

- 1 (a) (i) Upper box: (split-ring) commutator OR split-ring B1
 Lower box: brush(es) OR contact(s) B1
- (ii) X (is the N pole) B1
- (b) (i) Any two from: B2
 Greater current (through coil) OR battery with greater voltage
 More turns in coil OR coil with greater area
 Use stronger magnet OR soft-iron core in coil OR bring magnetic poles closer to coil
- (ii) Coil rotates in opposite direction B1
 OR rotates anticlockwise
 OR rotation reversed
- (c) Magnetic field is cut (by the wires of the coil) B1
- Electromagnetic induction takes place
 OR Voltage/e.m.f. is induced/produced (causing current in the coil)
 OR Current is induced (in the coil) B1

[Total: 8]

- 2 (a) slip-rings (and brushes) B1
- (b) (i) sinusoidal curve, any value at $t = 0$ B1
- (ii) appropriate T value indicated on graph B1
- (iii) smaller T /time of one cycle OR higher frequency B1
 higher maximum current/greater amplitude/higher peaks/higher peak-to-peak B1
- (c) diode/rectifier B1

[Total: 6]

- 3 (a) (i) $(V_2 =) V_1 N_2 / N_1$ **OR** $230 \times 2000 / 40\,000$ C1
 11/11.5/12V A1
- (ii) any three from:
alternating/ changing magnetic field (in core)
 (magnetic field) transferred (**allow** conducted) to coil Q
 changing flux linkage/ in Q
 e.m.f./ voltage induced in Q B3
- (b) (i) diode B1
 (ii) it conducts in (only) one direction B1
- [Total: 7]**

- 4 (a) (i) electromagnetic induction B1
- (b) pointer deflects B1
 pointer returns to zero B1
- (ii) greater deflection (of pointer) B1
 pointer deflects in opposite direction and returns to zero
OR deflects for shorter time B1
- [Total: 5]**

- 5 (a) changing (magnetic) flux induces e.m.f. in secondary IGNORE induces current
no change of flux with constant supply voltage/d.c.
- (b) (i) $I_1 V_1 = I_2 V_2$ in any form OR $I_2 V_2 / V_1$
($I_2 = 1.2 \times 12 / 120 =$) 0.12 A
- (ii) transformer 100% efficient OR has no (heat/energy) losses OR output power = input power

B1

B1

B1

C1

A1

B1

[Total: 6]

- 6 (a) (i) (magnetic field) lines closer together/denser/more lines
- (ii) (magnetic field (lines) direction reversed
- (b) (i) ammeter needle deflects/reading on ammeter
(magnetic) field cuts coil OR changing (magnetic) field
(electromagnetic) induction
- (ii) deflection/reading on ammeter smaller OR lasts longer
slower rate of cutting field lines OR slower rate of change of field

B1

B1

B1

B1

B1

B1

B1

[Total: 7]

- 7 (a) at least 3 concentric circles centred on wire B1
 arrows clockwise on each circle / at least one circle B1
 spacing of circles increasing as radius increases B1
- (b) arrow pointing down on side AB, up on side CD B1
- (ii) forces on AB and CD are opposite OR up and down and separated / not in same line (so cause rotation) B1
 OR have moments in same sense / direction
 OR cause couple / torque
- (iii) to reverse current in loop or keep current in AB or CD in the same direction B1
 OR keep current on side near a pole in the same direction when (plane of) coil is vertical
 OR every half turn
 OR when AB and CD swap sides
 so that:
 rotation continues (in same direction)
 OR so that rotation doesn't reverse its direction
 OR to maintain sense/direction of moments/couple
 OR coil turns more than half a revolution B1

[Total 7]

- 8 (a) first box only ticked in each line 2 × B1 [2]
- (b) (output/V/I/power increases M1
 greater (rate of change of) field/flux
 OR sensible reference to $V_1 / V_2 = N_1 / N_2$ OR V_1 proportional to V_2 A1 [2]
- (ii) output/V/I/power zero M1
 accept nothing happens **NOT** no change
 field/flux does not change
 ignore transformers only work with a.c./don't work with d.c. A1 [2]
 special case for answer about what happens at moment of switching on/off:
 correct statement of some output etc. for short time M1
 change of field/flux A1

[Total: 6]