

Solutions

2.1

$$P = VI = 230 \text{ V} \times 4.0 \text{ A} = \mathbf{920 \text{ W}}$$

(equation/substitution 1, answer with unit 1.)

2.2

Convert time: $5.0 \text{ min} = 300 \text{ s}$ (C1).

$$E = Pt = 1500 \text{ W} \times 300 \text{ s} = 450\,000 \text{ J} = \mathbf{450 \text{ kJ}}$$

(C1, conversion of J to kJ A1.)

2.3 Energy per coulomb is the potential difference: $V = E/Q = 360 \text{ J}/30 \text{ C} = \mathbf{12 \text{ V}}$ ✓
(as labelled) (C1). Current:

$$I = \frac{Q}{t} = \frac{30 \text{ C}}{20 \text{ s}} = \mathbf{1.5 \text{ A}}$$

(C1, A1.)

3.1 (a)

$$P = I^2 R = (0.50)^2 \times 12 = 0.25 \times 12 = \mathbf{3.0 \text{ W}}$$

(C1, A1.) (b) Convert: $8.0 \text{ min} = 480 \text{ s}$ (C1).

$$E = Pt = 3.0 \text{ W} \times 480 \text{ s} = \mathbf{1440 \text{ J}} \approx 1400 \text{ J} \text{ (2 s.f.)}$$

(C1, A1.) (c) Power halves to 1.5 W : $P = I^2 R$ and I is unchanged, so halving R halves P .

3.2 (a) $P = VI$ (power = potential difference $\times$ current). (b)

$$I = \frac{P}{V} = \frac{4.4 \text{ W}}{40 \text{ V}} = \mathbf{0.11 \text{ A}} \text{ (2 s.f.)}$$

(rearrangement C1, substitution C1, answer A1.) (c) Convert: $1 \text{ hour} = 3600 \text{ s}$ (C1).

$$I = \frac{Q}{t} = \frac{396 \text{ C}}{3600 \text{ s}} = 0.11 \text{ A} \checkmark$$

3.3 (a) Straightener: $I = P/V = 120/230 = \mathbf{0.52 \text{ A}}$ (2 s.f.) (C1 + A1). Kettle: $I = 2000/230 = \mathbf{8.7 \text{ A}}$ (2 s.f.) (C1 + A1). (b) Convert: $3.6 \text{ kJ} = 3600 \text{ J}$ (C1).

$$t = \frac{E}{P} = \frac{3600 \text{ J}}{120 \text{ W}} = \mathbf{30 \text{ s}}$$

(rearrangement C1, answer A1.) (c) The kettle's rating means it transfers energy about 17 times faster ($2000/120$); at the same 230 V it draws a much larger current (8.7 A against 0.52 A); a thicker cable has lower resistance, so by $P = I^2 R$ the heating wasted in the cable stays small and safe at that current.