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|---|-----|--|----|-------------------|
| 1 | (a) | circuit with solenoid AND galvanometer or ammeter or voltmeter | B1 | |
| | | magnet labelled OR poles shown, with any orientation, near solenoid OR inside solenoid | B1 | |
| | | appropriate action described e.g. move magnet/solenoid | B1 | |
| | (b) | (i) | | M1 |
| | | magnetic field (in core) | | |
| | | (magnetic field is) alternating/changing/reversing | | |
| | | (ii) | | B1 |
| | | same frequency a.c. ticked | | |
| | | (iii) | | C1 |
| | | $V_S/V_P = N_S/N_P$ in any form OR ($V_S =$) $12 \times 200/50$ OR 48 (V) | | |
| | | $V_S I_S = V_P I_P$ in any form OR with numbers | | C1 |
| | | ($I_S =$) $12 \times 0.50/48 = 0.12$ A OR 0.13 A | | A1 |
| | | OR | | |
| | | $I_S/I_P = N_P/N_S$ in any form | | (C2) |
| | | ($I_S =$) $0.5 \times 50/200 = 0.12$ A OR 0.13 A | | (A1) |
| | | | | [Total: 9] |
| 2 | (a) | (alternating current causes alternating/changing) magnetic field (in core) | B1 | |
| | | alternating/changing magnetic field in secondary coil | B1 | |
| | | voltage/e.m.f. induced (in secondary coil) | B1 | |
| | | more turns (on secondary) so greater output | B1 | [4] |
| | (b) | resistance increases (with/is proportional to length (of cable)) | B1 | |
| | | (energy losses) due to resistance (of cables)/heating in cables/electrical working (in cables)/ I^2R | B1 | [2] |
| | | (ii) | | B1 |
| | | reduced resistance or less heat loss | | |
| | | more metal or cables heavier or more pylons or more costly to construct | B1 | [2] |
| | | | | [Total: 8] |

- 3 (a) (i) Parallel lines perpendicular to pole faces with arrows N to S B1
- (ii) Arrow pointing to the right B1
- (b) (i) Geiger (counter) / Geiger (tube) (+ scaler / ratemeter) / photographic plate / scintillation counter / cloud chamber / luminescent or phosphorescent plate B1
- (ii) Out of the plane of the paper B1
- (iii) (Path is) a curve / circular / arc B1
- (iv) (Air molecules are) ionised / lose electrons B1
- [Total: 6]**

- 4 (a) down
down OR anti-clockwise } both B1
- (ii) BC is parallel to the field/doesn't cut field or vice-versa/not at angle to field
ignore BC not perpendicular to field B1
- (b) continues moving/turning NOT reverse/other direction M1
idea of moving things continue moving OR reference to Newton's Laws
OR reference to momentum/KE/inertia NOT reference to force still acting A1
- (c) more turns/several coils
iron core
increase current/voltage
stronger magnet
smaller air gap any 1 B1
curved poles
more efficient brushes
poles closer
use split-ring commutator [5]

- 5 (a) (i) arrow pointing vertically downwards B1
- (ii) magnetic fields due to current and magnet interact with each other
OR current produces magnetic field.
OR wire contains moving charges which experience a force in a magnetic field B1
- (iii) direction of force unchanged B1
- (b) arrow at P pointing down the page B1
curved path B1 [5]
- 6 (a) any three from:
use a strong(er) magnet
increase the number of coils in the solenoid / turns of solenoid closer together
move the magnet fast(er).
place iron core in the solenoid
use thick(er) wire / low(er) resistance wire for solenoid max B3
- (b) (i) $N_p/N_s = V_p/V_s$ OR $200/800 = V_p/24$ OR $V_p = N_p V_s / N_s$
OR $V_p = 200 \times 24 / 800$ C1
6.0V A1
- (ii) $I_p V_p = I_s V_s$ OR $I_p N_p = I_s N_s$ OR $I_p = I_s V_s / V_p$ OR $I_p = I_s N_s / N_p$
OR $I_p = (0.5 \times 24) / 6$ OR $I_p = (0.5 \times 800) / 200$ C1
2(.0)A
allow ecf from (b)(i) A1 [7]

- 7 (a) (i) current clockwise when viewed from top B1
- (ii) anticlockwise (however expressed) allow ecf from (a)(i)
OR down on left and/or up on right B1
- (b) (i) faster B1
- (ii) faster OR the same B1
- (iii) faster B1
- (c) (increasing) back / opposing e.m.f. allow an opposing (induced) current B1 [6]