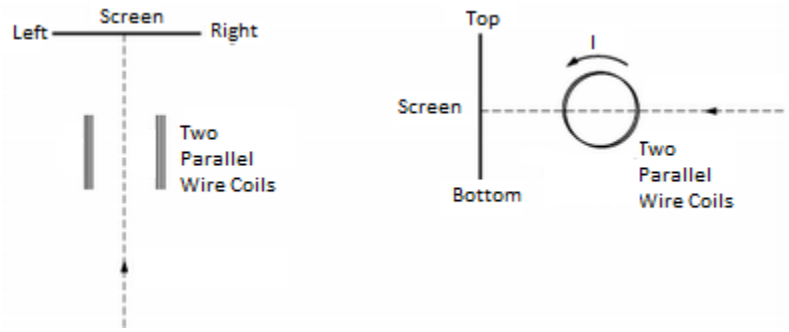
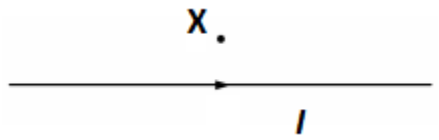
PS I AP Physics 2 Electromagnetic Induction
Multiple Choice Questions



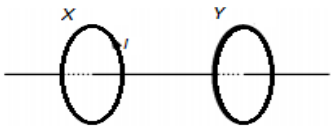
1. A beam of electrons travels between two parallel coils of wire, as shown in the figures above. When the coils do not carry a current, the electron beam is undeflected and hits the center of the screen, as indicated by the dashed line. When the coils carry a constant current I, the electron beam is deflected toward which edge of the screen?

A. The top
B. The bottom
C. The left
D. None; it is not deflected.



2. A long straight wire carries a current *I* toward the right. What is the direction of the magnetic field resulting from the wire at point x?

A. Out of the page
B. Into of the page
C. Toward the left
D. Toward the right



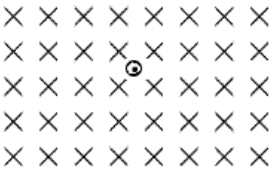
3. The two circular wire loops are represented above lie on the same axis. If the current I in loop X is increasing linearly with respect to time, which of the following is true of the induced current in loop Y ?

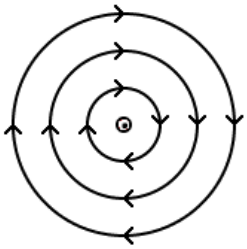
A. It is in the same direction as that in loop X and is increasing with respect to time.
B. It is in the opposite direction of that in loop X and is increasing with respect to time.
C. It is in the same direction as that in loop X and is constant.
D. It is in the opposite direction of that in loop X and constant.

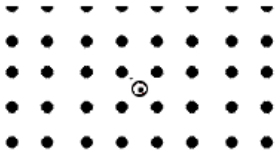
4. An electron enters the magnetic field above. What direction is the magnetic force acting on the charge when it enters?

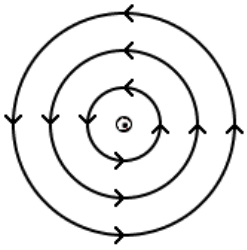
A. Up
B. Down
C. Right
D. Left

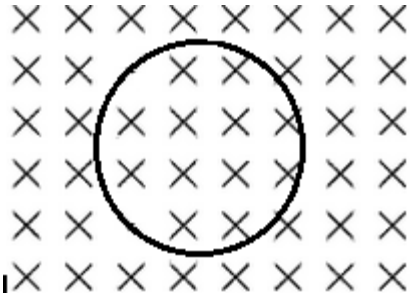
5. Which of the following diagrams accurately portrays the magnetic field resulting from a wire directed out of the page?

A.


C.


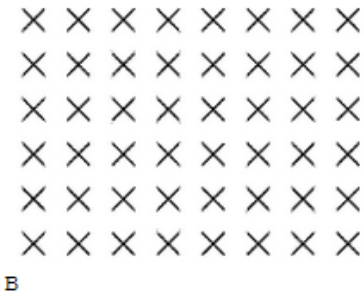
B.


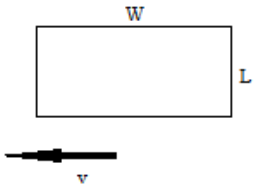
D.




6. A conducting loop of wire with radius r is placed in an increasing magnetic field B directed into the page as shown above. What the direction of the induced current of the wire?

A. Clockwise
B. Counterclockwise
C. Up
D. Down





Use this diagram for Questions 7-11.

7. A loop of conducting wire with length L and width W is entering a magnetic field B at velocity v. What direction will the induced current travel in?

A. Clockwise
B. Counterclockwise
C. Up
D. Down

8. What is the induced EMF?

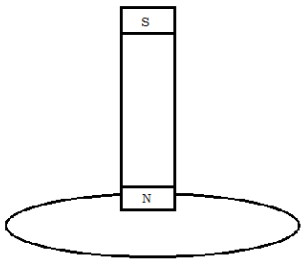
A. ILB
B. BLv
C. BL/v
D. There is no induced EMF

9. The loop of wire has a resistance R. What is the value of the induced current?

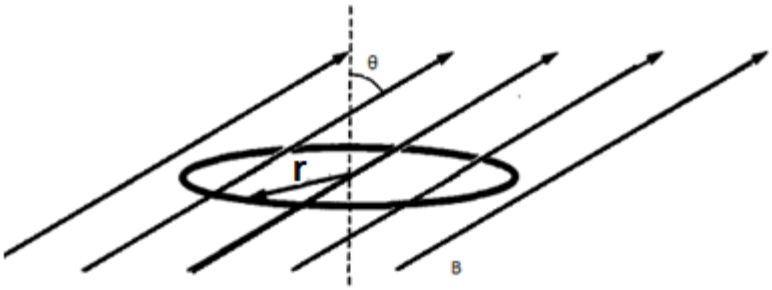
A. BLv/R
B. ILB/R
C. BL/vR
D. There is not induced current

10. What is the direction of the magnetic force on the loop as it enters magnetic field B?
    A. Up
    B. Down
    C. Right
    D. Left

11. What is the direction of the magnetic force on the loop as it leaves magnetic field B?
    A. Up
    B. Down
    C. Right
    D. Left

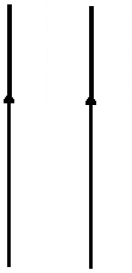


12. A magnet is slowly descending into a loop of wire. What direction is the induced current in?
    A. Clockwise
    B. Counterclockwise
    C. Upwards
    D. Downwards



13. A conducting circular loop of wire with radius r and resistance R is placed in a changing magnetic field B directed upwards at an angle θ. What is the magnetic flux through the loop?

A. $2\pi rB\cos\theta$
B. $2\pi rB\sin\theta$
C. $B\pi r^2\cos\theta$
D. $B\pi r^2\sin\theta$



Use this diagram for Questions 14-15.

14. Two wires with current I are a distance r apart. In what direction is the force on the left wire?

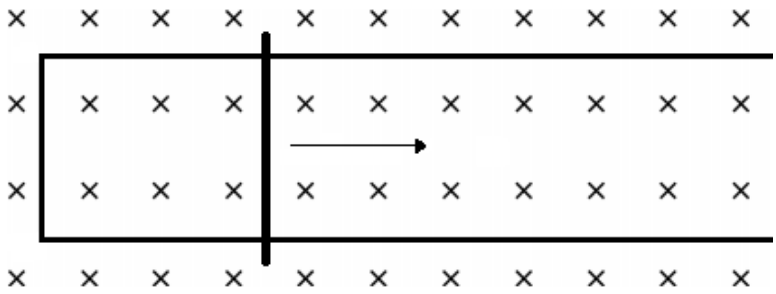
A. Up
B. Down
C. Right
D. Left

15. What is the magnitude of the force between the wires?

A. $\mu_o I^2/2\pi r$
B. $\mu_o I/2\pi r$
C. $\mu_o I^2/\pi r^2$
D. 0

A square coil of wire with a side length of 10 cm is looped around 10 times. The coil sits in an increasing magnetic field. The magnetic field increases linearly from 1T to 2T within 5 seconds. **Use this information for Questions 16-17.**

16. What is the induced EMF of the coil?
    A. 200 V
    B. 20 V
    C. 2 V
    D. 0 .02 V
17. If the same loop of wire has a resistance of 2Ω, what is the induced current in the loop?
    A. 100 A
    B. 10 A
    C. 1 A
    D. 0.01 A



In the diagram above, a conducting rod with length L moves horizontally on a set of conducting rails at a constant velocity v through a magnetic field B. **Use this diagram for Questions 18 – 25.**

18. What direction is the induced current in the circuit?
    A. Clockwise
    B. Counterclockwise
    C. Right
    D. Left

19. What is the direction of the induced magnetic field?
    A. Into the page
    B. Out of the page
    C. Left
    D. Right

20. What is the induced EMF in the circuit?

A. Bv
B. vR
C. BLv
D. 0

21. If the resistance of the rod is R, what is the magnitude of the induced current in the circuit?

A. Bv/R
B. v
C. BLv/R
D. 0

22. If the resistance of the rod is R, what is the magnitude of the magnetic force acting on the rod?

A. B^2vL/R
B. vLB/R
C. B^2L^2v/R
D. 0

23. What direction is the magnetic force in?

A. Left
B. Right
C. Up
D. Down

24. Given the direction of the magnetic force, which of the following statements must be true?

A. The track has a resistance of 2R
B. The induced magnetic field is into the page
C. There is a force pushing the rod to the left
D. There is a force pushing the rod to the right

25. There is a friction between the rod and the track it is riding on. The coefficient of friction is μ. If the rod has mass m, what is the applied force?

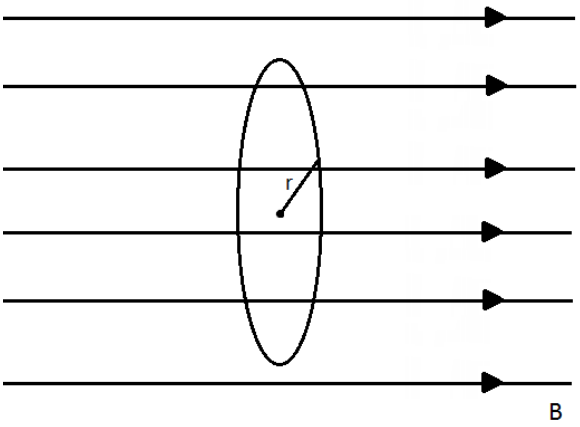
A. B^2L^2v/R + μmg
B. B^2L^2v/R - μmg
C. B^2Lv/R + μmg
D. B^2vL/R - μmg

26. What is the SI unit for EMF?

A. Farad
B. Ohm
C. EMF
D. Volt

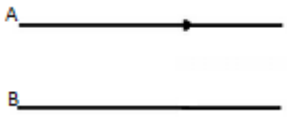
27. When a current runs through a wire, a magnetic field is created. However, computer cables create little to no magnetic field external to their insulation. How is this possible? (Hint: computer cables contain multiple wires inside)

A. The cables are insulated with plastic.
B. The supply and return cables run anti parallel and their magnetic fields essentially cancel out.
C. The supply and return cables run parallel and their magnetic fields essentially cancel out.
D. The currents are too small to create a significant magnetic field.



28. A circular loop of conducting wire is placed in a magnetic field B and has radius r. The loop is spinning in the magnetic field at an angular velocity of ω with respect to its diameter. Which of the following equations can be used to find the magnetic flux as a function of time?

A. $B\pi r^2 cos(t)$
B. $B\pi r^2 sin(t)$
C. $B\pi r^2 sin(\omega t)$
D. $B\pi r^2 cos(\omega t)$



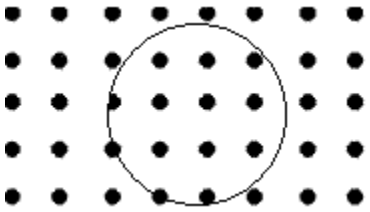
A current flows to the right through wire A, which is fixed in place. Wire B are held in equilibrium by the magnetic force and the gravitational force. **Use this diagram for Questions 29-30.**

29. What is the direction of the current through wire B?

A. Right
B. Left
C. Both directions.
D. There is no current in wire B; the magnetic field from wire A attracts the metal in wire B.

30. Wire A is moved down slightly so that the two wires have a smaller separation between them but wire A is still above wire B. What is the result of this change?

A. Wire B stays suspended in the air.
B. Wire B accelerates downwards
C. Wire B accelerates upwards
D. Wire B moves upwards at a constant velocity



31. A circular loop of wire is placed in a magnetic field as show above. If the magnetic field is increasing, what direction is the induced current in?

A. Clockwise
B. Counterclockwise
C. Into the page
D. Out of the page

32. Why do you need to swipe your credit card in the credit card reader for it to accept your charge?

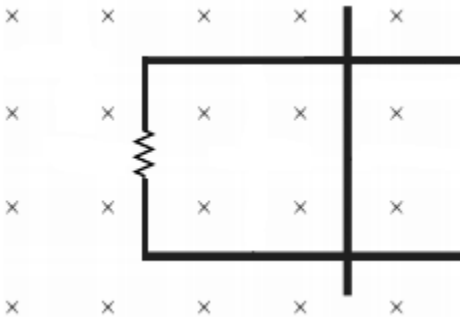
A. The magnetic field in the reader only works when the credit card is moving.
B. The current in the reader flows when the credit card strip is stationary.
C. The magnetic field in the credit card strip needs to move to induce a current in the reader.
D. The magnetic field in the credit card strip only exists when it is moving.

33. At the South Pole, the Earth's magnetic field is directed upwards. If a plane is flying over the South Pole, which wing will have the higher potential?

A. The left wing
B. The right wing
C. Both wings have the same potential
D. It is impossible to answer this question without knowing whether the plane is flying east or west

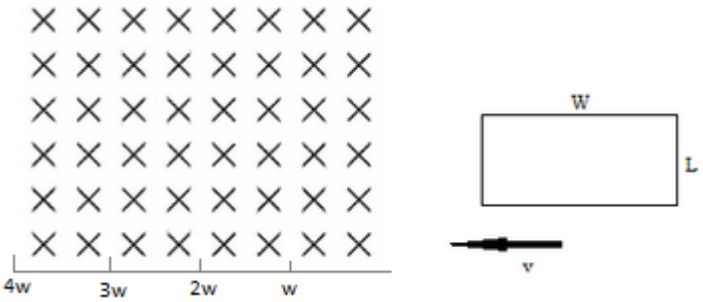
34. A loop of wire sits in an unchanging magnetic field. Which of the following is a NOT a way to induce a current through the loop?

A. Rotate the loop about its diameter
B. Spin the loop about its center
C. Stretch the loop
D. Squeeze the loop

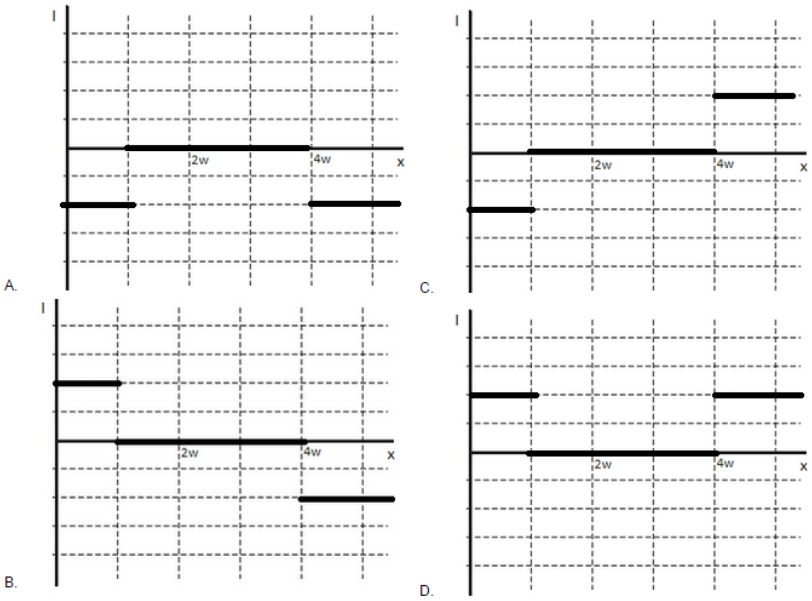


35. A rod of length L lies on a set of conducting rails connected to a resistor R. The rod is pulled to the right at a constant velocity v through a magnetic field B. How much power is dissipated in the resistor as the rod is being pulled?

A. 0
B. B^2L^2v/R
C. B/R
D. B^2Lv/R



36. As shown above, a single loop of wire enters a magnetic field B with a constant velocity v. Which of the following graphs accurately depicts the direction of the induced current at specific points as the left edge of the loop moves through the magnetic field, assuming a clockwise direction is positive and a counterclockwise direction is negative?



37. A square loop of wire with 2 turns and a side length of 1 m is placed in a changing magnetic field. If the magnetic field changes from 2 T to 4 T within 8 seconds, what is the average induced EMF?

A. 0.25 V
B. 0.5 V
C. 0 V
D. 2 V

38. A square loop of wire with 10 turns and a side length of 1 m is placed in a changing magnetic field. If the magnetic field changes from 2 T to 4 T within 8 seconds, what is the average induced EMF?

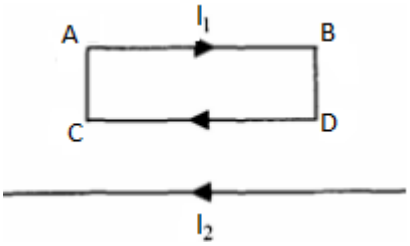
A. 1.25 V
B. 2.5 V
C. 0 V
D. 5 V

39. Which of the following laws is used to find the direction of the induced current in a loop of wire placed in a changing magnetic field?

A. Lenz's Law
B. Faraday's Law
C. Ampere's Law
D. Gauss's Law

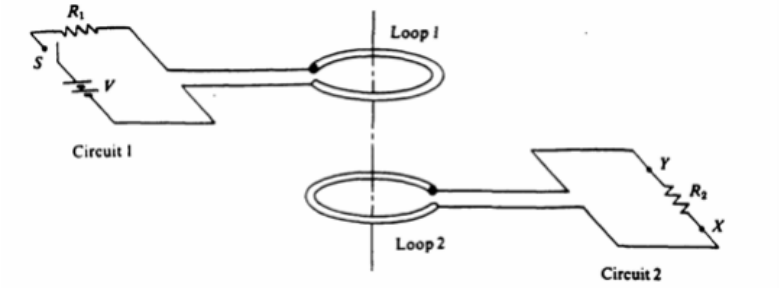
40. What are some similarities between a motor and a generator?

A. They both rely on Faraday's Law.
B. Both require an input current to work.
C. Both need to be rotated by an external force.
D. Ampere's Law explains the operation of both.



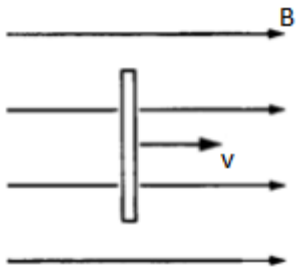
41. A square loop of wire carries current I_1 above in a clockwise direction a straight wire that carries current I_2 towards the left. In what direction is the net force on the loop?

A. Up
B. Down
C. Right
D. Left



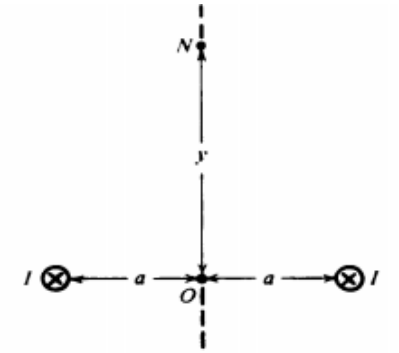
42. How does the current flow through resistor R_2 behave once switch S is closed?

A. From point Y to X
B. From point X to Y
C. The current oscillates between X and Y
D. There is no current through the resistor



43. A conducting bar travels through magnetic field B at constant velocity v. Which part of the bar has a higher electric potential?

A. The top
B. The bottom
C. Neither
D. Electric potential is zero in the bar



44. What direction is the magnetic field in at point N?

A. Up
B. Down
C. Right
D. Left

45. Lenz's law concerning the direction of an induced current in a conductor by a magnetic field could be a restatement of?

A. Ampere's Law
B. Ohm's Law
C. Tesla's Law
D. The Law of Conservation of Energy

46. Which of the following will generate a current in a conducting loop? **Select two answers:**

A. A bar magnet moving towards the loop.
B. A bar magnet remaining stationary within the loop.
C. The loop rotating on an axis perpendicular to the bar magnet.
D. A magnet and the loop moving to the right with the same velocity.

47. How can the magnetic flux through a coil of wire be increased? **Select two answers:**

A. Increase the magnitude of the magnetic field that passes outside the loop
B. Increase the magnitude of the magnetic field that passes through the loop.
C. Increase the cross sectional area of the loop.
D. Orient the loop so its normal vector is perpendicular to the external magnetic field direction.

48. Which is true about the functionality of a Ground Fault Circuit Interrupter? **Select two answers:**

A. Its functionality can be explained using Faraday's Law.
B. It is best used in dry areas of the house.
C. It opens the electric circuit to a wall outlet after the main circuit breakers have opened.
D. It opens the electric circuit to a wall outlet before the main circuit breakers have opened

49. A metal bar is being pushed along two conducting rails that are connected by a stationary wire parallel to the moving bar. What is **required** to generate a constant current in the bar/rail/wire configuration? **Select two answers:**

A. An external constant perpendicular magnetic field within the bar/rail/wire configuration.
B. An external constant parallel magnetic field within the bar/rail/wire configuration.
C. The bar needs to be pushed so that it moves with a constant velocity.
D. The bar has to stay stationary.

Answers:

1. B
2. A
3. D
4. A
5. D
6. B
7. B
8. B
9. A
10. D
11. D
12. A
13. C
14. C
15. A
16. D
17. D
18. B
19. B
20. C
21. C
22. C
23. A
24. D
25. A
26. D
27. B
28. D
29. A
30. C
31. A
32. C
33. B
34. B
35. B
36. C
37. B
38. B
39. A
40. A
41. B
42. B
43. C
44. D
45. D
46. A, C
47. B, C
48. A, D
49. A, C