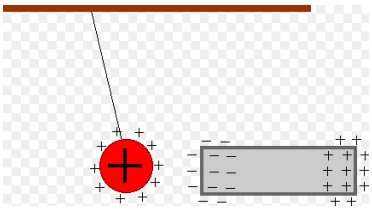
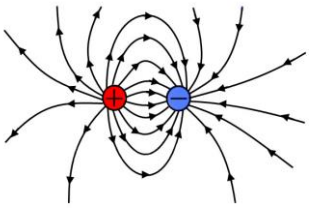


Physics 12

ELECTROSTATICS



So far in Physics 12 we have discussed several different types of **forces**:

- **Pushes and pulls** *from ropes, surfaces, beams etc.*
- **Gravity**

Another fundamental force was first noticed by the Greeks hundreds of years ago. They noticed that Amber (fossilized sap) would *"magically"* attract and move bits of straw.

They called this phenomenon "Elektron" (Electron) after the Greek word for Amber. Now we call use the term **"**Static electricity".

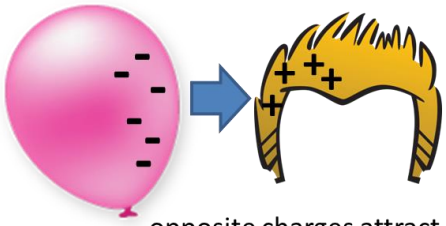
When we see things repel or stick together because of static electricity we are seeing another **fundamental force** of universe at work:

Electric Force

Many materials (not just Amber and straw) display this behavior. Why does it happen?

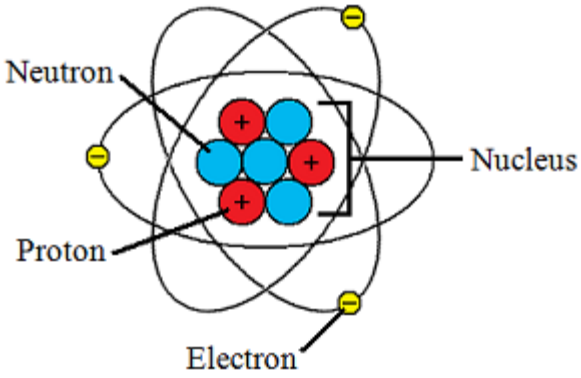
It all starts with **Electric "charge".** Electric charge is created on object when the object *losses or gains* electrons.

Extra electrons on a balloon give it a net **Electric Charge**



opposite charges attract

Remember:



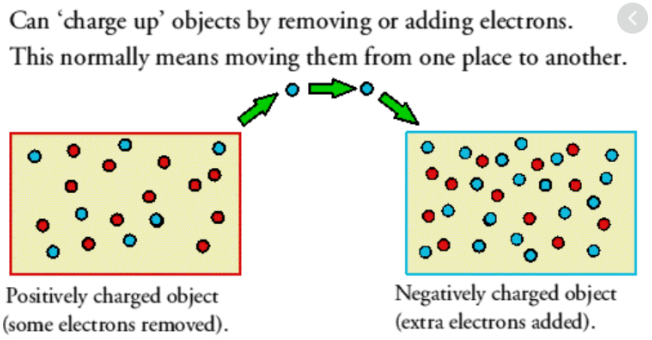
All matter is made up of atoms:

In solid materials atoms are held tightly in place. Their ***nuclei*** are **NOT** free to move about.

The ***electrons of atoms in a solid ARE free to move*** (especially electrons on the outside orbitals of the atom).

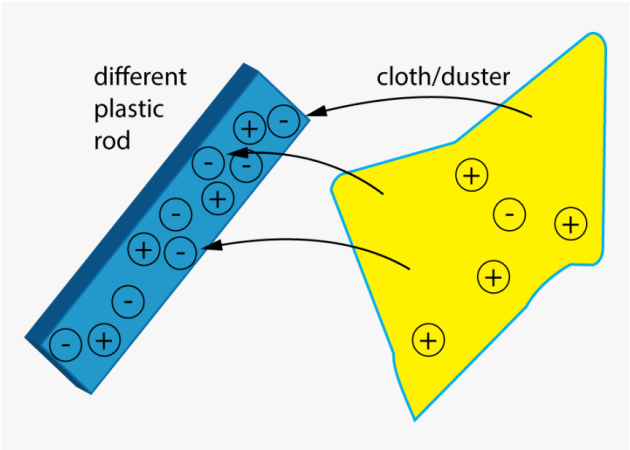
If a number of ***electrons are taken away*** from a neutral object – the total ***charge*** of the ***object becomes positive***.

<u>Diagram</u>



If a number of ***electrons are added*** to a neutral object – the total ***charge*** of the ***object becomes negative***

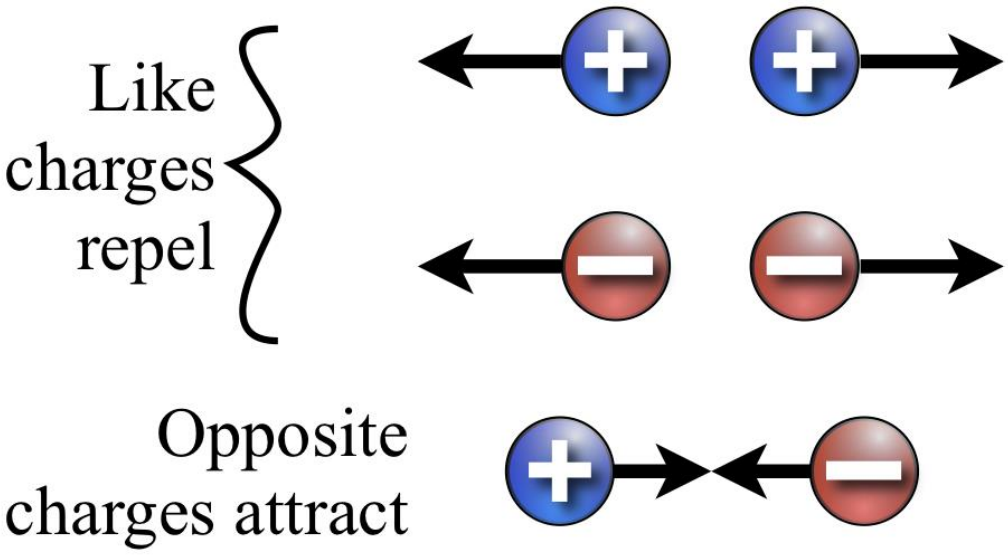
<u>Diagram:</u>



When we put charged object near one anther they experience a FORCE:

Opposite *electric* ***charges*** ***attract*** ***each other with a*** ***force***.

Similar *electric* ***charges*** ***repel*** ***each other with a*** ***force***.



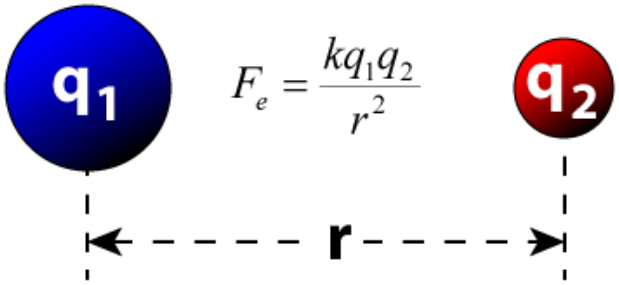
ELELCTROSTATIC **FORCES** are caused when two objects with **electric charges** are near each other.

"Electro – **static**" Force is a force caused by an electric charge that is **not moving** (static).

Coulomb's Law.

The attractive or repulsive **force** between two charged objects depends on two things:

1. **Amount of charge** on each object
2. The **distance** between the charges



$$F = \frac{k\,Q_1Q_2}{r^2}$$

F *= force in Newtons*

k *= Coulomb's constant 9.0x10⁹* ***Nm²/C²***

Q_1 *= amount of charge on one object in* ***Coulombs***

Q_2 *= amount of charge on second object in* ***Coulombs***

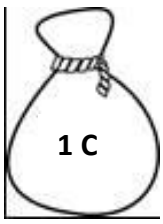
r *= the distance between the two charges in* ***meters***

The **units** for charge are called **Coulombs. "C"**

The charge on a single **electron** is -1.6 x10^{-19} Coulombs.
(Elementary Charge)

The charge on a single **proton** is + 1.6x 10^{-19} Coulombs

1 coulomb = 6.24 x 10^{18} electrons. *(sack of electrons)*



Intro to Electrostatics

1. *Will two electrons placed next to each other attract or repel each other?*

2. *Will two protons placed next to each other attract or repel each other?*

3. *Does an electron placed next to a proton repel or attract each other?*

4. *Describe what an elementary charge is?*

5. *How many coulombs is in an elementary charge?*
   (on your formula sheet)

6. *What is a Coulomb?*

7. *How many electrons or protons make up a Coulomb of charge?*

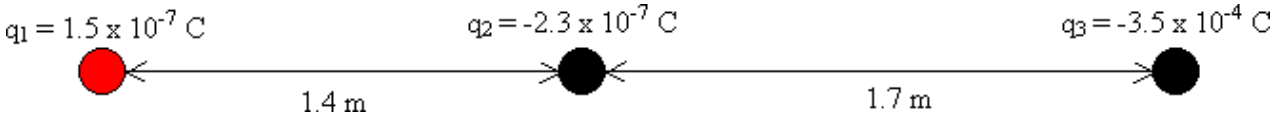
8. *Write the formula for Coulombs law.*

9. *What are the **two factors** that affect the electric force between two particles according to **Coulombs law**.*

10. *What is "k" in Coulombs law – state the actual value and the units.*

11. *One charge of 2.0 C is 1.5m away from a –3.0 C charge. Determine the force they exert on each other.* *Answer: 2.4 x 10^{10}N*

12. *The following three charges are arranged as shown. Determine the net force acting on the charge q_3 (charge 3).*
Answer: 0.2N to the right
(Watch your force directions)
Hint: total force = force caused by q_1 + force caused by q_2 (watch direction)



13. *Use the internet, and list 3 application of electrostatics we did not look at in class.*