

Physics 321
Homework 4

Due at midnight on the day of Hour 5.

By now, you are probably getting fairly proficient with solving problems using Maple. If not, you should invent a few differential equations and try working through solutions, plotting results, etc. (If you are new to Maple, you'll find that it has a few idiosyncracies. Sometimes it just refuses to do what you want it to do.)

So for Lorentz forces, you should note:

- 1) Maple will do cross products, but I find that in Cartesian coordinates, it's usually just as easy to them by hand and put them in Maple.
- 2) The Lorentz force does not change the speed of an object, only its direction.
- 3) In uniform fields, charged particles spiral with the cyclotron radius and frequency being given by the equations:

$$m\omega = qB$$

$$p = qBr$$

Be able to derive these equations (using the Lorentz force as the centrifugal force).

1. The magnetic field of a wire is given by the expression $B=0.305/r$ where r , the distance from the wire, is in meters and B is in Tesla. The wire is on the z -axis and current flows in the $+z$ direction. Recall that a right-hand rule will give you the direction of the field lines around the wire. A charge of $+2.43$ mC and mass 0.100 g moves under the influence of the magnetic field of the wire. The initial conditions are:

$$x(0) = 0.100m, \quad y(0) = 0, \quad z(0) = 0$$

$$\dot{x}(0) = 0, \quad \dot{y}(0) = 0, \quad \dot{z}(0) = +1.00m/s$$

Plot the motion of the particle over the time interval 0 to 1 second.