KING FAHD UNIVERSITY OF PERTOLEUM & MINERALS
PHYSICS DEPARTMENT
QUIZ #9 - CHAPTER 26

NAME: Key ID# SECTION#

An electric device, which heats water by immersing a resistance wire in the water, generates 3000 J of heat per minute when an electric potential difference of 12 V is placed across its ends. What is the resistance of the heater wire?

$$P = \frac{\text{Energy}}{\text{time}} = \frac{3000\ \text{J}}{60\ \text{sec}} = 50\ \text{W}$$

$$P = \frac{V^2}{R} \Rightarrow R = \frac{V^2}{P} = \frac{(12)^2}{50} = \boxed{2.88\ \Omega}$$

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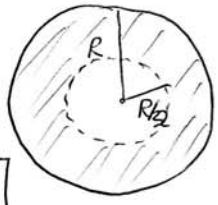
A cylindrical wire of radius R = 2.0 cm has a uniform current density J = 2.0×10^5 A/m^2. What is the current through the portion of the wire between radial distances R/2 and R?

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



$$I = J A = J \left[\pi R^2 - \pi \left(\frac{R}{2} \right)^2 \right]$$

$$I = 2 \times 10^5 \times \left[\pi (0.02)^2 - \pi (0.01)^2 \right]$$

$$\boxed{I = 188.5 \text{ A}}$$

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What diameter must a copper wire have if its resistance is to be the same as that of an equal length of an aluminum wire with 3.26 mm diameter? [$\rho_{Al} = 2.75\times10^{-8}$ Ω.m; $\rho_{Cu} = 1.69\times10^{-8}$ Ω.m]

$$R_{Al} = R_{Cu}$$

$$\rho_{Al}\frac{L_{Al}}{A_{Al}} = \rho_{Cu}\frac{L_{Cu}}{A_{Cu}}$$

$$A_{Cu} = \frac{\rho_{Cu}}{\rho_{Al}} A_{Al}$$

$$\pi r_{Cu}^2 = \frac{\rho_{Cu}}{\rho_{Al}} \pi r_{Al}^2$$

$$d_{Cu} = d_{Al}\sqrt{\frac{\rho_{Cu}}{\rho_{Al}}} = 3.26\sqrt{\frac{1.69}{2.75}}$$

$$= 2.55 \text{ mm}$$