Solutions

Each answer shows the steps, then the **result**.

2.1

- resistance = p.d./current ($R = V/I$)

2.2

- the current is **proportional** to the p.d. (at constant temperature)

2.3

- $V = 6.0$ V, $I = 0.30$ A
- $R = V/I$

$$R = \frac{6.0\ \text{V}}{0.30\ \text{A}} = \mathbf{20}\ \Omega$$

2.4

- $d = 0.50\ \text{mm} = 5.0 \times 10^{-4}\ \text{m}$
- $A = \pi d^2/4$

$$A = \frac{\pi(5.0 \times 10^{-4}\ \text{m})^2}{4} = \mathbf{2.0 \times 10^{-7}}\ \text{m}^\mathbf{2}$$

2.5

- it **decreases**

3.1 C

- a straight line through the origin means $I \propto V$, so R is constant — Ohm's law, which holds for a **metal wire at constant temperature**
- **A** a filament heats and R rises, so the graph bends; **B** a diode conducts one way only; **D** a thermistor's R falls as it warms

3.2

- a larger current **heats** the filament, raising its temperature
- a hotter metal has a **higher resistance** (ions vibrate more and impede the electrons)

3.3

(a) ammeter in **series** with the wire

- voltmeter connected **across** (in parallel with) the wire; a cell drives the current

(b) $V = 1.5$ V, $I = 0.45$ A

- $R = V/I$

$$R = \frac{1.5\ \text{V}}{0.45\ \text{A}} = 3.33\ \Omega$$

- $d = 0.40\ \text{mm} = 4.0 \times 10^{-4}\ \text{m}$; $A = \pi d^2/4$

$$A = \frac{\pi(4.0 \times 10^{-4}\ \text{m})^2}{4} = 1.26 \times 10^{-7}\ \text{m}^2$$

- $\rho = RA/L$

$$\rho = \frac{(3.33\ \Omega)(1.26 \times 10^{-7}\ \mathrm{m}^2)}{0.80\ \mathrm{m}} = \mathbf{5.2 \times 10^{-7}}\ \Omega\,\mathrm{m}$$

3.4

- it **decreases**