Solutions

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

2.1

- the **energy transferred per unit charge** as charge passes through a component ($V = W/Q$)

2.2

- **e.m.f.** is energy given **to** each coulomb by the source; **p.d.** is energy given **up** by each coulomb in a component

2.3

- $P = VI$, $P = I^2R$, $P = V^2/R$

2.4

- $P = VI$

$$P = (12\ \text{V})(2.0\ \text{A}) = \mathbf{24}\ \text{W}$$

3.1 A

- $P = VI$

$$P = (240\ \text{V})(0.50\ \text{A}) = \mathbf{120}\ \text{W}$$

- **B** multiplies V by 2; **C** is $V \times I$ with a dropped 240; **D** quotes the voltage as a power

3.2

(a) $P = 2.4\ \text{kW} = 2400\ \text{W}$, $V = 240\ \text{V}$

- $I = P/V$

$$I = \frac{2400\ \text{W}}{240\ \text{V}} = \mathbf{10}\ \text{A}$$

(b) $R = V^2/P$

$$R = \frac{(240\ \text{V})^2}{2400\ \text{W}} = \mathbf{24}\ \Omega$$

3.3

- the 10 Ω resistor dissipates more power
- at the same voltage $P = V^2/R$, so the **smaller** resistance gives the **larger** power

3.4

- $P = 60\ \text{W}$, $t = 5.0\ \text{min} = 300\ \text{s}$
- $E = Pt$

$$E = (60\ \text{W})(300\ \text{s}) = \mathbf{1.8 \times 10^4}\ \text{J}$$

3.5

(a) the **energy transferred** to the component **per unit charge** passing through it

(b) $I = 0.040$ A, $t = 3.0$ min $= 180$ s

- $Q = It$

$$Q = (0.040 \text{ A})(180 \text{ s}) = \mathbf{7.2} \text{ C}$$

(c) the lower branch has the full 9.0 V across 360 Ω + 540 Ω = 900 Ω

$$I_2 = \frac{9.0 \text{ V}}{900 \ \Omega} = \mathbf{0.010} \text{ A}$$

(d) branch currents add to the battery current

$$I_1 = 0.040 \text{ A} - 0.010 \text{ A} = \mathbf{0.030} \text{ A}$$

(e) the upper branch also has 9.0 V across it

$$R_{\text{upper}} = \frac{9.0 \text{ V}}{0.030 \text{ A}} = 300 \ \Omega$$

- $R = 300 \ \Omega - 150 \ \Omega = \mathbf{150} \ \Omega$

(f) $P_{\text{total}} = VI$

$$P_{\text{total}} = (9.0 \text{ V})(0.040 \text{ A}) = \mathbf{0.36} \text{ W}$$

- in the 150 Ω resistor use the **branch** current I_1, not the battery current

$$P = I_1^2 R = (0.030 \text{ A})^2 (150 \ \Omega) = \mathbf{0.135} \text{ W}$$