Solutions

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

2.1

- $Q = It$

$$Q = (2.0\ \text{A})(15\ \text{s}) = \mathbf{30}\ \text{C}$$

2.2

- $t = 4.0 \times 60\ \text{s} = 240\ \text{s}$
- $I = Q/t$

$$I = \frac{240\ \text{C}}{240\ \text{s}} = \mathbf{1.0}\ \text{A}$$

2.3

- the 0–1 A range
- it is the smallest range above 0.25 A, so the needle moves well up the scale; the 0–100 mA range would be overloaded and the 0–10 A range would read only coarsely

2.4

- $E = W/Q$

$$E = \frac{27\ \text{J}}{18\ \text{C}} = \mathbf{1.5}\ \text{V}$$

2.5

- $R = V/I$

$$R = \frac{12\ \text{V}}{0.50\ \text{A}} = \mathbf{24}\ \Omega$$

2.6

- Q: twice the length, so **12** Ω
- S: twice the area, so **3.0** Ω

2.7

- $P = IV$

$$P = (2.5\ \text{A})(12\ \text{V}) = \mathbf{30}\ \text{W}$$

$$E = Pt = (30\ \text{W})(40\ \text{s}) = \mathbf{1200}\ \text{J}$$

2.8

- $E = Pt$ in kWh

$$E = (3.0\ \text{kW})(1.5\ \text{h}) \times 10 = \mathbf{45}\ \text{kWh}$$

- cost $= 45 \times 0.55 = 24.75 \approx \mathbf{25}$ yuan

3.1 D

- twice the length doubles the resistance and half the area doubles it again, so $R_{\text{Y}} = 4R$

- **A** takes both changes the wrong way; **B** assumes they cancel; **C** counts only the length

3.2 C

- a charged rod attracts an uncharged object as well as an oppositely charged one, so attraction proves nothing; only repulsion is a sure test

3.3

(a) the work done by a unit charge (one coulomb) passing through the phone

(b) $t = 30 \times 60 \text{ s} = 1800 \text{ s}$

- $Q = It$

$$Q = (2.0 \text{ A})(1800 \text{ s}) = \mathbf{3600} \text{ C}$$

(c) $E = IVt$

$$E = (2.0 \text{ A})(5.0 \text{ V})(1800 \text{ s}) = \mathbf{18\,000} \text{ J}$$

(d) plastic has no free electrons

- its electrons are held in their atoms, so charge cannot flow through it

3.4

(a) cell, switch, variable resistor and ammeter in series with the wire

- voltmeter in parallel across the wire
- correct symbols in a complete loop

(b) close the switch and read the ammeter and the voltmeter

- adjust the variable resistor to obtain several pairs of readings
- calculate $R = V/I$ for each pair and take the average, or plot V against I and use the gradient

(c) $R = V/I$

$$R = \frac{3.0 \text{ V}}{0.60 \text{ A}} = \mathbf{5.0}\ \Omega$$

(d) the resistance increases

- because the filament gets hotter as the current rises

3.5

(a) $E = Pt$

$$E = (1.5 \text{ kW}) \times \frac{20}{60} \text{ h} = \mathbf{0.50} \text{ kWh}$$

(b) the lamp uses 0.10 kW, so it needs $0.50/0.10 = 5.0$ h

- $5.0 \text{ h} \div 20 \text{ min} = \mathbf{15}$ times longer

(c) $I = P/V$

$$I = \frac{1500 \text{ W}}{230 \text{ V}} = \mathbf{6.5} \text{ A}$$