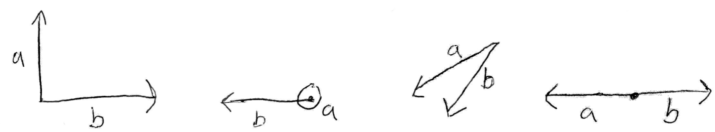
PHY 122 HW 8

1. For each of the following pairs of vectors $\vec{a}$ and $\vec{b}$:

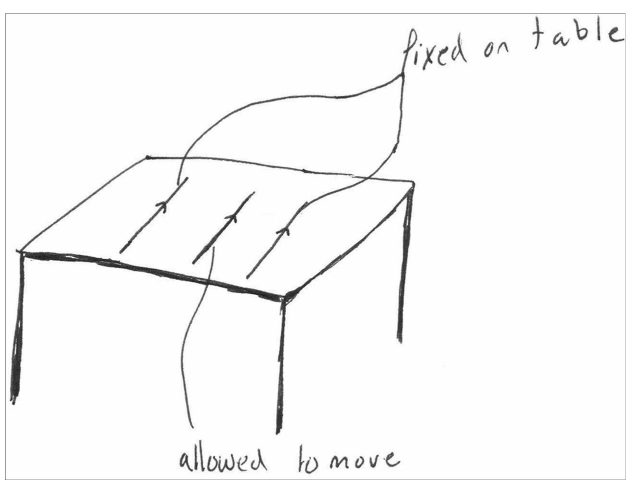


   (a) What is the direction of the vector $\vec{a} \times \vec{b}$ ($\odot$ means a vector pointing out of the page)?
   (b) Taking the magnitudes of $\vec{a}$ and $\vec{b}$ to be equal, rank their cross products in order of ascending magnitude.

2. Knowing what the magnetic field looks like from a current carrying wire, where do you think the magnetic field points from many wires tightly packed (but not touching) along side each other each carrying the same current as shown below with the currents going into the page.

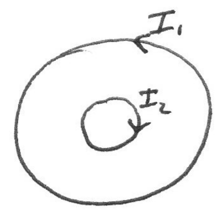
3. A 70 kg man skates out of a roller disco in the middle of a desert. After hours of ferocious skating, his rollerskates have accumulated a charge of .1 Coulombs. If the man is moving at 10 m/s underneath a power line 5 m above the ground, what current (both magnitude and direction) is needed to lift him off the ground?

4. Three parallel wires a, b, and c of length 1 m are lying on a table and carrying current I_a, I_b, and I_c respectively. Only the wire b is allowed to move. If all these currents are positive and $\frac{I_a}{3} = \frac{I_b}{4} = \frac{I_c}{5} = I$ and the distance between a and c is d. What distance from wire c will wire b come to rest?

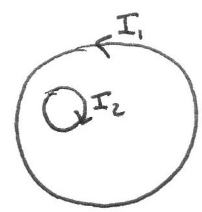


5. Two solenoids of equal lengths are situated such that one is inside the other. The larger solenoid has a number of turns per unit length of n. The large solenoid has half as many loops as the small solenoid which has $2n$ turns per unit length. If the current of the large solenoid is $I_1 = A$ amps and the current of the small solenoid is $I_2 = 4A$ amps, but in the opposite direction:

   (a) What is the total magnetic field inside the small solenoid when they share the same central axis (concentric)?



(b) What is the total magnetic field inside the small solenoid when the small solenoid is off center from the large solenoid?



6. In the figure below, current flows into the page on the inner wire, and out of the page on the outer conducting shell. Each has a uniform current density j, and both the inner wire and outer shell carry a total current I (although in opposite directions).

   (a) Does the fact that both the inner wire and outer shell have the same current density and same total current place a constraint on the relationship between r_a, r_b, and r_c?

   (b) If we were going to use Ampere's Law to calculate the magnetic field everywhere inside and outside this cable, what regions of space would we have to consider? Not that we would ever have to do something like that...

   (c) Use Ampere's Law to calculate the magnetic field everywhere inside and outside this cable.