

Question Number	Answer	Mark
17a	Energy (supplied) to/per unit charge Or Work done (supplied) to/per unit charge Or The work done moving unit charge around the whole circuit	(1) (1)
17bi	Use of sum of e.m.f. = sum of p.d. Or see $\mathcal{E} = V + Ir$ with correct substitutions $r = 1.9 \times 10^{-2} \Omega$ <u>Example of calculation</u> $\mathcal{E} = V + Ir$, $12.0 \text{ V} = 11.81 \text{ V} + (9.83 \text{ A}) r$. so $r = 0.0193 \Omega$	(1) (1) (2)
17bii	Plot V against I Determine the gradient Gradient is $-r$ OR Plot I against V Determine the gradient Gradient is $-(1/r)$ OR Plot $(\mathcal{E} - V)$ against I Determine the gradient Gradient is r	(1) (1) (1) (1) (1) (1) (1) (1) (1) (3)

17c	<p>Calculates circuit current using $I = \mathcal{E} / \text{Total } R$</p> <p>Or Calculates p.d. across fixed resistor using potential divider equation (1)</p> <p>Use of a power equation (to calculate Power dissipated in fixed resistor) (1)</p> <p>Divides final power by initial power</p> <p>Or Divides difference in power by initial power</p> <p>Or Calculates 70% of initial power (1)</p> <p>Calculated value for final power/initial power is greater than 70% of initial power so student incorrect</p> <p>Or Calculated value for difference between initial and final power is less than 30% so student incorrect</p> <p>Or Calculated value for 70% of initial power is less than the final power so student incorrect (1)</p> <p>(Candidates who use incorrect values of I, V or R in either power calculation for MP2 cannot be awarded MP3 or MP4)</p> <p><u>Example of calculation</u></p> <p>Initially $I = \mathcal{E} / \text{Total } R = 9.0 \text{ V} / (5.0 + 0.10 \, \Omega) = 1.76 \text{ A}$</p> <p>Power of external resistor = $I^2 R = (1.76 \text{ A})^2 (5.0 \, \Omega) = 15.5 \text{ W}$</p> <p>When $r = 0.50 \, \Omega$, $I = \mathcal{E} / \text{Total } R = 9.0 \text{ V} / (5.0 + 0.50 \, \Omega) = 1.64 \text{ A}$</p> <p>Power of external resistor = $I^2 R = (1.64 \text{ A})^2 (5.0 \, \Omega) = 13.4 \text{ W}$</p> <p>Percentage of original value = $(13.4 \text{ W}) / (15.5 \text{ W}) = 0.86$ (or 86%)</p>	(4)
	Total for question 17	10