Electromagnetic Induction

- **Faraday's Law:**

Michael Faraday discovered that a changing magnetic flux will induce a voltage in a conductor.

$$\text{Induced Voltage: } \mathcal{E}_{ind} = \frac{-N\,\Delta\,\Phi}{\Delta t}$$

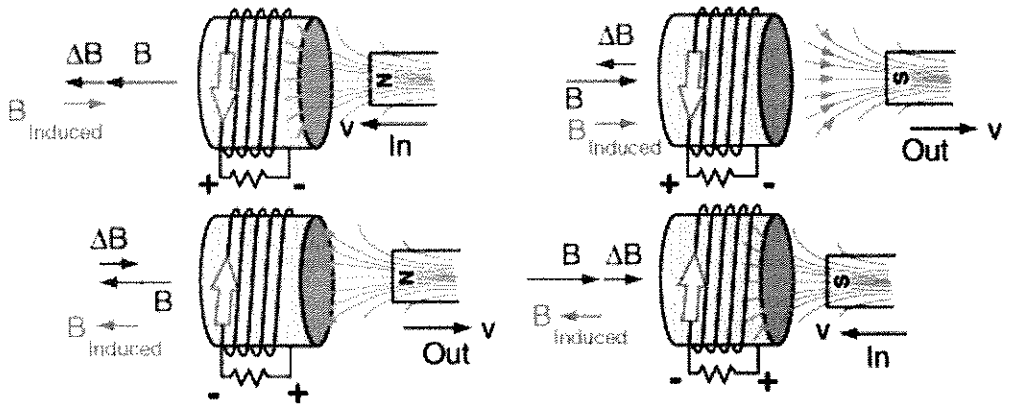
"Special Case" – a conducting rod moves through a magnetic field:

$$\mathcal{E}_{ind} = Blv$$

- In other words, if you do something to change the number of field lines in a magnetic field near a conductor, the conductor will behave like a battery with a + and – terminal.
- If the conductor is in a loop (closed circuit) electric current is induced:

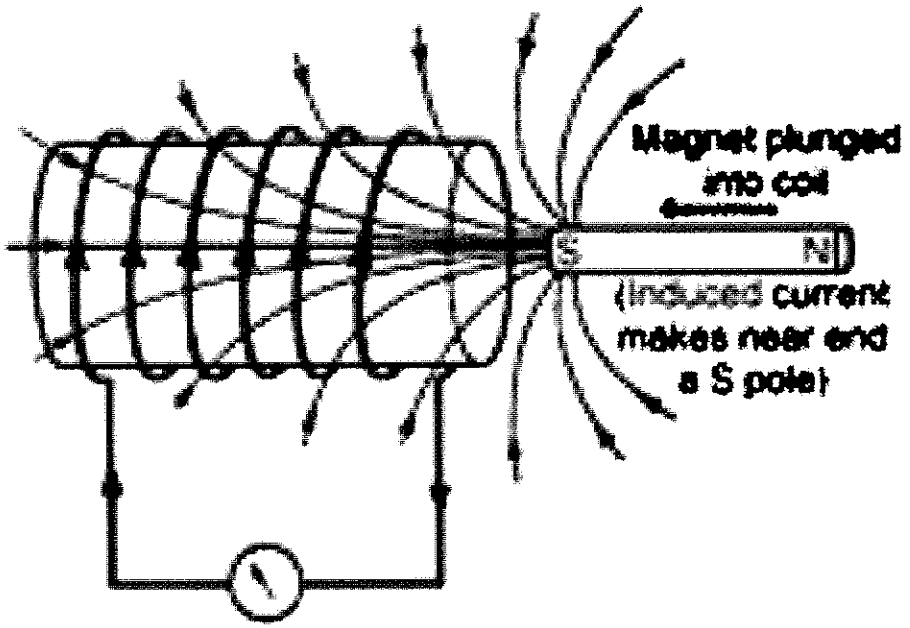
- Direction of the induced current is given by the **Lenz's Law:**

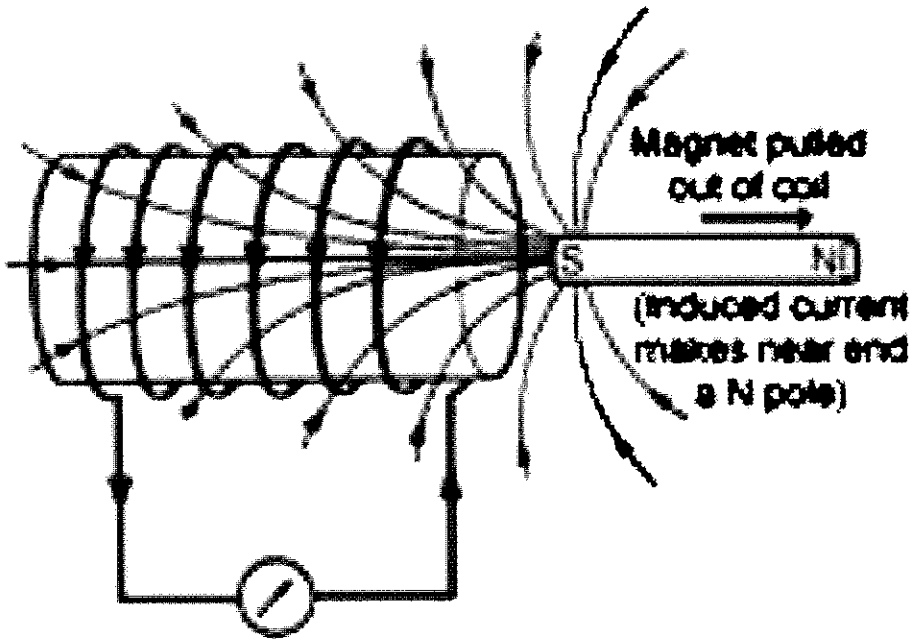
A current produced by an induced emf moves in a direction so that its magnetic field OPPOSES the original change in flux



MAGNETIC FLUX = number of magnetic field lines passing through the loop of a wire

Symbol: _____ Units:_____ = _____





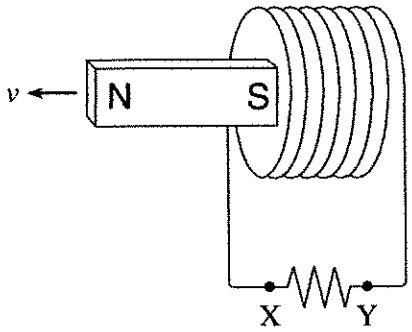
1. A straight wire, 0.20 m long, moves at a constant speed of 7.0m/s perpendicular to a magnetic field of strength 8.0×10^{-2}T.

a) Find the emf induced in the wire.

b) If the wire is part of a circuit that has a resistance of 0.50Ω. What is the current through the wire?

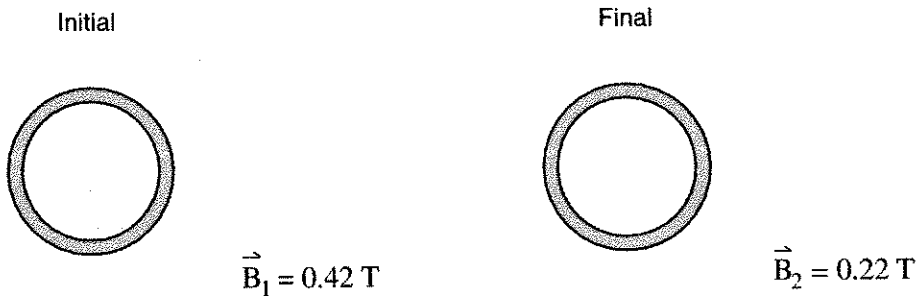
2. A straight wire, 25m long, is mounted on an airplane flying at 125m/s. The wire moves in a perpendicular direction through Earth's magnetic field ($B=5.0 \times 10^{-5}$T). What emf is induced in the wire?

3. A bar magnet is moved away from a coil as shown. What is the direction of the current through the resistor and the polarity of the left end of the coil?



	Direction of Current Through the Resistor	Polarity of Left End of Coil
A.	X to Y	North
B.	X to Y	South
C.	Y to X	North
D.	Y to X	South

4. A 200-turn coil has a 15.2 V potential difference induced in it when the magnetic field changes from 0.42 T to 0.22 T in the opposite direction in 3.2×10^{-2} s. What is the radius of this coil?



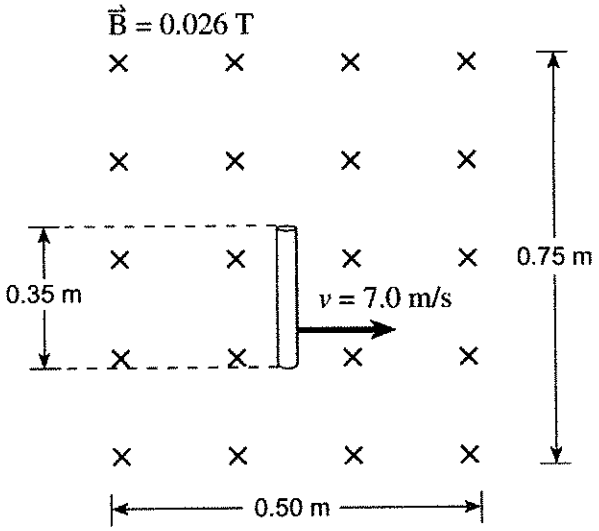
A. 3.5×10^{-2} m

B. 5.1×10^{-2} m

C. 5.9×10^{-2} m

D. 6.2×10^{-2} m

5. A 0.35 m length of a conducting rod is moving perpendicular to a 0.026 T magnetic field as shown.

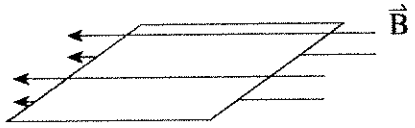


What is the potential difference as measured across the ends of the conducting rod?

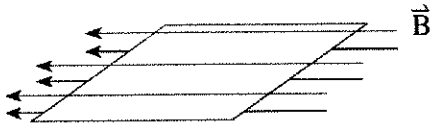
A. 0.0 V
B. 0.064 V
C. 0.091 V
D. 0.13 V

6. Which of the four situations below shows the greatest amount of magnetic flux for a rectangular coil?

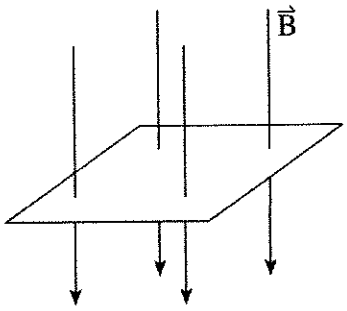
A.



B.



C.



D.