1. A velocity selector is a device that measures the speed of a charged particle by shooting the particle through oppositely charged plates enclosed in a tube. Inside the tube is a constant magnetic field, B. If a particle is to travel, undeflected, down the center of the tube, the magnetic force must equal the electric force. If the magnetic field of 0.630 T is perpendicular to the electric field of 5.00 x 104 N/C, find the speed of an electron sent through the velocity selector. (*Ans: 79,400 m/s*)
2. An alpha particle (He nucleus) is shot at 5.0 x 106 m/s into a magnetic field of 0.20 T in a device known as a mass spectrometer. What is the radius of the path followed by the alpha particle? (Hint: He nuclei contain 2 protons and 2 neutrons, each with a mass of 1.67 x 10-27 kg.) (*Ans: 0.52 m)*
3. An electron is shot through two oppositely charged, parallel plates at a velocity of 4.5×106 m/s. The plates have an electric field strength of 2.5 x 106 N/C between them. If there is also a magnetic field in the region between the plates, it will also enact a magnetic force on the electron. If that force is equal and opposite the electric force, the electron can pass between the plates undeflected. What is the magnitude and direction of a magnetic field that would allow this to happen? (remember this is an electron) *Ans: 0.56 T either into or out of the page, depending on how you draw the diagram)*
4. A) A long wire carries 10 A of current from left to right. An electron 1 cm above the wire is travelling to the right at a speed of 1.0 x 10 ^7 m/s. What are the magnitude and direction of the magnetic force on the electron? (*Ans: 3.2 x 10-16 N)* B) A magnetic field can deflect a beam of electrons, but it cannot do work on them to speed them up. Why?
5. Evelyn wears glasses whose wire frames are shaped like two circles, each with an area of 2.0 x 10-3 m2. The horizontal component of the Earth’s magnetic field in Evelyn’s home town is 1.9 x 10-5 Tesla. If Evelyn turns her head back and forth, rotating it through 90 degrees every 0.50 seconds, what is the magnitude of the induced voltage in the wire frame of one eyepiece? (Hint: A 90 degree rotation means the eyepiece goes from perpendicular to parallel or vice versa. What is the change in flux when something goes from perpendicular to parallel?) (*Ans = 7.6 x 10-8 V)*
6. Audrey disassembles the control box of her electric train and finds a small transformer inside. Its primary coil is made up of 600 loops and the secondary coil is made up of 60 loops. A) If the household voltage supplied to the train is 120 V, what voltage is required to make the train run? (*Ans: 12V) B)* Is this a step-up or a step-down transformer? How can you tell? C) on an unrelated note, pigeons and bees have multiple-domain magnetite magnets within their skulls that are connected with a large number of nerves to the brain. How does this aid the animals in navigation?