Answer on Question 32811, Physics, Electric Circuits

Question:

A 0.40 mm diameter copper wire carries a current of 3 μA. Find the current density in the wire:

a) $15.16 A/m^2$.

b) $33.32 A/m^2$.

c) $26.17 A/m^2$.

d) $23.87 A/m^2$.

Solution:

By the definition of the current density we have:

$$J = \frac{I}{A},$$

here, J is the current density, I is the current flowing through the wire, $A = \pi \frac{d^2}{4}$ is the cross-sectional area of the wire, d is the diameter of the wire.

Then, we can substitute A into the first formula and find the current density in the wire:

$$J = \frac{I}{A} = \frac{4I}{\pi d^2} = \frac{4 \cdot 3 \cdot 10^{-6}\ A}{\pi \cdot (4 \cdot 10^{-4}\ m)^2} = 23.87 \frac{A}{m^2}.$$

Answer:

d) $23.87 A/m^2$.