Electric Currents & Magnetic Fields 4/13/05 #5

- Hans Oersted discovered in 1820 that electric current could produce a deflection of a compass needle.

Result: Electric Current creates a magnetic Field

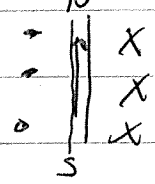
Magnetic Field Along a Straight Long Wire $B = \frac{\mu_0 I}{2\pi r}$

$\mu_0 = 4\pi \times 10^{-7}\ T\,m/A$

Permeability of free Space

(Ability to Magnetize an object/Space)

Ex1 A long straight horizontal power line carries a conv. current of 50A. If the current flows in a south direction, what is the magnitude of the magnetic field 1m directly below the line



$$B = \frac{\mu_0 I}{2\pi r} = \frac{(4\pi \times 10^{-7}\ T\,m/A)(50A)}{2\pi (1.0m)} = 1 \times 10^{-5}\ T$$

Magnetic Field in a Solenoid

$$B = \mu_0 n I \qquad n = \frac{N}{L} \quad \frac{\text{number of turns}}{\text{meter}}$$

Ex2 A solenoid .3m long w/ 10^3 turns per meter carries a current of 5A. What is the magnitude of the magnetic field through the center of the solenoid.

Given: $I = 5A$, $n = 10^3$ turns/m

Find: B

$B = \mu_0 n I$

$= (4\pi \times 10^{-7}\ T\,m/A)(10^3\ m^{-1})(5A)$

$= 2\pi \times 10^{-3}\ T$

Change core material of a solenoid ie. Iron greatly increases the Result - B increases by thousands of times.