

Mark Scheme

Q1.

Question Number	Answer	Mark
	A is the correct answer (Reading on V_1 decreases, readings on V_2 and A increase) B is not the correct answer as the decreased resistance of the thermistor will lead to a greater share of the p.d. across the fixed resistor C is not the correct answer as the meter readings show what would happen if the temperature decreased D is not the correct answer as none of the three meter readings would change in the ways stated	(1)

Q2.

Question Number	Answer	Mark
	The only correct answer is C - $\frac{2\varepsilon}{3}$ A is not correct because the two resistors in parallel have half the resistance of the resistor connected across the voltmeter B is not correct because the resistors do not share the potential difference equally D is not correct because the p.d. cannot be greater than the emf	1

Q3.

Question Number	Answer	Mark
	D is the correct answer A is not correct because the current should increase and the potential difference should increase. B is not correct because the current should increase. C is not correct because the potential difference should increase.	1

Q4.

Question Number	Answer	Mark
	A is the correct answer B is not the correct answer as both the ammeter and voltmeter readings decrease. C is not the correct answer as the voltmeter reading decreases. D is not the correct answer as the ammeter reading decreases.	(1)

Q5.

Question Number	Answer	Mark
	The only correct answer is B $\left(V \times \frac{x}{l}\right)$ A is not correct because this is an incorrect ratio of length C is not correct because this incorrect ratio of length D is not correct because incorrect ratio of length	1

Q6.

Question Number	Answer	Mark
	D is the correct answer as the sum of the e.m.f.s is equal to the sum of the p.d.s in the circuit. A is not the correct answer as if the resistance of the LDR halved the voltmeter reading would increase. B is not the correct answer as increasing the light intensity would increase the voltmeter reading (as the LDR would have a lower resistance) C is not the correct answer as increasing the light intensity would increase the voltmeter reading (as the LDR would have a lower resistance)	(1)

Q7.

Question Number	Answer	Mark
	The only correct answer is D (increases ; decreases) A is not correct as thermistor resistance will decrease and voltmeter reading will decrease so an ammeter reading increase B is not correct as thermistor resistance will decrease and voltmeter reading will decrease so an ammeter reading increase C is not correct as thermistor resistance will decrease and voltmeter reading will decrease so an ammeter reading increase	1

Q8.

Question Number	Answer	Mark
	C is the correct answer as power for the whole circuit = $\mathcal{E} \times I$ and I increases whilst e.m.f. remains the same A is not the correct answer as increased intensity increases the number of conduction electrons released by the LDR B is not the correct answer as the potential difference across the LDR will decrease, causing the potential difference across the resistor to increase D is not the correct answer as the resistance of an LDR decreases as light intensity increases	(1)

Q9.

Question Number	Answer	Mark
	D is the correct answer A is not the correct answer as increasing temperature causes an increase in current for this circuit. B is not the correct answer as increasing temperature causes an increase in current for this circuit. C is not the correct answer as increasing temperature decreases the p.d. across the thermistor, but increases the p.d. across the fixed resistor.	(1)

Q10.

Question Number	Answer	Mark
(a)	Use of $R = V/I$ (1) Or Equates ratio of resistances to ratio of p.d.s (1) $R = 1300 \Omega$ (1) <u>Example of calculation</u> Whole circuit current = $V/R = 1.19 \text{ V} / 5000 \Omega = 2.38 \times 10^{-4} \text{ A}$ R (of LDR) = $V/I = (0.31 \text{ V}) / (2.38 \times 10^{-4} \text{ A}) = 1300 \Omega$	2
(b)	Calculates p.d. across fixed resistor as 1.497V (1) Difference between 1.50 and 1.497 is less than 0.01V (1) OR Calculates p.d across the LDR as 0.003 V (1) $0.003 < 0.01\text{V}$ (1) OR As resistance of the LDR decreases, the voltmeter reading increases (1) p.d. across the LDR becomes less than 0.01 V (1) OR Ratio of resistor resistance to LDR resistance becomes very high (1) p.d. across the LDR becomes less than 0.01 V (1) (Do not allow MP1 for use of $V = IR$ with current value calculated in (a)) (3rd or 4th methods – allow “there is hardly any p.d. across the LDR”) (For all MP, allow “resolution of the voltmeter” for “0.01V”) (For MP1 via 3rd method, allow “p.d. across (fixed) resistor increases” for “the voltmeter reading increases”)	2
Total for Question		4

Q11.

Question Number	Answer	Mark
(a)	The resistance of the LDR increases,(so the current decreases) Or The resistance of the LDR increases, so the LDR has a greater p.d. So the p.d. across the fixed resistor decreases (dependent on MP1)	(1) (1) 2
(b)	Use of $V = IR$ Use of R_{LDR}: $R_{resistor} = 3:2$ $R_{LDR} = 33 \Omega$ OR Use of V_{LDR}: $V_{resistor} = 3:2$ Use of $V = IR$ $R_{LDR} = 33 \Omega$ <u>Example of calculation</u> $R_{resistor} = \frac{0.62 \text{ V}}{28 \times 10^{-3} \text{ A}} = 22.1 \Omega$ $R_{LDR} = 22.1 \Omega \times \frac{3}{2} = 33.2 \Omega$ OR $0.62 \text{ V} \times \frac{3}{2} = 0.93 \text{ V}$ $R_{LDR} = \frac{0.93 \text{ V}}{28 \times 10^{-3} \text{ A}} = 33 \Omega$	(1) (1) (1) (1) (1) (1) (1) 3
Total for question		5

Q12.

Question Number	Answer	Mark																																								
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	Indicative content - Resistance of LDR decreases - Due to increase in number of (conduction) electrons - So the resistance of circuit decreases - Or This results in greater current in circuit/LDR/resistor - e.m.f. of the circuit is the same - And due to $P = VI$ Or $P = I^2R$ Or $P = V^2/R$ (for whole circuit) - The power dissipated by the circuit increases (IC2 – allow “number of charge carriers” or “charge carrier density”) (IC4 – allow “total circuit voltage/p.d.” for “e.m.f.”) (IC6 – needs to be related to correct V, I, R for whole circuit)	6
	Total for question	6

Question Number	Answer	Mark								
(a)	Uses ratio of resistances to p.d.s (1) $V = 1.2 \text{ V}$ (1) OR Use of $R = V/I$ (1) $V = 1.2 \text{ V}$ (1) <u>Example of calculation</u> $V = \left(\frac{55 \text{ k}\Omega}{12 \text{ k}\Omega + 55 \text{ k}\Omega} \right) \times 1.5 \text{ V} = 1.23 \text{ V}$	2								
(b)	1 mark for each correct reason (1)(1) 1 mark for each explanation (1)(1) <table><tr><th>Reason</th><th>Explanation</th></tr><tr><td>Cell has (internal) resistance</td><td>Terminal/cell p.d. is lower Or lost volts</td></tr><tr><td>Resistance in wires/connections</td><td>Wires/connections have p.d. across them too.</td></tr><tr><td>Voltmeter has a “low” resistance Or voltmeter draws current</td><td>Resistance of parallel combination would be less than 55 kΩ (so p.d. would be lower)</td></tr></table>	Reason	Explanation	Cell has (internal) resistance	Terminal/cell p.d. is lower Or lost volts	Resistance in wires/connections	Wires/connections have p.d. across them too.	Voltmeter has a “low” resistance Or voltmeter draws current	Resistance of parallel combination would be less than 55 kΩ (so p.d. would be lower)	4
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Cell has (internal) resistance	Terminal/cell p.d. is lower Or lost volts									
Resistance in wires/connections	Wires/connections have p.d. across them too.									
Voltmeter has a “low” resistance Or voltmeter draws current	Resistance of parallel combination would be less than 55 kΩ (so p.d. would be lower)									
Total for question		6								

Q14.

Question Number	Answer	Additional Guidance	Mark
(a)	EITHER Use of ratio of resistances (1) Use of corresponding ratio of p.d.s (1) Minimum voltmeter reading = 1.8 V (1) OR Use of $R = \frac{V}{I}$ to determine circuit current (1) Use of $R = \frac{V}{I}$ to determine pd across 6.8 kΩ resistor (1) Minimum voltmeter reading = 1.8 V (1)	<u>Example of calculation</u> $\frac{V}{3.0 \text{ V}} = \frac{6.8 \text{ k}\Omega}{6.8 \text{ k}\Omega + 4.7 \text{ k}\Omega} W$ $V = 3.0 \text{ V} \times \frac{6.8 \text{ k}\Omega}{11.5 \text{ k}\Omega} = 1.77 \text{ V}$ Allow 1 mark for any use of $R = \frac{V}{I}$ for MP1	3
(b)	Use of $P = \frac{V^2}{R}$ (1) $P = 7.8 \times 10^{-4} \text{ W}$ ecf from (a) (1)	Allow use of $P = VI$ or $P = I^2R$ <u>Example of calculation</u> $P = \frac{(3.0)^2}{(6.8 + 4.7) \times 10^3 \Omega} = 7.83 \times 10^{-4} \text{ W}$	2
(c)	Use of $I = \frac{\Delta Q}{\Delta t}$ and of $V = \frac{W}{Q}$ (1) $E = 680 \text{ J}$ (1)	<u>Example of calculation</u> $Q = 2.5 \text{ A} \times (1.5 \times 60) \text{ s} = 225 \text{ C}$ $E = 225 \text{ CC} \times 3.0 \text{ V} = 675 \text{ J}$	2
Total for question			7

Question Number	Answer	Mark
(a)	Uses $R = V/I$ for resistor (1) Or uses potential divider Uses $R = V/I$ for thermistor (1) R for thermistor = $19\ \Omega$ (1) Temperature = $32 - 36^\circ\text{C}$ (1) <u>Example of calculation</u> $R = V/I$, $I = V/R$ (for resistor), $I = (3.42\ \text{V}) / (11.5\ \Omega) = 0.297\ \text{A}$ $R = V/I$ (for thermistor) = $(9.00 - 3.42\ \text{V}) / (0.297\ \text{A}) = 18.8\ \Omega$	4
(b)	Increased e.m.f. leads to greater current (1) (Increased current leads to) greater temperature (1) Resistance of thermistor would decrease (1) (The proportion of the total p.d. across thermistor would decrease so) voltmeter reading would more than double so student incorrect (1) (For MP4 there needs to be a clear conclusion that the student is incorrect)	4
Total for question		8

Q16.

Question Number	Answer	Mark
(a)	10°C corresponds to 2.0 Ω (1) Use of ratio of resistances (1) Use of corresponding ratio of p.d.s (1) To a p.d. of 0.7(06) V (1) If temperature goes below this level then resistance of thermistor increases (1) So p.d. to heater (switch) increases and so heater switch does perform as required (1) <u>Example of calculation</u> $\frac{V}{6.0} = \frac{2.0}{15 + 2.0}$ $V = 0.706 \text{ V}$ Or 10°C corresponds to 2.0 Ω (1) Use of $I = V/R$ for whole circuit (1) Use of $V = IR$ for thermistor (1) To a p.d. of 0.7(06) V (1) If temperature goes below this level then resistance of thermistor increases (1) So p.d. to heater (switch) increases and so heater switch does perform as required (1) <u>Example of calculation</u> $I = 6.0 \text{ V} / (2 + 15) \Omega$ $= 0.353 \text{ A}$ $V = 0.353 \text{ A} \times 2.0 \Omega$ $= 0.706 \text{ V}$	6

(b)	Increase in temperature results in more electrons released Or Increase in temperature results in more electrons moving into conduction band (1) So resistance decreases (dependent on MP1) (1) [allow converse argument]	2
Total for question		8

Q17.

Question Number	Answer	Mark																				
* a	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 indicative content. <table><tr><th>Number of indicative marking points seen in answer</th><th>Number of marks awarded for indicative marking 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> 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 of answer and sustained line of reasoning</th></tr><tr><td>Answer shows a coherent and logical structure with linkages 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 linkages between points and is unstructured</td><td>0</td></tr></table> Indicative content • When temperature is higher, greater energy to electrons (in thermistor) • When temperature is higher, more conduction/free electrons • When temperature is higher, lower resistance in thermistor • Decreased p.d. across thermistor / YZ Or current in circuit/thermistor increases • Increased p.d. across fixed resistor Or increased p.d. across XY • So for the air conditioning application, secondary circuit should be across XY (Allow converse statements for IC 1,2, 3 and 4) (Do not allow contradicting statements for IC4 e.g. lower V so lower I)	Number of indicative marking points seen in answer	Number of marks awarded for indicative marking points	6	4	5-4	3	3-2	2	1	1	0	0		Number of marks awarded for structure of answer and sustained line of reasoning	Answer shows a coherent and logical structure with linkages and fully sustained lines of reasoning demonstrated throughout	2	Answer is partially structured with some linkages and lines of reasoning	1	Answer has no linkages between points and is unstructured	0	(6)
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Answer shows a coherent and logical structure with linkages and fully sustained lines of reasoning demonstrated throughout	2																					
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b	Ratio of p.d.s to resistances	(1)	(3)
	See either 775 Ω or 263 Ω for light dependent resistor	(1)	
	Difference = (-) 512 Ω	(1)	
	Or		
	Use of $R = V/I$ to calculate current	(1)	
	See either 775 Ω or 263 Ω for light dependent resistor	(1)	
	Difference = (-) 512 Ω	(1)	
	Example of calculation		
	$\frac{7.29 \text{ V}}{4.71 \text{ V}} = \frac{1200 \Omega}{R}$ so $R = 775 \Omega$		
	$\frac{9.84 \text{ V}}{2.16 \text{ V}} = \frac{1200 \Omega}{R}$ so $R = 263 \Omega$		
	Difference in resistance = 263 Ω - 775 Ω = (-) 512 Ω		
Total for question			9

Q18.

Question Number	Answer	Mark
(a)	Either Resistance at 54°C = 0.95 - 1.0 (kΩ) (1) Use of resistors in parallel formula (1) Use of $V = IR$ (1) Milliammeter reading = 9.0 (mA) (1) (MP2 can only be awarded if the thermistor resistance is added to 3.0 kΩ prior to using the formula). Or Resistance at 54°C = 0.95 - 1.0 (kΩ) (1) Use of $V = IR$ to calculate current in 2.0 kΩ resistor (1) Use of resistors in series formula and $V = IR$ (1) Milliammeter reading = 9.0 (mA) (1) <u>Example of calculation</u> At 54°C, resistance of thermistor (read from graph) = 1.0 kΩ. $\frac{1}{R_T} = \frac{1}{2000 \Omega} + \frac{1}{(3000+1000)\Omega}, \text{ so } R_T = 1333 \Omega$ $I = \frac{V}{R} = \frac{12 \text{ V}}{1333 \Omega} = 9.0 \text{ mA}$	4
(b)(i)	Resistance (of thermistor) increases (1) (Thermistor takes a larger share of the pd) so voltmeter reading increases (1) (MP2 dependent on MP1 being awarded)	2
(b)(ii)	Either Potential difference (across 2.0 kΩ resistor) is constant (1) Power dissipated (by 2.0 kΩ resistor) remains the same because $P = V^2/R$ (1) Or Current (in 2.0 kΩ resistor) is constant (1) Power dissipated (by 2.0 kΩ resistor) remains the same because $P = I^2 R$ (1) Or Potential difference and current (for 2.0 kΩ resistor) are both constant (1) Power dissipated (by 2.0 kΩ resistor) remains the same because $P = VI$ (1)	2
Total for question		8

Question Number	Answer	Mark
ai	Use of $\frac{1}{R} = \frac{1}{500\ \Omega} + \frac{1}{600\ \Omega}$ (1) Use of $V = IR$ (1) Voltmeter reading = 6.3 (V) (1) <u>Example of calculation</u> $\frac{1}{R_{\text{parallel}}} = \frac{1}{500\ \Omega} + \frac{1}{600\ \Omega}$, so $R_{\text{parallel}} = 273\ \Omega$ $V = IR = 23.0 \times 10^{-3}\ \text{A} \times 273\ \Omega = 6.28\ \text{V}$	3
aii	p.d. across thermistor = 12 V – 6.3 V (allow ecf from ai) (1) Use of $P = VI$ (allow use of $P = I^2R$ or $P = V^2 / R$) (1) $P = 0.13\ \text{W}$ (1) <u>Example of calculation</u> p.d. across thermistor = 12.0 V – 6.3 V = 5.7 V $P = VI = 5.7\ \text{V} \times 23 \times 10^{-3}\ \text{A}$ $P = 0.13\ \text{W}$	3
b	Resistance (of circuit/thermistor) increases (1) Ammeter reading decreases (dependent on MP1) Or Current decreases (dependent on MP1) (1) p.d. across thermistor increases Or $V=IR$ for fixed/parallel resistors, and I decreases (1) Reading on voltmeter decreases (dependent on MP3) Or p.d. across fixed/parallel resistors decreases (dependent on MP3) (1) (Allow 1 mark maximum if stated that both ammeter and voltmeter readings decrease, and no other marks have been awarded)	4
Total for question		10

Q20.

Question Number	Acceptable Answer	Additional Guidance	Mark
(a)	6 J of energy is transferred to each coulomb of charge (by the battery) (1)	Accept: 6 V is the potential difference between the terminals of the battery if no current is drawn Terminal potential difference is 6 V (since internal resistance is negligible)	1

(b)(i)	p.d across $200\ \Omega$ resistor = $6.00 - 1.64$ (= 4.36 V) Use of $R = \frac{V}{I}$ Or Ratio of resistance = ratio of p.d. $I = 2\text{ (mA)}$	(1) (1) (1) <u>Example of calculation</u> $200\ \Omega = \frac{4.36\text{ V}}{I}$ $I = \frac{4.36\text{ V}}{200\ \Omega} = 2.18 \times 10^{-2}\text{ (A)}$	3
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(b)(ii)	EITHER Use of $R = \frac{V}{I}$ for resistance of parallel section Or Use of $R = \frac{V}{I}$ for resistance of total circuit and subtract $200\ \Omega$ (1) Use of resistors in parallel equation. (1) $R_X = 304\ \Omega$ (1) (Allow ecf from (b)(i)) OR Use of $R = \frac{V}{I}$ for current in $100\ \Omega$ resistor (1) Use of $I_{\text{tot}} = I_1 + I_2$ for current in resistor X (1) $R = 304\ \Omega$ (1) (Allow ecf from (b)(i))	Show that value gives $456\ \Omega$ (MP3 dependent on MP2 being awarded) <u>Example of calculation</u> $R_{\text{parallel}} = \frac{1.64\ \text{V}}{2.18 \times 10^{-2}\ \text{A}}$ $= 75.23\ \Omega$ show that value $= 82\ \Omega$ $\frac{1}{R_X} + \frac{1}{100\ \Omega} = \frac{1}{75.23\ \Omega}$ $R_X = 303.7\ \Omega$ OR $I = \frac{1.64\ \text{V}}{100\ \Omega} = 1.64 \times 10^{-2}\ \text{A}$ $2.18 \times 10^{-2}\ \text{A} - 1.64 \times 10^{-2}\ \text{A}$ $= 5.4 \times 10^{-3}\ \text{A}$ $R = \frac{1.64\ \text{V}}{5.4 \times 10^{-3}\ \text{A}} = 303.7\ \Omega$	3
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(b)(iii)	Use of $P = \frac{V^2}{R}$ Or use of $P = VI$ (1) Or use of $P = I^2R$ (1) $P = 2.70 \times 10^{-2} \text{ W}$ (Allow ecf from (b)(i) or (b)(ii) for I)	<u>Example of calculation</u> $P = \frac{(1.64 \text{ V})^2}{100 \Omega}$ $P = 2.70 \times 10^{-2} \text{ W}$	2
(c)	The resistance of the parallel combination would increase (1) So the ratio / share of parallel combination resistance to other resistance increases and so does the voltmeter reading, so student is correct (1)		2

Q21.

Question Number	Answer	Mark
a	Use of resistors in parallel formula (1) Resistance of parallel section of circuit calculated as 1.33Ω (1) Total circuit resistance = 2Ω + their parallel resistance Or Use of ratio of resistance:p.d. (1) Use of $I = V/R$ to calculate total circuit current (3A) Or Use of $I = V/R$ to calculate p.d. across resistor A (6V) (1) Use of $P = VI$, $P = V^2/R$ or $P = I^2R$ (1) A = 18W, B = 2W, C = 2W, D = 8W (1) Example of calculation $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$ (for parallel combination) $\frac{1}{R_p} = \frac{1}{2} + \frac{1}{4}$ $R_p = 1.33\Omega$ Total resistance in circuit = $(1.33 + 2.00) = 3.33\Omega$ $I = V/R$ (for whole circuit) = $10.0\text{ V} / 3.33\Omega = 3.00\text{ A}$ For resistor A, $P = I^2R = (3.00\text{ A})^2 \times 2.00\Omega = 18\text{ W}$ Current through D = $\frac{2}{3} (3.00\text{ A}) = 2.00\text{ A}$ For D, $P = I^2R = (2.00\text{ A})^2 \times 2.00\Omega = 8\text{ W}$ For B and C, $P = I^2R = (1.00\text{ A})^2 \times 2.00\Omega = 2\text{ W}$	6
b	(With resistor D removed there is) lower circuit current Or (with resistor D removed there is) lower p.d. across A (1) Seeing an appropriate power equation to support the conclusion that power would be less in A (1)	2
c	As p.d increases, current increases (1) (As current increases,) temperature increases (allow "heats up") (1) Atoms/ions/lattice have greater vibrations/KE (1) Increased rate of collisions between electrons and atoms/ions (1)	4
Total for question		12

Question Number	Answer	Mark
a	See $V_T = V_1 + V_2$ (1) See $IR_T = IR_1 + IR_2$ (1) (Divides by I to give) $R_T = R_1 + R_2$ (1)	3
b	Use of $V = IR$ with 7.0V and 0.5A (1) Use of $\frac{1}{R_{tot}} = \frac{1}{R_1} + \frac{1}{R_2}$ (1) $R = 12\Omega$ (1) Or Use of $V = IR$ with 6Ω and 0.5A (to get 3V across 6Ω resistor) (1) Second use of $V = IR$ with $V = 4V$ (1) $R = 12\Omega$ (1) <u>Example of calculation</u> R for whole circuit = $(7.0V/0.5A) = 14\Omega$ So R for parallel section = $14 - 6 = 8\Omega$ $1/8 = 1/24 + 1/R_2$ $R_2 = 12\Omega$	3

ci	Use of $V = IR$ to determine circuit current (1) Use of $P = I^2R$ or $P = V^2/R$ or $P = VI$ (1) $P = 1.5 \times 10^{-2} \text{ W}$ (1) Or Ratio of resistances used to calculate p.d. across R (1) Use of $P = V^2/R$ (1) $P = 1.5 \times 10^{-2} \text{ W}$ (1)	3
cii	<u>Example of calculation</u> $I = 12.0 \text{ V} / (8000 + 670 \Omega) = 1.38 \times 10^{-3} \text{ A}$ $P = (1.38 \times 10^{-3} \text{ A})^2 \times 8000 = 0.015 \text{ W}$	
	Decrease in the number of conduction/ free electrons (1) Greater resistance of LDR (1) Less p.d. across the fixed resistor (allow "voltage" for "p.d.") (1) Use of a suitable power equation to conclude that less power dissipated in the fixed resistor. (1) (Converse argument not allowed for MP1 & MP2) (For MP4, do not accept an answer that includes an incorrect statement about one of the variables)	4
Total for question		13

Question Number	Answer	Mark
(a)(i)	Use of $P = VI$ and $V = IR$ Or Use of $P = I^2 R$ and $V = IR$ Appropriate algebra to derive $P = \frac{V^2}{R}$	(1) (1) 2
(a)(ii)	EITHER Their resistance from graph divided by 4 Use of $P = \frac{V^2}{R}$ Use of p.d. across battery = $5 \times$ p.d. across R p.d. across battery = $9.0 - 9.2$ V OR Their resistance from graph divided by 4 Use of $P = I^2 R$ Use of $V = I(R + R_t)$ p.d. across battery = $9.0 - 9.2$ V <u>Example calculation</u> Resistance of $R = \frac{35 \Omega}{4} = 8.75 \Omega$ $0.38 \text{ W} = \frac{V_R^2}{8.75 \Omega}$ $V_R = \sqrt{0.38 \text{ W} \times 8.75 \Omega} = 1.82 \text{ V}$ $V_B = 5 \times 1.82 \text{ V} = 9.1 \text{ V}$	(1) (1) (1) (1) (1) (1) (1) (1) (1) 4

(b)(i)	Number of conduction electrons (per unit volume) increases So current increases (for the same potential difference and $R = V/I$)	(1) (1) 2
(b)(ii)	(Increased temperature caused) increased lattice/atom/ion vibrations (in the thermistor and the wire resistor) This caused an increase in collisions between electrons and the lattice/ions/atoms (in the thermistor and the wire resistor) So the resistance of the wire resistor increased (Because current decreases) total resistance of the circuit must increase So the increase in the resistance of the wire resistor must be greater than the decrease in the resistance of the thermistor	(1) (1) (1) (1) (1) 5
Total for question		13