

| Question Number | Answer | Acceptable answers | Mark |
|-----------------|--|---|------------|
| 1(a) | Any one from the following points <ul style="list-style-type: none"> • (overheating) in a computer (1) • (waste heat) in a light bulb (1) • (sparks/heat) in an electric motor (1) | Note: any applicable example where dissipation of thermal energy is a clear disadvantage (charge flowing) in a resistor | (1) |

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| 1(b) | substitution (1) 500 = I x 230 transposition (1) 500/230 evaluation (1) 2.2 (A) | substitution and transposition in either order 2.17 (A) / 2 (A) give full marks for correct answer, no working | (3) |

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| 13(c) | joules per coulomb | | (1) |

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| 1(d) | An explanation linking two of the following points <ul style="list-style-type: none"> • electron collision (1) • (in the/and the) lattice (1) | allow hit, bump into for collide atoms/electrons/molecules/ions not between atoms | (2) |

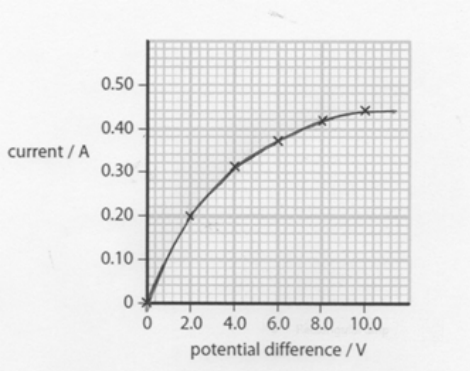
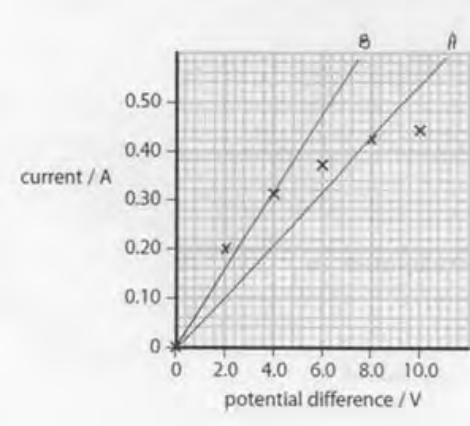
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| 1(e) | (Resistance =) 20 000 Ω (from graph) (1) substitution (1) 0.0006 x 20 000 evaluation (1) 12 (V) | ecf if clear misread of R from graph ignore powers of ten until evaluation Give full marks for correct answer, no working | (3) |

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|-----------------|---------------------|--------------------|------------|
| 2(a)(i) | D variable resistor | | (1) |

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| 2(a)(ii) | B in parallel with the lamp | | (1) |

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| 2(a)(iii) | <p>A description including</p> <ul style="list-style-type: none"> resistance changed (1) reduced/decreased/lowered (1) <p>OR</p> <ul style="list-style-type: none"> voltage/p.d /EMF (of supply) changed (1) increased /turned up/higher(1) | <p>remove (variable) resistor /component X (2)</p> <p>number of batteries/number of cells</p> <p><u>add</u> another cell/battery/battery pack/power pack/power supply (2)</p> | (2) |

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| 2(b)(i) | both points correct (1) | allow + / - half square | (1) |

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| 2(b)(ii) | <p>curve of best fit judged by eye (1)</p>  <p>The graph shows current in Amperes (A) on the y-axis (0 to 0.50) and potential difference in Volts (V) on the x-axis (0 to 10.0). Five data points are plotted at approximately (2.0, 0.20), (4.0, 0.30), (6.0, 0.38), (8.0, 0.42), and (10.0, 0.44). A smooth curve is drawn through these points, starting at the origin and leveling off as potential difference increases.</p> | <p>Must pass through zero and two other points. 5th point can be either (8.0,0.42) or (8.0, 0.44)</p> <p>straight line of best fit through origin tolerance between lines A and B shown on the diagram</p>  <p>The graph shows the same five data points as the first graph. Two straight lines, labeled A and B, are drawn through the origin and the data points. Line A is steeper than line B. The data points are approximately at (2.0, 0.20), (4.0, 0.30), (6.0, 0.38), (8.0, 0.42), and (10.0, 0.44).</p> <p>5th point can be either (8.0,0.42) or (8.0, 0.44)</p> | (1) |

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|-----------------|--|--|------------|
| 2(c) | substitution (1) 10/0.44 or 250/11 evaluation (1) 23 (ohms) | give full marks for correct answer, no working 22.7(ohms), 22.73 (ohms), 22.72(ohms) Ignore excessive decimal places. | (2) |

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| 2(d)(i) | an explanation linking two of the following points <ul style="list-style-type: none"> • electric(al)(energy) (1) • (is converted) to heat / thermal (energy) (1) • (is converted) to light (1) | electricity | (2) |

Total marks for question 3 = 10

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|-----------------|---|---|------------|
| 3(a)(i) | 11x 0.4 (substitution) (1) 4.4 (V) (1) | Full marks for correct answer with no calculation | (2) |

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| 3(a)(ii) | 0.6 - 0.4 (A) (1) | 0.2 or 1/5 (A) | (1) |

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| 3(a)(iii) | B | | (1) |

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| 3(b) | An explanation linking: electrons (1) {colliding with / bumping into} ions in the lattice /atoms in the metal (1) | colliding with other electrons If no other marks scored, allow for 1 mark for "electrical energy { transferred/changed} into thermal/heat energy" <u>do not allow</u> energy being created or produced | (2) |

| Question Number | Indic | Mark |
|-----------------|--------------|---|
| QWC | *) | |
| | | (6) |
| Level | 0 | No rewardable content |
| 1 | 1 - 2 | <ul style="list-style-type: none"> a limited explanation linking light affecting LDR AND heat affecting thermistor OR a correct relationship for one device, e.g. thermistors change resistance when the temperature changes and LDRs change resistance when it gets dark OR the {resistance decreases/ current increases} of a LDR when the light gets brighter the answer communicates ideas using simple language and uses limited scientific terminology spelling, punctuation and grammar are used with limited accuracy |
| 2 | 3 - 4 | <ul style="list-style-type: none"> a simple explanation correctly linking the temperature and light with resistance or current for both devices OR a correct relationship for one device with a link to the way this affects the current and resistance. e.g. the resistance of a LDR increases when the light gets dimmer and when the temperature lowers the resistance of a thermistor increases OR the resistance of a LDR decreases when the light gets brighter and this increases the current the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately spelling, punctuation and grammar are used with some accuracy |
| 3 | 5 - 6 | <ul style="list-style-type: none"> a detailed explanation including the qualitative relationships for both devices and a link to the way resistance change affects the current in BOTH of them, e.g. the resistance of a LDR is less when the light gets brighter which increases the current. When the temperature lowers the resistance of a thermistor increases. This means that the current will decrease as the thermistor cools down. the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately spelling, punctuation and grammar are used with few errors |

Total for question 5 = 12 marks

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| 4(a)(i) | D decrease the resistance of the variable resistor | | (1) |

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| 4(b)(i) | <p>correct symbol for ammeter or voltmeter (seen anywhere) (1)</p> <p>one meter connected in parallel with lamp/variable resistor/supply and one meter in series with lamp(1)</p> <p>both meters correctly connected (ammeter in series and voltmeter in parallel with lamp) (1)</p> | <p>Ignore gaps, lines through symbols and wire connected to side of variable resistor</p> <p>Symbols do not have to be correct for this mark voltmeter connected across both components is same as voltmeter connected across supply</p> <p>Symbols do not have to be correct for this mark</p> <p>any shape, labelled ammeter, in series with lamp AND any shape, labelled voltmeter, in parallel with lamp gains marking points 2 and 3</p> | (3) |

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| 4(b)(ii) | <p>substitution (1) 0.5 x 8</p> <p>evaluation (1) 4 (V)</p> | <p>bad 4.0 x 10ⁿ gains 1 mark eg bad 40 or 0.4 = 1 mark (BOD for correct substitution)</p> <p>give full marks for correct numerical answer, 4 (V) even if no working</p> | (2) |

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| 4(c) | <p>An explanation linking the following points</p> <p>Heat/thermal energy is produced (1)</p> <p>In the lamp/bulb / variable resistor / connecting wires (1)</p> | <p>Ignore sound (energy) and 'it is inefficient'</p> <p>Accept 'it' as meaning the lamp Eg 'it also produces heat' gains both marks</p> <p>Idea that (some) energy is wasted/lost in the lamp/variable resistor/wires gains maximum of 1 mark</p> | (2) |

| Question Number | Answer | Acceptable answers | Mark |
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| 4(d) | <p>substitution (1) 0.4 x 5</p> <p>evaluation (1) 2 (W)</p> | <p>bald 2.0×10^n gains 1 mark eg bald 20 or 0.2 = 1 mark (BOD for correct substitution)</p> <p>give full marks for correct numerical answer, 2 (W) no working</p> | (2) |

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| 5(a)(i) | B | (1) |

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| 5(a)(ii) | substitution (1) $V = 0.5 \times 12$ evaluation (1) $V = 6$ (V) | Correct answer with no working shown gains two marks. | (2) |

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| 5(a)(iii) | <ul style="list-style-type: none"> P / ammeter reading would increase. (1) Q / voltmeter reading would increase (1) | They(both) would increase for two marks | (2) |

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| 5(a)(iv) | (current/it) would decrease (1) | smaller/lower/reduce/less Ignore slowing down | (1) |

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|------------------|--|--------------------|-------|--|--|--|--|--|--|---|------------|
| 5(b) | <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%; text-align: center;">component symbol</th> <th style="width: 50%; text-align: center;">graph</th> </tr> </thead> <tbody> <tr> <td style="height: 40px;"></td> <td style="height: 40px;"></td> </tr> <tr> <td style="height: 40px;"></td> <td style="height: 40px;"></td> </tr> <tr> <td style="height: 40px;"></td> <td style="height: 40px;"></td> </tr> </tbody> </table> | component symbol | graph | | | | | | | <p>All three lines correct for 2 marks</p> <p>One or two lines correct for 1 mark</p> <p>More than one line against any box cannot score more than 1 mark in total.</p> | (2) |
| component symbol | graph | | | | | | | | | | |
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