Resistance & Resistivity

Mark Scheme 4

Level	International A Level
Subject	Physics
Exam Board	CIE
Topic	Current of Electricity
Sub Topic	Resistance & Resistivity
Paper Type	Theory
Booklet	Mark Scheme 4

Time Allowed: **52 minutes**

Score: **/43**

Percentage: **/100**

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

1	**(a (i)**	F / A	B1	[
	(ii)	$\Delta L / L$	B1	[
	(iii)	allow $FL / A\Delta L$	B1	[1]
	(iv)	allow $\rho L / A$ or $\rho (L + \Delta L) / A$	B1	[1]
	(b) (i)	$\Delta L = FL / EA$		
		$= (30 \times 2.6) / (7.0 \times 10^{10} \times 3.8 \times 10^{-7})$	M1	
		$= 2.93 \times 10^{-3}$ m = 2.93 mm	A0	[1]
	(ii)	$\Delta R = \rho \Delta L / A$	C1	
		$= (2.6 \times 10^{-8} \times 2.93 \times 10^{-3}) / (3.8 \times 10^{-7})$		
		$= 2.0 \times 10^{-4}\ \Omega$	A1	[2]
	(c)	change in resistance is (very) small	M1	
		so method is not appropriate	A1	[2]

CHEMISTRY ONLINE
— TUITION —

2 **(a (i)** at 22.5 °C, R_T = 1600 Ω or 1.6 kΩ — C1
total resistance = 800 Ω — A1 [2]

(ii) *either* use of potential divider formula *or* current = 9 / 2000 (4.5 mA) — C1
V = (0.8/2.0) × 9 — V = (9/2000) × 800
= 3.6 V — = 3.6 V — A1 [2]

(b) (i) total resistance = 4/5 × 1200 — C1
= 960 Ω — A1 [2]

(ii) for parallel combination, 1/960 = 1/1600 + 1/R_T
R_T = 2400 Ω / 2.4 kΩ — C1
temperature = 11 °C — A1 [2]

(c) e.g. only small part of scale used / small sensitivity — B1
non-linear — B1 [2]
(*any two sensible suggestions, 1 each, max 2*)

3 **(a) (i)** $P = VI$ …… C1
60 = 12 × I
I = 5.(0) A …… A1 [2]

(ii) *either* $V = IR$ *or* P I^2R or $P = V^2 / R$ …… C1
either 12 = 5 × R *or* 60 ^{2} × R or $^2/R$ …… ……
R = 2.4 Ω …… A0 [2]

(b) $R = \rho L/A$ …… C1
$A = \pi \times (0.4 \times 10^{-3})^2$ (= 5.03×10^{-7}) …… C1
$L = (2.4 \times 5.03 \times 10^{-7})/(1.0 \times 10^{-6})$
= 1.2 m …… A1 [3]

(c) resistance is halved …… M1
either current is doubled *or* power ∝ 1/R …… …… M1
power is doubled …… A1 [3]

4 **(a)** **(i)** returns to original shape / size / length etc. B1
when load / distorting forces / weight / strain is removed ..... B1 [2]

(ii) $R = \rho L / A$ ..... B1 [1
2 $E = WL / Ae$ ..... B1 [1]

(b) $E = WR / e\rho$ C1
$= (34 \times 0.44) / (7.7 \times 10^{-4} \times 9.2 \times 10^{-8})$ C1
$= 2.1 \times 10^{11}$ Pa ..... A1 [3]

[Total: 7]

5(a) (i) stress = ***F I A*** C1
= 25 *I* (1.7 x 10-^{6})
= 1.47 x 10^{7} Pa ……(do not allow 1 sig fig) A1

(ii) stress = E x strain C1
1.47 x 10^{7} = 7.1 x 10^{10} x **(Af / 1.8)**
Af = 0.37 mm ……;…… A1 [4]

(b) ***R*** = ***JJLIA*** OR ***RocL*** …… C1
so, ***ARIR*** = Af ***I l*** …… C1
M = (3.7 x 10^{-4} 1 1.8) x o.o = 6.2 x 10-^{6} n …… A1 [3]

May calculate ***p*** = 2.833 ... x 10^{-8} nm
giving new ***Ras*** 3.0006167 x 10^{-2} Q
hence M - full credit possible

However, if rounds off ***p*** as 2.83 x 10^{-8} n m,
then R_{new} < Rold!
Allow 1 mark only for R ∝ L