Electricity

What is it?

What Forces Are at Work in it?

And What Can We Build With It?

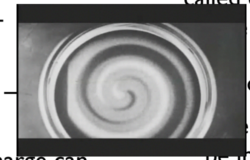
Electric Charge

What are the parts of an atom with a charge?

Protons have a + charge(+e)

Electrons have a – e)

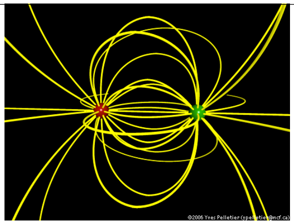
So, an electric charge can be either **positive** or **negative**



- These **elementary units of charge** are called elementary … they are the … charges ever …olated. …re believed to be indivisible.

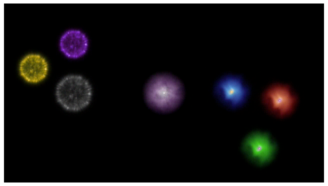
Like Charges ___________

Opposite Charges



In classical physics, the space surrounding an electric charge, or in the presence of a time-varying magnetic field, has a property called an electric field. This electric field exerts a force on other electrically charged objects. The concept of an electric field was introduced by Michael Faraday.

Would you like to know how quantum physics describes a field?



Would you like to know how quantum physics describes a field?

(From New Latin *ēlectricus*, "amber-like") is a general term that encompasses a variety of phenomena resulting from the presence and flow of electric charge

The potential between the two lines is 500kV, that's half a megavolt! At these potentials the air molecules get ionized, becoming plasma, the air becomes a conductor transfering electricity creating an impressive electric discharge. The video was taken in BC Canada.

Now Lets Talk About Types of Electricity

Static Electricity

Electric Current

Static Electricity

The word static means "not moving". So what to you think static electricity is?

It is a buildup of electric charge that stays where it is once it is put there.

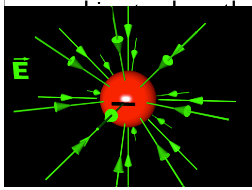
Lightning is a discharge of electric charge.

Field Around a Point (or Spherical) Charge

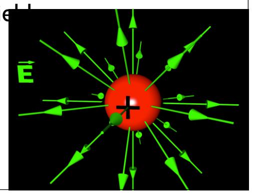
As long as the point, or sphere, is a conductor the charge can spread uniformly.

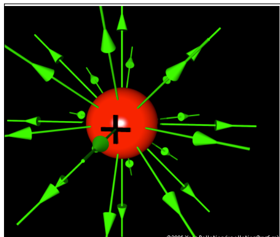
Field lines around it are normal to the surface and

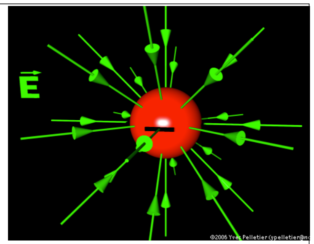
electric fi



Why are they outward?





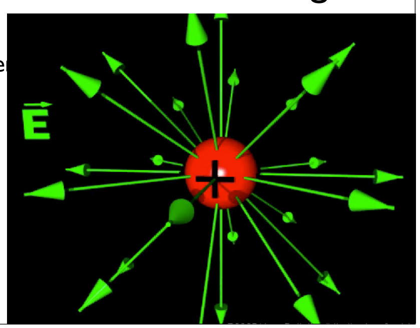


They are directed radially out from a positive charge

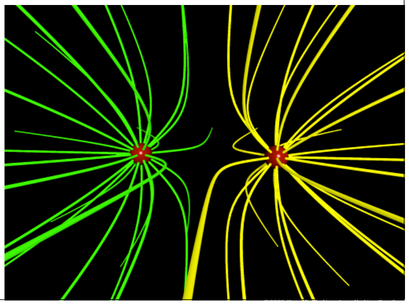
And radially inward for a negative charge

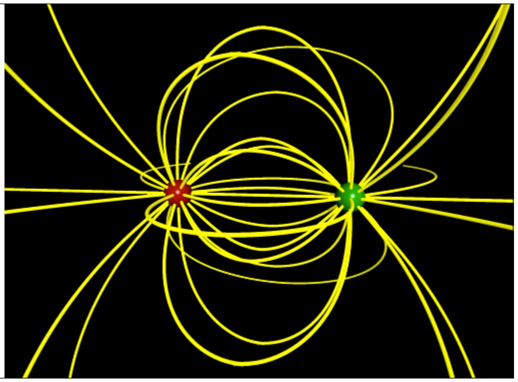
Field Around a Point Charge

The increasing distance betwee field lines represents a decrease in electric field strength.

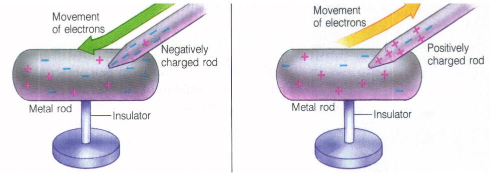


These electric fields interact with each other





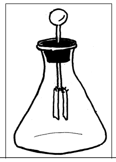
- **<u>Conduction:</u>** charging an object through actual ***<u>physical contact</u>.***
- ***Conduction*** → ***Contact***

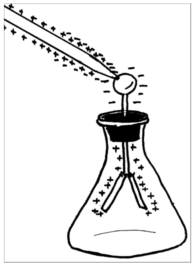


Conduction

An Electroscope can be charged by conduction.

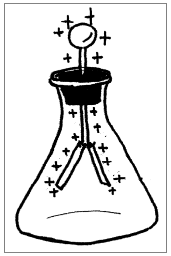
When a positively charged object touches the knob, the neutral leaves become positively charged and repel each other.





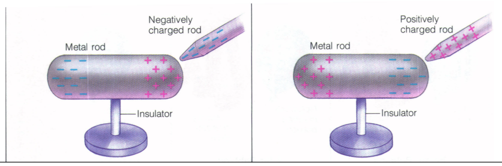
Conduction

This leaves the electroscope with a net positive charge (same as the rod that charged it) because a lot of the electrons have been removed!



Methods of Charging

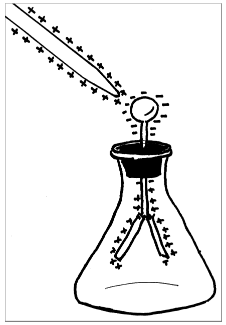
- **Induction:** charging an object ***without physical contact.***
- ***Induction*** → ***Indirect charging***



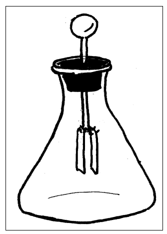
Induction

The negative electrons are attracted to the positively charged rod

The leaves temporarily become positively charged, like the rod



Induction



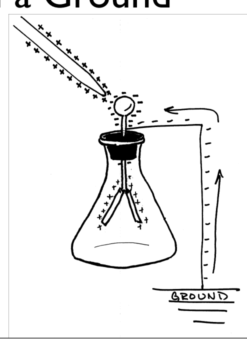
After taking the rod away, since there was no actual transfer of charge, the electroscope goes back to normal.

Meaning that it has a net neutral charge.

Induction with a Ground

Here, negative electrons are drawn up through the ground as well as being drawn up from the leaves because they are attracted to the positively charges rod.

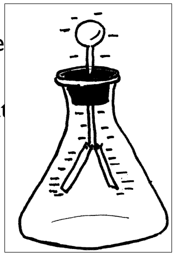
They collect in the knob.



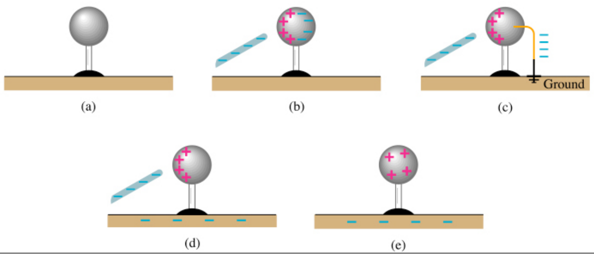
Induction with a Ground

After taking the ground and rod away, all the extra electrons get evenly distributed throughout the electroscope.

You are left with a net charge that is opposite that of the charged rod.



The process, in the correct order!



Friction, 3rd Method of Charging

Rubbing a balloon with a cloth transfers electrons from the cloth to the balloon.

The action of rubbing is what causes the electrons to transfer.

The cloth tends to hold the electrons more loosely than the balloon. So the cloth gives the balloon electrons. The balloon gets a ___________ charge!

What Do You Call a Material That Protects You From an Electric Charge?

INSULATOR: Does Not Conduct Electric Charge Well. Does Not Allow Electrons to Flow Freely.
Rubber, Plastic, Glass, Wood.

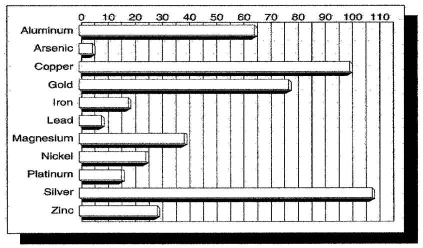
What kind of things **conduct** electricity well?

Conductor: Any Substance That Allows Electrons to Move Freely

ELECTRIC CONDUCTIVITY

The graph shows the electric conductivity of some metals at 20°C. The conductivity for copper is arbitrarily given the value of 100 percent, with which the conductivity of other metals is compared.

Relative Electric Conductivity of Metals at 20°C as Compared to That of Copper (100)



What Is This?

Who saw Indiana Jones?

The biblical powers of the Arc of the Covenant can be explained by static electricity.

Conservation of Charge

In a closed system where electric charge carriers can not enter or leave, the total net charge remains constant.

But the distribution of the charges can change.

The Coulomb

One coulomb equals $6.25x10^{18}$ elementary charges

The charge on one electron equals $-1.6x10^{-19}$ coulomb. (-e)

The charge on one proton equals $1.6x10^{-19}$ coulomb. (+e)

- **Net charge on an object must be an integral multiple of e!**

Example

Which charge is a valid electrical charge for an object?

a) $8x10^{-20}$ C

b) $5.32x10^{-18}$ C

c) $1.1x10^{-15}$ C

d) $1.52x10^{-17}$ C

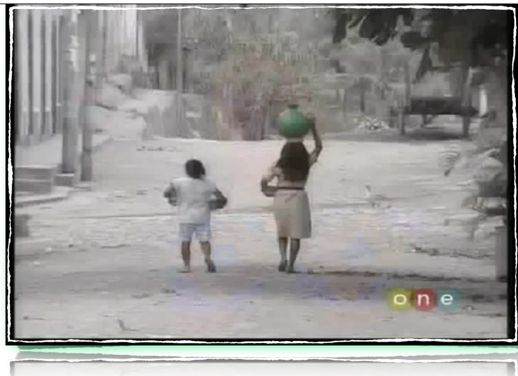
e) 0

d & e

0 is a neutral object

$1.52x10^{-17}$ C/1.6x10-19C/e = 95 e

That's 95 protons!

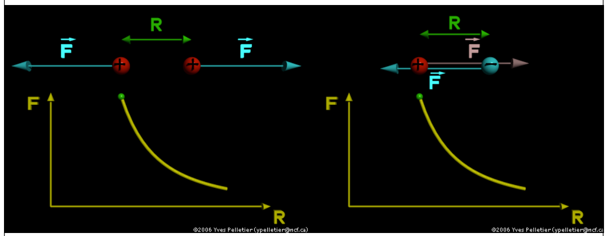


Coulomb's Law

Coulomb's Law

$$F_e = k\frac{q_1 q_2}{r^2}$$

$$F_g = G\frac{m_1 m_2}{r^2}$$



$k = 9.0 \times 10^9\ N \cdot m^2/C^2$

That "k" is good for finding the electrostatic force in air or a vacuum.

But what if it's not in air or a vacuum?