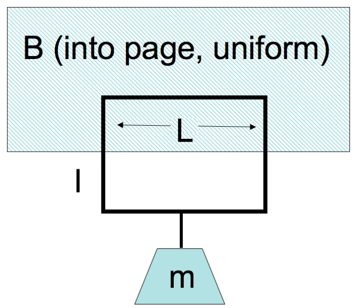
A wire loop in a B field has a current I. The B-field is localized, it's only in the hatched region, roughly zero elsewhere. Which way is I flowing to hold the mass in place?

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,

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

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???

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?

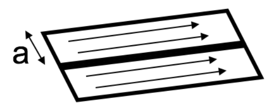
A. $J = I/a^2$
B. $J = I/a$
C. $J = I/4a$
D. $J = a^2I$
E. None of the above

Current I flows down a wire (length L) with a square cross section (side a). If it is uniformly distributed over the outer surfaces only, what is the magnitude of the surface current density K?

A. $K = I/a^2$
B. $K = I/a$
C. $K = I/4a$
D. $K = aI$
E. None of the above

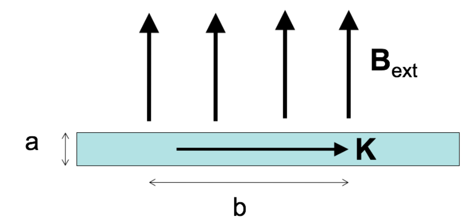
A "ribbon" (width a) of surface current flows (with surface current density K). Right next to it is a second identical ribbon of current. Viewed collectively, what is the new total surface current density?

A. K
B. $2K$
C. $K/2$
D. Something else



A "ribbon" (width a) with uniform surface current density K passes through a uniform magnetic field $\mathbf{B}_{ext}$. Only the length b along the ribbon is in the field. What is the magnitude of the force on the ribbon?

A. KB
B. aKB
C. $abKB$
D. bKB/a
E. $KB/(ab)$



Which of the following is a statement of charge conservation?

A. $\frac{\partial \rho}{\partial t} = -\nabla \mathbf{J}$
B. $\frac{\partial \rho}{\partial t} = -\nabla \cdot \mathbf{J}$
C. $\frac{\partial \rho}{\partial t} = -\int \nabla \cdot \mathbf{J} d\tau$
D. $\frac{\partial \rho}{\partial t} = -\oint \mathbf{J} \cdot d\mathbf{A}$