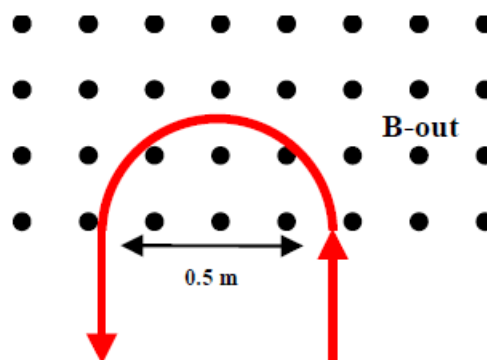
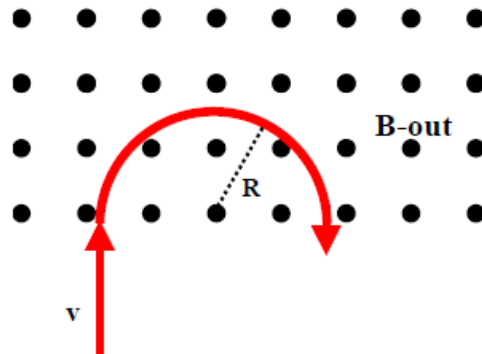


Homework 4 : Dielectric, Magnetostatics & Lorentz force

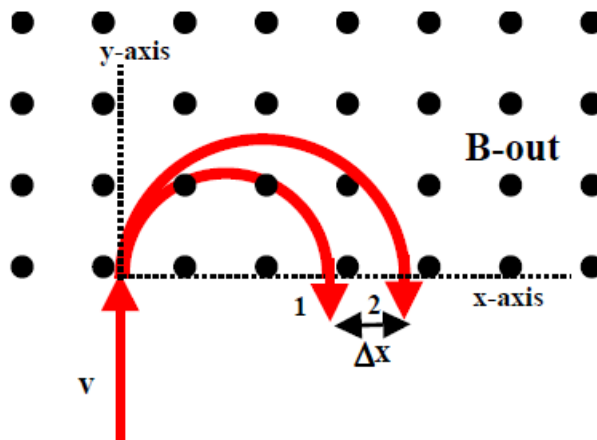
1. Determine the energy stored in the electric field created by two plates capacitor whose space is filled with a dielectric.
2. A charged particle, $Q = 0.5 \text{ C}$, enters a region with a uniform magnetic field $\vec{B} = 2\hat{x} + 3\hat{y} + 4\hat{z}$ (in Tesla). If its velocity is given by $\vec{v} = 2\hat{x} + 3\hat{y} + 2\hat{z}$ (in m/s), what is the magnitude of the magnetic force on the particle (in N)?
3. One end of a straight wire segment is located at $(x, y, z) = (0, 0, 0)$ and the other end is at $(1\text{m}, 2\text{m}, 3\text{m})$. A current of 2 A flows through the segment. The segment sits in a uniform magnetic field $\vec{B} = 2\hat{x} - 1\hat{y}$ (in Tesla). What is the magnitude of the magnetic force (in N) on the wire segment?
4. An electric power transmission line located an average distance of 20 m above the earth's surface carries a current of 800 Amps from east to west, in a region where the earth's magnetic field is 0.8 gauss due north at 60° below the horizontal. What is the magnitude of the force per meter on the line?
5. A charged particle, $Q = 0.1 \text{ C}$, traveling in the x –direction with velocity $\vec{v} = v_0\hat{x}$ enters a region of space that has an electric field in the y –direction given by $\vec{E} = E_0\hat{y}$ with $E_0 = 10 \text{ V}$ and a magnetic field in the z –direction given by $\vec{B} = B_0\hat{z}$ with $E_0 = 0.2 \text{ Tesla}$. If the particle experiences no net force and continues with the same speed and direction, what is its speed v_0 (in m/s)?
6. A charged particle traveling in the y –direction with a momentum of 0.01 kg ms enters a region of space that has a uniform 1 Tesla magnetic field in the z –direction as shown the Figure. If the particle enters the magnetic field at the point A and then exits the magnetic field at the point B located a distance of 0.5 m to the left of the point A , what is the charge of the particle (in mC)?



7. A charged particle traveling in the y –direction enters a region of space that has a uniform 2 Tesla magnetic field in the z -direction as shown in the Figure. If the particle has a charge of 0.1 C and a mass of 0.2 kg how long (in *seconds*) does it take for the particle to reverse direction and exit the region?



8. Particle #1 and particle #2 travel along the y –axis and enter a region of space that has a uniform 2 Tesla magnetic field in the z –direction as shown in the Figure. Both particles have the same charge, $Q = 0.1\text{ C}$, and both have the same speed, $v = 10\text{ m/s}$. If the particles are a distance $\Delta x = x_2 - x_1 = 0.3\text{ meters}$ apart when they exit the region, what is the difference in their mass, $\Delta M = M_2 - M_1$ (in *grams*)?



9. A circular loop of wire of radius $R = 1\text{ m}$ is carrying a current of 2 A as shown in the Figure, A particle with charge $Q = 3 \times 10^{-3}\text{ C}$ is on the axis of the loop (z -axis) a distance of $d = 0.5\text{ meters}$ away from the loop and is moving with a speed of $2 \times 10^6\text{ m/s}$ along the x –axis (i.e. perpendicular to the axis of the loop). What is the magnitude of the magnetic force on the particle due to the loop?

