In the first stage of the mass spectrometer, with $\mathbf{E} = E_0\hat{z}$ (pointing upward) and $\mathbf{B} = B_0\hat{x}$ (pointing out of the page), which particles travel through in a straight line?

A. All particles regardless of speed
B. Particles with speed B_0/E_0
C. Particles with speed E_0/B_0
D. Can't tell without knowing q and/or m

You may assume all particles move exclusively in the +y direction.

If we place a physical filter (i.e., a piece of metal with a thin slot that is a bit larger than the beam width to avoid diffraction) at the end of the first stage, which particles (assume they are all positively charged) hit the upper-part of the filter? Which hit the lower part?

A. Fast moving particles hit the upper part; slow ones hit the lower part
B. Slow moving particles hit the upper part; fast ones hit the lower part
C. It's not possible to tell without q and/or m

Can we use the same mass spectrometer set up for negatively and positively charged particles? That is, will our set up distinguish between particles of a given mass and differently-signed charges?

A. Yes
B. No

For our velocity selector where $\mathbf{E} = E_0\hat{z}$ and $\mathbf{B} = B_0\hat{x}$ and we start particles from rest, we end up with the following **coupled** equations of motion,

$$m\dot{v}_y = qv_zB_0$$
$$m\dot{v}_z = qE_0 - qv_yB_0$$

How might we solve them for $y(t)$ and $z(t)$?

A. Just integrate the equations of motion
B. Guess the general solution
C. Take the time derivative of one and plug into the other
D. Give up???