Physics 008   **Problem Set #9**   **Fall 2009**

My Lectures from : Purcell Chapter 6
          Web Notes : Lecture Notes #6
          Other Notes: Magnetic Fields; Source B Field

Purcell Problems:
     6.04 Bent wire
     6.05 Three wires
     6.08 Wire bent in right angle
     6.12 Strange bent wire
     6.16 Power of superposition
     6.17 Solenoids
     6.22 Magnetic torque
     6.25 Vector potential given a field
     6.26 Vector potential for a wire
     6.28 Proton path of motion
     6.32 Cathode ray tube

1. Transformation of fields – A very large sheet of charge lies
   in the x-y plane of frame F. The charge per unit length is
   σ. In frame F', this sheet moves to the right with speed v.
(a) What is the electric field in the rest frame F(above and
    below the sheet)?
(b) What is the electric field in the frame F'(above and below
    the sheet)?
(c) What is the magnetic field in the frame F'(above and below
    the sheet)?
(d) Show that the results of (b) and (c) are consistent with the
    Lorentz transformations for electric and magnetic fields(Eq
    60 of Purcell Chapter 6)

2. Electric and magnetic forces – Two infinite lines of charges
   with charge per unit length λ_0 in their rest frame are
   separated by a distance d. These charges are moving in a
   direction parallel to their length with speed v.
(a) In the rest frame, what is the electric force per unit
    length that the top line feels due to the bottom line? Give
    both direction and magnitude.
(b) Repeat (a) in the lab frame.
(c) In the lab frame, what is the magnetic force per unit length
    that the top line feels due to the bottom line? Give both
    direction and magnitude.
(d) What is the total force per unit length in the lab frame?