Physics 142 - Fall 2007 - Problem Set 1

Due at end of lecture on Sept 13, 2007

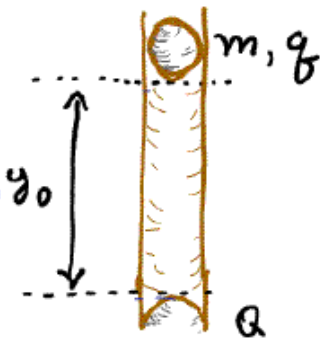
1. 22-2 (i.e., chapter 22 problem 2 in your text)
2. 22-3
3. 22-13
4. 22-14
5. 22-17

   Addendum to problem (5):
   How many Nimitz class aircraft carriers would a force of this magnitude be able to lift at Earth's surface?
   FYI - A Nimitz class aircraft carrier has a displacement tonnage of ~100,000 Tons.
6. 22-27
7. 22-53

(8) Go to the class website and play with the Coulomb force computer visualization. play with this demo. Explore the vector nature of the Coulomb force. See how the force scales with charge magnitude and distance. Observe that the resultant force is the vector superposition of the individual forces.

(9) Two charges, $-Q$ and $-3Q$, are a distance ℓ apart. These two charges are free to move but do not because there is a third charge nearby. What must be the charge and placement of the third charge for the first two to be in equilibrium?

(10) Three charged particles are placed on the corners of an equilateral triangle of side 1.20 m. The charges are $+4.0\ \mu C$, $-8.0\ \mu C$, and $-6.0\ \mu C$. Calculate the magnitude and direction of the net force on the $-6.0\ \mu C$ charge due to the other two charges.



(11) A small (point) mass m, which carries a charge q, is constrained to move vertically inside a narrow frictionless cylinder. At the bottom of the cylinder is a point mass Q having the same charge sign as q.

(a) Show the mass m will be in equilibrium at height

$$y_0 = \sqrt{\frac{kqQ}{mg}}$$

(b) Show that if the mass m is displaced by a small amount from its equilibrium position and released, it will exhibit simple harmonic motion with angular frequency

$$\omega = \sqrt{\frac{2g}{y_0}}$$