Problem Set Due: Wedn., Oct. 29, 2015

Read Bloomfield: Chapters 10 & 11 (10.1-10.3, 11.1)

There will be a Quiz #2 on Friday, Oct. 30

Physics Problems (show explicitly all your work for full credit):

1. Bloomfield: Exercise 1, page 355
3. Bloomfield: Problem 27, page 358
4. Bloomfield: Exercise 1, page 390
5. Bloomfield: Problem 5, page 391

6. In demonstrating the concept of electrical attraction to a friend, you inflate a rubber balloon and charge it by rubbing it against your shirt and show how the force of attraction pulls your shirt away from your body.

*Given:* A force of 0.12 N is produced when the balloon is held 1.0 cm from the shirt, but this force is shown to decrease when the distance is increased to 2.0 cm.

\( k = 9.0 \times 10^9 \text{ Nm}^2/\text{C}^2 \)

*Find:* (a) How much electrical charge was transferred between the balloon and the shirt to produce the known force at the smaller distance? \( 3.6 \times 10^{-8} \)

(b) What force is produced at the larger distance? (0.03)
7. A positively charged object of charge $q$ and mass $m$ is placed between two charged plates (one positively charged and the other negatively charged).

*Given:* The Lorentz force on a charged object is: $F = qE$.

*Find:* (a) What is the direction of the force on the charged object? (up, down, left, right, out of page, into page?)
(b) Sketch the electric field in the region between the charged plates.
(c) What is the acceleration of the charge object in terms of the electric field, $E$, $q$, and $m$. (*for parts (c), (d), (e), provide only the equation*)
(d) What distance, $\Delta d$, does the object move in time $\Delta t$? (Express this in terms of $E$, $\Delta t$, $q$, and $m$).
(e) What is the kinetic energy of the charged particle after it travels a distance $\Delta d$? (Express this in terms of $E$, $\Delta d$, and $q$).

8. A small metal sphere with a charge of +0.05 C and a mass of 25 g (0.025 kg) enters a region where there is a magnetic field of 0.5 T. The sphere is traveling with a velocity of 200 m/sec in a direction perpendicular to the magnetic field, as shown.

(a) What is the magnitude of the magnetic force acting on the sphere? (5)
(b) What is the direction of the magnetic force exerted on the sphere when it is at the position shown?
(c) Will this force change the magnitude of the velocity of the sphere? Explain.
(d) From Newton’s second law, what is the magnitude of the acceleration of the charged sphere? (200)
(e) Since centripetal acceleration is equal to $r^2/v^2$, what is the radius of the curve the particle will move through under the influence of the magnetic force? (200)