

3. We use Gauss' law for magnetism: $\oint \vec{B} \cdot d\vec{A} = 0$. Now, $\oint \vec{B} \cdot d\vec{A} = \Phi_1 + \Phi_2 + \Phi_C$, where Φ_1 is the magnetic flux through the first end mentioned, Φ_2 is the magnetic flux through the second end mentioned, and Φ_C is the magnetic flux through the curved surface. Over the first end the magnetic field is inward, so the flux is $\Phi_1 = -25.0 \mu\text{Wb}$. Over the second end the magnetic field is uniform, normal to the surface, and outward, so the flux is $\Phi_2 = AB = \pi r^2 B$, where A is the area of the end and r is the radius of the cylinder. Its value is

$$\Phi_2 = \pi(0.120 \text{ m})^2(1.60 \times 10^{-3} \text{ T}) = +7.24 \times 10^{-5} \text{ Wb} = +72.4 \mu\text{Wb} .$$

Since the three fluxes must sum to zero,

$$\Phi_C = -\Phi_1 - \Phi_2 = 25.0 \mu\text{Wb} - 72.4 \mu\text{Wb} = -47.4 \mu\text{Wb} .$$

The minus sign indicates that the flux is inward through the curved surface.