Name: _____

Circuits

Mark Scheme

Date:

Time:

Total marks available:

Total marks achieved: _____

Mark Scheme

Q1.

Question Number	Acceptable answers	Additional guidance	Mark
	A The p.d. across the resistor added to the p.d. across the thermistor must equal 6 V. This occurs when the current is 0.5 A.	0.5	1
	B assumes all the p.d. is across the thermistor C assumes that resistor and thermistor connected in parallel D assumes that the p.d. across the resistor and thermistor is more than 6 V		

Q2.

Question Number	Acceptable Answer	Additional Guidance	Mark
	• Ammeter in series with LED **and** voltmeter in parallel with LED **(1)**		1

Q3.

Question Number	Answer	Mark
	D Step 4	1
	Incorrect Answers: A – this step uses the conservation of energy B – this step is just a statement of Ohm's law C – this step uses the conservation of energy	

Q4.

Question Number	Answer	Mark
	C	1

Q5.

Question Number	Answer	Mark
	D 1080 C	**1**
	Incorrect Answers: A – current divided by time, with the time in seconds B – current divided by time, with the time in minutes C – correct formula of current × time but the time is in minutes and not seconds	

Q6.

Question Number	Acceptable answers	Additional guidance	Mark
	A uses the parallel resistors equation $\frac{1}{R_T}=\frac{1}{R}+\frac{1}{R}=\frac{2}{R}$	$\frac{R}{2}$	**1**
	B assumes resistors in parallel have the same total R as each individual R C is the addition of both resistances as if they were in series D is the product of both resistances		

Q7.

Question Number	Answer	Mark
	B	**1**

Q8.

Question Number	Answer	Mark
	B	**1**

Q9.

Question Number	Answer	Mark
	B	**1**

Q10.

Question Number	Answer	Mark
	$I_3 = I_2 + I_1$ (possible reference to $(Q/t)_1$ etc accepted) (1) Charge is conserved **Or** Conservation of charge **Or** charge into point = charge out of point **Or** no charge lost (1) Correct reference to same time (1) (e.g. same charge etc in same time **Or** $(Q/t)_3 = (Q/t)_1 + (Q/t)_2$ etc)	3
	Total for question	3

Q11.

Question Number	Answer	Mark
	current same in series **Or** current is different if not in series (1) to ensure the total resistance in the circuit isn't increased **Or** to ensure no pd lost (1) because that would reduce the current being measured (1) [Just saying current changes or resistance changes is not sufficient for MP2 and 3. Candidates who **only** refer to what would happen if ammeter in parallel can only score MP1]	3
	Total for question	3

Q12.

Question Number	Acceptable Answer	Additional Guidance	Mark
	• The replacement charger will still have to supply the same charge (6510 C) (1) • The replacement charging plug takes more time to charge **Or** the old charging plug takes less time to charge (1) • Replacement charging plug uses a lower current therefore reduces heating effect (1) • The phone may try and draw a current of 1 A which may damage the charging plug (1)	MP1: may be awarded for use of 6510 C in a calculation for MP2 MP2 calculation to support this using t = Q/I Or if the phone uses 1A the time to charge will be the same	4

Q13.

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	Use of 3600 × W h to give energy stored = 24 900 (J) (1)	Example of calculation 6.91 W h = 6.91 × 3600 s = 24 876 J	1

Question Number	Acceptable Answer	Additional Guidance	Mark
(ii)	• Use of $V = W/Q$ (1) • $Q = 6510$ C (1)	Example of calculation $Q = \frac{24\,876\text{ J}}{3.82\text{ V}} = 6512$ C (ecf for calculated energy from (a)(i)) (show that value gives $Q = 6545$ C)	2

Question Number	Acceptable Answer	Additional Guidance	Mark
(iii)	• Use of $Q = It$ **Or** $W = VIt$ (1) • Use of $\frac{\text{time in seconds}}{3600}$ (1) • $t = 2.0$ (h) (1)	Example of calculation $t = \frac{6512\text{ C}}{0.9\text{ A}} = 7235.6$ s $t = \frac{7235.6\ s}{3600} = 2.01$ h (ecf for calculated charge from (a)(i)) (show that value gives $t = 2.02$ h)	3

Q14.

Question Number	Answer		Mark
(a)	Series sketch with two bulbs	**(1)**	
	Connected in series: because when one is removed there is a break in the circuit **Or** because when one is removed there is no current **Or** so the bulbs could have different p.d.s	**(1)**	
	Not connected in parallel because: if one removed, still complete circuit (for the other) **Or** if one removed, still current (through the other) **Or** full mains voltage would have blown small bulb	**(1)**	**3**
(b) (i)	Use of $P = IV$ $I = 0.17$ (A) (at least 2 sf required) <u>Example of calculation</u> $40\ \text{W} = I \times 230\ \text{V}$ $I = 0.17\ \text{A}$	**(1)** **(1)**	**2**
(b)(ii)	Use of appropriate equation $R = 1300\ \Omega$ <u>Example of calculation</u> $P = V^2/R$ $40\ \text{W} = (230\ \text{V})^2 / R$ $R = 1323\ \Omega$	**(1)** **(1)**	**2**
(b)(iii)	Use of $R = V/I$ $R = 13\ \Omega$ <u>Example of calculation</u> $R = 2.5\ \text{V} / 0.2\ \text{A}$ $R = 12.5\ \Omega$	**(1)** **(1)**	**2**
(c)	Current – both require about the same (not just both have 0.2 A)	**(1)**	
	Potential difference – total (required) p.d. is very close to mains supply **Or** (operating) p.d. for mains bulb much greater than (operating) p.d. for torch bulb	**(1)**	**2**

(d)	Lower resistance	**(1)**	
	(smaller current, so) lower temperature (so less vibration of lattice ions) **Or** (smaller current, so) smaller drift velocity	**(1)**	
	fewer collisions of electrons with lattice ions **Or** less frequent collisions of electrons with lattice ions	**(1)**	
	Less energy dissipation (as heat) **Or** less ke lost in collisions	**(1)**	**4**
	Total for question		**15**