# Resistance & Resistivity

## Mark Scheme 2

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|---|---|
| **Level** | International A Level |
| **Subject** | Physics |
| **Exam Board** | CIE |
| **Topic** | Current of Electricity |
| **Sub Topic** | Resistance & Resistivity |
| **Paper Type** | Theory |
| **Booklet** | Mark Scheme 2 |

**Time Allowed:** **80 minutes**

**Score:** **/66**

**Percentage:** **/100**



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

1 **(a) (i)** *either* $P = V^2 / R$ *o* $I = 1200 / 230$ or $5.22$ C1
$R = (230 \times 230) / 1200$
$R = 230^2 / 1200$ or $R = 230 / 5.22$ M1
$= 44.1\,\Omega$ $= 44.1\,\Omega$ A0 [2]

**(ii)** $R = \rho L / A$ C1
$= (1.7 \times 10^{-8} \times 9.2 \times 2) / (\pi \times \{0.45 \times 10^{-3}\}^2)$ M
$= 0.492\,\Omega$ A0 [2]

**(b)** current $= 230 / 44.6$ C1
power $= (230 / 44.6)^2 \times 44.1$ C1
$= 1170\,\text{W}$ A [3]
(*allow full credit for solution based on potential divider*)

**(c)** e.g. less power dissipated in the heater / smaller p.d. across heater /
more power loss in cable / current lower B1
cable becomes heated / melts B1 [2]
(*any two sensible suggestions, 1 each, max 2*)

2 **(a** total resistance in series = 2*R*
total resistance in parallel = ½*R* .....M1
ratio is 2R / ½R = 4 .....(*allow mark if clear numbers in the ratio*) ..... A0 [1]

**(b)** at 1.5 V, current is 0.10 A ..... C1
resistance = $V/I = \frac{1.5}{0.1}$
= 15 Ω ..... A1 [2]
(*use of tangent or any other current scores no marks*)

**(c)**

| | p.d. acro each lamp / V | resistance of each lamp / Ω | combined resistance / Ω |
|---|---|---|---|
| series | 1.5 | 15 | 30 |
| parallel | 3.0 | 20 | 10 |

column 1 ..... A1
columns 2 and 3: max 3 marks with -1 mark for each error or omission ..... A3 [4]

**(d) (** ratio is 3 .....(allow e.c.f.) ..... A1 [1]

**(ii)** resistance increases as potential difference increases ..... B1
increasing p.d. increases current ..... B1
current increases non-linearly so resistance increases ..... B1 [3]

**[Total: 11]**

3 **(a** power = $VI$ C1
current = $10.5 \times 103 / 230$ M1
= 45.7 A A0 [2]

**(b)** p.d. across cable = 5.0 V C1
$R$ = 5.0 / 46 C1
= 0.11 Ω A1 [3]

**(ii)** $R = \rho L / A$ C1
$0.11 = (1.8 \times 10^{-8} \times 16 \times 2) / A$ C1
$A = 5.3 \times 10^{-6}$ m$^2$ A1 [3]
(*wires in parallel, not series, allow max 1/3 marks*)

**(c)** *either* power = $V^2 / R$ *or* power $\propto V^2$ C1
ratio = $(210 / 230)^2 = 0.83$ A1 [2]

**(ii)** resistance of cable is greater M1
greater power loss/fire hazard/insulation may melt
wire may melt/cable gets hot A1 [2]

4 (a) (i) $R = \rho L / A$ B1

(ii) strain = $\Delta L / L$ B1
*either* $\Delta R = \rho \Delta L / A$ *or* $R \propto L$ with $\rho$ and $A$ constant B1
dividing, $\Delta R / R = \Delta L / L$ A0 [3]

(b) Young modulus = stress / strain C1
strain = $72.0 / (1.20 \times 10^{-7} \times 2.10 \times 10^{11})$ C1
$= 2.86 \times 10^{-3}$ (*allow 1/350* A1
$\Delta R = 2.86 \times 10^{-3} \times 4.17 = 1.19 \times 10^{-2}\ \Omega$ A1
answer given to 3 sig. fig B1 [5]

5 **(a) (i)** resistance is ratio *V/I* (at a point) **B1**

*either* gradient increases or *I* increases more rapidly than V **B1** **[2]**

*(If states R = reciprocal of gradient, then 0/2 marks here)*

**(ii)** current = 2.00 mA **C1**

resistance = 2 000 Ω **A1** **[2]**

**(b) (i)** straight line from origin **M1**

passing through (6.0 V, 4.0 mA) (allow ½ square tolerance) **A1** **[2]**

**(ii)** individual currents are 0.75 mA and 1/33 mA **C1**

current in battery = 2.1 mA **A1** **[2]**

*(allow argument in terms of $P = I^2R$ or IV)*

**(c)** same current in R and in C **M1**

p.d. across C is larger than that across R **M1**

so since power = *VI*, greater in C **A1** **[3]**

6 **(a)** **(i)** $P = VI$ C1

current = 60/240 = 0.25 A A1

**(ii)** $R$ ( = $V/I$) = 240/0.25 M1

= 960 Ω A0 **[3]**

**(b)** $R = \rho L/A$ *(wrong formula, 0/3)* C1

$960 = (7.9 \times 10^{-7} \times L)/(\pi \times \{6.0 \times 10^{-6}\}^2)$ C1

$L$ = 0.137 m A1 **[3]**

*(use of $A = 2\pi r$, then allow 1/3 marks only for resistivity formula)*

**(c)** e.g. the filament must be coiled/it is long for a lamp B1 **[1]**

*(allow any sensible comment based on candidate's answer for L)*

**Total** **[7]**

7 **(a)** **(i)** resistance = $V/I$ ..... C1
= 6.0/(40 x $10^{-3}$)
= 150 Ω ..... A1
(no marks for use of gradient)

**(ii)** at 8.0 V, resistance = 8.0/(50 x $10^{-3}$) = 160 Ω..... C1
change = 10 Ω ..... A1 [4]

**(b)** **(i)** straight line through origin.....M1
passes through $I$ = 40 mA, V = 8.0V ..... A1

**(ii)** current in both must be 40 mA ..... C1
e.m.f. = 8.0 + 6.0 = 14.0 V ..... A1 [4]