Name: _____

EMF

Mark Scheme

Date:

Time:

Total marks available:

Total marks achieved: _____

Mark Scheme

Q1.

Question Number	Answer	Mark
	C	1

Q2.

Question Number	Answer	Mark
	D	1

Q3.

Question Number	Acceptable answers	Additional guidance	Mark
	• Due to the internal resistance of the cell **(1)** • There is a potential difference across the internal resistance of the cell **Or** there will be 'lost volts' **(1)** **Or** $V = \mathcal{E} - Ir$		2

Q4.

Question Number	Answer	Mark
	Use of $V = IR$ **(1)** Use of lost volts = emf − terminal pd **Or** use of total resistance − 6.6Ω **(1)** (quoting $\varepsilon = I(R + r)$ or $\varepsilon = V + Ir$ gets both marks) Internal resistance = 0.54 Ω **(1)** (rounding and different methods all give 0.5 Ω to 1 sig. fig .) Example of calculation $V = 0.21\ \text{A} \times 6.6\ \Omega = 1.39\ \text{V}$ $Ir = 1.5\ \text{V} - 1.39\ \text{V} = 0.11\ \text{V}$ $r = 0.11\ \text{V} \div 0.21\ \text{A} = 0.54\ \Omega$	3
	Total for question	3

Q5.

Question Number	Acceptable answers		Additional guidance	Mark
	• Identifies $\mathcal{E} = 1.36$ V	**(1)**	MP1: This may be implied in a calculation MP3: allow either e.m.f. to be sub for the use of mark MP5: descriptions of r and V both required MP5: conditional mark on MP4 Example calculation $I = 0.84$ V / 5.92 Ω $I = 0.142$ A 1.36 V = 0.84 V + 0.142 A × r $r = 3.66$ Ω	**5**
	• Use of $I = V/R$ with $R = 5.92$ Ω and $V = 0.84$ V	**(1)**		
	• Use of $\mathcal{E} = V + Ir$ **Or** equivalent to determine r	**(1)**		
	• $r = 3.7$ (Ω)	**(1)**		
	• Both are correct (because r has increased and $\mathcal{E}$ has decreased)	**(1)**		

Q6.

Question Number	Answer		Mark
(a)	Variable resistor in series Ammeter in series and voltmeter in parallel with cell (If there are extra fixed resistances they can be ignored, as long as the terminal p.d. is being measured. Assume the ammeter has zero resistance, so its precise placement doesn't matter as long as it is in series)	**(1)** **(1)**	**2**
(b)	Best fit straight line drawn Substitution of values from student's line for gradient using at least half current axis ($\Delta I \geq 80$ mA) $\mathcal{E} = 3.9$ V to 4.1 V $r = 1.6$ Ω to 2.5 Ω Example of calculation gradient = (3.7 V – 4.0 V) / 0.16 A = – 1.9 Ω	**(1)** **(1)** **(1)** **(1)**	**4**
(c)	Start y-axis at 3.0 V (accept reference to points from 3.0 to 3.75 V) This will allow plots to be made more accurately **Or** This will allow intercept and change in V to be determined to more sf **Or** this will allow read-offs to be made with more precision (Only award this mark if first mark awarded)	**(1)** **(1)**	**2**
	Total for Question		**8**

Q7.

Question Number	Answer		Mark
(a)	Negative gradient (accept curve)	**(1)**	
	Straight line (dependent on first marking point)	**(1)**	
	Reference to terminal p.d. = e.m.f. – 'lost volts' **Or** $V = \varepsilon - Ir$	**(1)**	
	Intercept on V axis = ε **Or** Intercept on y axis = ε **Or** ε = value of V on graph when $I = 0$ (accept from labelled graph)(mark not awarded if line passes through origin)	**(1)**	
	Gradient = $-r$ **Or** magnitude of gradient is r (accept gradient = $-r$ marked on graph)	**(1)**	**5**
***(b)**	(QWC – Work must be clear and organised in a logical manner using technical wording where appropriate)		
	Ammeter explanation:		
	If ammeter has resistance, current decreased	**(1)**	
	but doesn't affect the determination because current through cell/r is measured		
	Or doesn't affect the determination because the voltmeter measures the terminal p.d. for that current	**(1)**	
	OR		
	The resistance of the ammeter contributes to the load/circuit/total resistance	**(1)**	
	Values of p.d. corresponding to given values of current will be unchanged	**(1)**	
	Voltmeter explanation:		
	If voltmeter has smaller resistance it would draw current	**(1)**	
	measured current not current through cell/r	**(1)**	**4**
	Total for question		**9**