Solutions

AP Physics 2 - Test 07 - Electromagnetism Pt. 2

Score: 100 ?

1. The figure shows a bar moving to the right on two conducting rails. To make an induced current i in the direction indicated, in what direction would the magnetic field be in the area contained within the conducting rails?

○ A out of the page

● B into the page

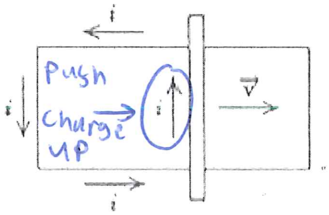
○ C to the right

○ D to the left

F = Palm

V = thumb

Fingers point in



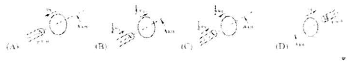
2. In each of the following situations, a bar magnet is aligned along the axis of a conducting loop. The magnet and the loop move with the indicated velocities. In which situation will the bar magnet NOT induce a current in the conducting loop?

○ A A

● B B

○ C C

○ D D



3. There is a counterclockwise current I in a circular loop of wire situated in an external magnetic field directed out of the page as shown. The effect of the forces that act on this current is to make the loop

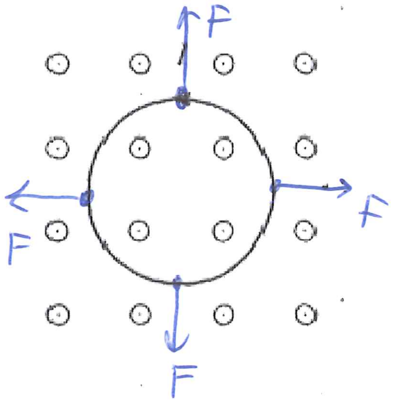
● A Expand the loop in size

○ B Contract the loop in size

○ C Rotate the loop counterclockwise (from the image's reference view)

○ D Accelerate out of the page

All points have a force outward.



4. The figure shows a rectangular loop of wire of width l and resistance R. One end of the loop is in a uniform magnetic field of strength B at right angles to the plane of the loop. The loop is pulled to the right at a constant speed v. What are the magnitude and direction of the induced current in the loop?

○ A Magnitude: BLvR
Direction: Clockwise

○ B Magnitude: BLvR
Direction: Counterclockwise

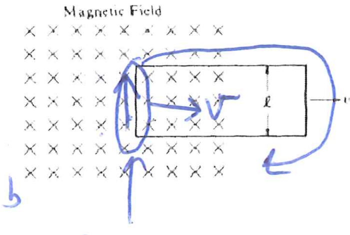
● C Magnitude: BLv/R
Direction: Clockwise

F = Palm

V = thumb

⊗ Fingers in Page

$\varepsilon = BLv \quad I = \frac{\varepsilon}{R} = \frac{BLv}{R}$



Push charge up at this point, so clockwise

Ⓓ Magnitude: BLv/R
Direction: Counterclockwise

5. A magnetic field B that is decreasing in strength with time is directed out of the page and passes through a loop of wire in the plane of the page, as shown. Which of the following is true of the induced current in the wire loop?

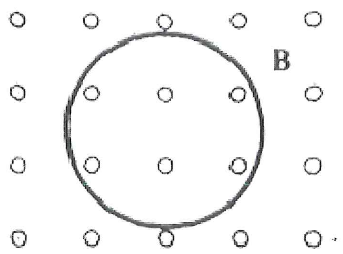
[✓ Ⓐ] It is counterclockwise in direction.

Ⓑ It is clockwise in direction.

Ⓒ It is directed out of the page.

Ⓓ It is zero in magnitude.

Lenz's Law



6. A single circular loop of wire in the plane of the page is perpendicular to a uniform magnetic field B directed out of the page, as shown. If the magnitude of the magnetic field is increasing in strength, then the induced current in the wire is

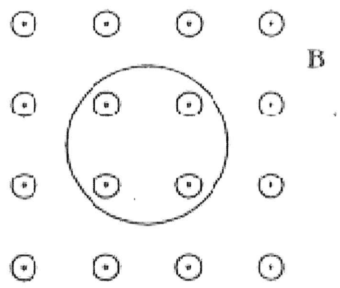
Ⓐ directed out of the paper

Ⓑ directed into the paper

[✓ Ⓒ] clockwise around the loop

Ⓓ counterclockwise around the loop

Lenz's Law



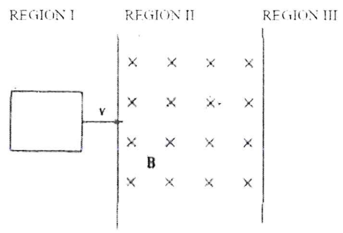
7. A loop of wire is pulled with constant velocity v to the right through a region of space where there is a uniform magnetic field B directed into the page, as shown. The induced current is as follows

Ⓐ Entering Region 2: Clockwise
Leaving Region 2: Clockwise

Ⓑ Entering Region 2: Clockwise
Leaving Region 2: Counterclockwise

[✓ Ⓒ] Entering Region 2: Counterclockwise
Leaving Region 2: Clockwise

Ⓓ Entering Region 2: Counterclockwise
Leaving Region 2: Counterclockwise



8. A square loop of wire of side 0.5 meter and resistance 10^{-2} ohm is located in a uniform magnetic field of intensity 0.4 tesla directed out of the page as shown. The magnitude of the field is decreased to zero at a constant rate in 2 seconds. As the field is decreased, what are the magnitude and direction of the current in the loop?

Ⓐ 0

[✓ Ⓑ] 5A, Counterclockwise

Ⓒ 5A, Clockwise

Ⓓ 20A, Counterclockwise

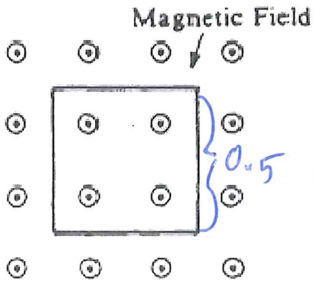
$$\varepsilon = \frac{\Delta\Phi}{t} = \frac{\Delta B A}{t} = \frac{0.4(0.25)}{2}$$

$$\varepsilon = 0.05$$

$$I = \frac{\varepsilon}{R} = \frac{0.05}{0.01}$$

$$\boxed{= 5A}$$

CCW by Lenz's Law



0.5 $A = 0.5^2$
$= 0.25$

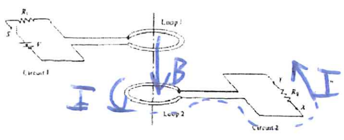
9. After the switch S is closed, the initial current through resistor R_2 is

[✓ A] from point X to point Y

B from point Y to point X

C zero at all times

D impossible to determine its direction



$\Delta\Phi$ is down

By Lenz's Law, induced current is CCW is second Loop

10. After the switch S has been closed for a very long time, the currents in the two circuits are

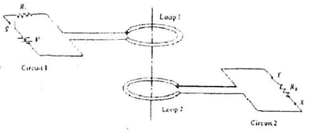
A zero in both circuits

B zero in circuit 1 and V/R_2 in circuit 2

[✓ C] V/R_1 in circuit 1 and zero in circuit 2

D V/R_1 in circuit I and V/R_2 in circuit 2

No change in flux of second loop.



11. Two parallel conducting rails, separated by a distance L of 2 meters, are connected through a resistance R of 3 ohms as shown. A uniform magnetic field with a magnitude B of 2 tesla points into the page. A conducting bar with mass m of 4 kilograms can slide without friction across the rails.

Determine at what speed the bar must be moved to induce an emf of 6 volts.

[✓ A] 1.5 m/s

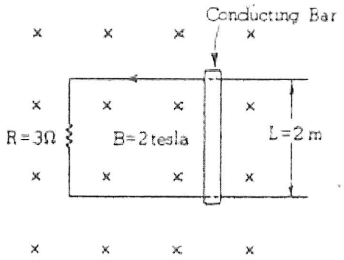
B 3 m/s

C 0 m/s

D 2 m/s

$$\varepsilon = vLB$$

$$v = \frac{\varepsilon}{LB} = \frac{6}{(2)(2)} = \boxed{1.5\ m/s}$$



12. Two parallel conducting rails, separated by a distance L of 2 meters, are connected through a resistance R of 3 ohms as shown. A uniform magnetic field with a magnitude B of 2 tesla points into the page. A conducting bar with mass m of 4 kilograms can slide without friction across the rails.

With this induced emf, what will be in induced current?

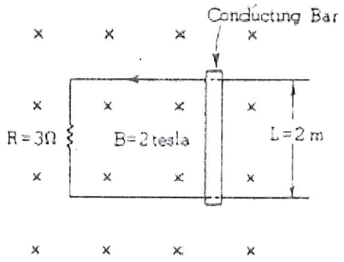
A 0 A

B 12 A

[✓ C] 2 A

D 4 A

$$I = \frac{\varepsilon}{R} = \frac{6}{3} = \boxed{2A}$$



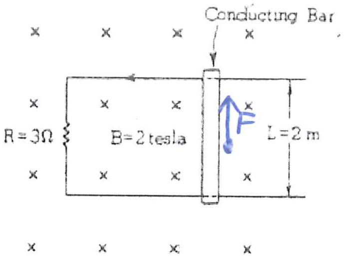
13. Two parallel conducting rails, separated by a distance L of 2 meters, are connected through a resistance R of 3 ohms as shown. A uniform magnetic field with a magnitude B of 2 tesla points into the page. A conducting bar with mass m of 4 kilograms can slide without friction across the rails.

Which direction must the bar be pulled to induce a current in the counterclockwise direction?

● right

○ B left

Bar needs to move to the right to push charge upward at that location. Thus, CCW current



14. Two parallel conducting rails, separated by a distance L of 2 meters, are connected through a resistance R of 3 ohms as shown. A uniform magnetic field with a magnitude B of 2 tesla points into the page. A conducting bar with mass m of 4 kilograms can slide without friction across the rails.

Determine the magnitude of the external force that must be applied to the bar to keep it moving at this velocity.

○ A 6 N

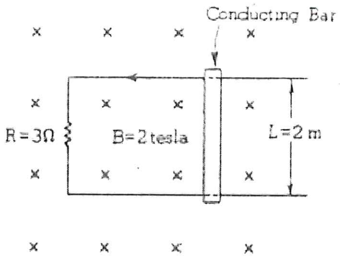
○ B 2 N

● 8 N

○ D 0 N

$F = BIL = (2)(\overset{2}{\ })(2)$

$F = 8N$



15. Two parallel conducting rails, separated by a distance L of 2 meters, are connected through a resistance R of 3 ohms as shown. A uniform magnetic field with a magnitude B of 2 tesla points into the page. A conducting bar with mass m of 4 kilograms can slide without friction across the rails.

Determine the rate at which heat is being produced in the resistor (electrical power dissipation).

○ A 12 Joules

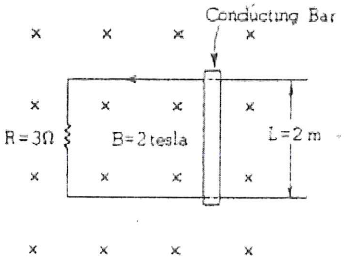
● 12 Watts

○ C 8 Watts

○ D 8 Joules

$P = I^2 R = (2^2)(3)$

$\boxed{P = 12\,W}$



16. Two parallel conducting rails, separated by a distance L of 2 meters, are connected through a resistance R of 3 ohms as shown. A uniform magnetic field with a magnitude B of 2 tesla points into the page. A conducting bar with mass m of 4 kilograms can slide without friction across the rails.

How much energy will be dissipated by the resistor after 10 seconds?

● 120 Joules

○ B 120 Watts

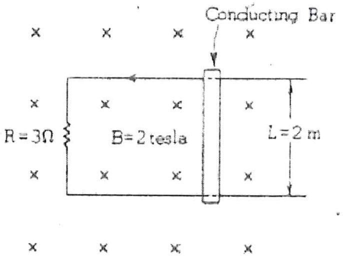
○ C 80 Watts

○ D 80 Joules

$P = \frac{W}{t}$

$W = P \cdot t = (12)(10)$

$= 120 J$



17. For the solenoids shown in the diagram (which are assumed to be close to each other), the resistance of the left-hand circuit is slowly increased. In which direction does the ammeter needle (indicating the direction of conventional current) in the right-hand circuit deflect in response to this change?

● A The needle deflects to the left.

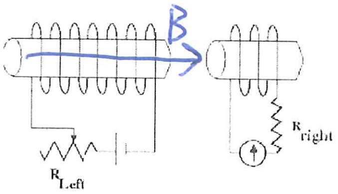
○ B The needle deflects to the right.

○ C The needle oscillates back and forth.

○ D The needle never moves.

Current, thus flux gets weaker.

$\Delta\Phi$ is to the right.



So apply Lenz's Law an Second coil must induce a field to the Right.

18. A strong bar magnet is held very close to the opening of a solenoid as shown in the diagram. As the magnet is moved away from the solenoid at constant speed, what is the direction of conventional current through the resistor shown and what is the direction of the force on the magnet because of the induced current?

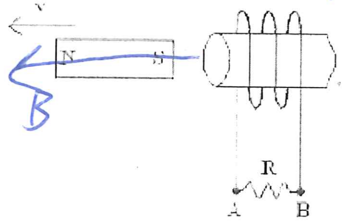
○ A **Current**: A to B
Force: To the left

$\Delta\Phi$: Flux decreases

○ B **Current**: B to A
Force: To the left

● C **Current**: A to B → Lenz's Law
Force: To the right → It will always be a resistive force.

○ D **Current**: B to A
Force: To the right



19. When a wire moving through a magnetic field has a voltage induced between the wire's ends, that voltage is

I. directly proportional to the strength of the magnetic field ✓
II. directly proportional to the velocity of the wire ✓
III. directly proportional to the diameter of the wire X

○ A I only

○ B II only

○ C III only

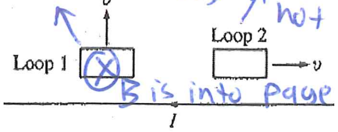
● D I and II only

$\mathcal{E} = vLB$

20. Two conducting wire loops move near a very long, straight conducting wire that carries a current I to the left. When the loops are in the positions shown, they are moving in the direction shown with the same constant speed v. Assume that the loops are far enough apart that they do not affect each other. Which of the following is true about the induced electric currents, if any, in the loops?

Flux decreases

Flux does not change



○ A **Loop 1**: No current
Loop 2: No current

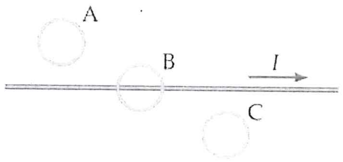
○ B **Loop 1**: No current
Loop 2: Counterclockwise

Lenz's Law

● C **Loop 1**: Clockwise
Loop 2: No current

○ D **Loop 1**: Counterclockwise
Loop 2: Clockwise

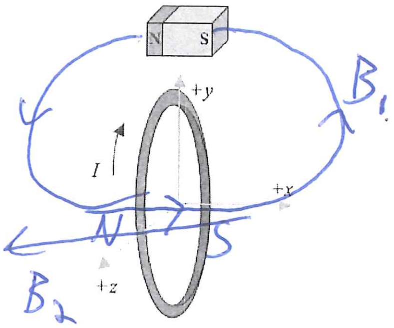
21. The wire in the figure carries a current I that is <u>increasing</u> with time at a constant rate. The wire and the three loops are all in the same plane. What is true about the currents induced in each of the three loops shown?



- (A) Loop A has counterclockwise current, loop B has no induced current, and loop C has clockwise current.
- (B) No current is induced in any loop.
- (C) The currents are clockwise in all three loops.
- [✓ (D)] Loop A has clockwise current, loop B has no induced current, and loop C has counterclockwise current.

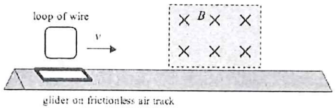
22. A long bar magnet is placed above a current loop oriented as shown. In which direction will the North pole of the bar magnet feel a force due to the current loop?

- [✓ (A)] +x
- (B) -x
- (C) +y
- (D) -y
- (E) The bar magnet will feel no force due to the current loop



Φ is to the right in the loop.

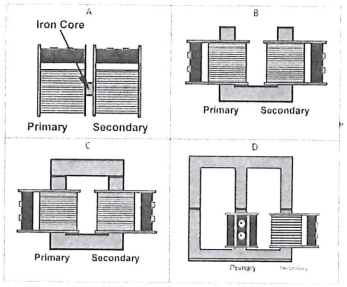
23. A single loop of conducting wire is mounted on a glider, which travels on a frictionless air track with an initial velocity *v*. When the front edge of the loop enters the magnetic field *B* pointing into the page as shown...



- (A) There is a clockwise current in the loop and the glider slows down.
- [✓ (B)] There is a counterclockwise current in the loop, and the glider slows down.
- (C) There is a clockwise current in the loop, and the glider speeds up.
- (D) There is a counterclockwise current in the loop, and the glider speeds up.
- (E) There is no current in the loop, and the glider travels and constant *v*.

24. Which of these transformer designs is most efficient?

- (A) A
- (B) B
- [✓ (C)] C
- (D) D



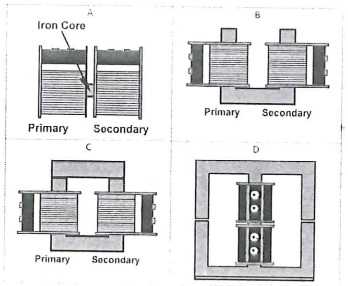
25. Which of these transformer designs is most efficient?

○ A

○ B

○ C

● D


A
Iron Core
Primary
Secondary
B
Primary
Secondary
C
Primary
Secondary
D