Answers - Electricity - 1

1.

(a)(i)	Ammeter		B1
(ii)	Voltmeter		B1
(b)	*I*: current		B1
	Δt: time (interval / duration)		B1
(c)(i)	$I = 7.5 \times 10^3 / 1500$		C1
	$I = 5.0$ (A)		A1
(ii)	$V = P / I$	(allow other variants)	C1
	$V = 1.2 \times 10^3 / 5.0$	(possible e.c.f)	C1
	$V = 240$ (V)	(-1 for missing k or 10^3 factor)	A1
(iii)	$E = 1.2 \times 10^3 \times 1500$		C1
	$E = 1.80 \times 10^6$ (J)	(-1 for missing k or 10^3 factor) penalise once only in (ii) & (iii)	A1
(iv)	units = 1500/3600 x 1.2 = 0.5 | units = $1.8 \times 10^6 / 3.6 \times 10^6 = 0.5$		C1
	cost = 0.5 x 6.4 = 3.2 (p) | (possible (e.c.f if (iii) used)		A1

2.

(a)(i)	Coulomb / C	(Allow Ampere second / As)	B1
(ii)	Voltmeter		B1
(b)(i)	P = VI	(Allow other variant)	C1
	V = 36 / 3.0		C1
	p.d. = 12 (V)		A1
(ii)	E = 36 x 600		C1
	energy = $2.1(6) \times 10^4$ (J) $\approx 2.2 \times 10^4$ (J)		A1
(iii)	$\Delta Q = I\Delta t$ / $Q = It$	(Allow other variant)	C1
	$\Delta Q = 3.0 \times 600$		C1
	charge = 1.8×10^3 (C)		A1
(iv)	$N = 1.8 \times 10^3 / 1.6 \times 10^{-19}$	(Possible ECF)	C1
	number = $1.1(3) \times 10^{22} \approx 1.1 \times 10^{22}$		A1

3.

(a)	$R = V / I$	C1
	symbols defined: R = resistance, V = p.d. / voltage and I = current	A1
	($V = IR$ with all symbols defined scores 1/ 2)	
	(R = p.d. / voltage per unit current scores 2/2)	
	(R = p.d. / voltage per unit amp / A scores 1/ 2)	
(b)	Resistance decreases as temperature increases.	B1
	Correct <u>curve</u> with R decreasing as temperature increases.	B1
(c)(i)	Resistance increases (as V increases)	B1
	Temperature increases / atoms vibrate more / more electron collisions (with atoms)	B1
(ii)	**1.** $P = 24 \times 2$	C1
	$P = 48$ (W)	A1
	2. $V = 12$ (V) when current is 2.0 (A) (Allow $V = 11.0$ V from graph)	C1
	$R = 12 / 2.0 = 6.0$ (Ω)	A1
	3. $R_T = 6.0 + 5.0 = 11.0$ (Ω) (possible e.c.f)	B1
	4. $V_L = 11.0 \times 2.0 = 22$ (V) | $R_{circuit} = 48 / 2.0^2 = 12$ (Ω)	C1
	$r = (24-22) / 2.0 = 1.0$ (Ω) | $r = 12.0 - 11.0 = 1.0$ (Ω)	A1

4.

(a)	$\rho = RA / L$	M1
	Symbols defined:	
	ρ = resistivity, A = <u>cross-sectional</u> area, R = resistance and L = length	A1
	($R = \rho L/A$ with all symbols defined scores 1/ 2)	
(b)(i)	$A = \rho L / R$	C1
	$A = 4.3 \times 10\text{-}6 \times 1.2 \times 10^{2} / 5.0$ (-1 for using L as 2.0 mm)	C1
	$A = 1.0(3) \times 10^{-8}$ (m^2)	A1
(ii)	$t = 1.0(3) \times 10^{-8} / 2.0 \times 10^{-3}$	
	$t = 5.1(6) \times 10^{-6}$ (m) (possible e.c.f)	B1

5.

(a)(i)	R = 50 Ω	C1
	I = 3.0 / 50	C1
	current = 0.06 (A)	A1
(ii)	$P = VI / V^2 / R / I^2 R$	C1
	power = 3.0 x 0.06	
	power = 0.18 (W) (Possible ECF)	A1
(b)(i)	'Constant' <u>temperature</u> implied (wtte)	B1
	(Do not allow reference to Ohm's law or to 'heating')	

(ii) 1. 40 (Ω) B1

2. $A = \pi \times (1.0 \times 10^{-5})^2 = 3.1(4) \times 10^{-10}$ (m^2) B1

$R = \rho L/A$ (Allow other variant) C1

$40 = 5.4 \times 10^{-8} \times L / 3.1(4) \times 10^{-10}$ (Possible ECF) C1

L = 0.23(3) (m) ≈ 0.23 (m) A1

Length is 9too) long, therefore must be coiled (wtte) B1

6.

(i) R = 1.28 / 0.80 C1

resistance = 1.6(0) (Ω) A1

(ii) $R = R_1 + R_2$ / 1.60 = r + 1.10 / r = (1.28 – 0.8 x 1.1) / 0.8 C1

r = 0.5(0) (Ω) ≈ 0.5 (Ω) (Possible ECF) A1

(iii) p.d = 1.10 x 0.80 = 0.88 (V) (Possible ECF) B1

7.

(a) $\rho = RA / L$ (Allow $R = \rho l/A$) M1

Symbols defined:

(ρ = resistivity) A = cross-sectional area, R = resistance and L = length A1

(resistivity = product of resistance and cross sectional area per (unit) length scores 2/2)

(resistivity = product of resistance and cross sectional area per (unit) metre scores 1/2)

(b)(i) $h = 1.2 \times 10^{-5} / 3.0 \times 10^{-4}$ C1

$h = 4.0 \times 10^{-2}$ (m) A0

(ii) $R = \rho l/A$

$R = 6.9 \times 10^{-2} \times 4.0 \times 10^{-2} / 3.0 \times 10^{-4}$ (-1 for 10^n error) C1

R = 9.2(0) (Ω) A1

(R = 920 (Ω) scores 1/2)

(c) Resistance decreases M1

by a factor of four because the length is halved (and area is doubled) A1

(Numerical approach with R = 2.3 (Ω) scores 2/2)

8.

(a)(i)		Parallel	B1
(ii)		$R = R_1R_2 / R_1 + R_2$ / $1/R_T = 1/R_1 + 1/R_2$	C1
		$R = 1.5 \times 1.0 / (1.5 + 1.0)$ / $R = 1/1.67$ / $1/R = 1.67$	C1
		$R = 0.6$ (Ω)	A0
(b)(i)		e.m.f. is the (total) energy (gained) / work done <u>per</u> (unit) charge	B1
		Energy transformed into electrical / gained by charges	B1
		OR	
		$E = W/Q$	M1
		(E = e.m.f) W = energy gained / converted to electrical and Q = charge	A1
(ii)		The chemicals (within the cell)	B1
(iii)		$R = R_1 + R_2$ / $R = 0.8 + 0.6$	C1
		$R = 1.4$ (Ω)	A1
(iv)		$I = 1.5 / 1.4$	C1
		$I = 1.0(7)$ (A) (Possible e.c.f)	A1
(v)	**1.**	$P = VI$ / I^2R / V^2/R	B1
	2.	$P_{int} = 1.0(7)^2 \times 0.8 = (0.916\ W)$ / $P_{ext} = 1.0(7)^2 \times 0.6 = (0.687\ W)$	C1
		ratio = 0.8 / 0.6 / ratio = 0.916/0.687	C1
		ratio = 1.3(3)	A1
		(ratio = 0.6/0.8 = 0.75 scores 2/3)	
		(ratio = 0.571, when R = 1.4Ω is used instead of 0.6Ω, scores 2/3)	
		(ratio = (1.07 × 0.8) / (1.07 × 0.6) scores 0/3)	