Problem 5.33 Given that a current sheet with surface current density $\mathbf{J}_s = \hat{\mathbf{x}}\,8$ (A/m) exists at $y = 0$, the interface between two magnetic media, and $\mathbf{H}_1 = \hat{\mathbf{z}}\,11$ (A/m) in medium 1 ($y > 0$), determine $\mathbf{H}_2$ in medium 2 ($y < 0$).

Solution:

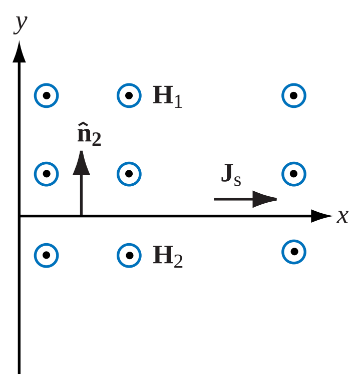

Figure P5.33: Adjacent magnetic media with $\mathbf{J}_s$ on boundary.

$$\mathbf{J}_s = \hat{\mathbf{x}}\,8 \text{ A/m},$$
$$\mathbf{H}_1 = \hat{\mathbf{z}}\,11 \text{ A/m}.$$

$\mathbf{H}_1$ is tangential to the boundary, and therefore $\mathbf{H}_2$ is also. With $\hat{\mathbf{n}}_2 = \hat{\mathbf{y}}$, from Eq. (5.84), we have

$$\hat{\mathbf{n}}_2 \times (\mathbf{H}_1 - \mathbf{H}_2) = \mathbf{J}_s,$$
$$\hat{\mathbf{y}} \times (\hat{\mathbf{z}}\,11 - \mathbf{H}_2) = \hat{\mathbf{x}}8,$$
$$\hat{\mathbf{x}}\,11 - \hat{\mathbf{y}} \times \mathbf{H}_2 = \hat{\mathbf{x}}8,$$

or

$$\hat{\mathbf{y}} \times \mathbf{H}_2 = \hat{\mathbf{x}}\,3,$$

which implies that $\mathbf{H}_2$ does not have an x-component. Also, since $\mu_1 H_{1y} = \mu_2 H_{2y}$ and $\mathbf{H}_1$ does not have a y-component, it follows that $\mathbf{H}_2$ does not have a y-component either. Consequently, we conclude that

$$\mathbf{H}_2 = \hat{\mathbf{z}}\,3.$$