Resistance & Resistivity

Mark Scheme 3

Level	International A Level
Subject	Physics
Exam Board	CIE
Topic	Current of Electricity
Sub Topic	Resistance & Resistivity
Paper Type	Theory
Booklet	Mark Scheme 3

Time Allowed: **51 minutes**

Score: **/42**

Percentage: **/100**

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1	**(a)**	**(i)**	in series $2X$ <u>or</u> in parallel $X/2$	M1	
			other relationship given <u>and</u> $4\times$ greater in series (than in parallel)	A1	[2]
		(ii)	due to the internal resistance	B1	
			total resistance for series circuit is not four times greater than resistance for parallel circuit	B1	[2]
		(iii)	**1.** $E = I_1(2X + r)$ or $12 = 1.2(2X + r)$	A1	
			2. $E = I_2(X/2 + r)$ or $12 = 3.0(X/2 + r)$	A1	[2]
		(iv)	$2X + r = 10$ and $X/2 + r = 4$ $X = 4.0\,\Omega$	A1	[
	(b)		$P = I^2R$ or V^2/R or VI	C1	
			ratio $= [(1.2)^2 \times 4] / [(1.5)^2 \times 4]$ $= 0.64$	A1	[2]
	(c)		the resistance (of a lamp) changes with V or I	B1	
			V or I is greater in parallel circuit or circuit 2 *or* V or I is less in series circuit or circuit 1	B1	[2]

2 **(a (i)** chemical to electrical B1 [1]

(ii) electrical to thermal / heat or heat and light B1 [1]

(b) (i) (P_B =) EI or $I^2(R_1 + R_2)$ A [1]

(ii) (P_R =) I^2R_1 A1 [1]

(c) $R = \rho l / A$ or clear from the following equation B1

ratio = $I^2R_1 / I^2R_2 = \dfrac{\rho l / \pi d^2}{\rho(2l) / \pi(2d)^2}$ or R_1 has $8\times$ resistance of R_2 C1

= 8 or 8:1 A1 [3]

(d) $P = V^2 / R$ or E^2 / R C1

(V or E the same) hence ratio is 1/8 or 1:8 = 0.125 (*allow ecf from* ***(c)***) A1 [2]

3 **(a** resistance = potential difference / current B1 [1]

(b) (i) metal wire in series with power supply and ammeter B1

voltmeter in parallel with metal wire B1

rheostat in series with power supply or potential divider arrangement or variable power supply B1 [3]

(ii) 1. intercept on graph B1 [1]

2. scatter of readings about the best fit line B1 [1]

(iii) correction for zero error explained B1

use of V and corrected I values from graph C1

resistance = V / I = 22.(2) Ω [e.g. 4.0 / 0.18] A1 [3]

(c) R = 6.8 / 0.64 = 10.625 C1

$\%R = \%V + \%I$

= (0.1 / 6.8) × 100 + (0.01 / 0.64) × 100 C1

= 1.47% + 1.56%

ΔR = 0.0303 × 10.625 = 0.32 Ω

R = 10.6 ± 0.3 Ω A1 [3]

4 **(a) (i)** metre rule / tape (*not 'rule'*) B [1]

(ii) micrometer (screw gauge) / digital caliper B1 [1]

(iii) ammeter and voltmeter / ohmmeter / multimeter on 'ohm' setting B1 [1]

(b) (i) resistivity = RA / L C1
= $[7.5 \times \pi \times (0.38 \times 10^{-3})^2 / 4] / 1.75$ M1
= 4.86×10^{-7} Ω m A0 [2]

(ii) (uncertainty in R =) [0.2 / 7.5] × 100 = 2.7%
and (uncertainty in L =) [3 / 1750] × 100 = 0.17% C1
(uncertainty in A =) 2 × (0.01 / 0.38) × 100 = 5.3 % C1
total = 8.13% C1

uncertainty = 0.395×10^{-7} (Ω m) A1 [4]
(*missing 2 factor in uncertainty in A, then allow max 3/4*)

(c) resistivity = $(4.9 \times 10^{-7} \pm 0.4 \times 10^{-7})$ Ω m A1 [1]