**Physics 12: Introduction to Electrostatics.**

* Electrostatics is the study of a new force, ***the electrostatic force*, Fe,** that exists between objects with charge. Charge like mass is a **fundamental quantity,** which means we cannot describe it terms of simpler quantities. Some objects have charge; some do not, much like mass. We simply don’t know why.
* There are two *opposite* types of charge. These are called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ .
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ charge is carried by a subatomic particle called an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ charge is carried by a subatomic particle called a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

* Two like charges will always \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

 Two opposite charges will always \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

We do not know why this is true, it is simply a fact of nature.

* All matter is a combination of these two particles, and neutrons that carry zero charge, and so all matter contains positive and negative charge. Most matter is neutral because of the very fine balance between \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

* Although a \_\_\_\_\_\_\_\_\_\_\_\_\_ has over 1800 times the mass of an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, they each carry the same magnitude of charge, called the *elementary charge, e*. Thus most matter contains nearly the exact same number of \_\_\_\_\_\_\_\_\_\_\_\_\_\_ as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* This elementary charge is equal to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and is called \_\_\_\_.

* An object can attain a **net charge** if there is an imbalance between the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. This imbalance can be caused in two main ways; **contact** and **induction**.

* When an object becomes charged (by contact or induction) the transfer of charge is nearly always caused by the motion of the \_\_\_\_\_\_\_\_\_\_\_\_\_\_. This is because the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are much more massive and are bound together in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* The atomic (valence) structure of some materials allows the \_\_\_\_\_\_\_\_\_\_\_\_\_ to move through the material without losing any energy (or very, very little).

These materials are called \_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_.

Materials that resist the movement of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are called \_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_.

 Materials that essentially stop the movement of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_.

* Excess charge will always move to the surface of a conductor. This is because the charge repels and will move to place the largest possible distance between each other and conductors do not resist this movement.
* When placed in a region within an **ELECTRIC FIELD** the direction of force on a positive charge is always opposite the direction of force on a negative charge at the same point.

* The SI unit for charge is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* The symbol for charge is \_\_\_\_ or \_\_\_\_.
* Charge is a conserved quantity in nature. In all physical processes the total amount of charge before and after the process must be the same.
* In 1785 Charles Augustine-de-Coulomb published a law quantifying the electrostatic force between two spherically uniform charges. It is now called *Coulomb’s Law*

$$F\_{e}=k\frac{Qq}{d^{2}}$$

k=9.00x109Nm2/C2

**Questions:**

1. Two neutral conducting spheres are in contact on insulating bases. As shown below a positively charged object is then brought near, but not into contact with, sphere A. While the charged object is in place the spheres are separated. How are the objects charged as a result?

**++++**

#  A B

**++++**

#  A B

2. An object carries a charge of +4.2x10-5C. How many electrons has it lost?

3. Three charges are arranged as shown below. What is the direction of the net electrical force on each? (Sketch an arrow for each on the diagram to the right.)

 A

 A B

 + -

 +

 C

 B

 C

4. A proton and an electron are placed on the x-axis. The proton is placed at 1.0cm the electron is placed at –1.0cm. The two are then released from rest. Which reaches the origin first? Explain.

5. A proton at a point in space experiences a force of 1.0x10-26N East. What force would an electron placed at the same point experience? Explain.

6. A proton at a point in space experiences an acceleration of 1.0N East. What acceleration would an electron placed at the same point experience? Explain.

7. Imagine two charges fixed in place as shown:

I II III IV

Where on the dotted line would you place an electron so that it would experience equilibrium?

Where on the dotted line would you place a proton so that it would experience equilibrium?

8. Imagine two charges fixed in place as shown:

I II III IV

Where on the dotted line would you place an electron so that it would experience equilibrium?

Where on the dotted line would you place a proton so that it would experience equilibrium?

9. Find the electrostatic force between two protons separated by 1.00cm. Is this force attractive or repulsive?

10. Find the gravitational force between two protons separated by 1.00cm. Is this force attractive or repulsive?

11. A large conducting sphere has 6.0x1017 excess electrons transferred to it.

 A. What is the charge of the sphere?

The sphere is then brought into contact with a second, smaller, neutral sphere.

 B. Describe the motion of the charge.

 C. What is the total charge on both spheres combined at equilibrium?

 D. The large sphere has \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ charge than the small sphere (fill in with MORE, LESS or SAME)