PHYS 1441 – Section 001
Lecture #15

Thursday, June 28, 2018

Dr. Jaehoon Yu

- Chapter 28:Sources of Magnetic Field
  - Sources of Magnetic Field
  - Magnetic Field Due to Straight Wire
  - Magnetic Materials
  - Hysteresis
- Chapter 29:EM Induction & Faraday's Law
  - Induced EMF and EM Induction
  - Faraday's Law of Induction
  - Lenz's Law

Announcements

- Class feedback survey at http://uta.mce.cc/
  - Bring out your and fill in the survey now
- Planetarium extra credit
  - Be sure to tape one end onto a sheet of paper with your name on it
  - Submit it at the beginning of the final exam at 10:30 – 12:30pm Monday, July 9
  - DO NOT miss the exam! You will get an F!
- Quiz #4
  - Beginning of the class Thursday, July 5
  - Covers CH 28.1 – what we finish Tuesday, July 3

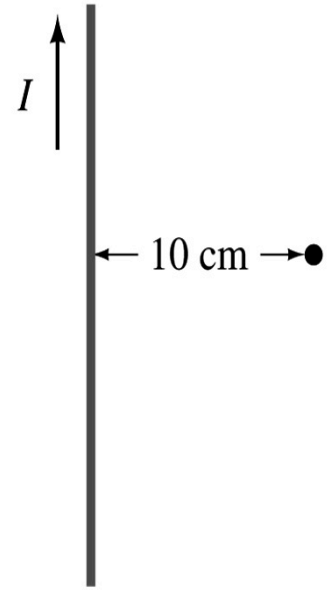
Sources of Magnetic Field

- We have learned so far about the effects of magnetic field on the electric current and the moving charge
- We will now learn about the dynamics of magnetism
  - How do we determine magnetic field strengths in certain situations?
  - How do two wires with electric current interact?
  - What is the general approach to finding the connection between current and magnetic field?

Magnetic Field due to a Straight Wire

- The magnetic field due to the current flowing through a straight wire forms a circular pattern around the wire
  - What do you imagine the strength of the field is as a function of the distance from the wire?
    - It must be weaker as the distance increases
  - How about as a function of current?
    - Directly proportional to the current
  - Indeed, the above are experimentally verified $B \propto \frac{I}{r}$
    - This is valid as long as r << the length of the wire
  - The proportionality constant is $\mu_0/2\pi$, thus the field strength becomes $B = \frac{\mu_0 I}{2\pi r}$
  - μ_0 is the permeability of free space $\mu_0 = 4\pi \times 10^{-7}\ T \cdot m/A$

Example 28 – 1



Calculation of B near wire. A vertical electric wire in the wall of a building carries a DC current of 25A upward. What is the magnetic field at a point 10cm due East of this wire?

Using the formula for the magnetic field near a straight wire

$$B = \frac{\mu_0 I}{2\pi r}$$

So we can obtain the magnetic field at 10cm away as

$$B = \frac{\mu_0 I}{2\pi r} = \frac{\left(4\pi \times 10^{-7}\ T \cdot m/A\right) \cdot \left(25A\right)}{\left(2\pi\right) \cdot \left(0.01m\right)} = 5.0 \times 10^{-5}\ T$$