

5.24 In a certain conducting region, the magnetic field is given in cylindrical coordinates by

$$\mathbf{H} = \hat{\phi} \frac{1}{r} [1 - (1 + 3r)e^{-3r}]$$

Find the current density \mathbf{J} .

Solution:

$$\begin{aligned}\mathbf{J} &= \nabla \times \mathbf{H} = \hat{\mathbf{z}} \frac{1}{r} \frac{\partial}{\partial r} \left(r \cdot \frac{1}{r} [1 - (1 + 3r)e^{-3r}] \right) \\ &= \hat{\mathbf{z}} \frac{1}{r} [3e^{-3r}(1 + 3r) - 3e^{-3r}] = \hat{\mathbf{z}} 9e^{-3r} \text{ A/m}^2.\end{aligned}$$
