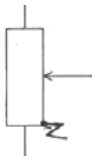
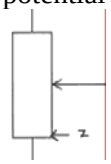
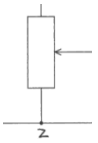
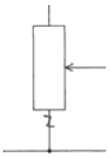
Question Number	Answer	Mark
1(a)	Current in A is **equal to** current in B (1) p.d across A is **less than** p.d. across B (1) Resistance of A is **less than** the resistance of lamp B (1)	**3**
(b)	Resistors in parallel have same p.d (1) Identifies $P = V^2/R$ OR $P = VI$ and $I_A > I_B$ (1) Uses this equation to state $P_A > P_B$. **OR** bulb A brighter than bulb B. Consequent on 2nd marking point (1)	**3**
	Total for question	**6**

Question Number	Answer	Mark
2	$I_3 = I_2 + I_1$ (possible reference to $(Q/t)_1$ etc accepted) **(1)** Charge is conserved **Or** Conservation of charge **Or** charge into point = charge out of point **Or** no charge lost **(1)** Correct reference to same time **(1)** (e.g. same charge etc in same time **Or** $(Q/t)_3 = (Q/t)_1 + (Q/t)_2$ etc)	**3**
	Total for question	**3**

Question Number	Answer		Mark
3	current same in series **Or** current is different if not in series to ensure the total resistance in the circuit isn't increased **Or** to ensure no pd lost because that would reduce the current being measured [Just saying current changes or resistance changes is not sufficient for MP2 and 3. Candidates wh **only** refer to what would happen if ammeter in parallel can only score MP1]	**(1)** **(1)** **(1)**	**3**
	Total for question		**3**

Question Number	Answer		Mark
4(a)	$Q = It$ stated A is a unit of current and h is a unit of time (hence Ah is charge) **Or** use of $Q = It$ with values in A and h Completed by conversion of h to s and use of C	**(1)** **(1)** **(1)** **(1)**	**2**
4(b)	Use of $W = IVt$ W = 10 000 J <u>Example of calculation</u> W = 0.19 A × 10 h × 1.5 V = 0.19 A × 10 × 60 × 60 s × 1.5 V W = 10260 J	**(1)** **(1)**	**2**
4(c)	Use of $W = QV$ Energy = 8600 J <u>Example of calculation</u> W = 7200 C × 1.2 V = 8640 J (lack of J only penalised once in (b) and (c))	**(1)** **(1)**	**2**
4(d)	Use of efficiency = (output energy/input energy) × 100% {It must be their (c) divided by their (b)} Efficiency = 86% (accept 0.86) Use of 10260 J →84% **ecf** their values from (b) and (c) (Do not award MP2 if efficiency is >100%) <u>Example of calculation</u> Efficiency = (8640 J ÷ 10000 J) × 100% = 86%	**(1)** **(1)**	**2**
	Total for question		**8**

Question Number	Answer	Mark
5(a)(i)	Ammeter and voltmeter both correct **(1)**	**1**
5(a)(ii)	Z at the bottom of the potential divider **(1)** from  or  down to  eg 	**1**
5(b)(i)	Current =0.75 (A) (range 0.74 A – 0.76 A) **(1)** Use of $V = IR$ **(1)** Resistance = 13-14 Ω **(1)** (incorrect current e.g. use of tangent, scores 1 max for use of $V = IR$) <u>Example of calculation</u> $R = \frac{V}{I} = \frac{10\ V}{0.75\ A} = 13.3\Omega$	**3**
***5(b)(ii)**	(QWC- Work must be clear and organised in a logical manner using technical wording where appropriate.) **Max 3** Initially or until about 4 V, I α V/Ohmic conductor **(1)** (Increasing the) <u>current</u> causes heating effect /temperature rise **(1)** Resistance increases OR increases lattice/ion/atoms vibrations **(1)** Rate of increase of current (with potential difference) decreases **(1)**	**3**
5(c)(i)	Reading current values at 4 V of <u>both</u> 0.3 (A) and 0.5 (A) **(1)** (power of 10 error allowed eg 3(A)and 5 (A) seen) Current = 0.8 A **(1)** (allowing for ± 0.1 mm square tolerance, accept range 0.76A to 0.84A)	**2**
5(c)(ii)	p.d. across R = 8 **(1)** $R = \frac{8\ V}{0.8\ A} = 10\ \Omega$ **(1)** (allow ecf from part (c)(i) for the value of I substituted) (accept answers in range 9.52 Ω to 10.53 Ω using range for I)	**2**
5(c)(iii)	Resistance of P greater than resistance of parallel combination **(1)** P will have a greater (share of the) pd **OR** R will have a lower (share of the) pd **(1)** Reading on voltmeter will increase **(1)**	**3**
	Total for question	**15**

Question Number	Answer	Mark
6(a)	Use of $Q = It$ or $\Delta Q = I\Delta t$ with any relevant time (1) $t = 5 \times 3600$ (1) divide Q by 1.6×10^{-19} (1) number of electrons = 4×10^{23} (1) <u>Example of calculation</u> Number of electrons = It/e Number of electrons = $3.5\ A \times 5 \times 3600\ s / 1.6 \times 10^{-19}\ C$ Number of electrons = 3.9×10^{23}	**4**
6(b)	Use of $E=hf$ (ignore powers of 10 errors in f) (1) (gives $E = 3.6 \times 10^{-19}$ J) Divides 10 by their value of energy (1) Number of photons = 3×10^{19} (1) (likely to see 2.7 or 2.8 depending on use of calculator: both correct) <u>Example of calculation</u> Energy of 1 photon = 6.63×10^{-34} Js $\times 5.5 \times 10^{14}$ Hz = 3.6×10^{-19} J Number of photons = $10\ W/3.6 \times 10^{-19}$ J Number of photons = 2.8×10^{19}	**3**
	Total for question	**7**