

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 10Ω 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) $I = 0.040 \text{ A}$, $t = 3.0 \text{ min} = 180 \text{ s}$

- $Q = It$

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

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

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

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

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