Chapter 25: Magnetic Induction & Lenz’s Law
Questions & Problems

\[ \Phi = A_{\text{eff}}B = AB\cos \theta \quad \mathcal{E}_{\text{induced}} = N \frac{\Delta \Phi}{\Delta t} \quad c = \lambda f \quad E_{\text{photon}} = hf \]

Example 25.1
Parts a through f of figure show one or more metal wires sliding on fixed metal rails in a magnetic field. For each, determine if the induced current is clockwise, counterclockwise, or is zero.

Example 25.2
A circular loop of wire rests on a table. A long, straight wire lies on this loop, directly over its center, as the drawing illustrates. The current I in the straight wire is increasing. In what direction is the induced current, if any, in the loop? Give your reasoning.
Example 25.3
A long, straight wire lies on a table and carries a current I. As shown in the drawing below, a small circular loop of wire is pushed across the top of the table from position 1 to position 2. Determine the direction of the induced current, clockwise or counterclockwise, as the loop moves past (a) position 1 and (b) position 2. Justify your answers.

Example 25.4
The loop in figure has an induced current as shown. The loop has a resistance of 0.10Ω. Is the magnetic field strength increasing or decreasing? What is the rate of change of the field (ΔB/Δt)?

Example 25.5
The circuit in the figure below is a square 5.0 cm on a side. The magnetic field increases steadily from 0 T to 0.50 T in 10 ms. What is the current in the resistor during this time?
Example 25.6
A 300-turn rectangular loop of wire has an area per turn of $5.0 \times 10^{-3} \text{m}^2$. At $t = 0 \text{s}$, a magnetic field is turned on, and its magnitude increases to 0.40 T when $t = 0.80 \text{s}$. The field is directed at an angle of $\phi = 30.0^\circ$ with respect to the normal of the loop. (a) Find the magnitude of the average emf induced in the loop. (b) If the loop is a closed circuit whose resistance is $6.0 \Omega$, determine the average induced current.

Example 25.7
Gamma rays with the very high energy of $2.0 \times 10^{13} \text{eV}$ are occasionally observed from distant astrophysical sources. What are the wavelength and frequency corresponding to this photon energy?

Example 25.8
What is the energy of 1 mol of photons that have a wavelength of 1.0 $\mu\text{m}$?