1. Consider the following spacecraft geometry,

An oxygen ion is formed in the vicinity of two experimental buses of a small satellite. The oxygen ion has an initial velocity in the x-direction only and an energy of 20 eV. The experimental buses have a potential difference of 20 Volts from a combination of voltage leaks from the instruments and differential spacecraft charging. The ion’s initial position is exactly halfway between the metallic plates enclosing the experimental instruments. The metallic plates are 15.24 cm long and separated by a distance of 12.7 cm.

a.) Derive the equations of motion for the ion as a function of time (i.e. $x(t)$ and $y(t)$) from the Lorentz force equation. Find the solution for the y position independent of time. **Hint:** Determine the initial conditions for the problem (i.e. at some time $t_0=0$) and apply these to the differential equations. Assume that no fringing fields are present.

b.) Calculate and plot the ion’s trajectory through the region between the plates.

c.) Determine the ion trajectory outside the plates.
d.) Will the ion strike the solar panel, and if so, where will the ion strike? (i.e. the x position of the impact).

(Hints: For ease of calculation, use the coordinate system provided. You will need to solve the differential equations set up by the Lorentz force equation discussed in class for the x,y positions as a function of time. Before setting out to solve the Lorentz force equation, establish the initial conditions of the problem. Writing a simple FORTRAN or MATLAB code is probably the easiest way to solve the equations of motion for small time/distance steps. The magnitude of the electric field is $E = \frac{V}{h}$ where h is the separation distance of the parallel plates. The direction of the electric field is left up to the student to decide.)