Physics 114 – Spring 2015 – Workshop module 7

1. Break up into groups of two. Each group of two should come up with two different drawings of a positive, negative, or neutral charge moving with a velocity, v, through a magnetic field B. Label ONLY the charge (+,-,0) and the velocity vector (which could have magnitude 0) and the B field vector (which could have a magnitude 0) at a given instant. The directions of the velocity vector and B field vector are arbitrary, though it will be best if you allow the vectors to be in the plane of the paper or perpendicular to the paper. Now each group should go to the board and reproduce their drawings there. The class should discuss and agree on the direction for the magnetic force on each of the moving charges. Try to be tricky with at least one of your three drawings! If, for some reason there are too few people in your workshop to make a reasonable number of examples … each person should make up three … or your TA will join in a make up a few.

2. Back into your groups of two … or different groups if you are so inclined. Each group should make two drawings of a straight-line current segment (in the plane of the paper or perpendicular to the paper) in a magnetic field (again, the B vector should be in the plane of the paper or perpendicular to the paper). The current can be either moving positive or negative charge, but you must specify which. Again, take turns showing the workshop your drawings. The group should discuss and agree on the direction of the magnetic force on each current segment.

3. A straight piece of conducting wire of mass M and length L is placed on a frictionless incline tilted at an angle θ from the horizontal. The length of the wire is perpendicular to the direction of the incline. There is a uniform, vertical magnetic field B up at all points. To keep the wire from sliding down the incline, a voltage source is attached to the ends of the wire. Make a sketch of the problem and appropriate free body diagrams. Determine the magnitude and direction of the current in the wire that will cause the wire to remain at rest (i.e., not slide down the incline).

4. A ^{7}Li nucleus contaminates a beam of protons used for cancer treatment. The ^{7}Li nucleus has a charge of +3|e| and a mass of $7m_p$. Protons have a charge of +1|e| and a mass of $1m_p$. Both the protons and the lithium move in a plane perpendicular to a magnetic field. The particles all have the same momentum. The ratio of the radius of curvature of the path of the proton (R_p) to that of the ^{7}Li nucleus (R_{Li}) is

    a. $R_p/R_{Li}=3$
    b. $R_p/R_{Li}=1/3$
    c. $R_p/R_{Li}=1/7$
    d. $R_p/R_{Li}=3/7$
    e. $R_p/R_{Li}=7$
    f. None of the above

5. A 1.0-kg copper rod rests on two horizontal rails 1.0 m apart and carries a current of 50 A from one rail to the other. The coefficient of static friction is 0.60. Suppose a uniform magnetic field exists in this region of space which is perpendicular to the bar, parallel to the rails and incident on the rail at a 20 degree angle with respect to the horizontal. What is the smallest magnetic field strength that would cause the bar to slide?