Test 3 : Additional Good Homework Problems

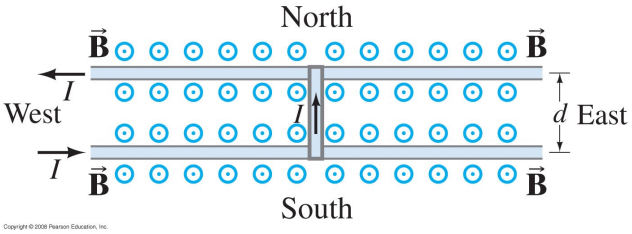
Chapter 27 : Magnetism

- HW 27-07 : A stiff wire 50 cm long is bent at a right angle in the middle. One section lies along the Z axis, and the other is along the line $y = 2x$ in the XY plane. A current of 20 A flows in the wire (down the axis and then out the line in the XY plane). The wire passes through a uniform magnetic field given by $\vec{B} = 0.318\hat{i}\ T$. Determine the magnitude and direction of the total force on the wire. (Enough to just find the vector force $\vec{F}$ in component form. Hint: look at the force on each half of the wire and add those vectors.)

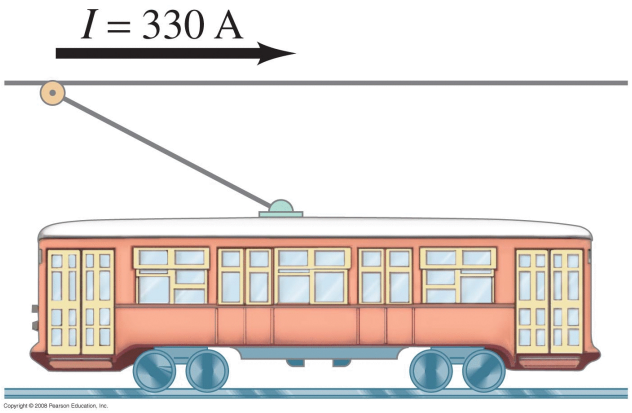
- HW 27-15 : Alpha particles of charge $q = +2e$ and mass $m = 6.6 \times 10^{-27}\ kg$ are emitted from a radioactive source at a speed of $1.6 \times 10^{7}\ m/s$. What magnetic field strength would be required to bend them into a circular path of radius $r = 0.18\ m$?

- HW 27-22 : An electron moves with velocity $\vec{v} = (7.0\hat{i} - 6.0\hat{j}) \times 10^{4}\ m/s$ in a magnetic field $\vec{B} = (-0.80\hat{i} + 0.60\hat{j})\ T$. Determine the magnitude and direction of the force on the electron. (Finding the vector $\vec{F}$ components is good enough here.)

- HW 27-60 : Suppose the rod in the figure has a mass of $m = 0.40\ kg$ and length 22 cm and the current through it is $I = 36\ A$. If the coefficient of static friction is $\mu_s = 0.50$, determine the minimum magnetic field $\vec{B}$ needed to start the rod moving.
(NOTE: this is a variation of the HW problem so here just assume the magnetic field is perfectly vertical, like it would be in a railgun scenario.)



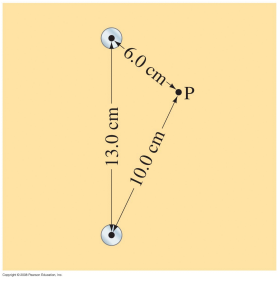
- HW 27-75 : The power cable for an electric trolley carries a horizontal current of 330 A directly towards the East. The Earth's magnetic field here has a strength of $5 \times 10^{-5}\ T$ and makes an angle of dip of 22^{o}. Calculate the magnitude and direction of the magnetic force on a 5.0 m length of this cable.
(Suppose each meter of the cable has a mass of 2.5 kg. Would the magnetic force on the cable be noticeable?)



Chapter 28 : Sources of Magnetic Fields

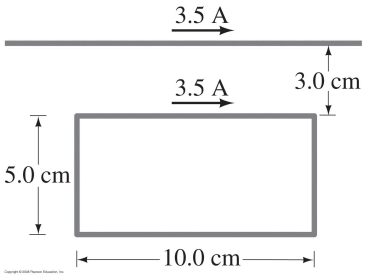
- HW 28-02 : If a (long straight) electric wire is allowed to produce a magnetic field no larger than that of the Earth ($5 \times 10^{-4}\ T$) at a distance of 15 cm from the wire, what is the maximum current the wire can carry?

- HW 28-07 : Two long thin parallel wires 13 cm apart carry 35 A currents in the same direction. Determine the magnetic field vector at a point 12 cm from one wire and 5 cm from the other.
(NOTE that I have changed the numbers here to produce a 'pythagorean triple', making the angle at point P exactly 90^o, so this is a right-triangle. The numbers in the figure produce something that is NOT a right triangle, forcing you to use the law of sines or law of cosines or something to determine the angles present here...)

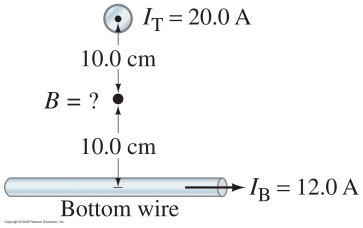


(Use the numbers given in the text, not the numbers in the figure.)

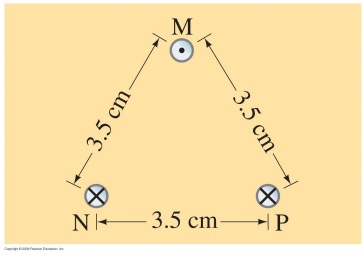
- HW 28-18 : A rectangular loop of wire is placed next to a straight wire. There is a current of 3.5 A in both wires (directions shown in the figure). Determine the magnitude and direction of the net **force** on the loop.



- HW 28-21 : Two long wires are oriented so that they are perpendicular to each other. At their closest, they are 20 cm apart. What is the magnitude of the magnetic field at a point midway between them if the top one carries a current of 20 A and the bottom one carries 12 A (directions shown in the figure).



- HW 28-51 : Three long parallel wires are 3.5 cm from one another. (Looking along them, they are at three corners of an equilateral triangle.) The current in each wire is 8 A but its direction in wire M is opposite to that in wires N and P. Determine the magnetic force per unit length on each wire due to the other two.



- HW 28-64 : (MODIFIED) : Model airplanes (and drones) can pick up static electricity as they fly through the air. Suppose we have a 175 g model airplane that has picked up a charge of +18 mC and is flying 8.6 cm away from and parallel to a long straight wire that is carrying a current of 25 A. If the plane is flying at 2.8 m/s, what acceleration (in g's) does this interaction give the airplane? In what direction? Would this force significantly affect the flight of the plane?