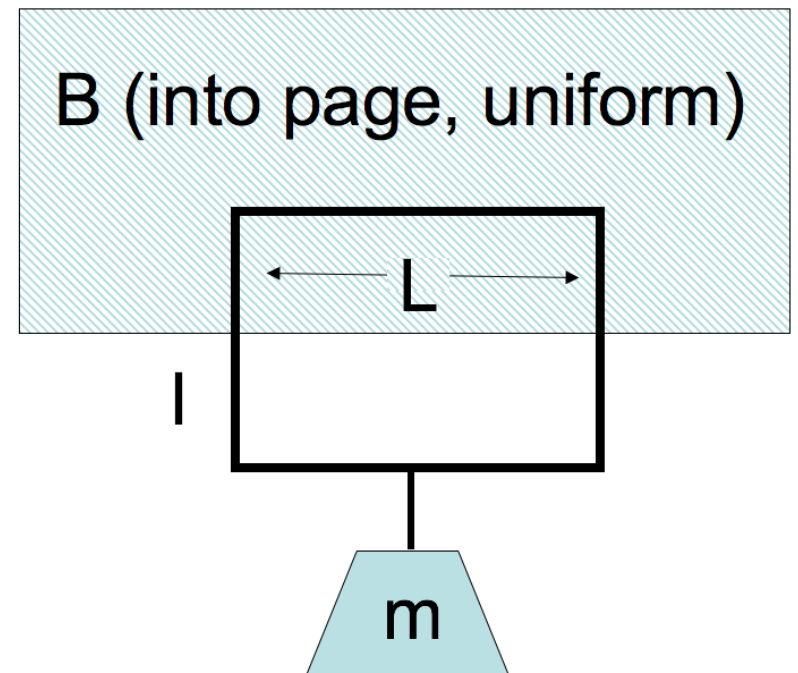


A wire loop in a B field has a current I . The B-field is localized, it's only in the hatched region, roughly zero elsewhere. Which way is I flowing to hold the mass in place?

- A. Clockwise
- B. Counter-clockwise
- C. You cannot "levitate" like this!



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,

$$\begin{aligned}m\dot{v}_y &= qv_zB_0 \\ m\dot{v}_z &= qE_0 - qv_yB_0\end{aligned}$$

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???

Positive ions flow right through a liquid, negative ions flow left. The spatial density and speed of both ions types are identical. Is there a net current through the liquid?

- A. Yes, to the right
- B. Yes, to the left
- C. No
- D. Not enough information given

Current I flows down a wire (length L) with a square cross section (side a). If it is uniformly distributed over the entire wire area, what is the magnitude of the volume current density J ?

A. $J = I/a^2$

B. $J = I/a$

C. $J = I/4a$

D. $J = a^2 I$

E. None of the above