Fundamentals of Electromagnetic Fields and Waves: I

Fall 2008, EE 30348, Electrical Engineering, University of Notre Dame

Assignment 1

Remember the policy on assignments - you should turn them in by 5pm of the due date. The due date for this assignment is **Thursday, September 4th, 2008**.

General notes: Present your solutions *neatly*. Do not turn in your rough worksheet where you might have walked down blind alleys - turn in the final solutions. Think of every assignment solution as a final report. If I can't read them, I can't grade. Show all steps, so that I can award partial points for correct steps. BOX your final answers. Draw figures wherever necessary.

1) This question is for you to brush up your vector math.
Iskander[1]: Problem 1.2, Problem 1.6, Problem 1.10, & Problem 1.12.

2) This question if for you to brush up your "old" electrostatics.
Iskander: Problem 1.19 & Problem 1.21.

3) This question if for you to brush up your "old" magnetostatics.
Iskander: Problem 1.24 & Problem 1.25.

4) May the Lorentz Force be with you.

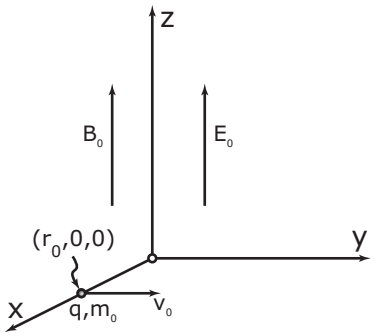

Figure 1: Setup for Problem 4.

A particle of mass m_0 and charge q is launched at $t = 0$ from the point $(r_0,0,0)$ with a velocity $\mathbf{v} = v_0\mathbf{a_y}$. There is an electric field $\mathbf{E} = E_0\mathbf{a_z}$ and a magnetic field $\mathbf{B} = B_0\mathbf{a_z}$, both along the z-axis.
a) Assume for this part that $E_0 = 0$. Show that the particle moves in a circular orbit in the $x - y$ plane with a angular frequency $\omega_0 = qB_0/m_0$ and radius $r_0 = v_0/\omega_0$. Google to find out popular names of r_0, ω_0.
b) Now consider the situation when the electric field is non-zero. Show that the particle moves in a spiralling motion. Find the velocity vector $\mathbf{v} = (v_x(t), v_y(t), v_z(t))$ and the spatial coordinates $\mathbf{r} = (x(t), y(t), z(t))$ at any time t.
c) Find the approximate number of rotations the particle completes around the $z-$axis in moving a distance L_0 along this axis.

[1]For many problems in Iskander, there are answers at the back of the book - you can check your answers before turning them in.