34.1. Model: The net magnetic flux over a closed surface is zero.

Visualize: Please refer to Ex34.1.

Solve: Because we can’t enclose a “net pole” within a surface, \( \Phi_m = \oint \vec{B} \cdot d\vec{A} = 0 \). Since the magnetic field is uniform over each face of the box, the total magnetic flux around the box is
\[
(1 \text{ cm} \times 2 \text{ cm})(-2 \text{ T} - 2 \text{ T} + 1 \text{ T} + 5 \text{ T}) + (1 \text{ cm} \times 1 \text{ cm})(-2 \text{ T}) + \Phi_{\text{unknown}} = 0
\]
\[
\Rightarrow \int \vec{B}_{\text{unknown}} \cdot d\vec{A} = -0.0002 \text{ T m}^2 \Rightarrow B_{\text{unknown}} \cos \theta = -2.0 \text{ T}
\]

The angle \( \theta \) must be 180°. Because \( \theta \) is the angle between \( \vec{B} \) and the outward normal of \( d\vec{A} \), the field \( \vec{B} \) is directed into the face.