Name: _____

Electricity

Mark Scheme

Date:

Time:

Total marks available:

Total marks achieved: _____

Mark Scheme

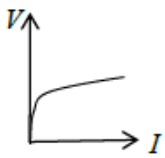
Q1.

Question Number	Acceptable answers	Additional guidance	Mark
	C	joule per coulomb.	1
	Incorrect Answers: A is reciprocal of volt B is definition of amp D is definition of watt		

Q2.

Question Number	Answer	Mark
	D	1

Q3.

Question Number	Acceptable Answer	Additional Guidance	Mark
	C 		1

Q4.

Question Number	Answer	Mark
	D	1

Q5.

Question Number	Answer	Mark
	A	1

Q6.

Question Number	Answer	Mark
	C	1

Q7.

Question Number	Answer	Mark
	C	1

Q8.

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		

Q9.

Question Number	Answer	Mark
	A	1

Q10.

Question Number	Answer	Mark
	B	1

Q11.

Question Number	Answer	Mark
	B	1

Q12.

Question Number	Answer	Mark
	C	1

Q13.

Question Number	Answer	Mark
	B	1

Q14.

Question Number	Answer	Mark
	C	1

Q15.

Question Number	Acceptable answers	Additional guidance	Mark
	D In the dark the resistance of the LDR will be very large so practically all the potential difference of 6V will be across it.	a little below 6 V	1
	A assumes the resistance of the LDR decreases to almost zero B assumes the resistance of the LDR decreases a little C assumes the resistance of the LDR increases a little		

Q16.

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	

Q17.

Question Number	Answer	Mark
	A dark and cold	**1**
	Incorrect Answers: B – correct description for LDR but incorrect for thermistor C – incorrect description for LDR but correct for thermistor D – incorrect description for LDR and incorrect for thermistor	

Q18.

Question Number	Answer	Mark
	D	1

Q19.

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

Q20.

Question Number	Answer		Mark
	(high resistance) so very little /negligible/zero current in the voltmeter **Or** because otherwise a current would pass through the voltmeter **Or** so the total resistance of the parallel combination isn't changed **Or** because otherwise total resistance of parallel combination would be reduced	(1)	
	because that would change /increase the current in the ammeter **Or** because that would mean the current through the ammeter was different to (larger than) the current through the component	(1)	2
	Total for question		2

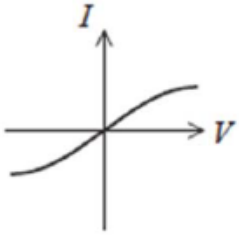
Q21.

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 (e.g. same charge etc in same time **Or** $(Q/t)_3 = (Q/t)_1 + (Q/t)_2$ etc)	(1)	3
	Total for question		3

Q22.

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

Q23.

Question Number	Answer	Mark
(a)	Correct curve in + + section (accept $V-I$ or $I-V$ graph but axes must be labelled) (1) Symmetrical negative curve (accept if ++ curve incorrect) (1)  	2
(b)	Drift velocity (of electrons) increases (as current increases) **Or** electrons gain (kinetic) energy (as current increases) **Or** rate of flow of electrons/charge increases (as current increases) (1) More (frequent) collisions of electrons with lattice ions (1) lattice ion vibrations increased **Or** (More) energy dissipated as heat in lattice **Or** (More) energy transferred when electrons collide with lattice ions (1) (accept charge carriers for electrons and atoms/ions/particles for lattice ions.)	3
	Total for question	5

Q24.

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** $W = VIt$ • Use of $\frac{\text{time in seconds}}{3600}$ • $t = 2.0$ (h)	(1) (1) (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

Q25.

Question Number	Answer		Mark
(a)	$Q = It$ stated A is a unit of current and h is a unit of time (hence Ah is charge) **Or** use of $Q = It$ with values in A and h Completed by conversion of h to s and use of C	(1) (1) (1) (1)	2
(b)	Use of $W = IVt$ $W = 10\ 000$ J Example of calculation $W = 0.19\ \text{A} \times 10\ \text{h} \times 1.5\ \text{V}$ $= 0.19\ \text{A} \times 10 \times 60 \times 60\ \text{s} \times 1.5\ \text{V}$ $W = 10260$ J	(1) (1)	2
(c)	Use of $W = QV$ Energy = 8600 J Example of calculation $W = 7200\ \text{C} \times 1.2\ \text{V}$ $= 8640$ J (lack of J only penalised once in (b) and (c))	(1) (1)	2
(d)	Use of efficiency = (output energy/input energy) × 100% {It must be their (c) divided by their (b)} Efficiency = 86% (accept 0.86) Use of 10260 J →84% **ecf** their values from (b) and (c) (Do not award MP2 if efficiency is >100%) Example of calculation Efficiency = (8640 J ÷ 10000 J) × 100% = 86%	(1) (1)	2
	Total for question		8

Q26.

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	• The IV graph of an ohmic conductor is a straight line through the origin **Or** V is directly proportional to I **(1)** • Hence Ohm's law is not obeyed for the LED **(1)**	MP1 accept converse argument MP2 dependent on MP1	**2**

Question Number	Acceptable Answer	Additional Guidance	Mark
(ii)	**Either** • $V_{LED} = 2\,V$ (from graph) **(1)** • Use of $V_{LED} + V_R = 5\,V$ **(1)** • Use of $R = \frac{V}{I}$ **(1)** • R = 170 Ω **(1)** **Or** • Use of $R = \frac{V}{I}$ **(1)** • $V_{LED} = 2\,V$ (from graph) **(1)** • Use of $R_{LED} + R = 278\,\Omega$ **(1)** • R = 170 Ω **(1)**	Example of calculation: $2\,V + V_R = 5\,V$ $\therefore V_R = 3\,V$ $R = \frac{3\,V}{18 \times 10^{-3}\,A} = 167\,\Omega$	**4**

Q27.

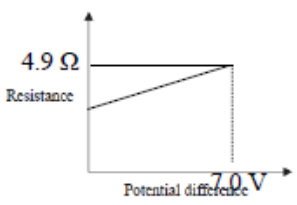
Question Number	Answer		Mark
(a)	The (maximum) length is (directly) proportional to the area	(1)	1
(b)(i)	Use of $\rho l/A = R$ $R = 1.34\ (\Omega)$ Example of calculation $R = 1.68 \times 10^{-8}\ \Omega\ m \times 80\ m \div 1.0 \times 10^{-6}\ m^2$ $R = 1.34\ \Omega$	(1) (1)	2
(b)(ii)	Use of $P = I^2R$ $P = 160$ W allow ecf from (i) Example of calculation $P = (11\ A)^2 \times 1.34\ \Omega$ $P = 162$ W (157 W if they use 1.3 Ω)	(1) (1)	2
(b)(iii)	Use of $V = IR$ **Or** use of $P = VI$ **Or** use of $P = V^2/R$ $V = 15$ V allow ecf from (i) and/or (ii) Example of calculation $V = 11\ A \times 1.34\ \Omega = 14.7$ V (14.3 V if 1.3 Ω is used)	(1) (1)	2
(c)	To prevent (use of a cable with) resistance that is too large (Accept answers that refer to maintaining or not exceeding a resistance of about 1.3 Ω) Meaning more energy / power / p.d. available for the shredder	(1) (1)	2
	Total for Question		9

Q28.

Question Number	Answer		Mark
(a)	Operable circuit with bulb and power supply variable to 12 V (ignore meters) Ammeter correctly positioned Voltmeter correctly positioned (voltmeter may be across ammeter as well, or whole circuit – but not across any additional resistive components such as a variable resistor)	(1) (1) (1)	3
(b)(i)	The gradient of this graph is the rate of change of current with p.d. Resistance is the ratio of pd/current **Or** It is calculated using a value of pd ÷ the corresponding value of current **Or** it isn't a straight line so the gradient is not *R* (credit *R* not constant, so value at 6 V isn't applicable to other voltages)	(1) (1)	2
(b)(ii)	Use of $R = V/I$ $R = 4.76\ \Omega$ Example of calculation $R = 6.00\ V / 1.26\ A$ $R = 4.76\ \Omega$	(1) (1)	2
*(c)	**(QWC – Work must be clear and organised in a logical manner using technical wording where appropriate)** The resistance increases (Because) the temperature increases (accept heats up) Increasing the amplitude of the oscillation of the lattice ions Leading to more (frequent) collisions of electrons with lattice ions Allow converse marks for an explanation explicitly based on decreasing potential difference	 (1) (1) (1) (1)	4
	Total for question		11

Q29.

Question Number	Acceptable answers		Additional guidance	Mark
(a)	• Use of $R = V/I$ using pair of points from the graph • $R = 4.9\ \Omega$	(1) (1)	Example of calculation $R = 7.00\ V / 1.44\ A$ $R = 4.86\ \Omega$	2

Question Number	Acceptable answers		Additional guidance	Mark
(b)	• Calculated resistance point plotted correctly at (4.9 Ω, 7.0 V) • Resistance increases (constantly) with potential difference • Positive intercept with y-axis (less than value from (a))	(1) (1) (1)	 MP3 conditional on MP2 being awarded.	3

<table>
<tr><th>Question Number</th><th>Acceptable answers</th><th>Additional guidance</th><th>Mark</th></tr>
<tr>
<td>* (c)</td>
<td>
This question assesses a student's ability to show a coherent and logically structured answer with linkages and fully-sustained reasoning.
Marks are awarded for indicative content and for how the answer is structured and shows lines of reasoning.
The following table shows how the marks should be awarded for structure and lines of reasoning
<table>
<tr><th>Number of indicative points seen in answer</th><th>Number of marks awarded for indicative points</th></tr>
<tr><td>6</td><td>4</td></tr>
<tr><td>5-4</td><td>3</td></tr>
<tr><td>3-2</td><td>2</td></tr>
<tr><td>1</td><td>1</td></tr>
<tr><td>0</td><td>0</td></tr>
</table>
Indicative content

(As V increases) acceleration/velocity/energy of electrons increases
greater energy transfer in collisions with lattice / ions
increasing the temperature of metal/filament/ions
amplitude of vibrations of lattice/ ions increases
collision (rate) between lattice /ions and electrons increases
Or shorter distance between collisions
Or greater chance of collision
due to the increase in resistance, current doesn't increase in proportion to potential difference
Or due to the increase in resistance the ratio of I/V decreases

</td>
<td>
The following table shows how the marks should be awarded for structure and lines of reasoning
<table>
<tr><th></th><th>Number of marks awarded for structure and lines of reasoning</th></tr>
<tr><td>Answer shows a coherent and logical structure with linkage and fully sustained lines of reasoning demonstrated throughout</td><td>2</td></tr>
<tr><td>Answer is partially structured with some linkages and lines of reasoning</td><td>1</td></tr>
<tr><td>Answer has no linkage between points and is unstructured</td><td>0</td></tr>
</table>
Accept charge carriers for electrons and only penalise once for omission of charge carriers or lattice ions

Linkage marks
<table>
<tr><th>Number of indicative content points awarded</th><th>Possible linkage marks</th></tr>
<tr><td>0, 1</td><td>0</td></tr>
<tr><td>2, 3</td><td>1</td></tr>
<tr><td>4, 5, 6</td><td>2</td></tr>
</table>
MP1 don't award for 'increased rate of flow'

MP2 to award mark there must be the idea of increased/greater energy transfer between electrons and ions
</td>
<td>6</td>
</tr>
</table>