

Resistance, Kirchhoff's rules and steady-state RC circuits

AP Physics 2 (algebra-based) · Lab answers

The sample data give a straight line through the origin with gradient close to $8.0 \Omega/\text{m}$. The answers below show how to turn the gradient into a resistivity and how to judge its uncertainty.

Level: AP Physics 2 (algebra-based) · **Curriculum:** AP P2 Unit 11

Question 1 Resistance values

$R = V/I = 1.12 / 0.235 = \mathbf{4.77 \Omega}$. R increases steadily with L : from 1.60Ω at 0.20 m to 8.00Ω at 1.00 m .

Question 2 Graph

The graph is a **straight line**, so R is directly proportional to L . A zero length of wire has zero resistance, so the line should pass through the origin.

Question 3 Gradient

Gradient = $(8.00 - 1.60) / (1.00 - 0.20) = 6.40 / 0.80 = \mathbf{8.0 \Omega/\text{m}}$.

Question 4 Resistivity

$R/L = \rho/A$, so $\rho = \text{gradient} \times A = 8.0 \times 6.2 \times 10^{-8} = \mathbf{4.9 \times 10^{-7} \Omega \cdot \text{m}}$. This agrees with the accepted value.

Question 5 Uncertainty in the area

The percentage uncertainty in d is $0.01 / 0.28 = 3.6 \%$. Since A depends on d^2 , the uncertainty in A is $2 \times 3.6 \% = \mathbf{7.1 \%}$. The resistivity has about the same uncertainty: $4.9 \times 10^{-7} \pm 0.35 \times 10^{-7}$, so $\rho = \mathbf{(4.9 \pm 0.4) \times 10^{-7} \Omega \cdot \text{m}}$.

Question 6 Why open the switch

Current heats the wire, and a hotter metal has a higher resistivity. Opening the switch keeps the temperature constant. If the wire heated, R would read **too high** at the longer lengths and the graph would curve upwards.

Question 7 Improving the method

A positive intercept comes from **contact resistance** at the clips, or a zero error in the length. Improve it by measuring the voltage directly between the clips (as in this set-up) and using sharp, clean clip contacts.