| Question | Answer | Mark |
|---|---|---|
| 1(a)(i) | Magnetic field at Y: 'towards the bottom of the page' ticked<br>Force at Y: 'to the left' ticked | **B1**<br>**B1** |
| (a)(ii) | There is a force on X<br>because of the (magnetic) field caused by Y<br>OR due to the (magnetic) field around / of Y<br>OR the (magnetic) fields due to X and Y interacting | **B1** |
| (b) | Change in current / field is brief / for short time / occurs as switch closes<br>Changing magnetic field / flux links with secondary coil / other coil / core OR field / flux lines cut coil<br>Causes induced voltage / current | **B1**<br>**B1**<br>**B1** |
| | | **Total: 6** |

2 **(a) (i)** ($I$ = )$P/V$ OR 18 000/120 OR 18/120 C1

150 A A1

**(ii)** ($E$ = )$Pt$ OR $18\,000 \times 30 \times 60$ OR $18\,000 \times 1800$ OR $18\,000 \times 30$ OR $5.4 \times 10^5$ C1

$3.2 \times 10^7$ J OR 9.0 kW h A

**(b)** any three of:
(high voltage means) low(er) current
for given supply power
(low(er) current means) less heat/thermal energy (generated in cables) OR $P = I^2R$
for given resistance (of cables)
cables heated by current B3 [7]

3 **(a (i)** changing magnetic field (in coil) **or** field lines cut coil (**or** *vice versa*) B
e.m.f./current induced B1

**(ii)** smaller deflection/current/reading/voltage **or** deflection lasts longer (ignore slower) B1
rate of cutting field lines/change of magnetic field reduced B1

**(iii)** deflection/current in opposite direction B1

**(b)** alternating/changing current (in primary coil) B1
alternating/changing magnetic field clearly in core B1
field channelled from primary to secondary by core (somehow expressed) **or** core increases effect B1
induced e.m.f. in secondary B1 **[9]**

4 **(a** first finger – field / magnetism / flux )
second finger – current / charge flow (NOT electron flow) ) both B1

**(b)** brush OR contact OR sliding connector B1
split ring OR commutator NOT slip ring B1

**(ii)** clockwise OR right side down OR left side up OR correct arrows on figure NOT turn to the right B1

**(iii)** more current / more voltage / "stronger battery" / more power )
more turns on coil / more coils )
stronger magnet Ignore bigger magnets )
closer magnet / magnetic poles ) any 2 B1, B1
more magnets )
iron core ) [6]

| | | | | | |
|---|---|---|---|---|---|
| 5 | **(a)** | **(i)** | circular line of force around wire through P | **M1** | |
| | | | arrow(s) on line anticlockwise - none wrong | **A1** | |
| | | **(ii)** | arrow through Q to left | **A1** | **3** |
| | **(b)** | **(i)** | none/stays same | **B1** | |
| | | **(ii)** | direction reverses | **B1** | **2** |
| | **(c)** | | at S - stronger | **B1** | |
| | | | at T - same (strength) | **B1** | |
| | | | at W - same (strength) | **B1** | **3** |
| | | | | | **[8]** |

| | | | | | |
|---|---|---|---|---|---|
| 6 | a(i) steel | | 1 | A1 | |
| | (ii) insert bar in coil( switch on,leave,switch off) | | 1 | B1 | |
| | (iii) to control/measure current or stop circuit/coil overheating | | 1 | B1 | 3 |
| | b(i) R = 12/4 | | | C1 | |
| | = 3 ohms* | 2 | | A1 | |
| | (ii) P = 12 x 4 | | | C1 | |
| | = 48 W* | 2 | | A1 | |
| | (iii) E = 48 x 5 | | | C1 | |
| | =240 J* | 2 | | A1 | 6 |
| | c(I) 5 (V) | | 1 | A1 | |
| | (ii) sum of p.d.'s = circuit supply p.d. | | | C1 | |
| | above + detail eg across each component/ in closed circuit etc | 2 | | A1 | 3 |
| | | | | QT | 12 |

| | | | | | |
|---|---|---|---|---|---|
| 7 | a (magnetic field) from left to right/ N to S | | 1 | B1 | 1 |
| | b(i) movement at right angles/between poles, up or down | | | C1 | |
| | (vertically)down,stated or reference to arrow on diagram or label | 2 | | A1 | |
| | (ii) mention of Fleming's L.H.R. or interacting fields | | | C1 | |
| | full explanation ~~leading to correct direction~~ e.g what fingers show | 2 | | A1 | 4 |
| | c use coil instead of single wire | | | B1 | |
| | mount coil on bearings | | | B1 | |
| | arrange suitable contacts e.g slip/slit rings and commutator | 2 | | B1 M2 | |
| | | | | QT | 7 |

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