Electricity: Current, Resistance and Resistivity

Electricity · 4 questions · step-by-step answers at the end

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USEFUL EQUATIONS

$Q = It$ $I = nAvq$ $V = W / Q$ $R = \rho L / A$ $P = VI = I^2R = V^2 / R$

Questions

Show your working in the space under each question.

1. A copper wire of cross-section 1.0×10^{-6} m² carries 2.0 A. With n = 8.5×10^{28} m^{-3}, find the drift velocity.

2. A constantan wire ($\rho = 4.9 \times 10^{-7}$ Ω m) is 1.5 m long and 0.40 mm in diameter. Find its resistance.

3. A wire is stretched to twice its length at constant volume. What happens to its resistance?

4. Why does the resistance of a metal increase with temperature?

Step-by-step answers

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1. $v = I/(nAq) = 2.0/(8.5 \times 10^{28} \times 1.0 \times 10^{-6} \times 1.6 \times 10^{-19}) = \mathbf{1.5 \times 10^{-4}\ m\ s^{-1}}$.

2. 1. $A = \pi d^2/4 = \pi(0.40 \times 10^{-3})^2/4 = 1.26 \times 10^{-7}\ m^2$.
2. $R = \rho L/A = (4.9 \times 10^{-7})(1.5)/(1.26 \times 10^{-7})$.
3. $R = \mathbf{5.8\ \Omega}$.

Answer: 5.8 Ω

3. L doubles and A halves, so $R = \rho L/A$ becomes **four times** larger.

4. The lattice ions vibrate with greater amplitude, so the electrons **collide with them more often**.