Name: _____

Edexcel_EMF_Old

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	Answer	Mark
	p.d. is electrical energy(/coulomb) transferred between two points/electrical energy transformed/converted to other forms (1) e.m.f is the energy(/coulomb) supplied to a circuit/given to the charge/energy output of the cell (1) (full credit if wording implies emf as electrical energy source and pd as electrical energy sink) If neither mark scored but reference to energy/charge is made scores 1 mark only	2
	Total for question	2

Q4.

Question Number	Answer		Mark
	Either Show that with $R=0$ then $\mathcal{E} = Ir$ A small r would result in a large current **Or** If there is a short circuit Limit current in external circuit	(1) (1) (1) (1)	2

Q5.

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**

Q6.

Question Number	Answer	Mark
(i)	Attempts to draw line of best fit to y-axis **(1)** $\mathcal{E} = 6.1 - 6.3\ \text{V}$ **(1)**	**2**
(ii)	Attempts to find gradient **Or** use of $E=V+Ir$ using their E and corresponding values of V and I from their graph **(1)** $r = 1.5\ \Omega$ to $1.6\ \Omega$ **(1)**	**2**

Q7.

Question Number	Answer		Mark
(a)	State ($V =$) $E - Ir$	(1)	
	Correct substitution	(1)	
	p.d. = 11V	(1)	
	OR		
	Use of ($V =$) Ir to attempt to find lost volts	(1)	
	Subtraction from E	(1)	
	p.d. = 11V	(1)	
	OR		
	Use of $E = I(R+r)$ to attempt to find R	(1)	
	Use of $V = IR$ with the value of R calculated	(1)	
	p.d. = 11V	(1)	**3**
	Example of calculation $V = 12\ \text{V} - 3 \times 10^{-3}\ \Omega \times 400\ \text{A}$ p.d. = 10.8 V		
(b)	To prevent large energy dissipation / wire heating up / wire melting / large pd across the wires OR to allow a large current	(1)	
	Resistance of cable low	(1)	**3**
	(cross-sectional) area large [Not surface area]	(1)	
	[Reverse argument in terms of a thin wire acceptable for all points]		
	Total for question		**6**

Q8.

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 $r = 1.6\ \Omega$ to $2.5\ \Omega$ 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

Q9.

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 but doesn't affect the determination because current through cell/r is measured	**(1)**	
	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**

Q10.

Question Number	Answer		Mark
(a)(i)	resultant e.m.f. = 15 V – 7.6 V = 7.4 V	(1)	1
(a)(ii)	Total resistance = 0.65 Ω + 0.050 Ω = 0.70 Ω	(1)	1
(a)(iii)	Use of $I = V/R$ I = 11 A (allow ecf for values from (i) & (ii)) (22.6 V gives 32.3 A) Example of calculation I = 7.4 V/ 0.7 Ω I = 10.6 A	(1) (1)	2
(b)(i)	Use of p.d. across series resistance = 4.3 A× 0.65 Ω Subtraction of calculated p.d. value from 15 V Terminal p.d. = 12.2 (V) [no ue] **OR** Use of p.d. across internal resistance of battery = 4.3 A× 0.05 Ω Addition of calculated p.d. value to 12 V Terminal p.d. = 12.2 (V) [no ue] Example of calculation p.d. across internal resistance = 4.3 A× 0.65 Ω = 2.8 V Terminal p.d. = 15 V – 2.8 V Terminal p.d. = 12.2 V	(1) (1) (1) (1) (1) (1)	3
(b)(ii)	Use of $P = VI$ Rate of energy = 65 W Example of calculation Power = 15 V × 4.3 A Power = 64.5 W	(1) (1)	2
(b)(iii)	Use of $P = I^2r$ (to find wasted power for internal resistance, series resistance or total resistance) (allow ecf from (a)(ii)) Subtraction of this value from answer to (b)(ii) (allow ecf) Efficiency = 80% (allow ecf) **Or** 12 V × 4.3 A (for useful power = 51.6 W) Use of ratio of useful power/total power Efficiency = 80% (efficiency = ratio of emfs leading to 80% scores 3 marks) Example of calculation Wasted power = $(4.3\ A)^2 \times 0.7\ \Omega$ = 13W Efficiency = (65 – 13)/65 Efficiency = 80%	(1) (1) (1) (1) (1) (1)	3
	Total for question		12

Question Number	Answer	Mark
(a)	**Plot of graph** Check points, 4 correct 2 marks, 3 correct 1 mark Line of best fit to include 0,0.6 and 0.52,0 (1)	3
(b)(i)	Use of V = 0.43 V in P = VI (1) ecf values for incorrect best fit line P = 0.17 W (1) **Example of calculation** P = 0.4 A × 0.43 V P = 0.172 W	2
(b)(ii)	Value of e.m.f. is when the current is zero (1) No 'lost' volts OR no energy loss (1) **OR** E = V + Ir I = 0, E = V	2
(b)(iii)	Identifies current in circuit (1) ecf values for incorrect best fit line Finds 'lost volts' (1) r = 0.24 Ω (1) **Example of calculation** r = (0.52 V - 0.40 V) ÷ 0.50 A r = 0.24 Ω	3
(c)	Graph of similar shape as in (a) but initially above the first graph (1) ecf values for incorrect best fit line Finishing at 0.52 V, 0.00 A (1)	2
	Total for question	12