Question	Answers	Extra information	Mark	AO / Specification reference
01.1	one mark for 'A' in correct place one mark for 'V' in the correct place one mark for resistor labelled correctly one mark for variable resistor labelled correctly		4	AO1 4.2.1.1
01.2	the rate of flow of charge/charge flowing per second		1	AO1 4.2.1.2
01.3	resistance = $\frac{\text{potential difference}}{\text{current}}$ **or** potential difference = current x resistance	allow $R = \frac{V}{I}$ or V = IR	1	AO1 4.2.1.3
01.4	$R = \frac{6}{0.3}$ = 20 unit = Ω	accept 20 with no working for the two calculation marks	1 1 1	AO2 4.2.1.3
02.1	circuits A and C are parallel circuits	no marks if more than one box ticked	1	AO1 4.2.2

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02.2	A, C B, D B, D	both letters (in either order) needed for the mark in each case	1 1 1	AO2 4.2.2
02.3	no the bulbs will be the same brightness because they are in a series circuit		1 1 1	AO2 4.2.2
03	**Level 3**: Correct diagrams with description of measurements (total current and potential difference) to be taken in each circuit. Rearrangement of equation to give an equation for resistance. Correct statement about relative magnitudes of equivalent resistances.		5-6	AO3 4.2.4.3
	Level 2: Diagrams or description of measurements (total current and potential difference) to be taken in each circuit lacking one or two details. Evidence of use of equation involving current, potential difference, and resistance. Correct statement about relative magnitudes of equivalent resistances		3-4	
	Level 1: One correct diagram. Either potential difference or current measurement mentioned. Little or no evidence of use of equation. Little or no statement about the relative magnitudes of the equivalent resistances.		1-2	
	No relevant content.		0	

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	Indicative content: • two correct circuits drawn with an ammeter in each circuit in an appropriate place to measure the total current, with or without a voltmeter across the battery • one circuit should be a parallel circuit with a bulb in each circuit, with an ammeter in the circuit closest to the cell • the other circuit should be a single circuit with two bulbs and one ammeter • you need to measure the total current in each circuit and the potential difference of the supply • you use the equation potential difference = current × resistance • rearrange to give resistance = $\frac{\text{potential difference}}{\text{current}}$ to calculate the equivalent resistance of each circuit • the equivalent resistance of the series circuit is bigger than the equivalent resistance of the parallel circuit			
04.1	as the temperature increases, the resistance decreases		1	AO1 4.2.1.4
04.2	the reading on the voltmeter will not change it is connected directly across the battery/there is only one component (other than the battery)		1 1	AO2 4.2.2

Question	Answers	Extra information	Mark	AO / Specification reference
04.3	the potential differences across resistors in a series circuit are in the same proportion as the size of the resistances there is $\frac{8\text{ V}}{12\text{ V}}$ across the thermistor, which is $\frac{2}{3}$ so the resistance of the thermistor is 20 kΩ this happens when the resistance is very cold there is $\frac{3\text{ V}}{12\text{ V}}$ across the thermistor, which is $\frac{1}{4}$ so the resistance of the thermistor is 3.3 kΩ this happens when the resistance is very hot		1 1 1 1 1 1 1	AO2 4.2.2
05.1	potential difference = 6 - 4 = 2 V	accept 2 V with no working for two marks	1 1	AO2 4.2.2
05.2	potential difference = current × resistance 4 = 0.2 × resistance resistance = $\frac{4}{0.2}$ = 20 Ω		1 1 1	AO1 AO2 4.2.1.2

Question	Answers	Extra information	Mark	AO / Specification reference
05.3	$R = \frac{2}{0.2}$ $= 10\ \Omega$ **or** total resistance = $\frac{6}{0.2} = 30\ \Omega$ so resistance of resistor = 30 - 20 = 10 Ω		1 1 **or** 1 1	AO2 4.2.2
05.4	decrease adding a resistor in series increases the total resistance of the circuit so less current will flow		1 1	AO2 4.2.2
06.1	component A		1	AO2 4.2.1.4
06.2	evidence of reading current and potential difference from the graph e.g., current = 0.5 A, potential difference = 5.0 V potential difference = current × resistance resistance = $\frac{\text{potential difference}}{\text{current}}$ $= \frac{5.0\text{V}}{0.5\text{A}}$ = 10 (Ω)	any correct pair of readings are suitable	1 1 1 1	AO1 AO2 4.2.1.2

Question	Answers	Extra information	Mark	AO / Specification reference
06.3	as the potential difference increases, the resistance of component A stays the same so the ratio of all the $\frac{\text{potential difference}}{\text{current}}$ readings stays the same (= 10 (Ω)) as the potential difference increases, the resistance of component B increases the ratio of the $\frac{\text{potential difference}}{\text{current}}$ readings increases, from $\frac{1.0}{0.2}$ = 5 Ω to $\frac{3.0}{0.4}$ = 7.5 Ω	do not accept any answer involving gradient of the lines	1 1 1 1	AO2 4.2.1.4
06.4	at 3.0 V, total current = 0.3 A + 0.4 A = 0.7 A		1 1	AO2 4.2.2
06.5	resistance = $\frac{V}{I}$ = $\frac{3}{0.7}$ = 4.3 (Ω)		1 1	AO2 4.2.2
07.1	4.0 A = 1.5 A + 0.5 A + current current = 2.0 A		1 1	AO2 4.2.2
07.2	the total current thorough the cell is equal to the sum of the currents in the branches/loops/current splits at junctions		1	AO1 4.2.2
07.3	12 V		1	AO2 4.2.2

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07.4	the potential difference across components in parallel is the same		1	AO1 4.2.2
07.5	R_2 has the bigger resistance the potential differences across both resistors are the same the current in R_2 is smaller than the current through R_1 a smaller current means a bigger resistance if the potential difference is the same, so R_2 has the biggest resistance.		1 1 1 1	AO2 4.2.1.2
08.1	charge = current × time	accept Q = It	1	AO1 4.2.1.2
08.2	charge = 2 × 25 = 50 Coulombs (C)	accept 50 with no working for two calculation marks	1 1 1	AO1 AO2 4.2.1.2
08.3	increased (the resistance)		1	AO2 4.2.1.3
08.4	decreased if the current is smaller, the charge flowing in the same time will be smaller		1 1	AO2 4.2.1.2

Question	Answers	Extra information	Mark	AO / Specification reference
09.1	charge = current × time $0.6 = 15\times10^{-3} \times$ time time = $\frac{0.6}{15\times10^{-3}}$ = 40 s	accept Q = It award one mark for 0.04 s (not converting from mA)	1 1 1	AO1 4.2.1.2
09.2	a graph labelled mass on x-axis, resistance on y-axis curved shape with decreasing gradient	one mark for a graph labelled mass on x-axis and resistance on y-axis one mark for curved shape with decreasing gradient	2	AO3 4.2.1.2

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09.3	as the mass of salt increases, the current increases the potential difference is constant/6V $R = \frac{V}{I}$, so the resistance will decrease (as mass increases) the current increases at a decreasing rate, so the resistance will decrease at a decreasing rate from 25 g to 30 g, the resistance decreases from 400 Ω to 240 Ω from 75 g to 80 g, the resistance decreases from 150 Ω to 146 Ω		1 1 1 1 1 1	AO2 AO3 4.2.1.2
10.1	graph should show that resistance initially drops sharply, but begins to gradually plateau as light intensity increases the curve should be a smooth arch showing a negative correlation	one mark for light intensity on x-axis and resistance on y-axis one mark for correct units one mark for correct shape of graph	3	AO2 4.2.1.4
10.2	sensible suggestion e.g., street lights, security lights		1	AO2 4.2.1.4

Question	Answers	Extra information	Mark	AO / Specification reference
10.3	description of how it is used appropriate circuit diagram explanation of why it is needed e.g., turning the lights on in a house when it gets dark outside connect up the light dependent resisitor in a circuit with a resistor and a battery circuit diagram with labelled components use the output potential difference across the light dependent resistor or the resistor to switch on the lights as the light level changes, the changing resistance produces a changing potential difference which can be used to turn on the lights when the potential difference reaches a certain level		2 1 2	AO2

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11.1	points should be plotted at the following co-ordinates: (5, 1.5), (10, 3.8), (15, 4.6), (20, 5.9), (25, 7.8) line of best fit should be straight	one mark for three or four points plotted correctly two marks for all points plotted correctly one mark for appropriate scales on correctly labelled axes one mark for appropriate line of best fit	4	AO2 4.2.1.3
11.2	independent variable = length dependent variable = resistance control variable = type of metal/diameter of wire/temperature of wire		1 1 1	AO3 4.2.1.3

Question	Answers	Extra information	Mark	AO / Specification reference
11.3	6.8 (Ω)	accept values between 6.5 and 7.3 (Ω)	1	AO2 4.2.1.3
11.4	take repeat measurements and calculate/plot the average/mean of repeat measurements		1	AO3 4.2.1.3
11.5	both students A and B are correct the line is straight (so it is linear) and goes through (0,0) (so it is directly proportional)		1 1 1	AO3 4.2.1.3