

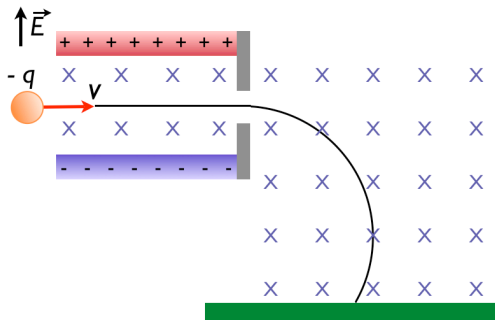
## PH 102 Quiz 4: Magnets and Such

1. Consider a proton moving with a speed of  $1 \cdot 10^5$  m/s through the earth's magnetic field ( $|\vec{B}| = 55 \mu\text{T}$ ). When the proton moves east, the magnetic force acts straight upward. When the proton moves northward, no force acts on it. What is the direction of the magnetic field?

- North
- South
- East
- West

2. What is the magnitude of the magnetic force in the previous example?

- $2.2 \cdot 10^{-9}$  N
- $6.6 \cdot 10^{-15}$  N
- $8.8 \cdot 10^{-19}$  N
- $4.4 \cdot 10^{-13}$  N

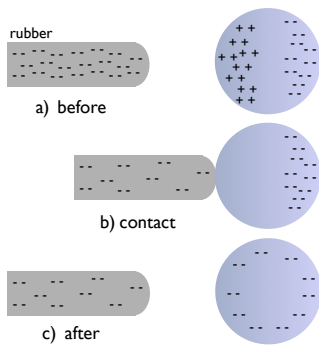


3. The figure shows a simplified mass spectrometer. Particles with charge  $q$  and mass  $m$  enter at left with a velocity  $v$ , and encounter a region with both an  $E$  and  $B$  field as shown. What is the relationship between  $v$ ,  $B$ , and  $E$  for particles that make it through the aperture in the middle of the detector?

- $EB = v$
- $E/B = v$
- $E^2/B = v$
- $B/E = v$

4. Once the particle enters the second region of the detector from the previous question, it is in a region of magnetic field only. In this region, the particle travels in a circular path. What is the radius of the circle?

- $r = mB/qv$
- $qvB/m$
- $r = qB/mv$
- $r = mv/qB$



5. Permanent magnets sticking to a refrigerator door happens because the permanent magnet is able to induce magnetic poles in the steel of the door. This process is analogous to electrically charging objects by *induction*, where a charged object induces opposing charges in a conductor without contact.

Can a process like *conduction*, where a charged object transfers some of its charges to another, happen with magnets? Refer to the figure at left for the analogy.

- No, because there are no single magnetic charges.
- Yes, but it is a small effect due since  $\mu_0 \ll \epsilon_0$
- Yes, this is how permanent magnets become magnetized
- No, because magnetic poles are not mobile.