Physics 111: Homework #6
Due Friday (in precept)

1. How does the force between two stationary positive charges change if:
   
   (a) Each charge is doubled.
   (b) The distance between the charges is reduced by two.
   (c) The positive charges are replaced by negative charges.
   (d) The charges are tripled, charge 1 is changed from positive to negative, and the distance is quadrupled.

2. If the two charges in the previous problem are called 1 and 2, then repeat each section above but this time describe how the electric field due to charge 1 is changed.

3. The Coulomb force law looks very similar to Newton's law of gravity. If I drop two objects with different charges in a uniform electric field which pulls them downward, will they accelerate at the same rate? Why or why not? What if they have the same charge but different masses? Will they accelerate at the same rate? Why or why not?

4. If the Coulomb force is so much stronger than gravity, why isn't the solar system held together by electromagnetic forces rather than gravitational forces?

5. Which best describes the source of electromagnetic waves: (a) a charge moving in circles; (b) any accelerating charge; (c) any accelerating particle; (d) a constant current; (e) none of these. Explain why each is correct, incorrect, or incomplete.

6. The Princeton radio station can be found by tuning the radio dial to “103.3 FM”. This means that the radio signal is transmitted at a frequency of 103.3 MHz. (MHz means a million Hz.) What is the wavelength of the radio waves from this station? Suppose the frequency is doubled. What is the speed of the radio signal? What is the wavelength?
7. If you spread a thin film of ethyl alcohol on a glass plate and shine white light on it, it appears green (500 nm wavelength). This occurs because light bouncing off the the top and bottom side interfere constructively. Draw a sketch showing light as an electromagnetic wave bouncing off the bottom and top layers and scattering back to your eye. Use the sketch to determine what the thickness of the film most be.

8. Jupiter is about 5 times as far from the Sun as the Earth is. Compared to the view from Earth, how many times brighter or dimmer does the Sun appear from Jupiter?

9. Why do some sunglasses have polarized lenses? That is, they block light of one polarization (and let light of the other polarization pass through.) To address this question, consider the sketch showing light coming from the Sun and scattering 90 degrees. The light from the Sun has an electric field that it either in and out of the paper (the circle with the dot) or along the direction of the double-arrow. Note that both directions are perpendicular to the path of the light (as they must be).

Will both polarizations be scattered towards the observer? If you want to block the sunlight, but still be able to see, why would polarized glasses help?