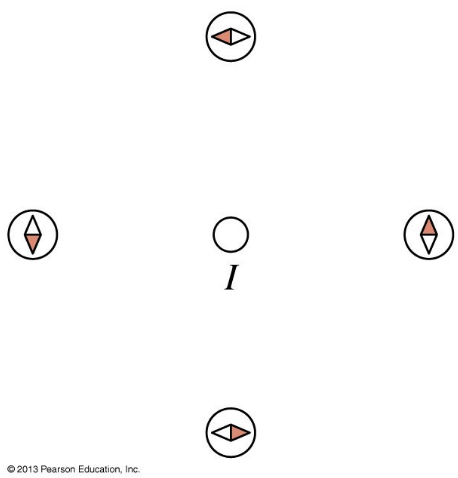
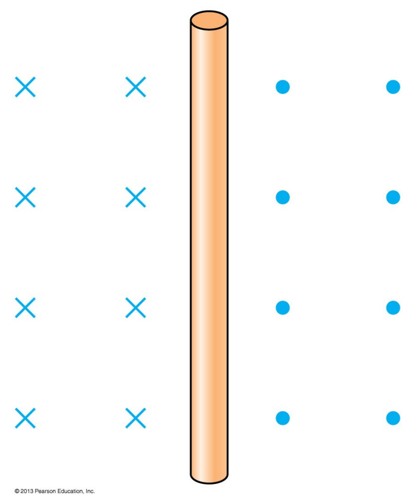
Summer and Fall 2015 – Electromagnetism and Light Course
HW03

Answer the following questions and upload to Canvas. If you cannot upload to Canvas, e-mail to "mpsonnenfeld@gmail.com" (Please note this is not my usual e-mail address but is a special one for collecting homework). Some of these are amenable to a word processor, but you will probably need to scan in sketches. I put this out in "doc" format so you can use the homework itself as a template. (Problems with a * are harder).

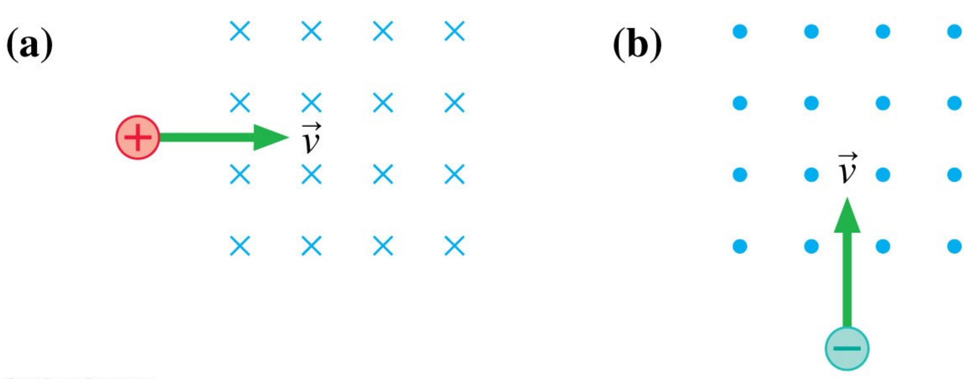
1) What is the current direction in the wire to the left below? (Those are four compasses, the red arrow points "North"). Explain.

2) What is the current direction in the wire to the right above? (The magnetic field points into the page at the X's and out of the page at the dots). Explain.





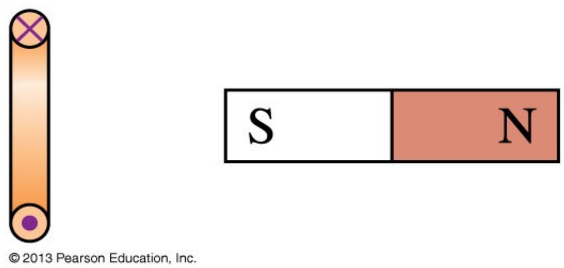
3) What is the initial direction of deflection for the charged particles entering the magnetic fields shown below? (Hint: By saying "initial direction of deflection", we are asking what the initial Force is on the particles).

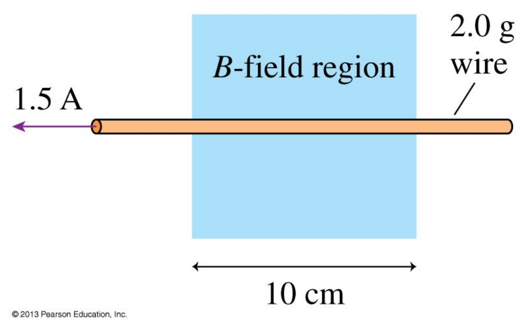


4*) Assuming that these particles stay in the uniform magnetic field shown, sketch the ultimate path that they take. This is tricky. Keep using your right-hand rule to arrive at a perhaps surprising result. (Hint: By saying "initial direction of deflection", we are asking what the initial Force is on the particles).

5) Determine the magnetic field direction that causes the charged particles shown in in the figure to experience the indicated magnetic force.

6) The south pole of a bar magnet is brought toward the current loop in the figure below. Does the current loop attract, repel, or have no effect on the loop? Explain. (The X means the current goes into the loop at the top of the figure and emerges at the bottom).





7) What magnetic field strength and direction will levitate the wire shown at right above?

8) What currents are needed to generate the magnetic field strengths given in the Table below at a point one centimeter from a long straight wire?

Field Source	Field Strength (T)
Surface of the Earth	5×10^{-5}
Refrigerator Magnet	5×10^{-3}
Laboratory Magnet	0.1 to 1
Superconducting Magnet	10

9) The "Gauss" is another unit for Magnetic Field. (It is NOT an SI unit). You are told that the field near the surface of the Earth if 0.5 Gauss. Use that fact to convert the other three entries in the table above to Gauss (from Tesla).

10) The element niobium, which is a metal, is a superconductor (i.e., no electrical resistance) at temperatures below 9 Kelvin. However, the superconductivity is destroyed if the magnetic field at the surface of the wire reaches 0.10 T. What is the maximum current in a straight 3.0—mm diameter superconducting niobium wire?

11) Give a step-by-step explanation, using both words and pictures, of how a permanent magnet can pick up a piece of nonmagnetized iron.