

<b>4</b>	<p><b>C is the correct answer as the p.d. across a uniform wire is directly proportional to its length</b></p> <p>A is not the correct answer as this does not show a directly proportional relationship          B is not the correct answer as this does not show a directly proportional relationship          D is not the correct answer as this does not show a directly proportional relationship</p>	<b>(1)</b>
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<b>3</b>	<p><b>The only correct answer is B (<math>JV^{-1}</math>)</b></p> <p>A is not correct because a coulomb is a <math>JV^{-1}</math>          C is not correct because a coulomb is a <math>JV^{-1}</math>          D is not correct because a coulomb is a <math>JV^{-1}</math></p>	<b>1</b>
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<b>7</b>	<p><b>D is the correct answer as efficiency is the useful power output (250W) divided by the total power input (Intensity x Area).</b></p> <p>A is not the correct answer as this is <math>(Power \times Area) / Intensity</math>          B is not the correct answer as this is <math>Intensity / (Power \times Area)</math>          C is not the correct answer as this is the reciprocal of the efficiency equation</p>	<b>(1)</b>
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<b>10</b>	<p><b>A is the correct answer as current = total charge / time</b></p> <p>B is not the correct answer as the charge of an electron is incorrectly inserted          C is not the correct answer as the time is incorrectly inserted          D is not the correct answer as the time and charge of an electron have been swapped around</p>	<b>(1)</b>
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<b>2</b>	<p><b>C is the correct answer</b></p> <p>A is not the correct answer as there is a small current In the reverse direction          correct answer as there is a small current In the reverse direction          D is not the correct answer as there is a small current when the p.d. <math>&lt; 0.7 V</math></p>	<b>(1)</b>
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<b>9</b>	<p><b>The only correct answer is B</b></p> <p><i>A is not correct as this graph shows R decreasing as temperature increases.</i></p> <p><i>C is not correct as this graph shows a constant value for R as temperature increases.</i></p> <p><i>D is not correct as this graph shows R decreasing as temperature increases.</i></p>	<b>(1)</b>
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<b>4</b>	<p><b>A is the correct answer (Both points X and Y represent positions on the graph where there is infinite resistance as the current is zero)</b></p> <p>B is not the correct answer as there is a non-infinite resistance at Z          C is not the correct answer as there is also infinite resistance at Y          D is not the correct answer as there is a non-infinite resistance at Z</p>	<b>(1)</b>
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<b>1</b>	<p><b>The only correct answer is B (filament bulb)</b></p> <p>A is not correct because a diode would only show a current in one direction          C is not correct because a resistor would give a straight line through the origin          D is not correct because a thermistor would produce an curve</p>	<b>1</b>
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Question Number	Acceptable Answer	Additional Guidance	Mark
18(a)	<p>Use of resistors in parallel formula</p> <p>Resistance of parallel section of circuit calculated as 1.33(<math>\Omega</math>)</p> <p>Total circuit resistance = <math>2\Omega</math> + their parallel resistance</p> <p><b>Or</b> Use of ratio of resistance: p.d.</p> <p>Use of <math>I = V/R</math> to calculate total circuit current (3A)</p> <p><b>Or</b> Use of <math>I = V/R</math> to calculate p.d. across resistor A (6V)</p> <p>Use of <math>P = VI</math>, <math>P = V^2/R</math> or <math>P = I^2R</math></p> <p>A = 18W, B = 2W, C = 2W, D = 8W</p>	<p>(1) <b>Example of calculation</b></p> <p>(1) <math>\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}</math> (for parallel combination)</p> <p>(1) <math>\frac{1}{R_p} = \frac{1}{2} + \frac{1}{4}</math></p> <p>(1) <math>R_p = 1.33 \Omega</math></p> <p>(1) Total resistance in circuit = <math>(1.33 + 2.00) = 3.33 \Omega</math></p> <p>(1) <math>I = V/R</math> (for whole circuit) = <math>\frac{10.0 \text{ V}}{3.33 \Omega} = 3.00 \text{ A}</math></p> <p>(1) For resistor A, <math>P = I^2R = (3.00 \text{ A})^2 \times 2.00 \Omega = 18 \text{ W}</math></p> <p>(1) Current through D = <math>\frac{2}{3}(3.00 \text{ A}) = 2.00 \text{ A}</math></p> <p>(1) For D, <math>P = I^2R = (2.00 \text{ A})^2 \times 2.00 \Omega = 8 \text{ W}</math></p> <p>(1) For B and C, <math>P = I^2R = (1.00 \text{ A})^2 \times 2.00 \Omega = 2 \text{ W}</math></p>	6
18(b)	<p>(With resistor D removed there is:)</p> <p>Greater circuit resistance</p> <p><b>Or</b> Lower circuit current</p> <p><b>Or</b> Lower p.d. across A</p> <p>As <math>P = VI</math>, the power in A would be less (MP2 dependent on MP1)</p>	<p>(1) Do not award MP1 if any of the three statements are quoted incorrectly</p> <p>(1) Allow reference to <math>P = V^2/R</math> or <math>P = I^2R</math></p>	2
18(c)	<p>(As p.d increases,) current increases</p> <p>(Increase of current linked to) increase in temperature</p> <p>The lattice vibrations increase</p> <p>Increased rate of collisions between electrons and atoms/ions/lattice</p>	<p>(1) Accept "filament heats up"</p> <p>(1) Accept "ions", "atoms" for "lattice"</p> <p>(1) Accept "frequency" for "rate"</p>	4
<b>Total for question 18</b>			<b>12</b>

Question Number	Answer	Mark
18(a)(i)	<p>Uses ratio of resistance to p.d.'s  <b>Or</b> Use of <math>V=IR</math></p> <p><math>V = 4.7 \text{ V}</math></p> <p><u>Example of calculation</u>  <math>V = 9 \text{ V} \times \frac{120 \Omega}{120 \Omega + 110 \Omega} = 4.7 \text{ V}</math></p>	<p>(1)</p> <p>(1)</p> <p><b>2</b></p>
18(a)(ii)	<p>Uses ratio of resistances</p> <p><math>R = 270 \text{ } (\Omega)</math></p> <p><u>Example of calculation</u>  <math>\frac{295 \Omega}{R} = \frac{120 \Omega}{110 \Omega}</math>  <math>R = \frac{295 \Omega \times 110 \Omega}{120 \Omega} = 270 \Omega</math></p>	<p>(1)</p> <p>(1)</p> <p><b>2</b></p>
18(b)(i)	<p>Uses ratio lengths : resistance using <math>300 \Omega</math> and two lengths  <math>R = 150 \Omega</math>  (MP2 is dependent upon awarding MP1)</p> <p><u>Example of calculation</u>  <math>\frac{33.0 \text{ cm}}{67.0 \text{ cm}} = \frac{R}{300 \Omega}</math>  <math>R = 148 \Omega</math></p>	<p>(1)</p> <p>(1)</p> <p><b>2</b></p>
18(b)(ii)	<p>Resistance is greater for a thinner wire  <b>Or</b> resistance between X and W is greater</p> <p>Actual value for the resistance of the variable resistor is greater  <b>Or</b> Measured value for resistance of the variable resistor is lower  (MP2 is dependent on awarding MP1)</p>	<p>(1)</p> <p>(1)</p> <p><b>2</b></p>
18(b)(iii)	<p>Use of micrometer  <b>Or</b> Use of digital calipers</p> <p>Measure at different orientations/places/points/positions/lengths</p> <p>If values are the same/similar, then wire is uniform  (Allow converse argument)</p>	<p>(1)</p> <p>(1)</p> <p>(1)</p> <p><b>3</b></p>
<b>Total for question 18</b>		<b>11</b>

Question Number	Answer	Mark	
12(a)	$\varepsilon = 1.50 \text{ V}$ (accept answers in the range 1.48 V to 1.52 V)	(1)	
	Attempt to calculate gradient of graph to find $r$	(1)	
	$r = 0.75 \Omega$ (accept answers in the range 0.72 $\Omega$ to 0.78 $\Omega$ )	(1)	3
12(b)	Gradient is doubled	(1)	
	y-intercept is doubled	(1)	2
	(If no other marks scored, allow "new graph has steeper gradient <b>and</b> y-intercept has a greater value" for 1 mark)		
	(If no other marks scored, allow new values for $\varepsilon$ and $r$ , consistent with their answers to (a))		
<b>Total for question 12</b>		<b>5</b>	

14(a)	There was no current (in the battery)	(1)
	So there was no potential difference across the internal resistance	(1)

14(b)	Voltmeter connected across battery <b>and</b> ammeter in series with battery	(1)	
	Variable resistor in series with battery <b>Or</b> potential divider	(1)	2
	<u>Example of circuit</u>		

14(c)(i)	e.m.f. = 8.8 V	(1)
	Calculates gradient of graph	(1)
	Internal resistance = 2.2 to 2.4 $\Omega$ <u>Example of calculation</u> $r = \frac{(8.8-0) \text{ V}}{(3.8-0) \text{ A}} = 2.3 \Omega$	(1)

14(c)(ii)	As the current (in the battery) increases, the potential difference across the internal resistance increases	(1)
	Until the p.d. across the internal resistance equals the e.m.f. (and current can no longer increase)	(1)
<b>Total for question 14</b>		<b>9</b>