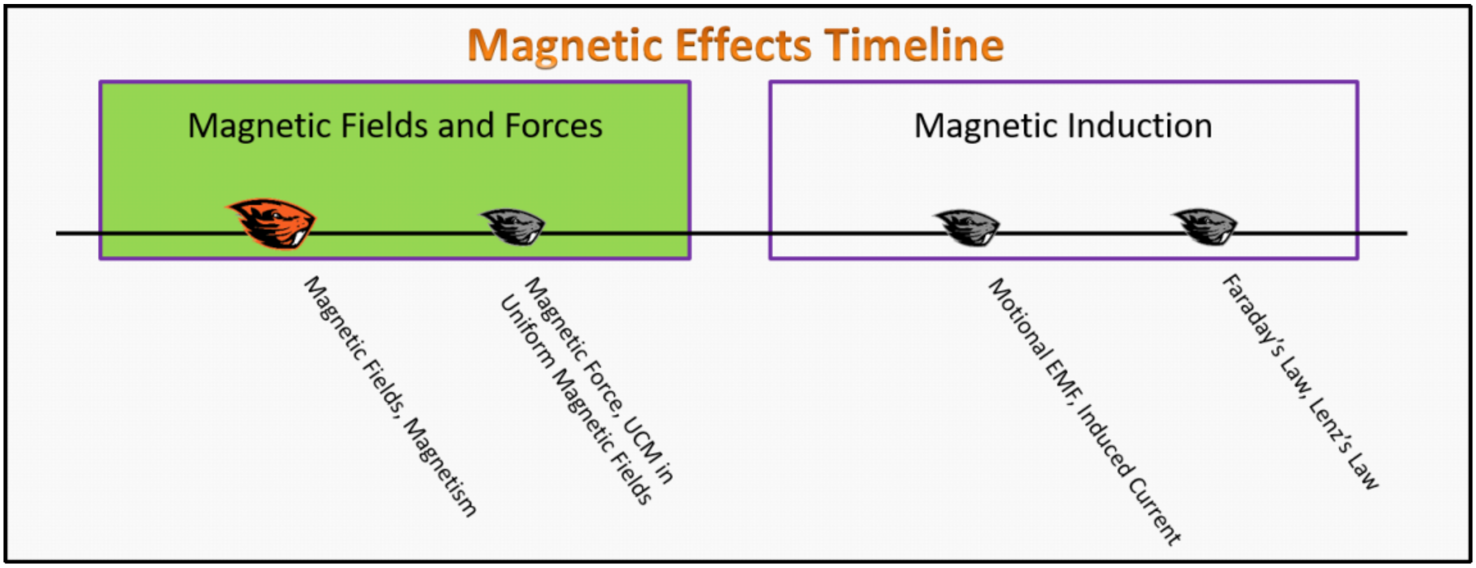
MI.L2.2 - Template

Wednesday, June 5, 2019 7:23 AM

Magnetic Induction
Foundation Stage (MI.L2.2)

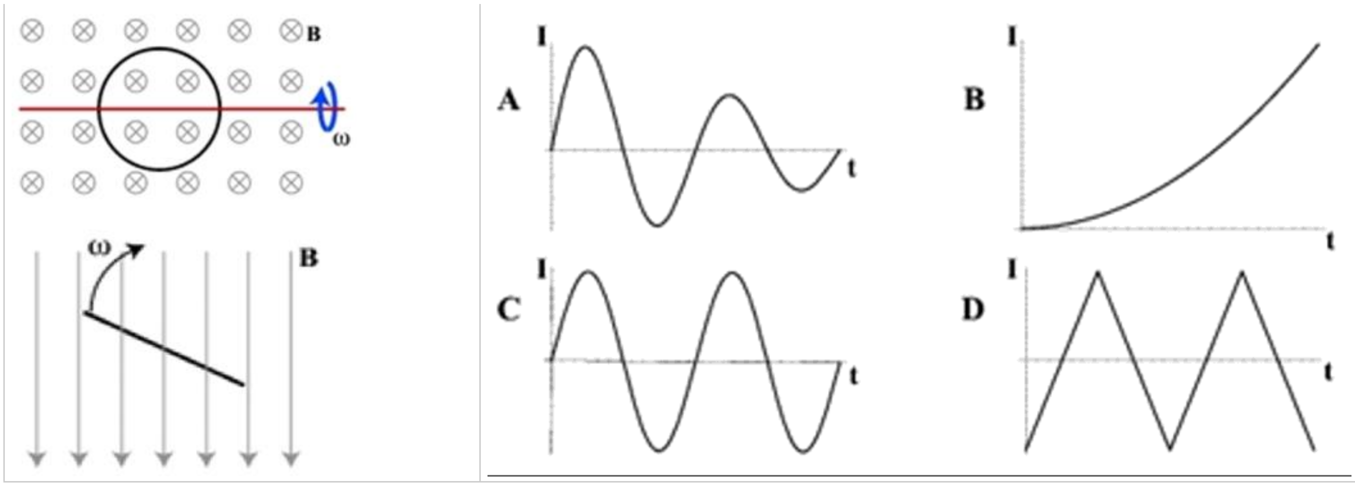
Lecture 2
Faraday's Law and Lenz's Law



Warm up

MI.L2.2-01:

Problem Statement: A metal loop with resistance R rotates in a magnetic field at constant angular velocity, as shown below. Which graph correctly depicts the dependence of the current in the loop on time?



Key Equations

$\boldsymbol{\Phi_B = \vec{B} \cdot \vec{A}}$	$\boldsymbol{\varepsilon = -\frac{\Delta \Phi_B}{\Delta t}}$

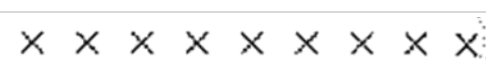
Questions

Act I: Currents, Magnetic Fields, and Induced EMF

MI.L2.2-02:

Problem Statement: The figure shows a triangle loop of wire in a uniform magnetic field. If the field strength changes from 0.30 to 0.10 T in 50 ms.

(a) What is the magnitude of the



average induced emf in the loop?

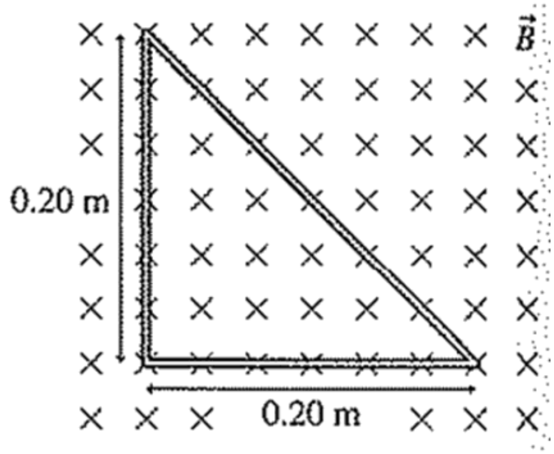
(1) 0.08 V

(2) 0.12 V

(3) 0.16 V

(4) 0.24 V

(5) 0.36 V



(b) What is the "direction" of the initial flux?

(1) up

(2) down

(3) left

(4) right

(5) into page

(6) out of page

(c) What is the "direction" of the final flux, and is it more or less than the initial flux?

(1) into page, more

(2) out of page, more

(3) into page, less

(4) out of page, less

(d) What is the "direction" of the change in flux?

(1) into page

(2) out of page

(e) What is the direction of the induced magnetic field?

(1) into page

(2) out of page

(f) What is the direction of the induced current in the loop?

(1) clockwise

(2) counterclockwise

(3) up

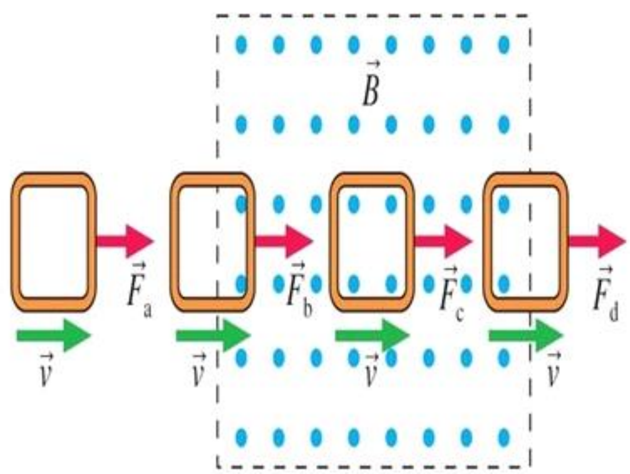
(4) down

(5) through

MI.L2.2-03:

Problem Statement: A square loop of copper wire is pulled through a region of magnetic field at constant speed.

(a) Rank the current that is induced in the loops. Rank from largest counterclockwise, to zero, to largest clockwise.

(1) $I_b = I_d > I_a = I_c$ (2) $I_c > I_b = I_d > I_a$ (3) $I_c > I_d > I_b > I_a$ (4) $I_d > I_a = I_c > I_b$	

(b) Rank in order, from strongest to weakest, the pulling forces F_a, F_b, F_c and F_d that must be applied to keep the loop moving at constant speed.

(1) $F_b = F_d > F_a = F_c$

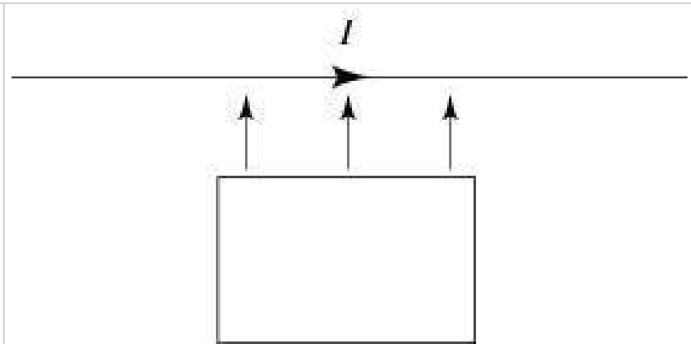
(2) $F_c > F_b = F_d > F_a$

(3) $F_c > F_d > F_b > F_a$

(4) $F_d > F_b > F_a = F_c$

MI.L2.2-04:

Problem Statement: A long, straight wire carries a steady current I. A rectangular conducting loop lies in the same plane as the wire, with two sides parallel to the wire and two sides perpendicular. Suppose the loop is pushed toward the wire as shown. Given the direction of I, the induced current in the loop is

(1) clockwise. (2) counterclockwise. (3) need more information	

MI.L2.2-05:

Problem Statement: A conducting ring is held a certain distance above a loop carrying a decreasing current as illustrated below.

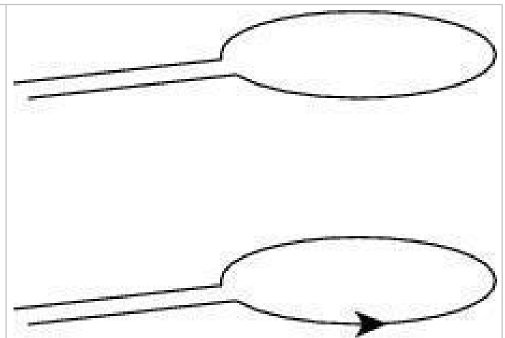
(a) Viewed from above, a current is induced in the top ring which flows in what direction?

(1) clockwise.

(2) counterclockwise.

(3) the answer depends on the distance between the two.

(4) none of the above.



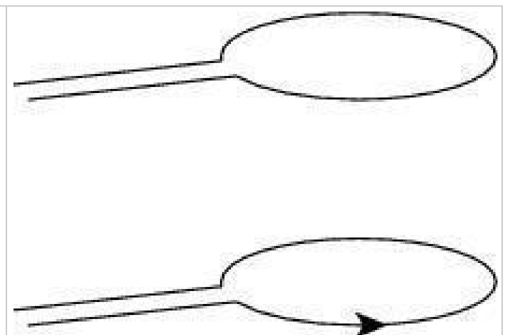
(b) If the current through the bottom loop instead increases, the two loops

(1) attract.

(2) repel.

(3) exert no force on each other.

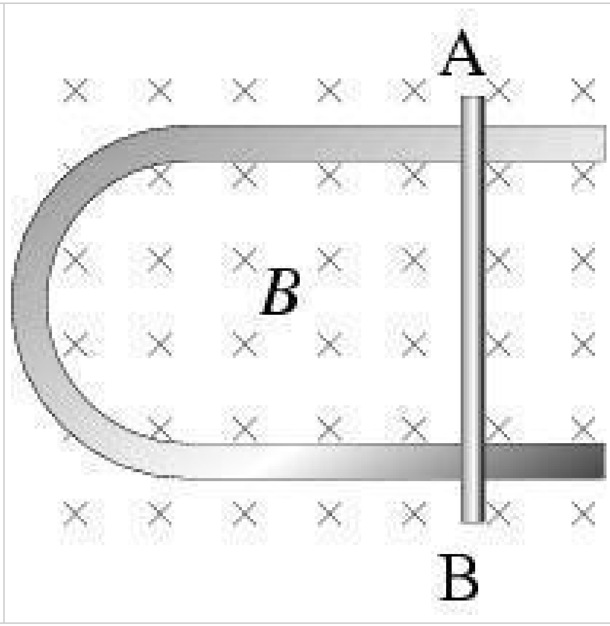
(4) exert torques on each other.



MI.L2.2-06

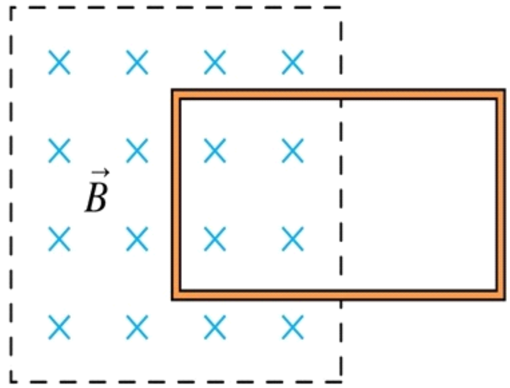
Problem Statement: Consider the arrangement shown below. Conducting rod AB is lying on a U-shaped conductor, making good electrical contact. The arrangement is placed in a magnetic field (into page). If the magnetic field strength is decreased, the rod…

(1) remains stationary.
(2) slides to the right.
(3) slides to the left.
(4) rotates clockwise.
(5) moves up (out of page).
(6) moves down (into page).
(7) none of the above



MI.L2.2-7

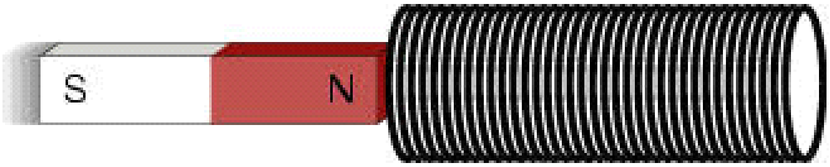
Problem Statement: A conducting loop is halfway into a magnetic field. Suppose the magnetic field begins to increase rapidly in strength. What happens to the loop?

(1) The loop is pulled to the left, into the magnetic field (2) The loop is pushed to the right, out of the magnetic field (3) The loop is pushed upward, toward the top of the page (4) The loop is pushed downward, toward the bottom of the page (5) The tension is the wires increases but the loop does not move	

Act I: Magnets and Induced EMF

MI.L2.2-08

Problem Statement: A magnet is inserted into 20 turns of copper wire at a certain speed. Which of the following is correct?



(1) No resistance to insertion is felt; in fact, the magnet is drawn in.

(2) Resistance to insertion is felt, and work must be done to push the magnet in.

MI.L2.2-09

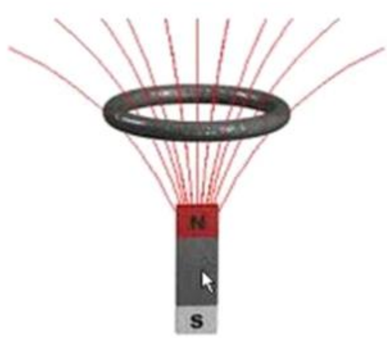
Problem Statement: The magnetic is falling downward away from the stationary loop. What, if any, is the direction of the induced current in the loop as viewed from above?

(1) No induced current

(2) Yes, clockwise

(3) Yes, counterclockwise

(4) No, clockwise



MI.L2.2-10

Problem Statement: A permanent magnet is dropped through a long aluminum tube, as shown. As the magnet drops, electric currents are induced around the tube. Compared to a freely falling magnet, the magnet through the tube drops…

(Hint: Consider the effects of induced currents through strips ahead of and behind the dropped magnet)

(1) more slowly.
(2) exactly the same way.
(3) faster.
(4) Need more information.