Exercise walk-through

2.2
Current, resistance and potential difference (4.2.1.3, RP3)

AQA · GCSE · Physics

Circuit symbols, charge and current

- Circuit diagrams use standard **circuit symbols** .
- Learn the symbols for a cell, battery, open and closed switch, lamp, fuse, resistor, variable resistor, ammeter, voltmeter, **diode**, LED, **thermistor** and **LDR**.
- An ammeter is always connected **in series** with a component, and a voltmeter **in parallel** across it.
- For charge to flow, there must be a closed circuit with a source of potential difference, such as a cell. **Electric current** is the rate of flow of electrical **charge** :

$$Q = It$$

Current, resistance and potential difference

- The current through a component depends on the potential difference across it and on its **resistance** :
- V is potential difference in volts (V), I is current in amperes and R is resistance in ohms (Ω).
- For the same potential difference, a bigger resistance gives a smaller current.
- **Worked example 4.** A potential difference of 0.45 V drives a current of 0.0075 A through a coin.

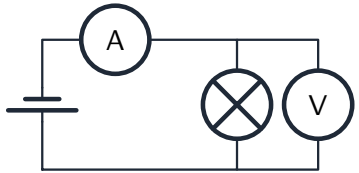
$$V = IR$$

The National Grid

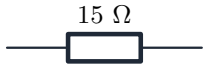
- A **step-up transformer** increases the potential difference from the power station to a very high value for transmission.
- For the same power, a higher potential difference means a smaller current ($P = VI$).
- A smaller current heats the cables less ($P = I^2R$), so less energy is wasted and the grid is more efficient.
- A **step-down transformer** then decreases the potential difference to about 230 V, a safer value for homes.

Exercises 2.1·2.2

2.1 A lamp has a potential difference of 6.0 V across it and a current of 0.50 A through it. Calculate its resistance. [2]

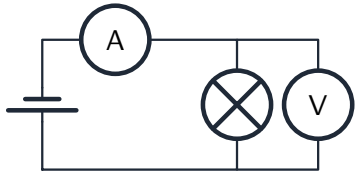


2.2 A 15 Ω resistor has a potential difference of 4.5 V across it. Calculate the current. [2]



Exercises 2.1·2.2

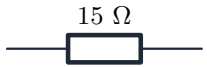
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2.1

- $6.0 \div 0.50 = \mathbf{12}\ \Omega$

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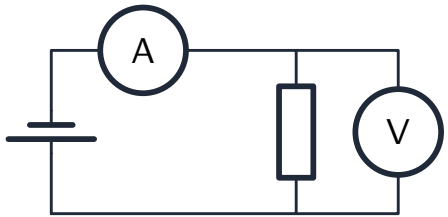


2.2

- $4.5 \div 15 = \mathbf{0.30}$ A

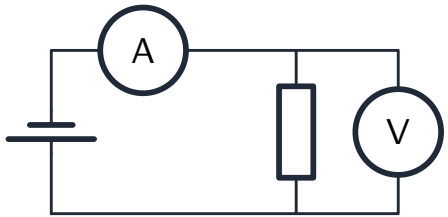
Exercise 2.3

2.3 Explain why the ammeter is connected in series with the component and the voltmeter in parallel. [2]



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2.3

- the ammeter must have the same current through it as the component; the voltmeter measures the potential difference across the component, between its two ends

Exercise 3.1

3.1 A current of 120 mA flows through a 47 Ω resistor. Calculate the potential difference across it. [3]



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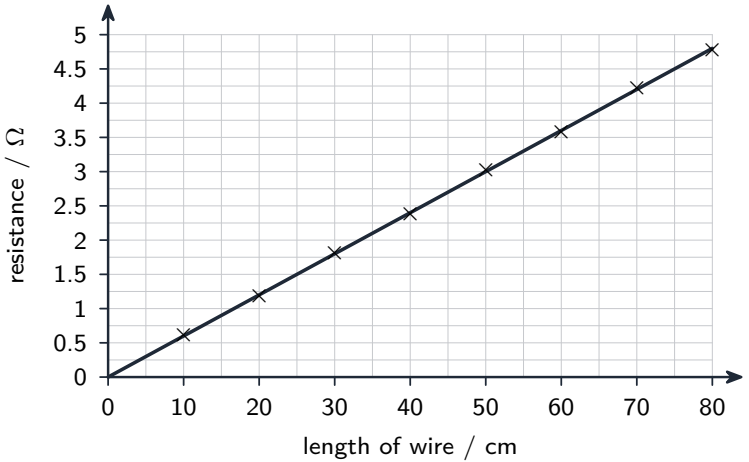
3.1

- 120 mA $= 0.12$ A
- $V = 0.12 \times 47$
- $V = \mathbf{5.6}$ V

Exercise 3.2 (a)

3.2 A student measures the resistance of different lengths of a wire. The graph shows the results.

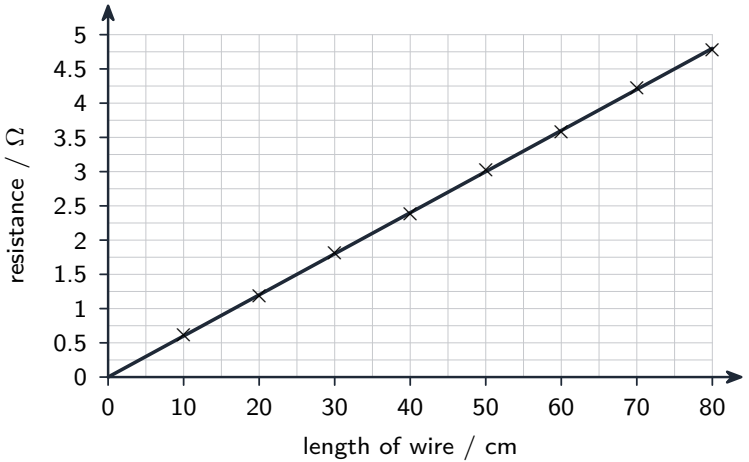
(a) Use the graph to find the resistance of 45 cm of the wire. [2]



Exercise 3.2 (a)

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(a) read at 45 cm; **2.7** Ω, accept 2.6–2.8

Exercise 3.2 (b)

3.2 A student measures the resistance of different lengths of a wire. The graph shows the results.

(b) The current through 60 cm of the wire is 0.50 A. Calculate the potential difference across it. [3]

Exercise 3.2 (b)

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(b) The current through 60 cm of the wire is 0.50 A. Calculate the potential difference across it. [3]

(b) $R = 3.6\ \Omega$ read; $V = 0.50 \times 3.6 = \mathbf{1.8}$ V

Exercise 3.2 (c)

3.2 A student measures the resistance of different lengths of a wire. The graph shows the results.

(c) Describe the relationship between resistance and length. [2]

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(c) Describe the relationship between resistance and length. [2]

(c) resistance is directly proportional to length; the graph is a straight line through the origin

Exercise 3.2 (d)

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(d) Describe how the student could carry out this investigation. [6]

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(d) Describe how the student could carry out this investigation. [6]

(d) points to include:

- tape the wire along a metre rule and connect it in a circuit with a cell and an ammeter
- connect one crocodile clip at 0 cm and move the other to set the length
- connect a voltmeter across the length of wire being tested
- record the current and potential difference for lengths of, e.g., 10 cm to 80 cm
- calculate $R = V \div I$ for each length, and plot R against length
- use a low current and switch off between readings so the wire does not heat up

Levels: **5–6** a full, logical answer with correct physics and correct terms; **3–4** several correct points, partly linked; **1–2** one or two relevant points.