

Answer on question #61338, Physics / Electromagnetism

Statement of a problem

5) A 0.40 mm diameter copper wire carries a current of $3\mu\text{A}$. Find the current density in the wire

- a) 15.16A/m^2
- b) 33.32A/m^2
- c) 26.17A/m^2
- d) 23.87A/m^2

Solution

5) $d = 0.4 \text{ mm} = 4 \times 10^{-4} \text{ m}$ – diameter of the copper wire;

$I = 3 \mu\text{A} = 3 \times 10^{-6} \text{ A}$ – current;

j –? – current density;

$$j = \frac{I}{S} = \frac{I}{\pi d^2/4} = \frac{4I}{\pi d^2}$$

$$j \approx \frac{4 \times 3 \times 10^{-6} \text{ A}}{3.142 \times (4 \times 10^{-4})^2 \text{ m}^2} \approx \frac{12 \times 10^{-6} \text{ A}}{5.027 \times 10^{-7} \text{ m}^2} = 23.87 \frac{\text{A}}{\text{m}^2}$$

Answer: d) 23.87A/m^2

6) Calculate the resistance of 180 m of silver wire having a cross section of 0.33mm^2 . The resistivity of silver is $1.6 \times 10^{-8} \Omega\text{m}$

- a) 11.2Ω
- b) 9.6Ω
- c) 14.6Ω
- d) 7.5Ω

Solution

$l = 180 \text{ m}$ – length of silver wire;

$\rho = 1.6 \times 10^{-8} \Omega \cdot \text{m}$ – resistivity of silver;

$S = 0.33 \text{ mm}^2 = 3.3 \times 10^{-7} \text{ m}^2$. – cross section of wire;

R –? – Resistance of wire;

$$R = \rho \frac{l}{S}$$

$$R = 1.6 \times 10^{-8} \Omega \cdot \text{m} \frac{180 \text{ m}}{3.3 \times 10^{-7} \text{ m}^2} = 8.7 \Omega$$

Answer: $R = 8.7 \Omega$, any of variants are not suitable.

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