Solutions

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

2.1

- the **energy transferred per unit charge** by the source in driving charge **around the complete circuit**

2.2

- $V = \varepsilon - Ir$

2.3

- equal to the **e.m.f.** ε

2.4

- any one: the resistance of the **electrolyte** in a cell; the resistance of the **wire windings** in a generator

3.1

- the 12 Ω and 6.0 Ω are in parallel

$$\frac{1}{R} = \frac{1}{12\ \Omega} + \frac{1}{6.0\ \Omega} = \frac{1}{4.0\ \Omega} \Rightarrow R = 4.0\ \Omega$$

- the terminal p.d. 8.0 V is across that combination, so $I = V/R$

$$I = \frac{8.0\ \text{V}}{4.0\ \Omega} = 2.0\ \text{A}$$

- lost volts $= \varepsilon - V = 9.0\ \text{V} - 8.0\ \text{V} = 1.0\ \text{V}$, and $r = (\varepsilon - V)/I$

$$r = \frac{1.0\ \text{V}}{2.0\ \text{A}} = \mathbf{0.50}\ \Omega$$

- energy wasted per second $= I^2 r$

$$P = (2.0\ \text{A})^2(0.50\ \Omega) = \mathbf{2.0}\ \text{W} = 2.0\ \text{J s}^{-1}$$

3.2 B

- $V = \varepsilon - Ir$: a larger current means a larger Ir drop inside the cell, so the terminal p.d. **decreases**
- **A** is the opposite; **C** would need $r = 0$; **D** is the open-circuit case ($I = 0$)

3.3

- **e.m.f.** is energy put **into** the circuit per coulomb by the source
- **p.d.** is energy taken **out** of the electrical form per coulomb in a component

3.4

- vary the external resistance and measure V and I
- plot V against I: the magnitude of the **gradient** is r (and the intercept is ε)