| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 1 a i | 0.72 (volts) (2)<br><br>**but if answer incorrect**<br><br>0.7185 or 0.718 or 0.719 or 0.7 (volts) (1) | 2 | <br><br><br><br>**Allow** 0.15 x 4.79 (1) |
| ii | **D** (1) | 1 | if answer line blank allow correct answer circled or underlined<br><br>more than one answer = 0 marks |
| b | **Any two from:**<br><br>increase the current by one from<br>- moving the slider clockwise or upwards or to the left<br>- having less wire / fewer coils in circuit [1]<br><br>decrease the current by one from<br>- moving the slider anticlockwise or downwards or to the right<br>- having more wire / coils in circuit [1]<br><br>increasing length increases resistance / increasing resistance decreases current / ORA [1] | 2 | **allow** labelled arrows or indications on diagram to indicate correct directions<br><br>for upwards **allow** towards the power supply<br><br><br><br>for downwards **allow** away from the power supply<br><br><br><br>**Allow** changing length changes resistance [1]<br>**But** increasing length decreases resistance / ORA [0]<br><br>**Allow** changing resistance changes current [1]<br>**But** increasing resistance increases current / ORA [0] |
| | **Total** | **5** | |

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<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>2</td><td>[Level 3]<br>truth table all correct<br>AND<br>An explanation about how logic system is used to display different numbers<br>AND<br>numbers (eg. 2) used to illustrate answer<br>Quality of written communication does not impede communication of the science at this level<br>(5 – 6 marks)<br>[Level 2]<br>truth table all correct<br>AND EITHER<br>explanation about how logic system is used to display different numbers<br>OR<br>Numbers (eg. 2) used to illustrate answer<br>Quality of written communication partly impedes communication of the science at this level<br>(3 – 4 marks)<br>[Level 1]<br>at least two rows in truth table correct<br>OR<br>explanation about how logic system is used to display different numbers<br>OR<br>numbers (eg. 2) used to illustrate answer<br>Quality of written communication impedes communication of the science at this level<br>(1 – 2 marks)<br>[Level 0]<br>Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</td><td>6</td><td>This question is targeted at grades up to A.<br><br>completed truth table:<br><br><table><tr><td>1</td><td>1</td><td>1</td></tr><tr><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>1</td><td>1</td></tr><tr><td>1</td><td>1</td><td>1</td></tr></table><br>how his logic system is used to display different numbers may include:<br>• Signals / states can be 0 / low / off or 1 / high / on<br>• logic system made of three OR gates and one NOT gate<br>• logic gates work to give different combinations of 0 and 1<br>• when the output / G is 1 then the shaded segment is switched on / ora<br><br>numbers to illustrate the answer may include:<br>• numbers 1 3 4 5 6 7 8 9 0 need G to be 1 to be correctly displayed<br>• number 2 need G to be 0 to be correctly displayed<br>• numbers 1, 7 and 0 need the middle bar to be 0<br><br>Use the L1, L2, L3 annotations in scoris.<br>Do not use ticks.</td></tr>
<tr><td></td><td>Total</td><td>6</td><td></td></tr>
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| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 3 a COMMON | 82<br>104<br>128<br>(1) | 1 | all correct for 1 mark |
| COMMON b i | $I_b$ is (always much) smaller than $I_c$ / ORA [1] | 1 | |
| COMMON ii | (idea that) a small base current is needed to switch on the transistor (1)<br><br>(this allows) a large current through the transistor (1) | 2 | **allow** higher level answers e.g. transistors have a high gain (1) |

| Question | Answer | Marks | Guidance |
|---|---|---|---|
| c | **max two from any of these advantages:**<br><br>robot can do jobs that are more: boring / dangerous / unpleasant / intricate / labour intensive / hygienic / take longer<br><br>Other advantages are that robots are safer / stronger / more efficient / faster<br><br>Other advantages that robots don't get sick / don't take holidays / don't get paid / don't make human errors / don't take breaks / don't need feeding / don't get tired<br><br>**max two from any of these disadvantages:**<br>robots may be limited in decision making / need reprogramming / expensive to buy or maintain / robots take peoples jobs / may take over (the world) / dangerous to humans if a fault develops (1) | 3 | **Ignore** can do repetitive work<br>**Ignore** robots do jobs that humans don't want to do |
| | **Total** | **7** | |

| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 4 a | **LDR** resistance decreases as light (level) increases / AW [1]<br><br>**Thermistor (NTC)** resistance decreases as temperature increases / AW [1] | 2 | **allow** ORA [1]<br><br>**allow** ORA [1]<br>**allow** heat for temperature<br>**allow** Thermistor PTC resistance increases as temperature increases [1] |
| b | **Any two from current passes:**<br><br>Idea of threshold voltage reached / AW [1]<br><br>in one direction / AW [1]<br><br>when the voltage is positive / resistance is low/AW [1] | 2 | <br><br>e.g. if voltage is high enough/ 0.6V<br><br>**Allow** (the idea that) current is correct direction for the diode [1]<br><br>**allow** no current when voltage is negative [1]<br>**allow** (idea that) circuit diagram shows diode in forward bias / current direction is L to R / anticlockwise for this diode [1] |
| | **Total** | **4** | |

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<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>5 a</td><td>
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<tr><th>X</th><th>Y</th><th>Z</th></tr>
<tr><td>(0)</td><td>(0)</td><td>1</td></tr>
<tr><td>(0)</td><td>(1)</td><td>0</td></tr>
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[2]
</td><td>2</td><td>all correct for 2 marks<br><br>2 or 3 rows correct for 1 mark</td></tr>
<tr><td>b</td><td>
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<tr><th>E</th><th>F</th><th>G</th></tr>
<tr><td>0</td><td>1</td><td>1</td></tr>
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| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 6 a | 7.5 (ohms) [2]<br><br>**but if answer incorrect**<br><br>correct values of voltage and current from graph [1] | 2 | <br><br><br><br>correct values e.g. 3 and 0.4 or 6 and 0.8 |
| b | **E** (no marks)<br><br>Idea that longer conductors have a greater resistance [1]<br><br>(idea that) the line with the shallowest / least gradient has the greatest resistance [1] | 2 | If E **NOT** chosen [0]<br><br>Longer length has lower current [1]<br><br>allow credit for candidates who calculate the resistance of E as 200 (Ω) [1] |
| c | **mistakes are:**<br><br><br><br>**electrons** not protons are the charge carriers<br><br>atoms vibrate **more** not less<br><br>**increases** the resistance of the conductor not decreases it | 2 | **allow mistakes indicated on the text**<br><br>three mistakes corrected [2]<br><br>one or two mistakes corrected [1] |
| | **Total** | **6** | |

| Question | | | Answer | Marks | Guidance |
|---|---|---|---|---|---|
| 7 | (a) | (i) | 0.15 (amps) (3)<br><br>**but if answer incorrect**<br><br>(I =) 0.75 / 5 (2)<br><br>**or**<br><br>5 or 4.8 to 5.2 (ohms stated as the resistance) (1) | 3 | **allow** answer in the range of 0.144 – 0.156 (amps) (3)<br><br>**allow** 5 in range of 4.8 – 5.2<br><br>**allow** 5 (ohms) seen (even in an incorrect calculation) (1)<br>eg. 5 / 0.75 (1)<br>eg. 5 (taken from graph / slope of graph) (1) |
| | | (ii) | as length increases current reduces / AW / ora (1) | 1 | **allow** inversely proportional<br>**ignore** resistance / faster or stronger current |
| | (b) | | straight line (by eye) on graph starting at / pointing towards (0,0) with a steeper gradient than original line (1) | 1 | curved line (by eye) scores (0) |
| | | | **Total** | **5** | |

| Question | | | Answer | Marks | Guidance |
|---|---|---|---|---|---|
| 8 | (a | | resistance decreases (1)<br><br>brightness of lamp / current increases (1) | 2 | **ignore** weaker resistance<br><br>**ignore** faster / stronger current<br><br>But resistance increases (0) so brightness of lamp / current decreases (1) |
| | **(b)** | **(i)** | 0.92 (Ω) (2)<br><br>**but if answer is incorrect**<br><br>$\frac{1}{R_T} = \frac{}{2} \quad \frac{1}{3} + \frac{1}{}$ (1)<br>**or**<br><br>$\frac{1}{R_T} = 0.5 + 0.33 + 0.25$ (1) | 2 | **allow** 0.92(307692) (2)<br>**allow** 0.9 (2)<br>**allow** $\frac{12}{13}$ (Ω) (2) |
| | | **(ii)** | 4.3 (amps) (2)<br><br>**but** $\frac{4}{0.92}$ (1) | 2 | allow 4.30 to 4.45 (2)<br><br>allow ecf from bi (2)<br>eg for ecf of 1.08 - allow 3.7 (2)<br><br>eg for ecf of 9 - allow 0.44 or 0.4 (2)<br><br>allow 4 / answer to bi (1) eg 4/1.08 (1)<br><br>**allow** 4.30 to 4.45 (2)<br><br>**allow** $\frac{4}{\text{answer to b(i)}}$ (1) |
| | **(c)** | | $I_e$ = 0.60 mA (1) | 1 | **Allow** 0.6 (1) |
| | | | **Total** | **7** | |