A Level OCR Physics

Chapter 11 Energy, power, and resistance

Question	Answers	Extra information	Mark	AO spec reference
1(a)	$R = V/I$ 7.00 to be seen either on the table or by the question	Must be written to 3 s.f.	1	4.2.3 AO1
(b)	± 0.01 A		1	2.2.1 AO1
(c)	Point plotted to within ½ a small square suitable line of best fit drawn.		1 1	1.1.3 AO1
(d)	Systematic error resistance of connecting wires or Error in measuring length introduced by crocodile clips	Allow any sensible source of systematic error	1 1	2.2.1 AO2
(e)	Large triangle seen or suitable data points from line of best fit Gradient = 13.5 ± 0.5	MUST NOT be data from table	1 1	1.1.3 AO1
(f)	Cross-sectional area of wire = $\pi\,(0.11\times10^{-3})^2 = 3.8\times10^{-8}$ m^2 Use of $R = \rho l/A$ to give gradient = ρ/A $\rho = 13.5 \times 3.8\times10^{-8} = 5.1\times10^{-7}$ (Ω m)	Ignore errors in powers of 10 for this mark poss error carried forward from gradient	1 1 1	4.2.4 AO3
(g)	% difference = $(5.1\times10^{-7} - 4.9\times10^{-7})/4.9\times10^{-7}$ % difference = 4% This data is accurate as below 10% difference	Allow justification for any sensible comment	1 1	2.2.1 AO2
2(a)	The current flowing into a junction must equal the current flowing out of the junction / Kirchhoff's first law (wtte)		1	4.1.1 AO1
(b)	The sum of the pds in a closed loop must equal the sum of emfs in that loop / Kirchhoff's second law (wtte)		1	4.3.1 AO1
(c)	Bulbs in series so same current flows into each		1	4.2.5

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	Use of or mention $P = I^2 R$ (or $P = VI$ or $P = V^2/R$) since I constant $P \propto R$ so A must have greater resistance		1 1	4.3.1 AO2
(d)	Bulbs in parallel so this time pd the same. $P = V^2/R$ since V constant $P \propto 1/R$ Bulb B brightest	If they think B has the higher resistance then allow e.c.f. if correct reasoning applied	1 1 1	4.2.5 4.3.1 AO2
3(a)	X is a (fixed)resistor The resistance is constant the voltage and current are directly proportional Y is a filament lamp The resistance increases with increasing voltage / current / as temperature increases resistance increases		1 1 1 1	4.2.3 AO1
(b)	$R = V/I$ $R = 5.0/0.3 = 16.7\ \Omega$	Must not draw a tangent here	1 1	4.2.3 AO2
(c)	pd across Y = 2.5 V (read from graph) pd across X = 5.0 V (read from graph) Emf = 7.5 V	Can also solve by determining resistance of each bulb with that current and calculating *V* by multiplying resistance by current.	1 1	4.2.3 4.3.1 AO2
(d)	Current in Y = 0.30 A (read from graph) Current in X = 0.20 A (read from graph) Total current = 0.50 A		1 1	4.2.3 4.3.1 AO2
4(a)	Area of 1 strand of cable = $\pi r^2 = \pi\,(1.665\times10^{-3})^2$ For 1 strand $R = \rho l/A = 2.82\times10^{-8} \times 1000 / \pi\,(1.665\times10^{-3})^2$ $R = 3.2\ \Omega$ Therefore for cable $1/R_T = 27\ (1/R_1)$		1 1	4.2.4 4.3.1 AO2

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	$R_T = 0.12\ \Omega$		1	
(b)	R of 1 m = 0.12/1000 = $1.2\times10^{-4}\ \Omega$ or use of $P = I^2R$ $I^2 = P/R$ = 500 A	Allow ecf from answer to 4(a)	1 1	4.2.5 AO3
(c)	$I = nAve$ $v = I/Ane = 500/\pi(1.665\times10^{-3})^2 \times 2.8\times10^{29} \times 1.6\times10^{-19}$ $v = 1.3\times10^{-3}$ m s^{-1}	possible ecf from 4(b)	1 1	4.1.2 AO2
(d)	$t = D/v = 1000/1.3\times10^{-3} = 7.7\times10^{5}$ s = 210 hours		1	3.1.1 AO1
5(a)	$W = Vq = 200 \times 1.6\times10^{-19} = 3.2\times10^{-17}$ J		1	4.2.2 AO1
(b)	3.2×10^{-17} J		1	4.2.2 AO1
(c)	$E = ½\,mv^2$ and $p = mv$ $E = mv^2/2 \times m/m$ (or any other sensible explanation) $E = p^2/2m$ can be rearranged to give …		1	3.5.1 3.3.2 AO2
(d)	$\lambda = h/p$ $\lambda = h/\sqrt{2mKE}$ $\lambda = 6.63\times10^{-34} / \sqrt{2 \times 9.11 \times 10^{-31} \times 3.2 \times 10^{-17}}$ $\lambda = 8.7\times10^{-11}$ m		1 1	4.5.3 AO3
6(a)	Axes labelled – resistance y axis and length /cm x axis R changing and not constant		1 1 1	4.2.4 1.1.3 AO2

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	Graph will be an inverse of shape on paper – when area large resistance small and vice versa			
(b)	Resistivity is constant for a material resistance depends on the length/cross-sectional/resistivity area of the sample		1 1	4.2.4 AO2
(c)	Measurements of pd and current can be used to determine resistance or $R = V/I$		1	4.2.3 AO2
(d)	Any sensible suggestion: Wall would have higher resistance than surrounding soil so would show up/well would have concentration of water lower resistance/changes in water content would show up/broken crockery make change resistivity of soil	**1** for what meter would measure, **1** for how that's useful	1 1	4.2.4 AO3
7(a)	Diode (LED) The component only conducts once you are above the threshold voltage/a certain voltage/2.6 V		1 1	4.2.3 AO1
(b)	Circuit diagram using a potential divider arrangement Voltmeter in parallel and ammeter in series with component correct diode symbol used	Lose mark if use of variable resistor	1 1 1	4.2.3 AO1
(c)	Infinite/allow very large		1	4.2.3 AO1
(d)	use of $R = V/I$ $R = 4/0.020\ A = 200\ \Omega$	ignore powers of 10 for this mark	1	4.2.3 AO2
8(a)	$P = V^2/R$ $R = V^2/P = 12^2/50 = 2.9\ \Omega$		1 1	4.2.5 AO1

Question	Answers	Extra information	Mark	AO spec reference
(b)	$1/R = 1/R_1 + 1/R_2 + 1/R_3$ 1/ 2.9 = 8/R R = 8 × 22.9 = 23.2 (23.0 if you use unrounded number)		1 1	4.3.1 AO2
(c)	$R = \rho l/A$ $A = \rho l/R$ $A = d$ × 0.003 m $d = 1.1\times10^{-5}$ × 0.75/23 × 0.003 = 0.12 mm		1 1	4.2.4 AO2
(d)(i)	5 µΩ cm = 5×10^{-6} cm = 5×10^{-8} m		1	4.2.4 AO2
(ii)	The thickness of the paint is the same as the thickness of the strips that was calculated in part **8(c)**.		1	4.2.4 AO3
(e)	This 1 cm strip will have a much lower resistance $R \propto \rho$ But the strip is 75 cm long so will not affect overall resistance.		1 1	4.2.4 AO3