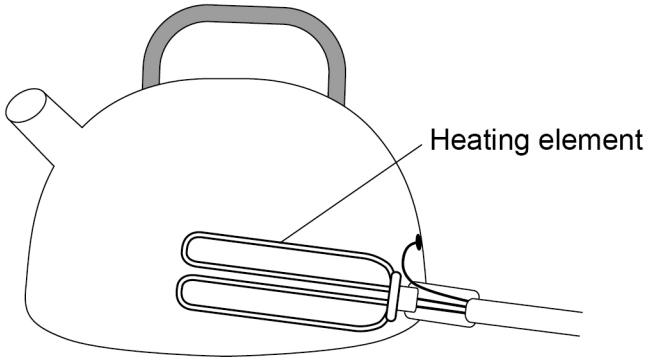
June 2019 | 8464/P/1H | Original Q5

0 5 A student investigated how the mass of water in an electric kettle affected the time taken for the water to reach boiling point.

The kettle switched off when the water reached boiling point.

Figure 4 shows the kettle.

Figure 4



0 5 . 1 The heating element of the kettle was connected to the mains supply.

Explain why the temperature of the heating element increased.

[2 marks]

0 5 . 2 Give **one** variable that the student should have controlled.

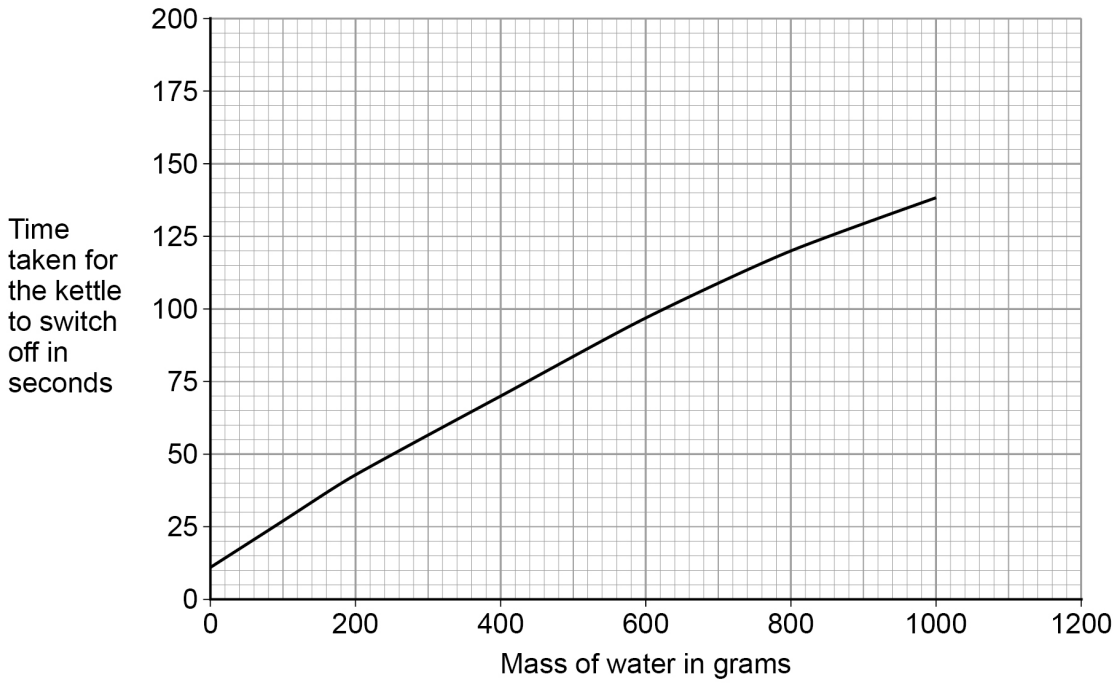
[1 mark]

6.2.3.2 Mains electricity

Question 02 · continued

Figure 5 shows how the mass of water in the kettle affected the time taken for the kettle to switch off.

Figure 5



0 5 . 3 Suggest why the line on **Figure 5** does **not** go through the origin.

[1 mark]

0 5 . 4 Suggest why the results give a non-linear pattern.

[1 mark]

Question 5 continues on the next page

6.2.3.2 Mains electricity

Question 02 · continued

0 5 . 5 The power of the kettle was 2.6 kW

The kettle took 120 seconds to heat 0.80 kg of water from 18 °C to 100 °C

Calculate the specific heat capacity of water using this information.

Give your answer to 2 significant figures.

[6 marks]

Specific heat capacity = _____ J/kg °C

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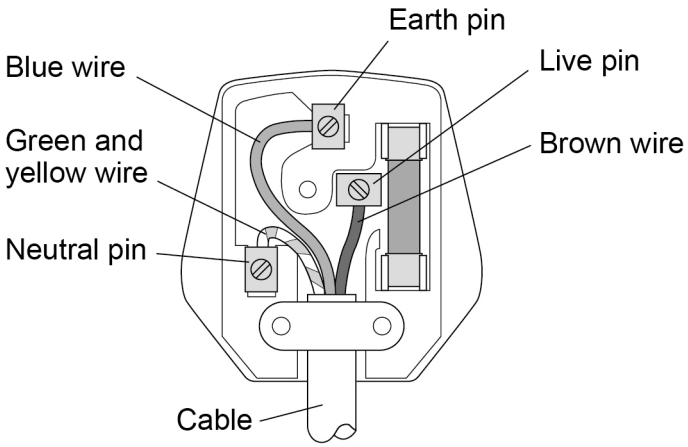
6.2.3.2 Mains electricity

Question 03

November 2020 | 8464/P/1H | Original Q1

0 1 **Figure 1** shows the inside of a plug.

Figure 1



0 1 . 1 The plug is **not** wired correctly.

What should be done to connect the wires in the plug correctly?

[1 mark]

Question 03 · continued

The correctly wired plug and cable connects a washing machine to the mains electricity supply.

0 1 . 2 Give the potential difference and frequency of the mains electricity supply in the UK.

[2 marks]

The potential difference is _____ V

The frequency is _____ Hz

0 1 . 3 The washing machine is switched on.

What is the potential difference between the neutral wire and the earth wire?

[1 mark]

Potential difference = _____ V

0 1 . 4 The plug has a fuse.

Draw the circuit symbol for a fuse in the space below.

[1 mark]

Question 1 continues on the next page

Question 03 · continued

The washing machine has a metal case.

A fault causes the live wire to make an electrical connection with the metal case of the washing machine.

0 1 . 5 The earth wire is **not** connected to the metal case of the washing machine.

Explain why it would not be safe for a person to touch the metal case.

[2 marks]

0 1 . 6 The earth wire is now connected to the metal case of the washing machine.

Explain why it would now be safe for a person to touch the metal case, even if the live wire touches the metal case.

[2 marks]

9

6.2.3.2 Mains electricity

Question 04

0 1 **Figure 1** shows a mobile phone with its battery removed.

Figure 1



A student measured the potential difference across the battery and then put the battery into the phone.

0 1 . 1 What is the equation linking current (I), potential difference (V) and resistance (R)?

[1 mark]

Tick (✓) **one** box.

$I = V R$ ☐

$R = I V$ ☐

$V = I R$ ☐

$V = I^2 R$ ☐

Question 1 continues on the next page

6.2.3.2 Mains electricity

Question 04 · continued

0 1 . 2 The current in the electronic circuit in the mobile phone was 0.12 A.

The potential difference across the battery was 3.9 V.

Calculate the resistance of the electronic circuit in the mobile phone.

[3 marks]

Resistance = _____ Ω

6.2.3.2 Mains electricity

Question 04 · continued

0 1 . 3 Write down the equation which links energy (E), power (P) and time (t).

[1 mark]

0 1 . 4 The battery was fully charged when it was put into the mobile phone.

The battery discharged when the mobile phone was switched on.

The average power output of the battery as it discharged was 0.46 watts.

The time taken to fully discharge the battery was 2500 minutes.

Calculate the energy transferred by the battery.

[3 marks]

Energy transferred = _____ J

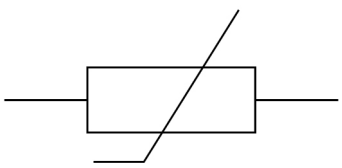
Question 1 continues on the next page

Question 04 · continued

The mobile phone includes a sensor to monitor the temperature of the battery.

Figure 2 shows the circuit symbol for a component used in the sensor.

Figure 2



0 1 . 5 What component does the circuit symbol shown in **Figure 2** represent?

[1 mark]

0 1 . 6 The temperature of the component in **Figure 2** increases.

The potential difference across the component remains constant.

Explain what happens to the current in the component.

[2 marks]

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6.2.3.2 Mains electricity

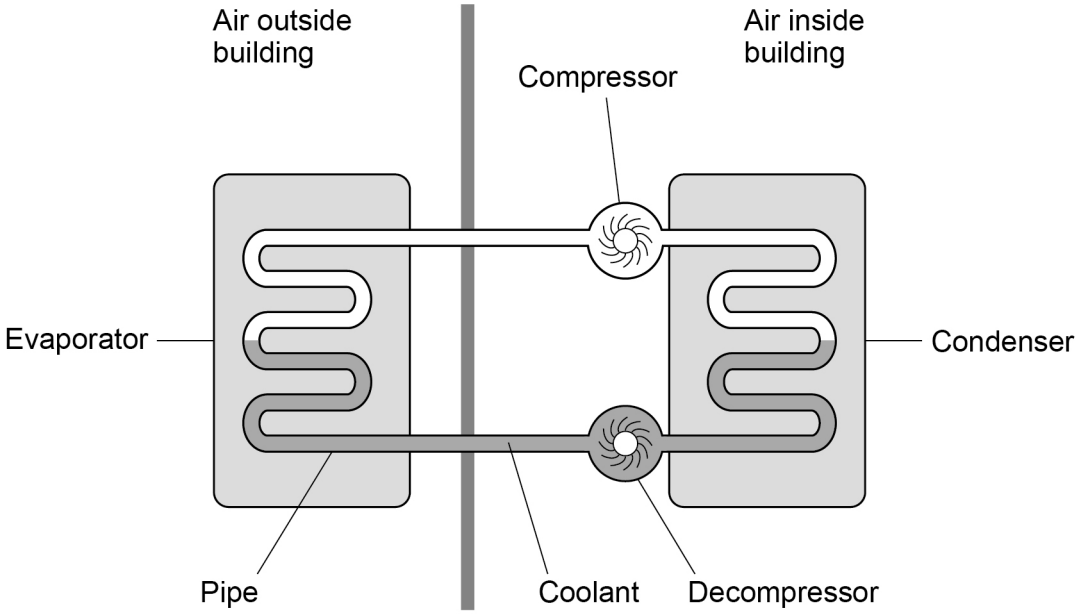
Question 05

November 2021 | 8464/P/1H | Original Q6

0 6 An air source heat pump transfers energy from the air outside a building to increase the temperature of the air inside the building.

Figure 13 shows an air source heat pump.

Figure 13



The compressor is connected to the mains electricity supply.

The pipe in the heat pump contains a substance called coolant.

In the evaporator, energy is transferred from the air outside the building to the liquid coolant.

The temperature of the coolant increases and it evaporates.

0 6 . 1 Explain what happens to the internal energy of the coolant as its temperature increases.

[2 marks]

6.2.3.2 Mains electricity

Question 05 · continued

0 6 . 2 What name is given to the energy needed to change the state of the liquid coolant?

[1 mark]

0 6 . 3 What happens to the mass of the coolant as it evaporates and becomes a vapour?

[1 mark]

Tick (✓) **one** box.

- Decreases ☐
- Stays the same ☐
- Increases ☐

0 6 . 4 The compressor increases the density and temperature of the coolant vapour inside the pipe.

Explain why the pressure in the pipe increases.

[2 marks]

Question 6 continues on the next page

6.2.3.2 Mains electricity

Question 05 · continued

0 6 . 5 The condenser transfers energy from the coolant to the air in the building.

When the total energy input to the heat pump system is 1560 kJ the temperature of the air in the building increases from 11.6 °C to 22.1 °C.

The efficiency of the heat pump system is 87.5%.

The mass of the air inside the building is 125 kg.

Calculate the specific heat capacity of the air in the building.

Give your answer in standard form.

[6 marks]

Specific heat capacity (standard form) = _____ J/kg °C

6.2.3.2 Mains electricity

Question 05 · continued

0 6 . 6 The air in the building gains 400 J for every 100 J of energy transferred from the mains electricity supply to the compressor.

An advertisement claims that the heat pump system has an efficiency of 400%.

Explain why the advertisement is **not** correct.

[3 marks]

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6.2.3.2 Mains electricity

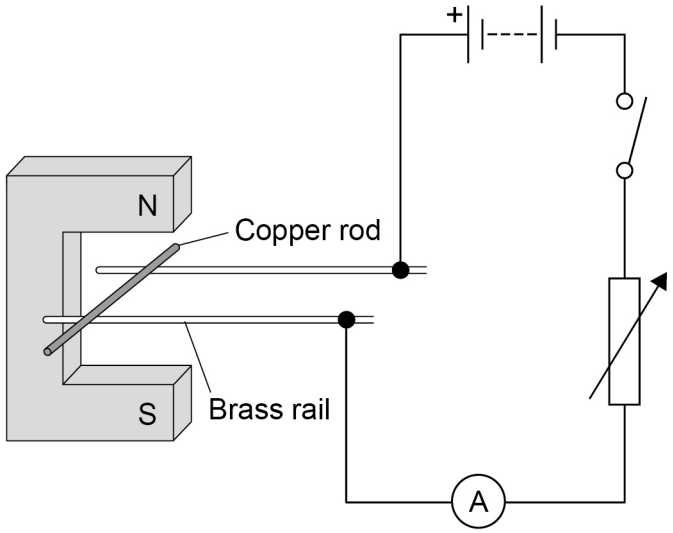
Question 06

June 2023 | 8464/P/2H | Original Q4

0 4 A teacher demonstrated the motor effect.

Figure 5 shows the equipment used. The equipment includes a permanent magnet.

Figure 5



0 4 . 1 The copper rod remains stationary while the switch is open.

Complete the sentence.

[1 mark]

The tendency for an object to remain stationary is

called _____ .

6.2.3.2 Mains electricity

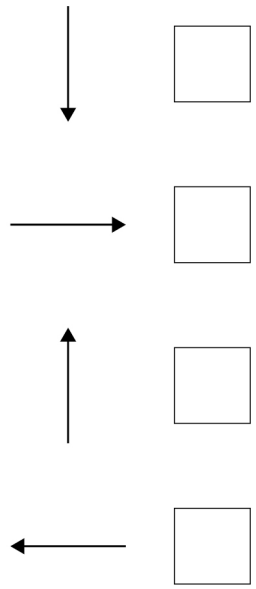
Question 06 · continued

When the switch is closed the copper rod accelerates.

0 4 . 2 In which direction will the copper rod accelerate?

[1 mark]

Tick (✓) **one** box.



0 4 . 3 Explain **one** way the teacher could increase the acceleration of the copper rod.

[2 marks]

Question 4 continues on the next page

6.2.3.2 Mains electricity

Question 06 · continued

0 4 . 4 The magnet used in the demonstration was a permanent magnet.

Figure 6 shows an iron bar and a permanent magnet.

Figure 6



Iron bar

Permanent magnet

Describe how the permanent magnet could be used to test if the iron bar is also a permanent magnet.

[2 marks]

6.2.3.2 Mains electricity

Question 06 · continued

0 4 . 5 **Figure 7** shows a magnetic compass used by walkers.

Figure 7



Explain how a magnetic compass provides evidence that the Earth has a magnetic field.

[2 marks]

8

6.2.3.2 Mains electricity

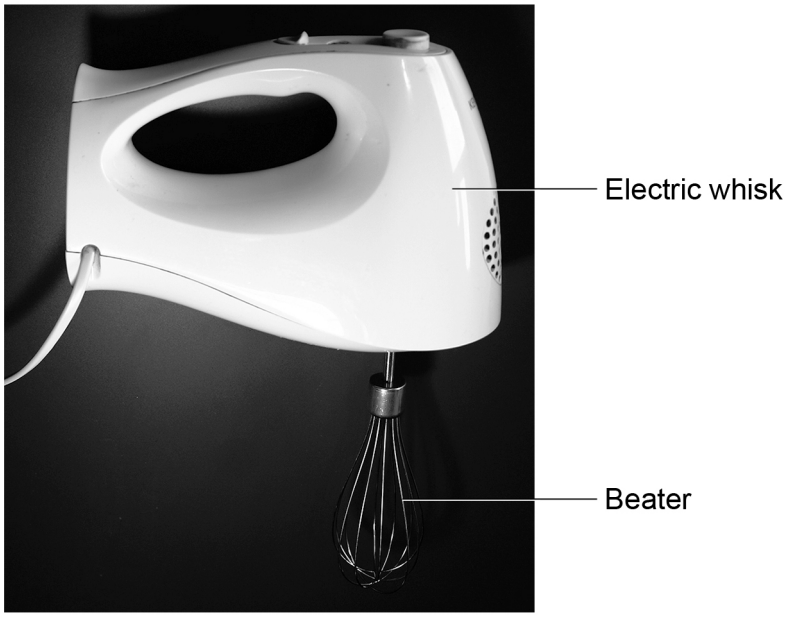
Question 07

June 2024 | 8464/P/1H | Original Q1

0 1 **Figure 1** shows an electric whisk that plugs into the mains electricity supply.

The whisk can mix food by spinning a beater.

Figure 1



0 1 . 1 Give **two** energy stores that increase when the whisk is switched on.

[2 marks]

1 _____

_____

2 _____

_____

6.2.3.2 Mains electricity

Question 07 · continued

Use the Physics Equations Sheet to answer questions **01.2** and **01.3**.

0 1 . 2 Work is done by the whisk when it is used to mix food.

Write down the equation that links power (P), time (t) and work done (W).

[1 mark]

0 1 . 3 The power output of the whisk is 92 W.

Calculate the time for the whisk to do 23 000 J of work.

[3 marks]

Time = _____ s

Question 1 continues on the next page

6.2.3.2 Mains electricity

Question 07 · continued

Use the Physics Equations Sheet to answer questions **01.4** and **01.5**.

0 1 . 4 Which equation links current (I), power (P) and resistance (R)?

[1 mark]

Tick (✓) **one** box.

$P = \frac{I}{R^2}$ ☐

$P = I R^2$ ☐

$P = \frac{I^2}{R}$ ☐

$P = I^2 R$ ☐

0 1 . 5 The current in the whisk is 500 mA.

The resistance of the whisk is 640 Ω.

Calculate the power of the whisk.

[3 marks]

Power = _____ W

6.2.3.2 Mains electricity

Question 07 · continued

The whisk has several settings that allow the beater to spin at different speeds.

A faster beater speed needs a greater power input from the mains electricity supply.

0 1 . 6 What is the potential difference between the live wire and neutral wire in the mains electricity supply?

[1 mark]

_____ V

0 1 . 7 Changing the beater speed does **not** change the potential difference between the live wire and neutral wire.

The power input to the whisk changes because the current in the whisk changes.

Complete the sentence.

[1 mark]

When the beater speed increases, the current in the whisk increases because the resistance of the whisk _____.

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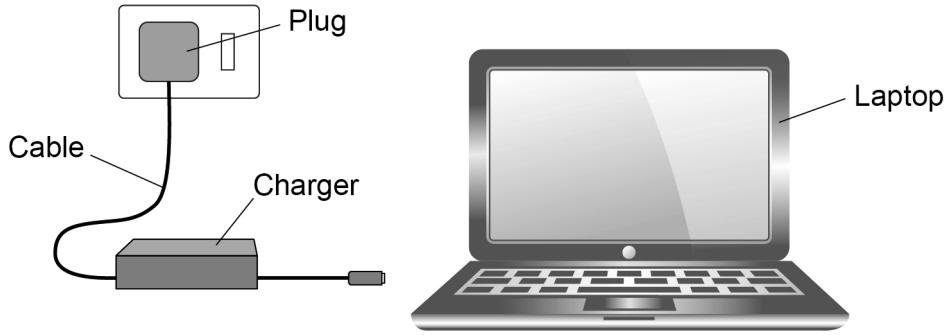
6.2.3.2 Mains electricity

Question 08

June 2025 | 8464/P/1H | Original Q5

0 5 **Figure 5** shows a laptop computer, and a charger plugged into the mains supply.

Figure 5



0 5 . 1 Give the potential difference and frequency of the UK mains electricity supply.

[2 marks]

Potential difference _____ V

Frequency _____ Hz

0 5 . 2 The cable that connects the charger to the plug contains **two** wires that have coloured insulation.

The cable does **not** contain an earth wire.

Name each wire in the cable.

Give the colour of the insulation covering each wire.

[2 marks]

Name of wire _____ Colour of insulation _____

Name of wire _____ Colour of insulation _____

6.2.3.2 Mains electricity

Question 08 · continued

0 5 . 3 The input to the charger is an alternating potential difference.

The output from the charger is a direct potential difference.

Describe the difference between an alternating potential difference and a direct potential difference.

[2 marks]

Question 5 continues on the next page

6.2.3.2 Mains electricity

Question 08 · continued

A student is using the laptop computer.

The student notices that the battery has no stored energy.

The student quickly plugs the charger into the laptop and continues to use the laptop.

0 5 . 4 The laptop charger provides a constant power to the laptop.

The laptop takes longer to charge when the student uses the laptop than when the laptop is not used.

Explain why.

[2 marks]

6.2.3.2 Mains electricity

Question 08 · continued

0 5 . 5 The potential difference across the laptop circuit is 15 V.

The average current in the laptop circuit when it is being used is 4.8 A.

The laptop charger provides a constant power of 97 W.

The maximum energy that the battery can store is 225 kJ.

Calculate the time taken to fully charge the battery from zero when the laptop is used continuously.

Use the Physics Equations Sheet.

Give your answer in hours.

[6 marks]

Time = _____ hours

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