Name

Quiz 6: Magnets and Such

$|\vec{\mathbf{F}}_B| = q|\vec{\mathbf{v}}||\vec{\mathbf{B}}|\sin\theta_{vB}$ charge q

$|\vec{\mathbf{F}}_B| = BIl\sin\theta$ wire

$\vec{\mathbf{B}} = \frac{\mu_0 I}{2\pi r}\hat{\theta}$ wire

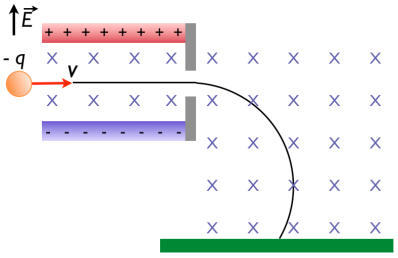
$\frac{|\vec{\mathbf{F}}_{12}|}{l} = \frac{\mu_0 I_1 I_2}{2\pi d}$ 2 wires, force per length

1. Consider a proton moving with a speed of $1 \cdot 10^5$ m/s through the earth's magnetic field ($|\vec{\mathbf{B}}| = 55\,\mu$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

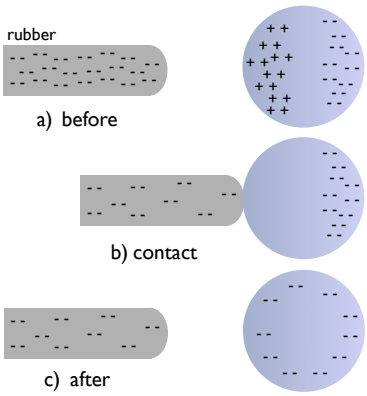


3. The figure shows a simplified mass spectrometer. Particles with charge q and mass m enter at left with a velocity v, and encounter a region with both an E and B field as shown. What is the relationship between v, B, and E for particles that make it through the aperture in the middle of the detector?

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

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?

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



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.