Solutions

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

2.1

- increase the current
- use a stronger magnetic field

2.2

- it increases (steps up) the voltage

2.3

- any three of: use a stronger magnet; move the magnet or coil faster; use more turns on the coil; use a coil of larger area

2.4

- slip rings and carbon brushes
- the e.m.f. is zero when the coil is upright, so its sides move along the field instead of cutting across it

2.5

- two coils, a primary and a secondary
- wound on a soft-iron core
- that links the coils magnetically but is not electrically connected to them

3.1 B

- reversing the current reverses the direction of the force

3.2

(a) $V_\mathrm{p}/V_\mathrm{s} = N_\mathrm{p}/N_\mathrm{s}$

$$\frac{12\ \mathrm{V}}{V_\mathrm{s}} = \frac{200}{1000} \Rightarrow V_\mathrm{s} = (12\ \mathrm{V}) \times 5 = \mathbf{60}\ \mathrm{V}$$

(b) step-up (more turns on the secondary)

3.3

- moving the magnet changes the magnetic field through the coil, which induces an e.m.f.
- make it larger by moving the magnet faster
- use a stronger magnet or more turns on the coil

3.4

(a) $I = P/V$

$$I = \frac{2.0 \times 10^6\ \mathrm{W}}{400\,000\ \mathrm{V}} = \mathbf{5.0}\ \mathrm{A}$$

(b) $P = I^2R$

$$P = (5.0\ \text{A})^2(5.0\ \Omega) = \mathbf{125}\ \text{W}$$

(c) at 10 kV the current would be 200 A, forty times larger

- the loss is I^2R, so it would be about 1600 times larger, roughly 200 kW

(d) $V_\text{p}/V_\text{s} = N_\text{p}/N_\text{s}$

$$\frac{20\,000\ \text{V}}{400\,000\ \text{V}} = \frac{500}{N_\text{s}} \Rightarrow N_\text{s} = \mathbf{10\,000}$$

turns

(e) a direct current gives a steady magnetic field in the core, and a field that does not change induces no e.m.f. in the secondary

3.5

(a) a sine-shaped curve

- crossing zero twice per turn, with two complete cycles shown

(b) the e.m.f. is zero when the coil is upright

- because its sides are then moving parallel to the field lines and cut none of them

(c) the peaks are higher

- and the cycles are closer together, so the frequency is higher