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# Final Revision

## ELECTROMAGNETIC INDUCTION

GR.12 ADV.

With Answer key

Compiled and edited

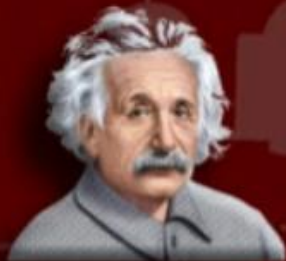
By

Mr.Rami Abdelfattah

قناة التليجرام

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سلسلة أينشتاين الخليج

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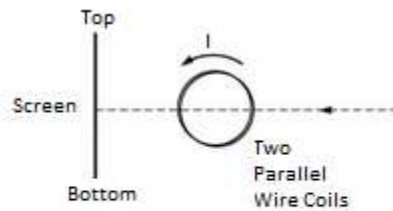
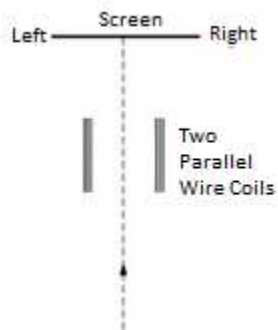
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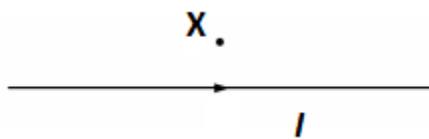
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### PS I AP Physics 2 Electromagnetic Induction Multiple Choice Questions



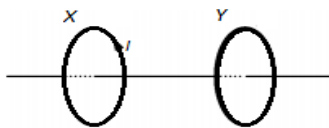
1. A beam of electrons travels between two parallel coils of wire, as shown in the figures above. When the coils do not carry a current, the electron beam is undeflected and hits the center of the screen, as indicated by the dashed line. When the coils carry a constant current  $I$ , the electron beam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

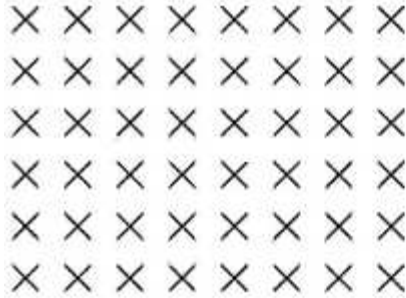
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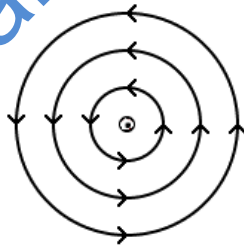
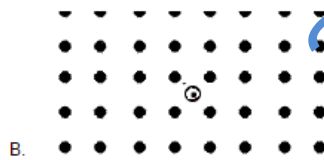
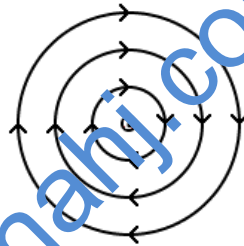
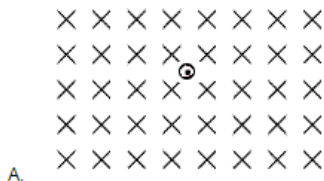


4. An electron enters the magnetic field above. What direction is the magnetic force acting on the charge when it enters?

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

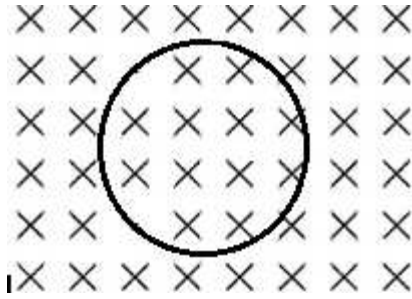
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5. Which of the following diagrams accurately portrays the magnetic field resulting from a wire directed out of the page?



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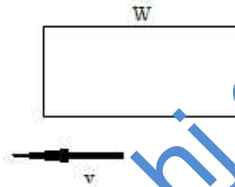
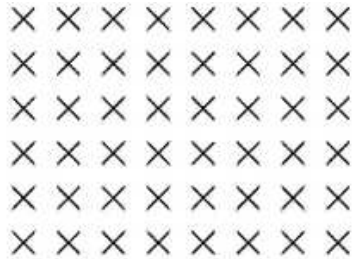
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6. A conducting loop of wire with radius  $r$  is placed in an increasing magnetic field  $B$  directed into the page as shown above. What the direction of the induced current of the wire?

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



Use this diagram for Questions 7-11.

B

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

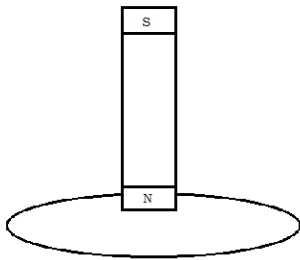
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10. What is the direction of the magnetic force on the loop as it enters magnetic field B?

- 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



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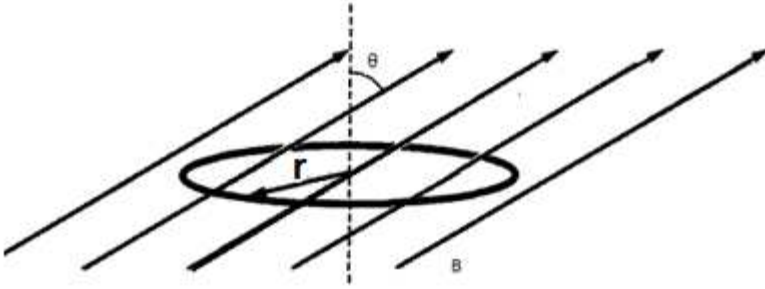
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12. A magnet is slowly descending into a loop of wire. What direction is the induced current in?

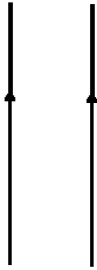
- A. Clockwise
- B. Counterclockwise
- C. Upwards
- D. Downwards

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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  $\theta$ . What is the magnetic flux through the loop?

- A.  $2\pi r B \cos\theta$
- B.  $2\pi r B \sin\theta$
- 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.  $\mu_0 I^2 / 2\pi r$
- B.  $\mu_0 I / 2\pi r$
- C.  $\mu_0 I^2 / \pi r^2$
- D. 0

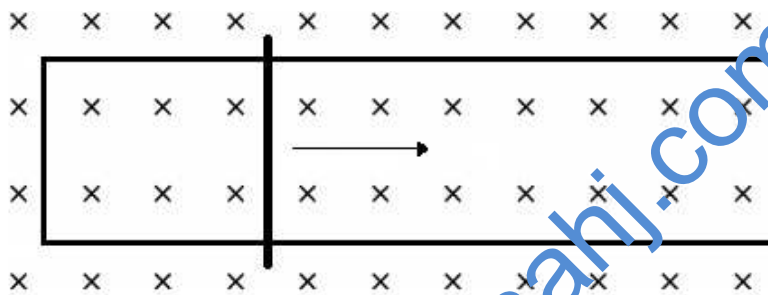
A square coil of wire with a side length of 10 cm is looped around 10 times. The coil sits in an increasing magnetic field. The magnetic field increases linearly from 1T to 2T within 5 seconds. **Use this information for Questions 16-17.**

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  $2\Omega$ , 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

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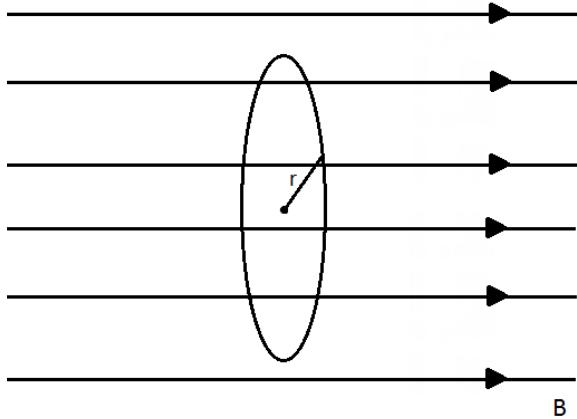
20. What is the induced EMF in the circuit?
- A.  $Bv$
  - B.  $vR$
  - C.  $BLv$
  - D. 0
21. If the resistance of the rod is  $R$ , what is the magnitude of the induced current in the circuit?
- A.  $Bv/R$
  - B.  $v$
  - C.  $BLv/R$
  - D. 0
22. If the resistance of the rod is  $R$ , what is the magnitude 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  $\mu$ . If the rod has mass  $m$ , what is the applied force?
- A.  $B^2L^2v/R + \mu mg$
  - B.  $B^2L^2v/R - \mu mg$
  - C.  $B^2Lv/R + \mu mg$
  - D.  $B^2vL/R - \mu mg$
26. What is the SI unit for EMF?
- A. Farad
  - B. Ohm
  - C. EMF
  - D. Volt

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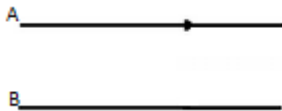
27. When a current runs through a wire, a magnetic field is created. However, computer cables create little to no magnetic field external to their insulation. How is this possible? (Hint: computer cables contain multiple wires inside)

- 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  $\omega$  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.  $B\pi r^2 \cos(\omega t)$



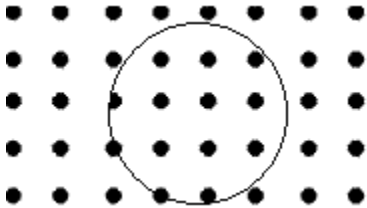
A current flows to the right through wire A, which is fixed in place. Wire B are held in equilibrium by the magnetic force and the gravitational force. **Use this diagram for Questions 29-30.**

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.

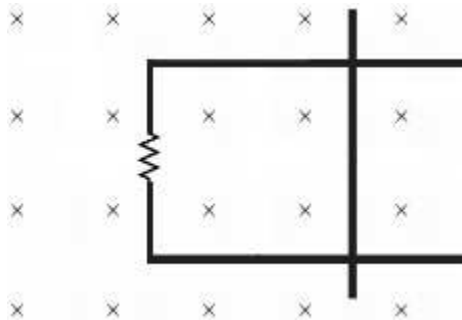


33. At the South Pole, the Earth's magnetic field is directed upwards. If a plane is flying over the South Pole, which wing will have the higher potential?

- 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.  $B^2 L^2 v / R$
- C.  $B / R$
- D.  $B^2 L v / R$

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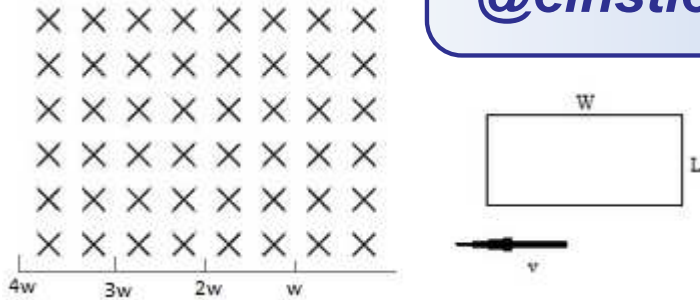
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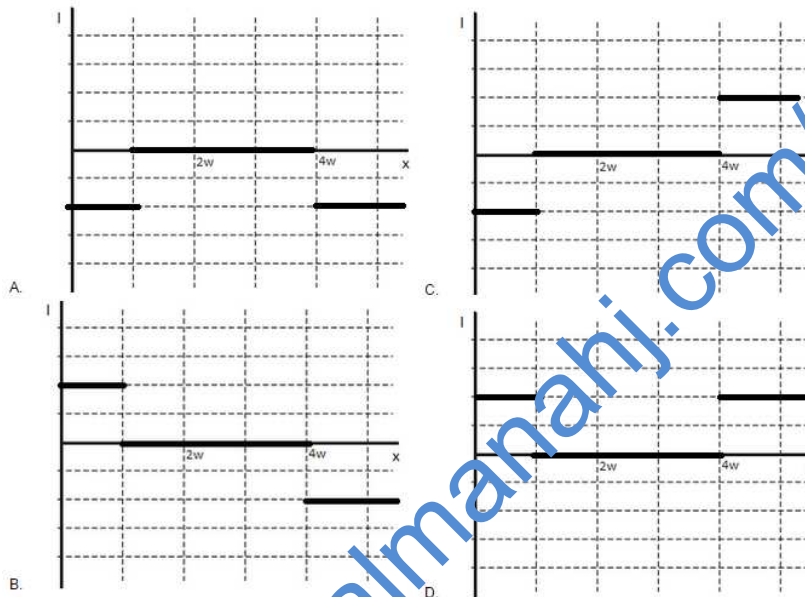
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36. As shown above, a single loop of wire enters a magnetic field  $B$  with a constant velocity  $v$ . Which of the following graphs accurately depicts the direction of the induced current at specific points as the left edge of the loop moves through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



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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?

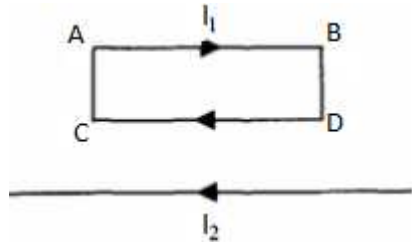
- A. 1.25 V
- B. 2.5 V
- C. 0 V
- D. 5 V

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

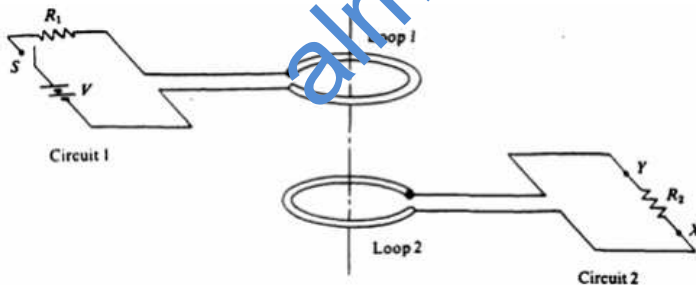
40. What are some similarities between a motor and a generator?

- 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

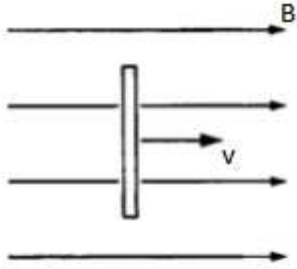
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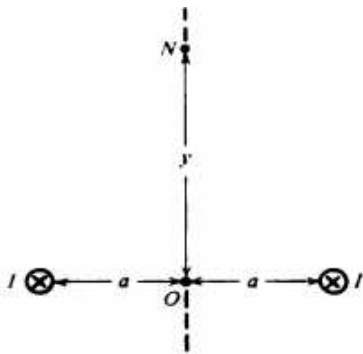
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43. A conducting bar travels through magnetic field  $B$  at constant velocity  $v$ . Which part of the bar has a higher electric potential?

- 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

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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.

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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

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41. B
42. B
43. C
44. D
45. D
46. A, C
47. B, C
48. A, D
49. A, C

