

15. (a) Let L be the length of a side of the square circuit. Then the magnetic flux through the circuit is $\Phi_B = L^2 B/2$, and the induced emf is

$$\mathcal{E}_i = -\frac{d\Phi_B}{dt} = -\frac{L^2}{2} \frac{dB}{dt} .$$

Now $B = 0.042 - 0.870t$ and $dB/dt = -0.870 \text{ T/s}$. Thus,

$$\mathcal{E}_i = \frac{(2.00 \text{ m})^2}{2} (0.870 \text{ T/s}) = 1.74 \text{ V} .$$

The magnetic field is out of the page and decreasing so the induced emf is counterclockwise around the circuit, in the same direction as the emf of the battery. The total emf is $\mathcal{E} + \mathcal{E}_i = 20.0 \text{ V} + 1.74 \text{ V} = 21.7 \text{ V}$.

- (b) The current is in the sense of the total emf (counterclockwise).