

## **PHYS 1200 Physics of Everyday Experience**

### **Review questions and exercises for Lecture 23 (E&M-1)**

1. What particles are in the atom, and what electric charges do they have? Which particles are in the nucleus of the atom? Does matter typically have a net charge?
2. What is the difference between gravitational and electrical forces?
3. Who discovered the law of force between electric charges?
4. What is the difference between conductors and non-conductors?
5. What charge transfer occurs when (a) plastic is rubbed with fur, and (b) glass is rubbed with silk?
6. Why is an uncharged conducting sphere attracted to a charged rod?
7. How can a stream of water or a wooden board moved by a charged rod?
8. What instrument is used to detect the presence of electric charge?
9. What is the cause of the sparking that occurs when a grounded rod is brought near a van de Graaff?
10. What is electric current?

Answers:

1. Atoms contain electrons that are negatively charged, protons that are positively charged, and neutrons that are uncharged. The nucleus contains the protons and neutrons. Although matter contains enormous numbers of positive and negative charges, it is typically neutral since in their normal state atoms contain equal numbers of protons and electrons.
2. Gravitational forces are always attractive, whereas electric forces can be attractive or repulsive.
3. Coulomb
4. Conductors have free electrons that can roam around whereas non-conductors do not have free electrons. Every electrons in a non-conductor is firmly bound to a particular atom.
5. (a) When plastic is rubbed with fur electrons are transferred from the fur to the plastic giving it a negative charge. (b) When glass is rubbed with silk, electrons are transferred from the glass to the silk, leaving the glass with a net positive charge.
6. An uncharged metal sphere has free electrons that can move around inside it. When a negative rod is brought near an uncharged metal sphere, the electrons in the sphere are pushed away from the side of the sphere closest the rod and move to the other side of the sphere. As a result, the side of the sphere closest to the rod contains an excess of positive charges which are attracted to the negative charges on the rod. Because the excess electrons that moved away from the rod are farther away from the rod, the repulsive force on them is smaller than the attractive force between the positive charges and the rod. If a positively charged rod is brought near the uncharged metal sphere, electrons in the sphere move closer to the rod and there is still an attractive force.
7. Water molecules  $\text{H}_2\text{O}$  have a positive side and a negative side – we call this a dipole. In general, the water molecules are all randomly oriented. However, when a negatively charged rod is brought near a stream of water, the water molecules rotate until the positive side is closest to the negative rod. This produces an attractive force. In materials like wood, that are called “dielectrics” the molecules get stretched a little bit, so that the positive and negative charges do not exactly cancel.
8. An electroscope
9. The sparks are an indication that electrons from the van de Graff are jumping to the grounded rod, and these electrons have enough energy to ionize and excite some of the air molecules. When molecules and atoms get excited they emit light.
10. An electric current is a flow of electric charges.