A square wire is 3 m long and each side of the square has a length of 2 mm. The resistance of this wire is 12 ohms. If a potential difference of 60 V is applied between the ends:

(a) How much current flows through the wire?

(b) How much power is dissipated by the wire?

(c) In 15 seconds how much heat energy is produced in the wire?

(d) What is the current density in the wire?

(e) What is the resistivity of the material from which the wire is made?

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\begin{align*}
(I) & \quad I = \frac{V}{R} = \frac{60 \text{ V}}{12 \Omega} = 5 \text{ A} & \quad 3 \text{ points} \\
(b) & \quad P = v \cdot I = 60 \text{ V} \cdot 5 \text{ A} = 300 \text{ W} & \quad 3 \text{ points} \\
(c) & \quad Q = P \cdot t = 300 \text{ W} \cdot 15 \text{ s} = 4500 \text{ J} & \quad 2 \text{ points} \\
(d) & \quad J = \frac{I}{A} = \frac{5 \text{ A}}{\left(2 \cdot 10^{-3} \text{ m}\right)^2} = 1.25 \cdot 10^6 \frac{\text{ A}}{\text{ m}^2} & \quad 4 \text{ points} \\
(e) & \quad R = \rho \cdot \frac{L}{A} \\
& \quad \rho = \frac{R \cdot A}{L} = \frac{12 \Omega \cdot 4 \cdot 10^{-6} \text{ m}^2}{3 \text{ m}} = 1.6 \cdot 10^{-5} \Omega \text{ m} & \quad 4 \text{ points}
\end{align*}
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