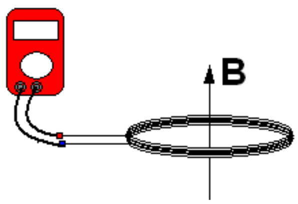
Physics II

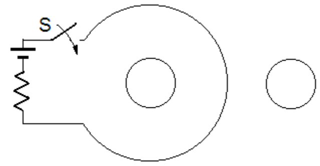
Induced Electromotive Force

Faraday, Lenz's law: $emf = -\frac{\Delta\phi}{time}$, where $\phi = \text{NBA}\sin\angle^{\text{B}}_{\text{Surface}}$

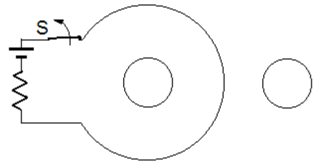
Problem 1.- A coil has a diameter of 0.25m and it is made of 1,500 loops of copper wire. It is in a region where the magnetic field is 5.5×10^{-5}T and perpendicular to the plane of the coil as shown in the figure. Find the average electromotive force produced by flipping the coil in a time of 0.15s, so the magnetic flux changes to the opposite direction.



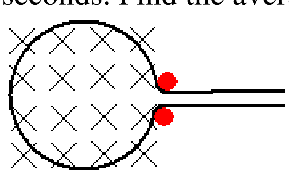
Problem 2.- What will be the direction of the current induced in each of the small circular loops when the switch "S" is suddenly closed?



Problem 2a.- What will be the direction of the current induced in each of the small circular loops when the switch "S" is suddenly opened?

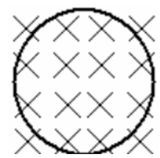


Problem 3.- A circular loop of wire of diameter 1.05m is located in a region where the magnetic field is 0.225T and perpendicular to the plane of the loop. You pull the wire reducing the diameter of the loop to 0.95m in 5 seconds. Find the average *emf* produced by this change.

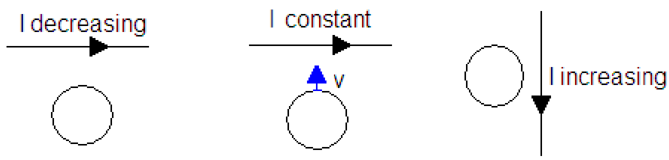


Problem 3a.- 0.4 meters of wire form a square in a region with a uniform magnetic field of 0.06 Tesla perpendicular to the square. The wire is reduced in length by 0.01 m in 10 seconds keeping its square shape. Calculate the resulting *emf*.

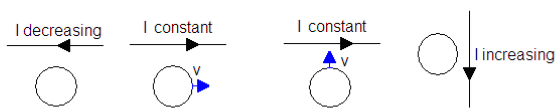
Problem 4.- A circular loop of wire encloses an area of 1.05m^2 and is in a region where the magnetic field has an intensity in tesla B=0.025t^2, where "t" is the time in seconds. The field is perpendicular to the plane of the loop as shown in the figure. Find the induced *emf* as a function of time.



Problem 5.- Indicate the direction of the induced current in the hoop in each of the following cases:



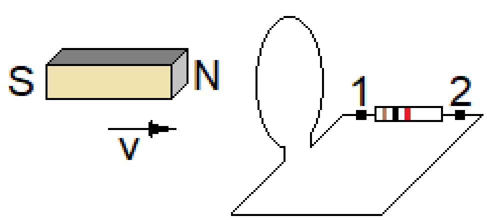
Note: In the second case the hoop is moving towards the wire.
Problem 5a.- Indicate the direction of the induced current in the loop in each of the following cases:



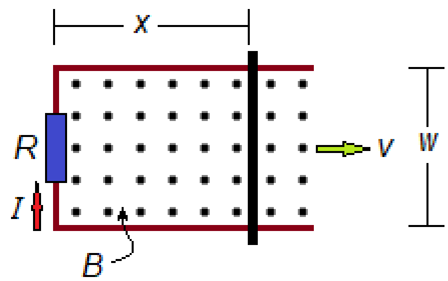
Note: v indicates velocity.

Problem 6.- How is the magnetic stripe in your credit card read when you swipe it at a store?

Problem 7.- A permanent magnet with its poles oriented as shown in the figure is moved towards a wire in the shape of a circle at a constant velocity. The magnet passes though the loop and moves away. The circular wire is connected to a circuit with a resistance R.
Graph and justify the variation in induced current in the resistance in terms of the time when the magnet approaches, passes through, and moves away from the loop.



Problem 8.- A circuit is built by connecting a resistance R=2Ω to a conducting wire in the shape of a U with width w = 0.5 m, and a sliding conducting bar that closes the circuit. Consider that this circuit is in a region where the magnetic field is B = 1 T perpendicular to the plane of the circuit and the resistances of the wire and bar are negligible.



a) Calculate the *emf* if the bar moves to the right at a speed v = 10m/s

b) Calculate the induced current in case (a).

c) Calculate the speed v necessary to induce a current of 0.5 A