

1	(a)(i)(ii) $R \propto L$ in words or symbols		
	(ii) AND $R \propto 1/A$ in words or symbols		B1
	(b) $P = IV$ OR $(I =) P/V$ OR 60/230 0.26 A		A1
	(c) length change divides resistance by 2/multiplies current by 2 cross-section change multiplies resistance by 3/divides current by 3 (overall) resistance of Y is 3/2 times bigger/ $3/2 \times 885 \Omega / 1327 \Omega$ OR current in Y 2/3 of 0.26 A = 0.17 A current in Y/Current in X = 2/3		C1 C1 C A1
			[Total: 7]
2	(a) (one third length so) one third R , accept any division by 3		C1
	(half area so) twice R , accept any doubling, including divide by $\frac{1}{2}$		C1
	(resistance = $0.45 \times 2/3$) = $0.3(0)\Omega$ accept 1 sig. fig.		A1 [3]
	(b) 1(Ω) and 3(Ω) used in correct parallel formula		C1
	2(Ω) added to candidate's <u>parallel</u> resistance		C1
	2.7 or 2.8 or 2.75 Ω		A1 [3]
	(ii) any 2 from: $I_1 = I_4$ OR $I_1 = I_2 + I_3$ OR $I_4 = I_2 + I_3$ OR other correct relevant equation/inequality e.g. $I_4 = 4I_3$, $I_4 > I_3$		B2 [2]
	(iii) any 2 from: $V_1 = V_4$ OR $V_1 = V_2 + V_3$ OR $V_4 = V_2 + V_3$ OR correct relevant inequality e.g. $V_1 > V_3$		B2 [2]
			[Total: 10]

- 3 (a) (i) Electron(s) B1
- (ii) At least 2 + signs on left-hand side of S
Same number of – signs on right-hand side of S B1
- (iii) Connect S to earth (with rod in place) M1
Remove connection of S to earth M1
Remove R / rod A1
- (b) (i) $Q = It$ OR $I = Q / t$ OR in words OR $I = 30/120$
 $= 0.25\text{A}$ or C/s C1
A1
- (ii) $E = IVt$ OR in words OR $0.25 \times 1.5 \times 10^6 \times 120$ C1
OR
 $E = QV$ OR in words OR $30 \times 1.5 \times 10^6$ (C1)
 $E = 45000000\text{J}$ / $4.5 \times 10^7\text{J}$ / 45MJ / 12.5kWh

[Total: 9]

- 4 (a) (i) more negatives in left than right B1
roughly same no. of positives as negatives B1 [2]
- (ii) clearly more negatives than positives, anywhere on sphere B1 [1]
- (b) (i) straight lines, radial towards point, arrows inwards B1
- (ii) direction of field OR direction of force on (point) positive (charge) B1 [2]

[Total: 5]

- 5 (a) ignore moving positive charge
electrons/negative charges removed from balloon NOT attracted to hair M1
 moved to hair/hair becomes negatively charged/idea of net positive charge on A1 [2]
 balloon
- (b) charge on left: positive/neutral B1
 charge on right: negative B1 [2]
- (c) stream deflected to right in diagram M1
 (negative) charges in water stream attracted by (charges on) balloon A1 [2]
- (d) metal (good) conductor/has free electrons B1 [1]
- 6 (a) rheostat/variable resistor AND control/vary/change/ limit B1
 current /resistance/power/voltage across heater
- (b) $P = VI$ in any form OR $(I =) P/V$ C1
 1.25 A A1
- (ii) $(R =) V/I$ in any form words or numbers C1
 (voltage across X =) 2.4 (V) OR 6 - 3.6 (V) C1
 1.92 Ω e.c.f. from (b) (i) A1
- (c) battery running down/going flat/energy of battery used up OR V or e.m.f. less B1
 OR more/increasing resistance (of heater) NOT resistance of X increases
- (d) (transformer condone step-up OR potential divider/potentiometer NOT extras B1
- (ii) diode OR rectifier OR L.E.D. NOT extras B1 [9]