OCR
Oxford Cambridge and RSA

A Level Physics A

H556/02 Exploring physics

Question Set 4

1 (a) State **one** S.I. base quantity other than length, mass and time.

Temperature / Current / Light Intensity ..... **[1]**

(b) Fig. 17 shows two resistors **X** and **Y** connected in series.

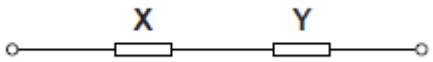

Fig. 17

The resistors are wires. Both wires have the same length L and diameter d. The material of **X** has resistivity ρ and the material of **Y** has resistivity 2ρ.

(i) Show that the total resistance R of the wires is given by the equation

$$R = \frac{12\rho L}{\pi d^2}.$$

$R = \frac{\rho L}{A}$ and $A = \pi\left(\frac{d}{2}\right)^2$ **[2]**

Combining we get → $R = \frac{4\rho L}{\pi d^2}$

ρ of X = ρ and ρ of Y = 2ρ

→ $R_X = \frac{4\rho L}{\pi d^2}$ → $R_Y = \frac{8\rho L}{\pi d^2}$

→ $R_{Total} = R_X + R_Y$ because in series

→ $R_{Total} = \frac{4\rho L}{\pi d^2} + \frac{8\rho L}{\pi d^2} = \frac{12\rho L}{\pi d^2}$

(ii) A student uses the equation in **(i)** to determine R.
The table below shows the data recorded by the student in her lab book.

Quantity	Value
ρ	$4.7 \times 10^{-7}\ \Omega\,m$
L	$9.5 \pm 0.1\,cm$
d	$0.270 \pm 0.003\,mm$

1. Name the likely instruments used by the student to measure L and d.

L: Ruler .....

d: Micrometer .....

[1]

2. Use the data in the table and the equation in **(i)** to determine R and the absolute uncertainty. Write your answer to the correct number of significant figures.

$$R = \frac{12\rho L}{\pi d^2} = \frac{12 \times 4.7 \times 10^{-7} \times 9.5 \times 10^{-2}}{\pi \times (0.27 \times 10^{-3})^2} = 2.34$$

relative uncertainty of $L = \frac{0.1}{9.5} = 0.0105$

relative uncertainty of $d = \frac{0.003}{0.27} = 0.011$

relative uncertainty of $R = \frac{0.1}{9.5} + \left(2 \times \frac{0.003}{0.27}\right) = 0.0327$

absolute uncertainty of $R = 0.0327 \times 2.34 \simeq 0.0766 \simeq 0.1$

$2.3 \pm 0.1\ \Omega$

$R =$ 2.3 $\pm$ 0.1 Ω **[4]**

3. The instrument used to measure d has a zero-error. The measured d is much **larger** than the actual value.
Discuss how the actual value of R compares with the value calculated above.

Actual R is large because actual d is smaller and $R \propto 1/d^2$ **[1]**

Total Marks for Question Set 4: 9

1. (b) (i)

1. (b) (ii). 2.