

Question number	Answer	Notes	Marks
1 (a)	(i) Voltmeter connected in parallel with a component; component is LDR;	not in parallel with wire	2
	(ii) measure current / take current reading; divide voltage (reading) by current (reading);	accept <ul style="list-style-type: none"> <li>• number of amps for current</li> <li>• p.d. or number of volts for voltage</li> <li>• <math>R = V/I</math></li> </ul> Ignore triangle mnemonics	2
(b)	(i) B – the diameter of the hole;		1
	(ii) C – the distance from the card to the LDR;		1
	(iii) Any one of - Move ruler to cover half the hole/halfway down the hole;  Draw guide lines;  Use set square;	idea of measuring across/over the diameter at right angles to ruler Placed against ruler Ignore: move ruler nearer the hole/start from 0 on the ruler	1

Continued

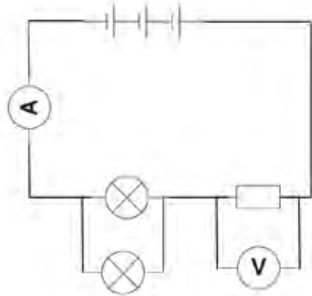
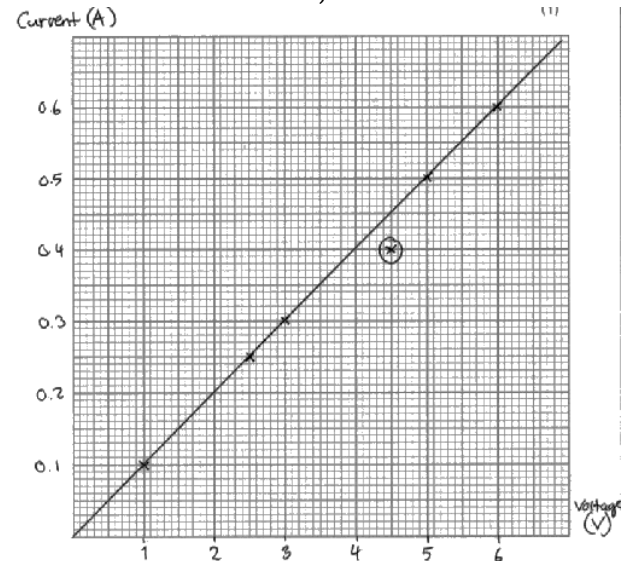
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1 (c) (i)	<p>suitable scales;</p> <p>axes labelled;</p> <p>Plotting of points;</p>	<p>Must use &gt; half width and half height of grid units on axis labels ignore orientation of graph to nearest ½ square, up to two marks available for this, -1 each error reject dot to dot allow a reasonably smooth curve, points should be evenly distributed about the line</p>	4																												
(ii)	<p>line of best fit;</p> <div data-bbox="451 842 1062 1295" data-label="Figure"> <table border="1" data-bbox="1117 878 1354 1148"> <thead> <tr> <th>diameter / mm</th> <th>resistance / Ω</th> </tr> </thead> <tbody> <tr> <td>8</td> <td>1050</td> </tr> <tr> <td>10</td> <td>890</td> </tr> <tr> <td>15</td> <td>640</td> </tr> <tr> <td>20</td> <td>490</td> </tr> <tr> <td>23</td> <td>430</td> </tr> <tr> <td>30</td> <td>340</td> </tr> </tbody> </table> </div>	diameter / mm	resistance / Ω	8	1050	10	890	15	640	20	490	23	430	30	340	<table border="1" data-bbox="1117 878 1354 1148"> <thead> <tr> <th>diameter / mm</th> <th>resistance / Ω</th> </tr> </thead> <tbody> <tr> <td>8</td> <td>1050</td> </tr> <tr> <td>10</td> <td>890</td> </tr> <tr> <td>15</td> <td>640</td> </tr> <tr> <td>20</td> <td>490</td> </tr> <tr> <td>23</td> <td>430</td> </tr> <tr> <td>30</td> <td>340</td> </tr> </tbody> </table>	diameter / mm	resistance / Ω	8	1050	10	890	15	640	20	490	23	430	30	340	1
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(iii)	<p>MP1 Idea of an inverse relationship;</p> <p>OR</p> <p>Pattern sentence linking resistance and diameter;</p> <p>MP2 Idea of a non-linear relationship;</p>	<p>ignore 'negative correlation'</p> <p>e.g. "the bigger the diameter, the lower the resistance"</p> <p>allow exponential decrease</p>	2																												

Total 14 marks

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2 (a) (i)	$P = I \times V$ ;	accept standard symbols or in words or rearranged	1
(ii)	substitution and rearrangement; evaluation;  e.g. (I =) 110/230 (I =) 0.48 (A)	allow 0.5, 0.47826 (A) condone 0.47, 0.4782	2
(b) (i)	any suitable suggestion; e.g. carries a high(er) <u>current</u> has low(er) <u>resistance</u>	ignore references to cable overheating/melting	1
(ii)	L or live;		1
(iii)	any suitable suggestion; e.g. double insulated does not have a metal case / has a plastic case	case is not a conductor / is an insulator	1
(c)	substitution into a suitable equation;  time in correct units;  evaluation;  e.g. ( $E = I \times V \times t$ ) (E =) 0.17 x 230 x 55.....1 mark (E =) 0.17 x 230 x 55 x 60...2 marks (E =) 130 000 (J).....3 marks  OR  ( $E = P \times t$ ) (E =) 40 x 55.....1 mark (E =) 40 x 55 x 60.....2 marks (E =) 130 000 (J).....3 marks	no mark for the equation as given in the paper allow if x60 / 3300 seen anywhere in working  129 030 (J) allow 131 835 for use of $V = 235V$  132 000(J)  total marks = 9	3

Question number	Answer	Notes	Marks
3 (a) (i)	Voltmeter connected in parallel with any circuit component; Component chosen is the thermistor;	Ignore a line through the voltmeter symbol	2
(ii)	(because voltage is) a controlled variable;	Allow idea of fair test	1
(iii)	Any one of - MP1. Idea of adjustment (of current or <b>circuit</b> resistance); MP2. To control the current;		1
(b)	Any three of -  <b>references to the data:</b> MP1. (yes it works) when the temps are high, the current almost matches the temperature; MP2. (no it's not OK) when the temps are lower, the current value does not match the temperature; MP3. It is only right at 10 (and 100);  <b>Practicality ideas:</b> MP4. The current cannot be <b>negative</b> when the temperature is negative; MP5. Idea that <b>Voltage</b> will not be constant/ voltage has to be adjusted to keep it constant;  <b>line ideas</b> MP6. Line/ graph is curved /eq;  MP7. <b>Line/ graph</b> does not pass through the origin;	however expressed  e.g. About t same from 80 °C to 100 °C; e.g. not equal at 20mA 20 °C           allow (graph shows that) current not <b>directly</b> proportional to temperature allow 0,0	3

Total 7 marks

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4 (a)	<p>mark each of these independently:</p> <p>MP1. a resistor in series with the lamp only;</p> <p>MP2. a second lamp in parallel with the first lamp;</p> <p>MP3. a voltmeter that measures the voltage across the resistor;</p> <p>MP4. an ammeter that measures the total current in the circuit;</p>	<p>circuit symbols used must be correct (no square voltmeter/ammeter etc.)</p> 	4														
(b) (i)	<p>labels on axes including units;</p> <p>scales on axes;</p> <p>plotting;;</p>	<p>axes can be either way round</p> <p>must occupy &gt;50% in each direction</p> <p>-1 for each error</p>	4														
(ii)	$I = 0.4, V = 4.5$ clearly indicated;		1														
(iii)	<p>Suitable line of best fit;</p> 	<table border="1"> <thead> <tr> <th>Voltage in V</th> <th>Current in A</th> </tr> </thead> <tbody> <tr> <td>1.0</td> <td>0.10</td> </tr> <tr> <td>2.5</td> <td>0.25</td> </tr> <tr> <td>3.0</td> <td>0.30</td> </tr> <tr> <td>4.5</td> <td>0.40</td> </tr> <tr> <td>5.0</td> <td>0.50</td> </tr> <tr> <td>6.0</td> <td>0.60</td> </tr> </tbody> </table>	Voltage in V	Current in A	1.0	0.10	2.5	0.25	3.0	0.30	4.5	0.40	5.0	0.50	6.0	0.60	1
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(iv)	voltage = current x resistance;	in words or standard symbols	1														
(v)	<p>substitution into correct equation using any suitable pair of values taken from the graph line or table;</p> <p>evaluation of <math>R = 10 \text{ } (\Omega)</math>;</p>	allow (0.1,1), (0.6,6) etc	2														

Total 13 marks

Question number	Answer	Notes	Marks
5 a	MP1. series circuit containing lamp and some form of power supply; MP2. ammeter in series with lamp; MP3. voltmeter in parallel across lamp; MP4. variable resistor in series OR use of variable power supply;	incorrect symbols or substantial gaps =- 1 ONCE allow either symbol for lamp ignore other components e.g. switch	4
b i	idea that gradient changes; e.g. voltage increases more rapidly than the current	look for a rate change expressed in student terms Accept <ul style="list-style-type: none"> <li>• line is curved</li> <li>• not a straight line</li> <li>• V is not proportional to I</li> </ul>	1
ii	MP1. Lamp heats up; MP2. Greater chance of electron collisions; MP3. (hence) resistance increases;	do not award marks for a description of the shape of the graph	3

(Total for question 5 = 8 marks)

Question number	Answer	Notes	Marks
6 (a) I	<p>MP1 Any circuit including <b>correct circuit symbols</b> for</p> <ul style="list-style-type: none"> <li>• battery /cell / d.c. power supply</li> <li>• ammeter</li> <li>• voltmeter ;</li> </ul> <p>ii MP2 ammeter clearly measures current through the wire; MP3 voltmeter clearly across wire;</p> <p>Idea of measuring current through the wire;</p> <p>Idea of measuring voltage across the wire;</p> <p>Idea of a range of values (of I and V); e.g. alter variable resistor OR repeat for different voltages</p>	<p>ignore other components for MP1</p> <p>allow even if voltmeter in series with ammeter allow circuit line drawn through meter allow voltmeter across a section of the test wire</p>	<p>3</p> <p>3</p>
(b) i	<p>any one of resistance changes (with temperature) ;</p> <p>ii wire gets hot <b>and</b> melts/burns/catches fire/dangerous; V proportional to I only at constant temperature;</p> <p>(c) Ohms Law is only true if temperature constant;</p> <p>i any one of putting the wire in a water bath ; taking the reading quickly; switching off between readings; using only small currents; voltage = current × resistance ;</p> <p>ii horizontal line above axis;</p>	<p>Reject incorrect relationship between R and <math>\theta</math> Ignore damage to wire Reject insulating the wire</p> <p>Allow to return to room temperature</p> <p>Allow <math>V = I \times R</math> and rearrangements</p>	<p>1</p> <p>1</p> <p>1</p> <p>1</p>

		Total	10
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