

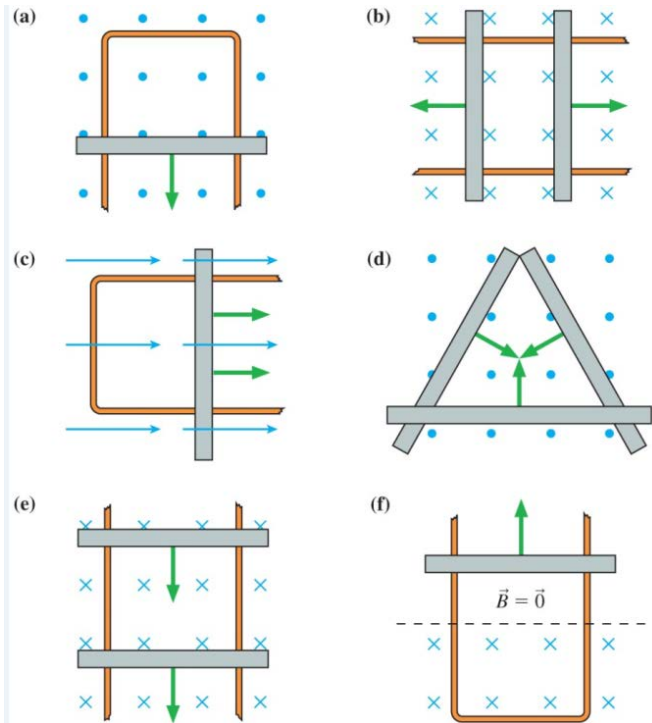
## Chapter 25: Magnetic Induction & Lenz's Law

### Questions & Problems

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

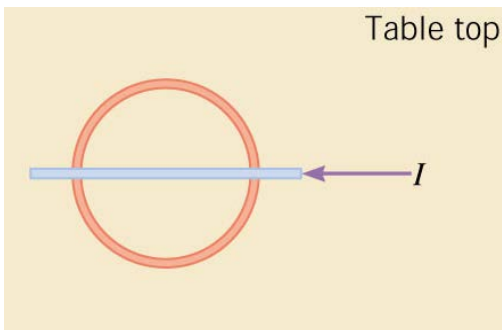
#### Example 25.1

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.



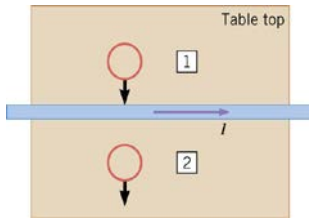
#### Example 25.2

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.



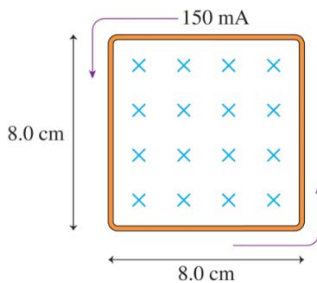
### Example 25.3

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.



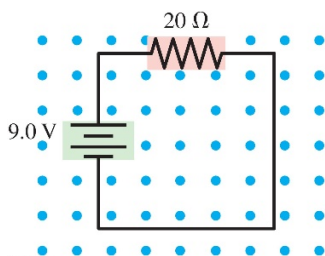
### Example 25.4

The loop in figure has an induced current as shown. The loop has a resistance of  $0.10\Omega$ . Is the magnetic field strength increasing or decreasing? What is the rate of change of the field ( $\Delta B/\Delta t$ )?



### Example 25.5

The circuit in the figure below is a square  $5.0\text{ cm}$  on a side. The magnetic field increases steadily from  $0\text{ T}$  to  $0.50\text{ T}$  in  $10\text{ ms}$ . 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  $t = 0$  s, a magnetic field is turned on, and its magnitude increases to 0.40 T when  $t = 0.80$  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  $2.0 \times 10^{13}$  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  $1.0 \mu\text{m}$ ?