Worksheet for Exploration 27.2: Velocity Selector

A mass spectrometer measures the mass of particles. The first step in the operation of the mass spectrometer is to select particles of a particular velocity. As you work through this exploration you will see how a velocity selector operates. The animation shows a positively charged particle entering a constant magnetic field directed into the screen.

a. BEFORE you play the animation, PREDICT the path the charge will follow. I have already made my prediction, let me see the path. Were you correct? If not, what caused your error?
    i. Make sure that you relate the direction of the initial velocity, the magnetic field, and then determine the force.

Now, suppose a constant electric field is added to the region with the magnetic field.

b. In which direction (right, left, up, down, into screen, or out of screen) should the electric field be oriented such that it could possibly cancel the force due to the magnetic field?

   E field direction=_____

c. In order to create the electric field, two charged plates are used. Which plate should be positively charged and which should be negatively charged to create the desired field?

   Upper plate charge=_____

   Lower plate charge=_____

d. I have made a prediction, let me check my thinking. Were you correct? If not, what misunderstanding caused your error?

e. Derive a mathematical relationship between the electric field, the magnetic field, and the velocity a particle must have to pass through the region undeflected.
    i. You should note what the net force on the particle is for this condition.

f.   In the animation, the electric field produced by the plates is 6000 N/C and the magnetic field is 0.3 T. Use your mathematical relationship to find the velocity the particles have in order to pass straight through the two fields. Once you have calculated your answer, put it in the box and press *play* to see if you were correct.

$V_{prediction}$=_____

$V_{measured}$=_____