AQA GCSE Physics | 8463

SPECIFICATION POINT 4.2.2

Series and parallel circuits

Past-paper questions

Tier	**Higher**
Question groups	**9**
Available paper years	**2003–2021**

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:** _____

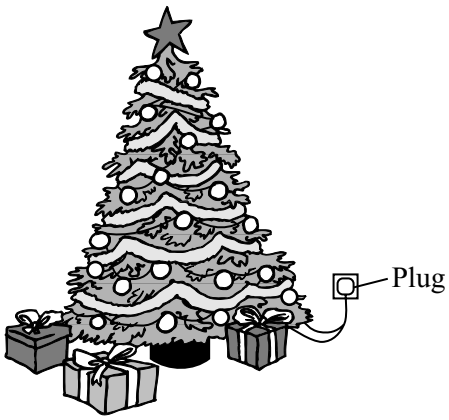
Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.2.2 Series and parallel circuits

Question 01

June 2003 | 3451H | Original Q8 | Legacy

8 A set of Christmas tree lights is made from twenty identical lamps connected in series.



(a) Each lamp is designed to take a current of 0.25 A. The set plugs directly into the 230 V mains electricity supply.

(i) Write down the equation that links current, potential difference and resistance.

.....

(1 mark)

(ii) Calculate the resistance of **one** of the lamps. Show clearly how you work out your final answer and give the unit.

.....

.....

.....

.....

Resistance = ...

(4 marks)

(iii) What is the total resistance of the set of lights?

.....

Total resistance = ...

(1 mark)

(b) How does the resistance of a filament lamp change as the temperature of the filament changes?

.....

.....

(1 mark)

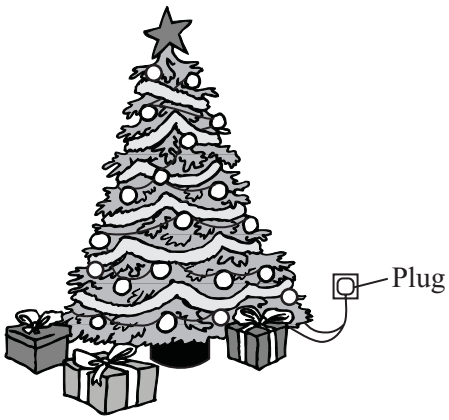
7

4.2.2 Series and parallel circuits

Question 02

June 2003 | 3462H3 | Original Q6 | Legacy

6 A set of Christmas tree lights is made from twenty identical lamps connected in series.



(a) Each lamp is designed to take a current of 0.25 A. The set plugs directly into the 230 V mains electricity supply.

(i) Write down the equation that links current, potential difference and resistance.

.....

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(ii) Calculate the resistance of **one** of the lamps. Show clearly how you work out your final answer and give the unit.

.....

.....

.....

.....

Resistance = ...

(4 marks)

(iii) What is the total resistance of the set of lights?

.....

Total resistance = ...

(1 mark)

(b) How does the resistance of a filament lamp change as the temperature of the filament changes?

.....

.....

(1 mark)

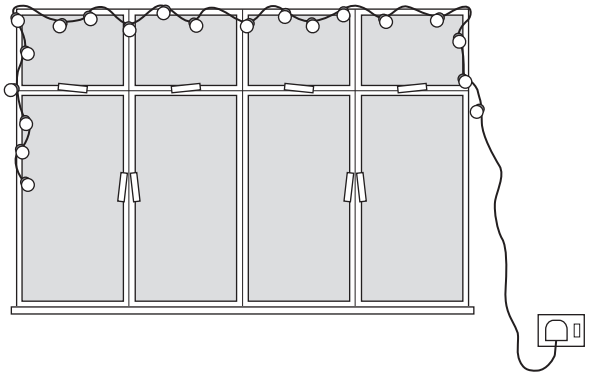
7

4.2.2 Series and parallel circuits

Question 03

January 2011 | PHY2H | Original Q6 | Legacy

6 A set of lights consists of 20 lamps connected in series to the 230 V mains electricity supply.



6 (a) When the lights are switched on and working correctly, the current through each lamp is 0.25 A.

6 (a) (i) What is the total current drawn from the mains supply?

.....

(1 mark)

6 (a) (ii) Use the equation in the box to calculate the charge passing through **one** of the lamps in 5 minutes.

charge = current × time

Show clearly how you work out your answer and give the unit.

.....

.....

.....

.....

Total charge = ...

(3 marks)

4.2.2 Series and parallel circuits

Question 03 · continued

6 (b) One of the lamps in the set is a fuse lamp. This contains a filament which melts if a fault occurs. A short time after the lights are switched on, a fault causes the filament inside the fuse lamp to melt and all the lamps go out.

The householder cannot find another fuse lamp so connects a piece of aluminium foil across the contacts inside the fuse lamp holder.
When switched on, the nineteen remaining lamps work.
What the householder has done is dangerous.

Explain why.

.....

.....

.....

.....

(2 marks)

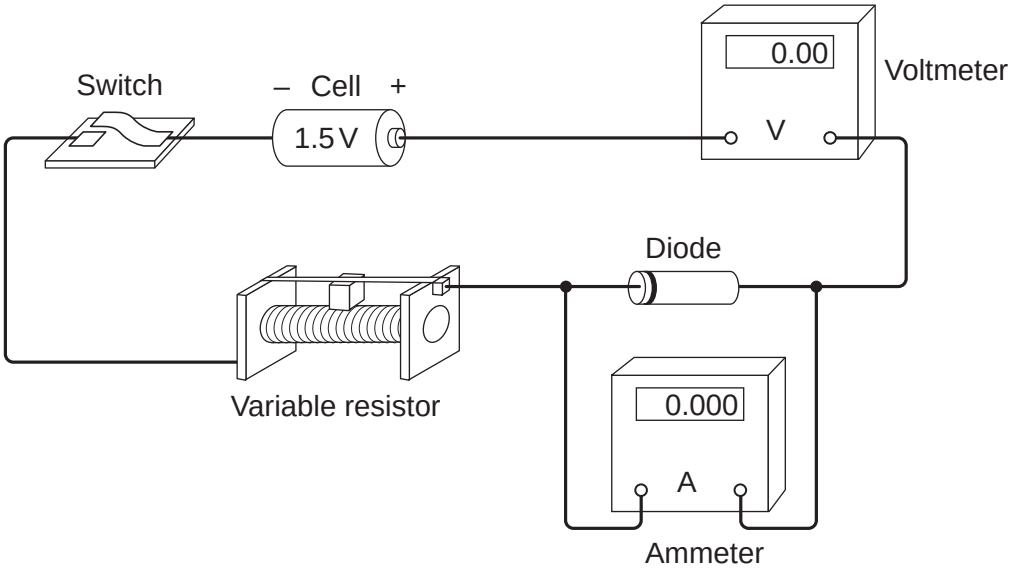
6

Turn over for the next question

4.2.2 Series and parallel circuits

Question 04

4 (a) A student set up the circuit shown in the diagram. The student uses the circuit to obtain the data needed to plot a current - potential difference graph for a diode.



4 (a) (i) Draw, in the boxes, the circuit symbol for a diode and the circuit symbol for a variable resistor.

Diode	**Variable resistor**

(2 marks)

4 (a) (ii) The student made two mistakes when setting up the circuit.

What **two** mistakes did the student make?

1 .....

.....

2 .....

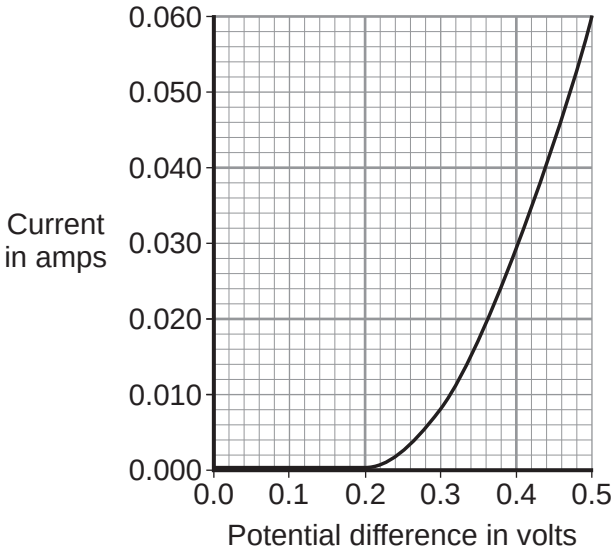
.....

(2 marks)

4.2.2 Series and parallel circuits

Question 04 · continued

4 (b) After correcting the circuit, the student obtained a set of data and plotted the graph below.



4 (b) (i) At what potential difference did the diode start to conduct an electric current?

..... V
(1 mark)

4 (b) (ii) Use data from the graph to calculate the resistance of the diode when the potential difference across the diode is 0.3 V.

Use the correct equation from the Physics Equations Sheet.

.....

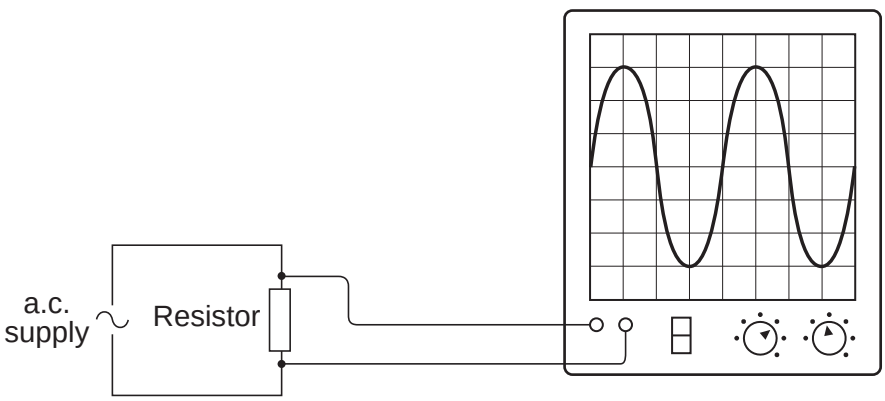
.....

.....

Resistance = ... ohms
(3 marks)

Question 4 continues on the next page

4 (c) The diagram shows the trace produced by an alternating current (a.c.) supply on an oscilloscope.



Each horizontal division on the oscilloscope screen represents a time of 0.01s.

4 (c) (i) Calculate the frequency of the a.c. supply.

.....

.....

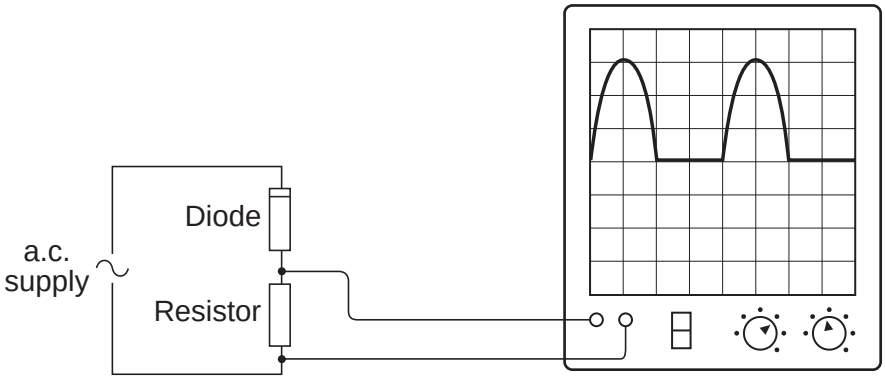
.....

Frequency = ... hertz
(2 marks)

4.2.2 Series and parallel circuits

Question 04 · continued

4 (c) (ii) A diode is now connected in series with the a.c. power supply.



Why does the diode cause the trace on the oscilloscope screen to change?

.....

.....

.....

.....

(2 marks)

12

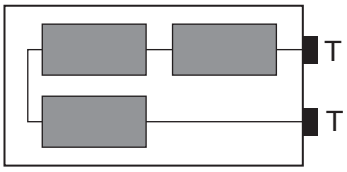
4.2.2 Series and parallel circuits

Question 05

June 2016 | PH2HP | Original Q3 | Legacy

3 (a) **Figure 5** shows the inside of a battery pack designed to hold three identical 1.5 V cells.

Figure 5

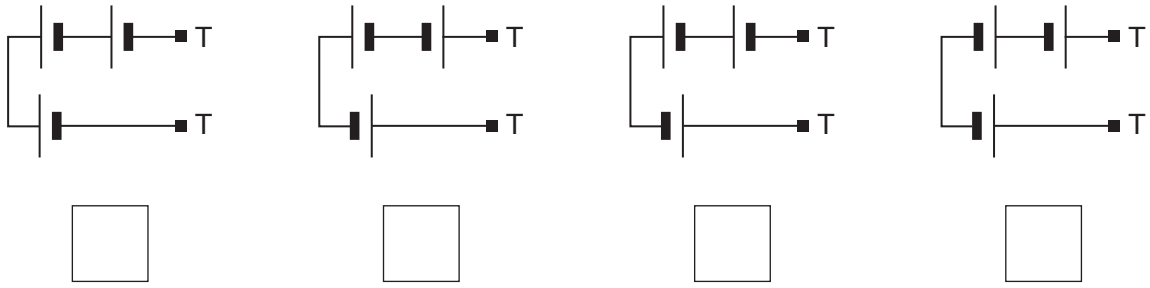


Which **one** of the arrangements shown in **Figure 6** would give a 4.5 V output across the battery pack terminals **T**?

[1 mark]

Tick (✓) **one** box.

Figure 6

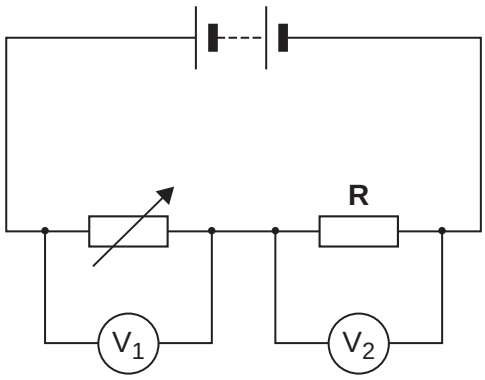


4.2.2 Series and parallel circuits

Question 05 · continued

3 (b) **Figure 7** shows a variable resistor and a fixed value resistor connected in series in a circuit.

Figure 7



Complete **Figure 7** to show how an ammeter would be connected to measure the current through the circuit.
Use the correct circuit symbol for an ammeter.

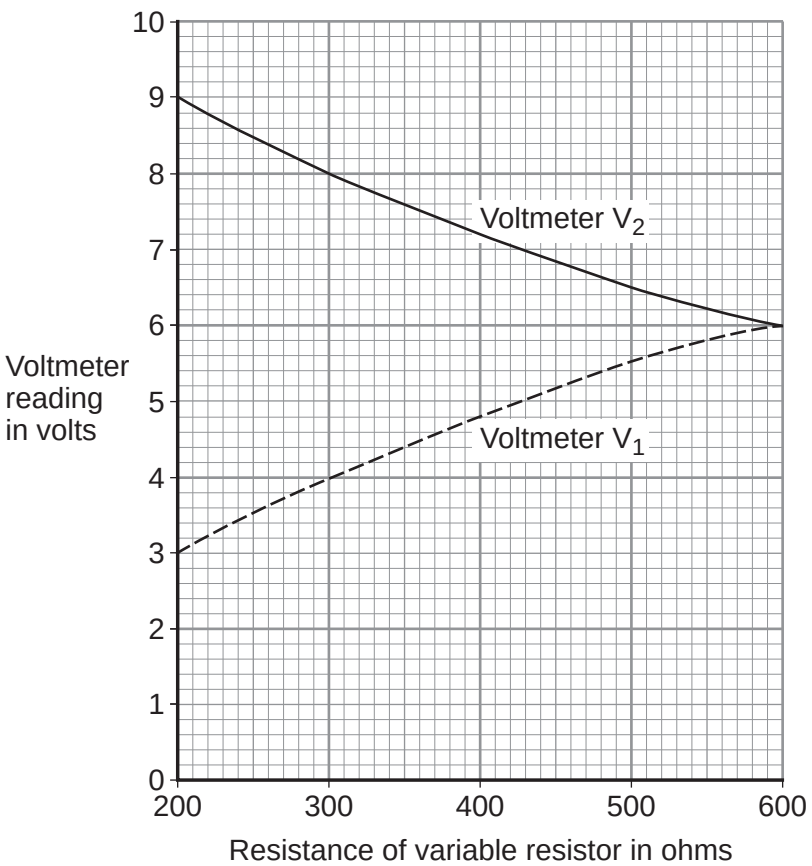
[1 mark]

Question 3 continues on the next page

3 (c) The variable resistor can be adjusted to have any value from 200 ohms to 600 ohms.

Figure 8 shows how the reading on voltmeter $\mathbf{V_1}$ and the reading on voltmeter $\mathbf{V_2}$ change as the resistance of the variable resistor changes.

Figure 8



3 (c) (i) How could the potential difference of the battery be calculated from **Figure 8**?

[2 marks]

Tick (✓) **one** box.

9 + 3 = 12 V ☐

9 – 3 = 6 V ☐

9 ÷ 3 = 3 V ☐

Give the reason for your answer.

_____

_____

4.2.2 Series and parallel circuits

Question 05 · continued

3 (c) (ii) Use **Figure 8** to determine the resistance of the fixed resistor, **R**.

[2 marks]

Resistance of **R** = _____ Ω

Give the reason for your answer.

_____

_____

3 (c) (iii) Calculate the current through the circuit when the resistance of the variable resistor equals 200 Ω.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

_____

_____

_____

Current = _____ A

9

4.2.2 Series and parallel circuits

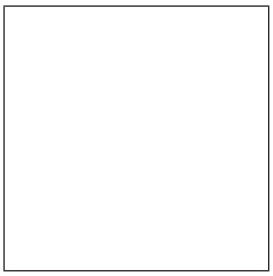
Question 06

June 2017 | PH2HP | Original Q5 | Legacy

5 The lighting in a home may be provided by LED bulbs, filament bulbs or halogen bulbs.

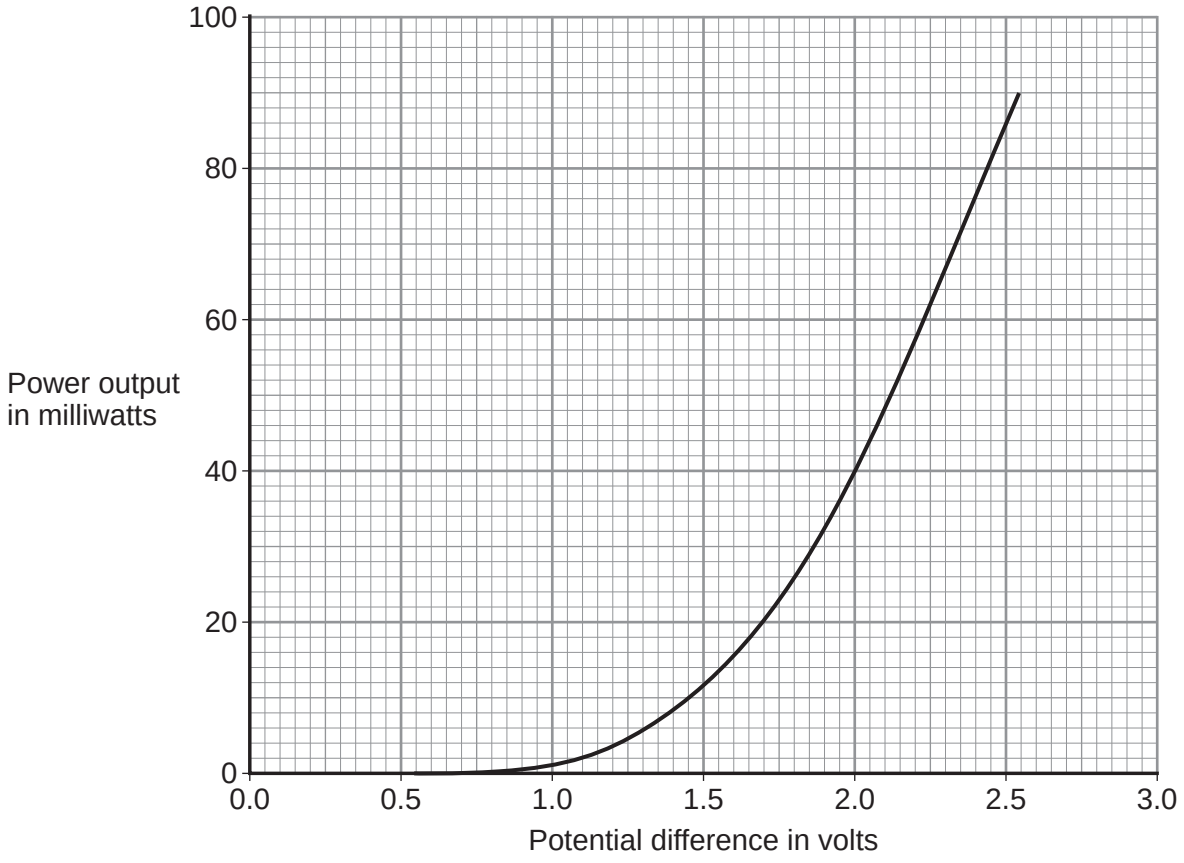
5 (a) (i) In the box below, draw the circuit symbol for an LED.

[1 mark]



5 (a) (ii) **Figure 6** shows how the power output from one type of LED varies with the potential difference across the LED.

Figure 6



1 milliwatt = 0.001 W

4.2.2 Series and parallel circuits

Question 06 · continued

The LED is connected in series with a battery and resistor.
The potential difference across the LED is 2.0 V

Use data from **Figure 6** to calculate the energy transferred by the LED in 5 minutes.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

Energy transferred = _____ J

5 (b) The resistance of a filament bulb increases as the temperature of the filament increases.

Explain, in terms of the electrons and ions inside the filament, why the resistance increases.

[2 marks]

5 (c) Why are LED bulbs cheaper to use than filament bulbs or halogen bulbs that produce the same brightness of light?

[1 mark]

7

4.2.2 Series and parallel circuits

Question 07

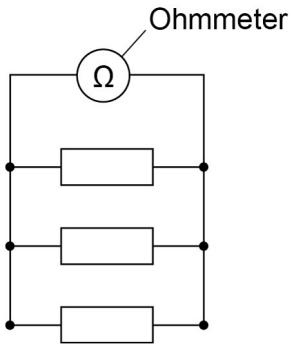
November 2020 | 8463/1H | Original Q8

0 8 A student investigated how the total resistance of identical resistors connected in parallel varied with the number of resistors.

The student used an ohmmeter to measure the total resistance of the resistors.

Figure 11 shows the student's circuit with 3 resistors.

Figure 11



The student repeated each reading of resistance three times.

Table 1 shows some of the results for 3 resistors in parallel.

Table 1

Number of resistors	Total resistance in ohms			
	Reading 1	Reading 2	Reading 3	Mean
3	15.8	15.3	**X**	15.7

0 8 . 1 Calculate value **X** in **Table 1**.

[2 marks]

X = _____ Ω

4.2.2 Series and parallel circuits

Question 07 · continued

0 8 . 2 The student thought that taking a fourth reading would improve the precision of the results.

The fourth reading was 16.2 Ω.

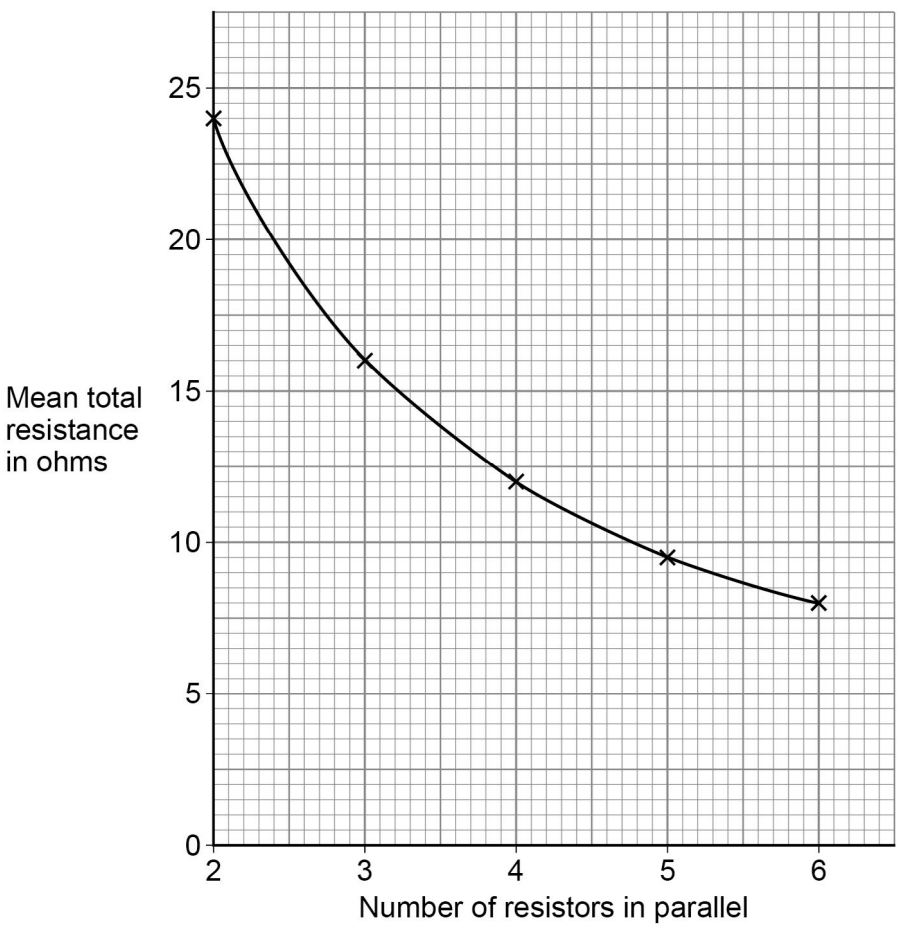
Explain why the student was wrong.

[2 marks]

Question 8 continues on the next page

Figure 12 shows the results from the investigation.

Figure 12



0 8 . 3 The student concluded that the number of resistors in parallel was inversely proportional to the mean total resistance.

Explain why the student was correct.

Use data from **Figure 12** in your answer.

[3 marks]

4.2.2 Series and parallel circuits

Question 07 · continued

0 8 . 4 Explain why adding resistors in parallel decreases the total resistance.

[2 marks]

9

Turn over for the next question

4.2.2 Series and parallel circuits

Question 08

0 7 A student investigated how the current in a series circuit varied with the resistance of a variable resistor.

Figure 8 shows the circuit used.

Figure 8

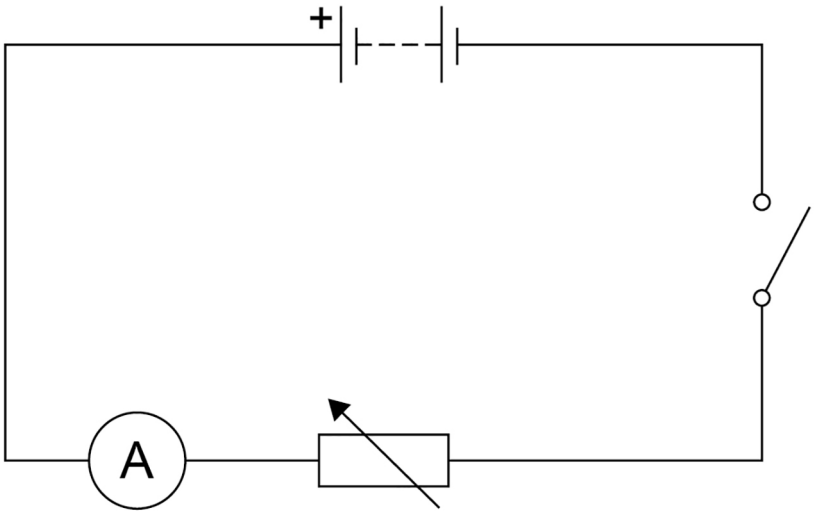
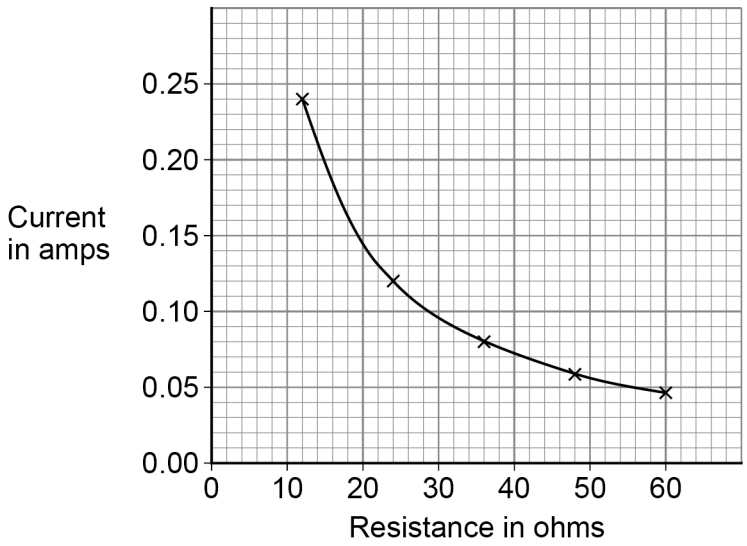


Figure 9 shows the results.

Figure 9



Question 08 · continued

0 7 . 1 The battery had a power output of 230 mW when the resistance of the variable resistor was 36 Ω.

Determine the potential difference across the battery.

[4 marks]

Potential difference = _____ V

0 7 . 2 The student concluded:

'the current in the circuit was inversely proportional to the resistance of the variable resistor.'

Explain how **Figure 9** shows that the student is correct.

[2 marks]

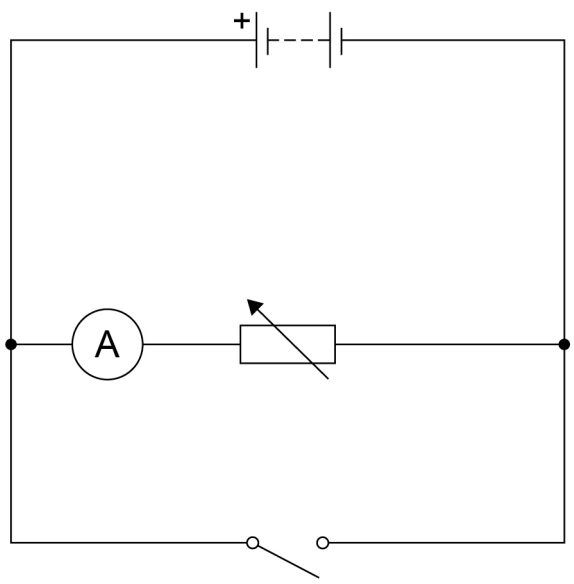
Question 7 continues on the next page

4.2.2 Series and parallel circuits

Question 08 · continued

0 7 . 3 **Figure 10** shows a circuit with a switch connected incorrectly.

Figure 10



Explain how closing the switch would affect the current in the variable resistor.

[2 marks]

8

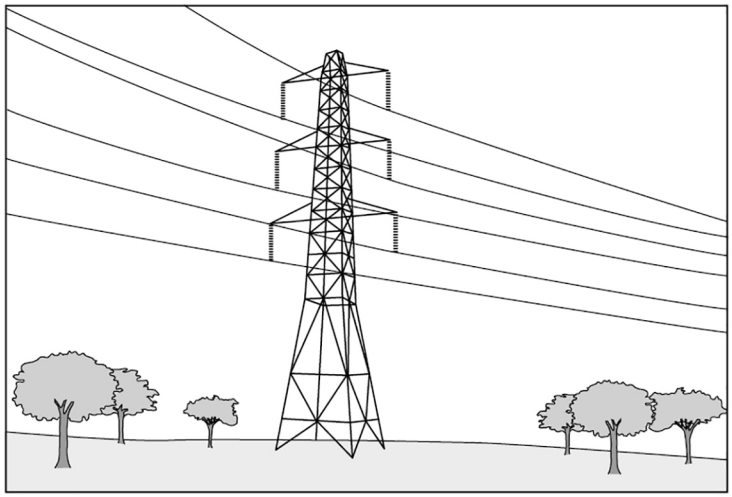
4.2.2 Series and parallel circuits

Question 09

November 2021 | 8463/1H | Original Q10

1 0 **Figure 13** shows some overhead power cables in the National Grid.

Figure 13



1 0 . 1 Explain the advantage of transmitting electricity at a very high potential difference.

[3 marks]

10.2 It is dangerous for a person to fly a kite near an overhead power cable.

Figure 14 shows a person flying a kite.

Figure 14



The person could receive a fatal electric shock if the kite was very close to, but not touching the power cable.

Explain why.

[3 marks]

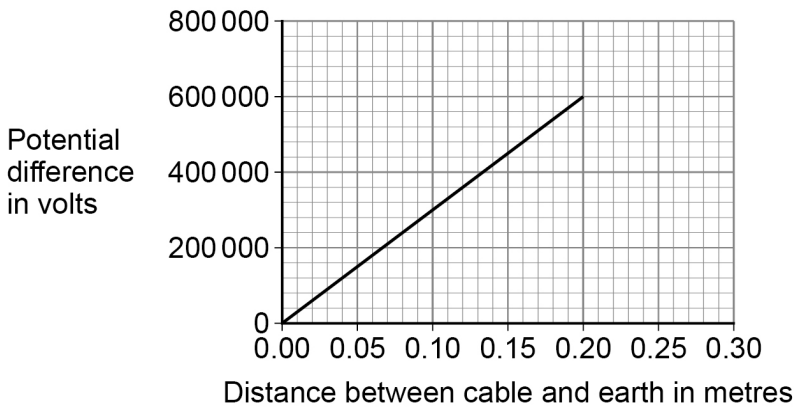
Question 10 continues on the next page

Question 09 · continued

A scientist investigated how the potential difference needed for air to conduct charge varies with the distance between a cable and earth.

Figure 15 shows the results.

Figure 15



1 0 . 3 The data in **Figure 15** gives the relationship between potential difference and distance when the air is dry.

When the humidity of air increases the air becomes a better conductor of electricity.

Draw a line on **Figure 15** to show how the potential difference changes with distance if the humidity of the air increases.

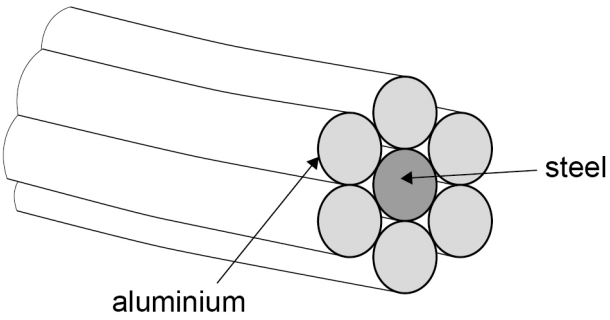
[2 marks]

4.2.2 Series and parallel circuits

Question 09 · continued

1 0 . 4 **Figure 16** shows a cross-section through a power cable.

Figure 16



A 1 metre length of a single aluminium wire is a better conductor than a 1 metre length of the steel wire.

The individual wires behave as if they are resistors connected in parallel.

Explain why the current in the steel wire is different to the current in a single aluminium wire.

[2 marks]

10