Question			Answer	Marks	Guidance
1	(a)	(i)	potential difference (across a component)/current (in it)	B1	**allow** symbols if symbols defined; voltage or p.d.; **allow** per **not** over
		(ii)	read 10 V from graph (R = V/I =) 10/ 0.04 = 250 (Ω)	C1 M1 A0	**allow** 9.8 or 9.9 **ecf** reading from graph
	(b)		R = ρl/A **or** ρ =RA/l ρ = 250 x 1.2 x 10^{-3} ρ = 0.30 (Ω m)	C1 C1 A1	select formula mark **ecf(a)(ii)**; a correct substitution correct answer **allow** 0.3
A **A** **A**	(c)		(graph curves so) R changes qualification: I increases faster than V **increased temperature is caused by (larger) <u>current</u> in slice** qualification: P = I^2R as R decreases ρ decreases	B1 B1 B1 B1 B1	**allow** R increases or decreases **allow**: by calculating two values of R **do not allow** either of the first two marking points if reference made linking gradient and R value **QWC mark; allow** heating effect is caused by.... **allow** 'R decreases' already stated earlier in answer **max** 3 out of 4 + QWC mark
			Total	**10**	

Question			Answer	Marks	Guidance
2	**(a)**	**(i)**	energy transfer per unit charge from chemical/other to electrical form	B1 B1	**allow** energy per unit charge
		(ii)	(Q = It =) 200 x 4 x 60 x 60 = 2.9 x 10^6 (C)	M1 A1	**accept** 200 x 14400 **accept** 2.88 x 10^6
		(iii)	E = QV = 2.88 x 10^6 x 24 = 6.9 x 10^7 (J)	C1 A1	**accept** 72 MJ if using 3 MC or 69.6 or 70 if using 2.9 MC
	(b)	**(**	correct symbol and polarity connected to X and Y	B1	**allow** one cell or more or two cells with dotted lines between
A **A** **A**		**(ii)**	V = 30 – 24 = 6 V R = V/I = 6/120 = 0.05 (Ω)	M1 M1 A0	evidence of the V subtraction needed **do not allow** use of E = V + I**r**; it must be I**R**
		(iii)	P = VI = 6 x 120 = 720 (J s^{-1})	C1 A1	**or** $I^2R = 120^2$ x 0.05 **or** $V^2/R = 6^2$ /0.05
		(iv)	(3600 – 720)/3600 = 2880/3600 = 0.8 = 80 (%)	C1 C1 A1	**ecf b(iii)**; using 2880 instead of 3600 gives 75%; scores zero **allow** (30 – 6)I/30I = 24/30 = 0.8 = 80 (%)
	(c)	**(**	t = Q/I = 2.88 x 10^6/120 **or** E/VI = 69 x 10^6/(24 x 120) t = 2.4 x 10^4/3600 = 6.7 h	M1 A1	**ecf (a)(iii); accept** 3 x 10^6 giving 2.5 x 10^4 s and 6.9 h **allow ora** using 7.0 h giving E = 72.5 MJ
		(ii)	power supplied = 30 x 120/1000 = 3.6 kW cost = 3.6 x 7 x 26 = 655 (p)	A1	**ecf c(i) accept** any consistent answer **do not allow** 2.88 kW giving 524 p **unless** repeated error from **b(iv)**
			Total	**17**	