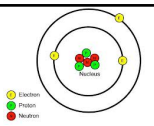
Chapter 18 - Electrostatics

VERY IMPORTANT!!!!

Atom Review



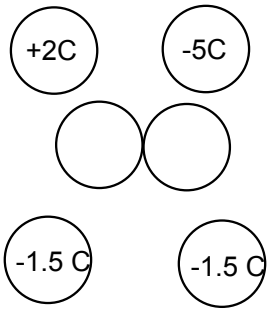
Nucleus	Outside nucleus
Protons (+1.6 x 10^{-19} C)	Electrons (-1.6 x 10^{-19} C)
Neutrons (0)	Loosely held (especially metals)
Held tight, do NOT move	Cause of electrostatics

Charge | q | C

Symbol for charge = q

Unit for charge = Coulomb = C = charge of one electron bolt

Charge is ALWAYS conserved



Total q = -3C

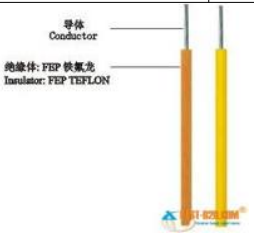
$n = \frac{q}{q_e}$

Total q = -3C

If made of same material, same size, conductive...charge will equally separate

Demo - light water and salt

Conductor	Insulator
Holds e^- loosely	Holds e^- tightly
ex. metals, tap water	ex. plastic, distilled water



Demo - charging tape and balloons and electroscope

- Like charges repel
- Unlike charges attract

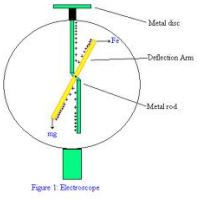


Figure 1: Electroscope

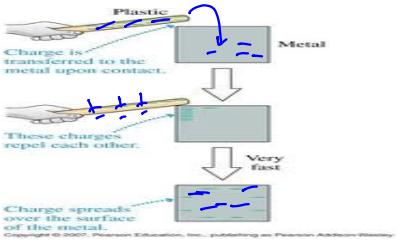
Ways to charge an object:

1) Contact

> Electrons simply transfer

> Each object SAME charge

> One object is always neutral

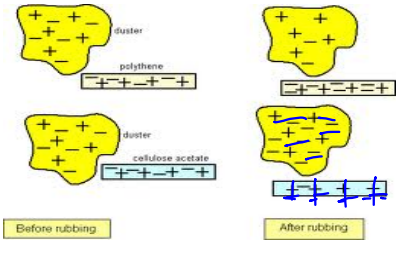


2) Charging by friction

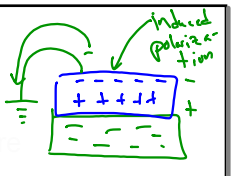
> Start with 2 neutral objects

> Each gets OPPOSITE charge

> Again electrons transfer



3) Charging by induction



> one object is charged

> both objects at the end are charged

> both objects have

4) Charging by VISA

Coulomb's Law

$$F_e = \frac{kq_aq_b}{R^2}$$

electrical F
???
grav. F

k = Coulomb's constant = 9×10^9 Nm²/C²

= $1/(4\pi\varepsilon_o)$

ε_o = permittivity of free space

= 8.85×10^{-12} C²/Nm²

van de Graaf demos.....

Electric Field = E

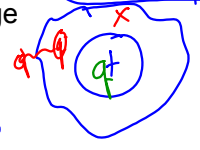
> area around charged object that the electric force can be felt

> Force per UNIT charge

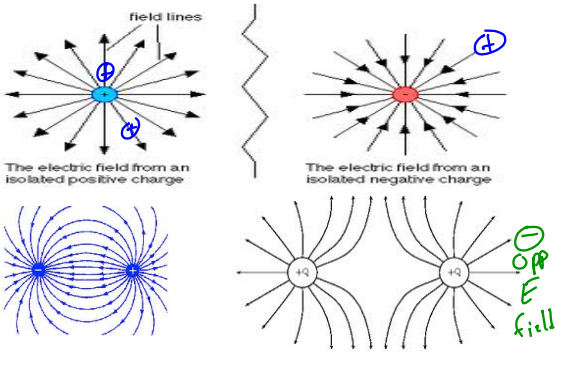
> **E = F/q**

> **units = N/C OR V/m**

E-field | E | N/C or V/m



Unit Test Charge = + 1 C charge
ALWAYS!!...just for defining electric field

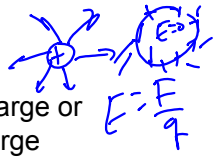


Arrows show direction for + test charge

Spacing of lines indicates stength...closer = stronger

E for point charge

- > Non uniform
- > Stronger near charge
- > points AWAY from + charge or TOWARD negative charge

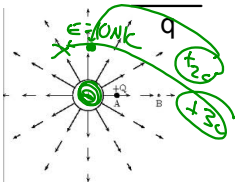


$E = F/q = kqq/r^2$

q

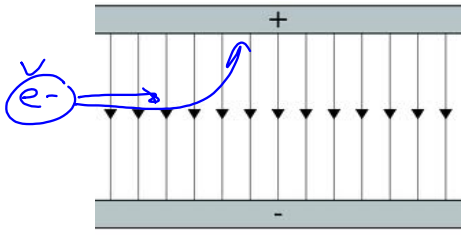
$E = kq/r^2$

$F = Eq$



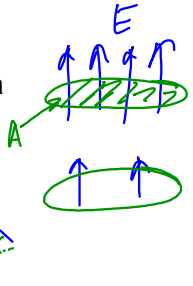
E-field for parallel plate

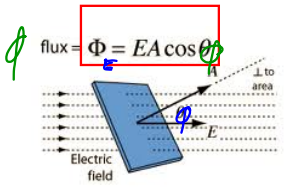
- > Uniform
- > Always points from + to -
- > Creates a Capacitor



Electric Flux

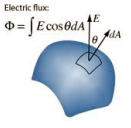
- > E-field WITHIN an area
- > EA (But must be ⊥)
- > symbol = Φ_E
- > Units = N/Cm^2





Gauss' Law

- > Sum of all the EA's of an arbitrary closed surface = gaussian surface
- > **$\Sigma EA = q/\varepsilon_o$**
- > q = net charge inside surface



Electric Shielding

What would the E-field inside a charged spherical conductor equal? ZERO!!!