33.30. Model: Assume that the field is uniform in space over the coil.

Visualize: We want an induced current so there must be an induced emf created by a changing flux.

Solve: To relate the emf and the current we need to know the resistance. From Equation 31.3,

\[ R = \frac{\rho_{\text{Cu}} A_{\text{wire}}}{\pi r_{\text{wire}}} = \frac{\rho_{\text{Cu}} N 2\pi r}{\pi r_{\text{wire}}} = \frac{2(100)(1.7 \times 10^{-4} \text{ m})(0.040 \text{ m})}{(2.5 \times 10^{-4} \text{ m})^2} = 2.18 \text{ \Omega} \]

The magnetic field is perpendicular to the plane of the coil so the flux for a single loop of the coil is \( \Phi = A \cdot B = BA \), if we take the normal to the coil to be in the same direction as the field. Using Faraday’s law,

\[ E = IR = NA \left| \frac{dB}{dt} \right| = N \pi r^2 \left| \frac{dB}{dt} \right| \Rightarrow \left| \frac{dB}{dt} \right| = \frac{IR}{N \pi r^2} = \frac{(2.0 \text{ A})(2.18 \Omega)}{100 \pi (0.040 \text{ m})^2} = 8.67 \text{ T/s} \]