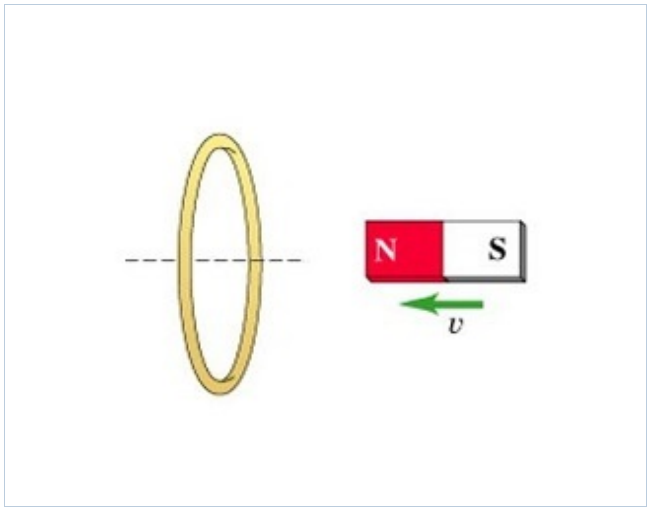
Description: Determine the direction of the induced current in a metal loop in the presence of a moving/stationary bar magnet.

For each of the actions depicted below, a magnet and/or metal loop moves with velocity $\vec{v}$ ($\vec{v}$ is constant and has the same magnitude in all parts). Determine whether a current is induced in the metal loop. If so, indicate the direction of the current in the loop, either clockwise or counterclockwise when seen from the right of the loop. The axis of the magnet is lined up with the center of the loop.

Part A

For the action depicted in , indicate the direction of the induced current in the loop (clockwise, counterclockwise or zero, when seen from the right of the loop).



View Available Hint(s) (6)

Hint 1. Magnetic flux

Magnetic flux is the product of the component of magnetic field perpendicular to a given area and the area itself. Conceptually, it is proportional to the number of magnetic field lines passing through a given area.

Hint 2. Induction and changing flux

Whenever magnetic flux through an area changes, an electromotive force (emf) is created around the area. This induced emf has a direction such that if a conductor is present, current will flow to create a secondary magnetic field that opposes the change in the original magnetic flux. Basically, the induced current will "try" to maintain the initial value of the magnetic flux.

Hint 3. How to find the direction of the magnetic field produced by a loop

To determine the direction of the magnetic field produced by a current in a loop, use the right-hand rule: curl the fingers of your right hand in the direction of the current; your thumb will point in the direction of the magnetic field produced by the loop.

Hint 4. Find the initial magnetic field through the loop

Does the magnetic field that passes through the loop due to the magnet point to the left or the right?

ANSWER:

- ○ right
- ◉ left

Hint 5. Find the change in magnetic flux

As the magnet is brought toward the loop, does the magnetic flux through the loop increase, decrease, or stay the same?

ANSWER:

- ◉ increases
- ○ decreases
- ○ stays the same

Hint 6. Induced magnetic field

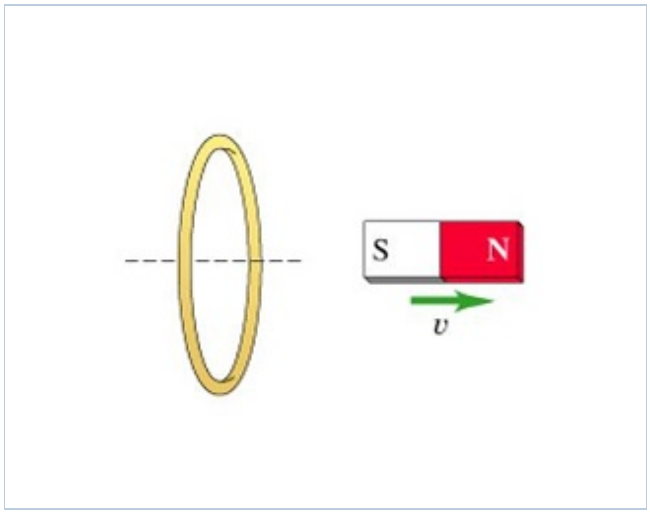
Since the magnetic flux is increasing with the field directed to the left, current will flow in the loop to create a magnetic field oriented to the right to oppose this increase in flux. Now, to create a field directed to the right, determine the direction in which current must flow through the loop.

ANSWER:

- ○ clockwise
- ◉ counterclockwise
- ○ zero

Part B

For the action depicted in , indicate the direction of the induced current in the loop (clockwise, counterclockwise or zero, when seen from the right of the loop).



View Available Hint(s) (3)

Hint 1. Find the initial magnetic field through the loop

Does the magnetic field that passes through the loop due to the magnet point to the left or the right?

ANSWER:

- (•) right
- ( ) left

Hint 2. Find the change in magnetic flux

As the magnet is moved away from the loop, does the magnetic flux through the loop increase, decrease, or stay the same?

ANSWER:

- ( ) increases
- (•) decreases
- ( ) stays the same

Hint 3. Induced magnetic field

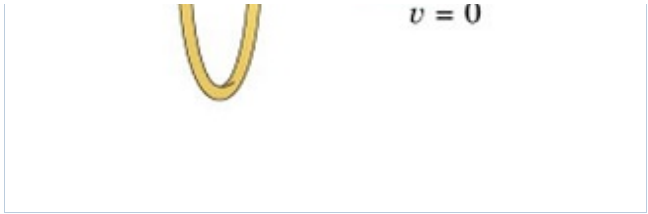
Since the magnetic flux is decreasing, with the field directed to the right, current will flow in the loop to create a magnetic field oriented to the right to replace this decrease in flux. Now, to create a field directed to the right, determine the direction in which current must flow through the loop.

ANSWER:

- ( ) clockwise
- (•) counterclockwise
- ( ) zero

Part C

For the action depicted in , indicate the direction of the induced current in the loop (clockwise, counterclockwise or zero, when seen from the right of the loop).



View Available Hint(s) (2)

Hint 1. Find the initial magnetic field through the loop

Does the magnetic field that passes through the loop due to the magnet point to the left or the right?

ANSWER:

- right
- left

Hint 2. Find the change in magnetic flux

Does the magnetic flux through the loop increase, decrease, or stay the same?

ANSWER:

- increases
- decreases
- stays the same

ANSWER:

- clockwise
- counterclockwise
- zero

Part D

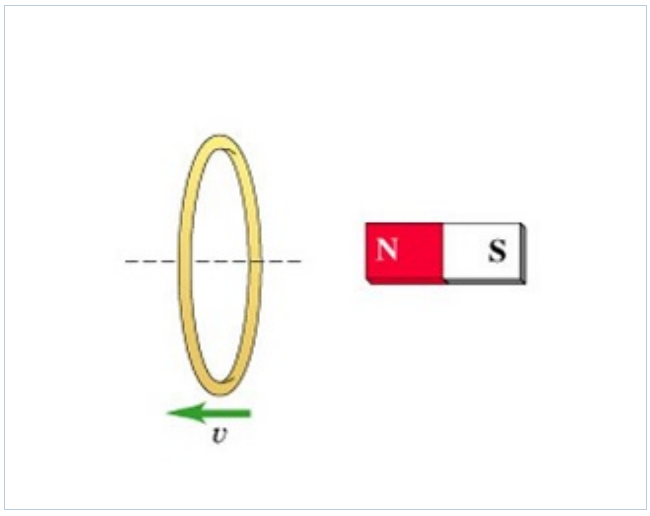
For the action depicted in , indicate the direction of the induced current in the loop (clockwise, counterclockwise or zero, when seen from the right of the loop).

ANSWER:

- clockwise
- counterclockwise
- (●) zero

Part E

For the action depicted in , indicate the direction of the induced current in the loop (clockwise, counterclockwise or zero, when seen from the right of the loop).



▼ **View Available Hint(s)** (1)

Hint 1. Find the change in magnetic flux

As the loop is moved away from the magnet, does the magnetic flux through the loop increase, decrease, or stay the same?

ANSWER:

- increases
- (●) decreases
- stays the same

ANSWER:

- (•) clockwise
- ( ) counterclockwise
- ( ) zero