10. D.C. Circuits

10.1 Practical circuits

Paper 2

Marking Scheme

Q1.

(c)	current in circuit = 1.35 / (10 + 15) (= 0.054 A)	**C1**
	r = (E – V) / I	**C1**
	= (1.5 – 1.35) / 0.054 = 2.8 Ω	**A1**
	or	
	by potential divider principle $\frac{0.15}{1.35} = \frac{r}{25}$	**(C2)**
	r = 2.8 Ω	**(A1)**
	or	
	I = 1.35 / (10 + 15) (= 0.054 A)	**(C1)**
	total resistance = 1.50 / 0.054 (= 27.8 Ω) r = 27.8 – 25	**(C1)**
	r = 2.8 Ω	**(A1)**
(d)(ii)	(as the current is greater and so there is a) larger p.d. across the internal resistance	**M1**
	(terminal p.d. will) decrease	**A1**

Q2.

(a)(i)	(V =) 1.50 – 1.36 (= 0.14 V)	**B1**
	current = V / R = 0.14 / 0.28 = 0.50 A	**A1**
(b)(i)	two resistors correctly shown in parallel with cell and no other components	**B1**
(b)(ii)	(external) resistance is now smaller **and** (so) current (in cell) is greater / (external) resistance smaller fraction of total resistance / internal resistance larger fraction of total resistance	**B1**
	(greater p.d. across internal resistance so) terminal p.d. is less	**B1**

Q3.

(b)(i)	heater	**A1**

Q4.

(c)	(ΔE =) 9.6 × 330 (= 3170 J)	**C1**
	final stored energy = 2.6×10^4 – 3170 = 2.3×10^4 J	**A1**

Q5.

(c)(iii)	I = 4.5 + 1.2 (= 5.7 A)	**C1**
	9.0 = 7.4 + 5.7r **or** 9.0 = 5.7 (1.3 + r) r = 0.28 Ω	**A1**

Q6.

(c)(i)	E = 2.4 V	**A1**
(c)(iii)	(–) internal resistance **or** (–) r	**B1**

Q7.

(c)	total resistance increases	**B1**
	current decreases (in battery) so total power decreases	**B1**

Q8.

(a)(i)	energy is dissipated in the internal resistance/r	**B1**
(a)(ii)	**1.** $I = Q / t$	**C1**
	$= 750 / 1500$ $= 0.50$ A	**A1**
	2. $V = W / Q$ **or** $V = W / It$	**C1**
	$= 5700 / 750$ **or** $5700 / (0.50 \times 1500)$ $= 7.6$ V	**A1**
	or	
	$V = P / I$ **and** $P = W / t$	**(C1)**
	$V = 3.8 / 0.50$ $= 7.6$ V	**(A1)**
	3. $r = (7.8 - 7.6) / 0.50$	**C1**
	$= 0.40\ \Omega$	**A1**

Q9.

(c)(i)	energy is dissipated in the internal resistance/r	**B1**
(c)(ii)	$E = IR + Ir$ **or** $E = I(R + r)$	**B1**

Q10.

(b)(ii)	$8.0 = (0.94 \times r) + (0.45 \times 16)$	**C1**
	$r = 0.85\ \Omega$	**A1**
(d)	total/combined resistance decreases	**B1**
	(current in battery increases so terminal) potential difference decreases	**B1**

Q11.

(a)	energy is dissipated in the internal resistance	**B1**
(b)	$E = V + Ir$	**B1**
(c)(i)	(graph shows) maximum value of potential difference is 2.8 (V) **or** (graph shows) when current/I (from battery) is zero, V is 2.8 (V) / E	**B1**
(c)(ii)	r = (–)gradient **or** $r = (E - V) / I$ **or** substituted values from the graph for E, V and I	**C1**
	$r = 1.4\ \Omega$	**A1**
(d)(iii)	energy $= EIt$ **or** $P = EI$ **and** $P = W / t$	**C1**
	$(9.2 - 1.6) \times 10^3 = 2.8 \times 0.50 \times t$	**C1**
	$t = 5.4 \times 10^3$ s	**A1**

Q12.

(b)(ii)	$E = V + Ir$ **or** $E = I(R + r)$	**C1**
	$5.6 = 4.8 + 0.32\,r$ so $r = 2.5\,(\Omega)$ **or** $5.6 = 0.32 \times (15 + r)$ so $r = 2.5\,(\Omega)$	**A1**