

Solutions

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

2.1

- the energy transferred per unit charge (from other forms to electrical)
- in driving the charge round a complete circuit

2.2

- e.m.f.: energy transferred **to** electrical energy per unit charge, inside the source
- p.d.: energy transferred **from** electrical energy per unit charge, in the resistor (to thermal energy)

2.3

- the ammeter in series with the resistor
- the voltmeter in parallel with (across) the resistor

2.4

- from $E = \frac{W}{Q}$: $W = EQ$

$$W = EQ = (1.5 \text{ V})(40 \text{ C}) = \mathbf{60 \text{ J}}$$

2.5

- battery, switch, thermistor and resistor in one series loop, with correct symbols
- voltmeter drawn in parallel across the thermistor only
- a complete circuit with no gaps

3.1 B

- e.m.f. is the energy per unit charge transferred by the source round a complete circuit
- **A**: it is not a force; **C** describes a p.d.; **D** is the terminal p.d., which is less than the e.m.f. when a current flows

3.2 B

- a voltmeter goes across a component and should draw no current: infinite resistance; an ammeter goes in series and should not reduce the current: zero resistance

3.3

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

(b) from $E = \frac{W}{Q}$: $W = EQ$

$$W = EQ = (12 \text{ V})(2.0 \times 10^3 \text{ C}) = \mathbf{2.4 \times 10^4 \text{ J}}$$

(c) the p.d. across the motor is the energy each coulomb gives up there, $V = \frac{W}{Q}$, so $W = VQ$

$$W = VQ = (11 \text{ V})(2.0 \times 10^3 \text{ C}) = \mathbf{2.2 \times 10^4 \text{ J}}$$

(d) the rest of the energy the charge was given

$$W = EQ - VQ = 2.4 \times 10^4 \text{ J} - 2.2 \times 10^4 \text{ J} = 2.0 \times 10^3 \text{ J}$$

is transferred to thermal energy inside the battery (or in the connecting wires)

- the e.m.f. is the energy given to each coulomb, and the p.d. across the motor is the energy each coulomb gives up there; the difference is given up elsewhere in the circuit

3.4

(a) cell or power supply, variable resistor, lamp and ammeter in series

- voltmeter across the lamp only
- correct symbols, complete circuit

(b) the voltmeter reading: it now measures the p.d. across the lamp **and** the variable resistor, which is larger than the p.d. across the lamp alone

- so the lamp's p.d. is overestimated