Faraday and Lenz’s law examples

Example 1

Consider the following conducting loop in a magnetic field directed into the page

What is the direction of the current in the loop if
a) the magnetic field strength is increasing?
b) the magnetic field strength is constant?
c) the magnetic field strength is decreasing?
d) the radius of the loop is increasing?
e) the loop rotates about a vertical axis going through its center?

Example 2

What is the direction of the induced current in the bottom conducting loop
a) when the switch is open?
b) just after the switch is closed?
c) a long time after the switch is closed?
d) just after the switch is reopened?
e) a long time after the switch is reopened.

\[ \overrightarrow{\mathbf{E}}_{\text{external}} = B \mathbf{A} \cos \theta \]
\[ \theta = 0 \rightarrow \theta > 0 \text{ (and } < \frac{\pi}{2} \text{)} \]
\[ \rightarrow I \text{ is CW} \]

\[ \overrightarrow{\mathbf{B}}_{\text{external}} = \text{constant} \]
\[ \rightarrow I = 0 \]

\[ \overrightarrow{\mathbf{B}}_{\text{external}} \uparrow \]
\[ \overrightarrow{\mathbf{B}}_{\text{induced}} \downarrow \]
\[ I_{\text{induced}} \text{ opposite of } I_{\text{bat}} \]

\[ \overrightarrow{\mathbf{B}}_{\text{external}} \] reverse of b)
Example 3

What is the direction of the current through the meter if
a) the bar magnet is held at rest?
b) the bar magnet is pushed into the solenoid?
c) the bar magnet is pulled out of the solenoid?

Example 4

The figure shows a 10-cm diameter loop in three different magnetic fields. The loop resistance is 0.1 Ω. For each case, determine the strength and direction of the induced current.

\[ \Phi = \pi r^2 B \]
\[ \frac{d\Phi}{dt} = \pi r^2 \frac{dB}{dt} \]
\[ I = \pi r^2 \frac{dB}{dt} \frac{\Omega}{R} \]

\[ I_a) = \frac{\pi 0.05^2 0.5}{0.1} \]

\[ \Phi = 0 \]
(\( \vec{A} \perp \vec{B} \))

\[ I_b) = \frac{\pi 0.05^2 0.5}{0.1} = 39.2 \text{ mA} \]
(CW)

\( \text{so } I = 0 \text{ A} \)

(since \( \vec{B}_{\text{ext}} \) is in decreasing)

\( \text{CW} = 39.2 \text{ mA} \)
(since \( \vec{B} \) is out increasing)