

4.6 If $\mathbf{J} = \hat{\mathbf{y}}4xz$ (A/m²), find the current I flowing through a square with corners at (0, 0, 0), (2, 0, 0), (2, 0, 2), and (0, 0, 2).

Solution: Using Eq. (4.12), the net current flowing through the square shown in Fig. P4.6 is

$$I = \int_S \mathbf{J} \cdot d\mathbf{s} = \int_{x=0}^2 \int_{z=0}^2 (\hat{\mathbf{y}}4xz) \Big|_{y=0} \cdot (\hat{\mathbf{y}} dx dz) = (x^2 z^2) \Big|_{x=0}^2 \Big|_{z=0}^2 = 16 \text{ A.}$$

