ELECTROSTATICS

By: Kate Decker, Paula Corral, Faith Cunningham, Jack Rappard, Linus Jones

ELECTRIC CHARGES

	Mass	Charge
Proton	1.7x10^-27	-1.6x10^-19
Neutron	1.7x10^-27	
Electron	9.1x10^-31	1.6x10^-19 C

Determining # of Elementary Charges

$$q=ne$$

q=Charge

n=# of elementary charges[(# of p+)-(# of e-)]

e=elementary charge constant (1.6x10^-19)

How to Move Charges

1. CONDUCTION: Where charges move between objects when they touch

2. INDUCTION: Separation of charge within an object because of the close approach of another charged object but without touching.

3. FRICTION: Where electrons are physically stripped from one material and transferred to another.

COULOMB'S LAW

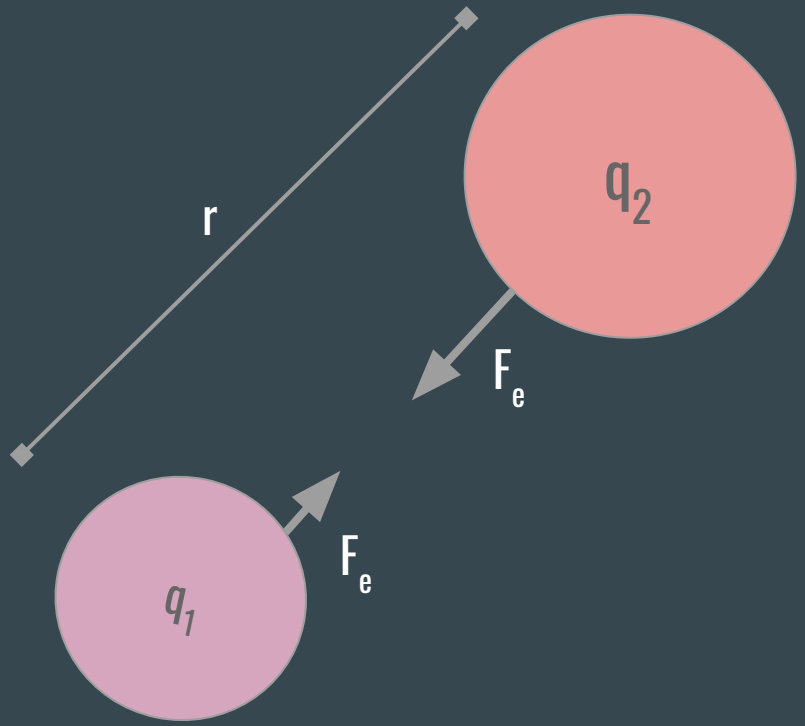
$$F_e = \frac{kq_1q_2}{r^2}$$

k= constant for electrostatics= $9.0 \times 10^9\ Nm^2/C^2$

How big is the first charge: q_1

How big is the second charge: q_2

How far apart are they: r



COULOMB'S LAW CONTINUED...

If Fe is positive ⟶ Force is repulsive

If Fe is negative ⟶ Force is attractive

K is often written in another way:

$K = 1/4\pi\varepsilon_o$

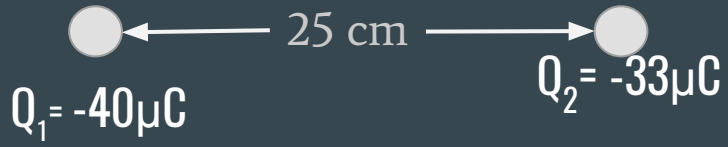
$\varepsilon_o = 8.85 \times 10^{-12} c^2 / Nm^2$

Examples #1

Determine the electric force on an electron in a Hydrogen atom from a Proton if they are separated by an average distance, r=0.7x10^-11 m.

Example #2

Determine the magnitude and direction of the Coulomb force on charge 1 due to charge 2.



Information you must know to solve:

$\mu = x\ 10^{-6}$

ELECTRIC FIELDS

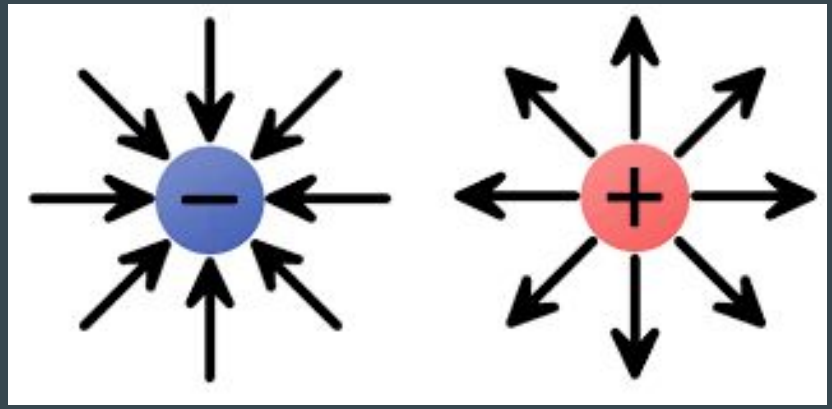
$E=F/q$

$E=kQ/r^2$

(Measured in N/c)

-q= charge feeling the field

-Q=charge creating the field



ELECTRIC POTENTIAL ENERGY & ELECTRIC POTENTIAL

$$PE_e = \frac{kQq}{R}$$

$$V = kQ/r$$

Equation for point charge

$$\Delta V = \Delta PE_e / q$$

CAPACITANCE

- Capacitor- A device that can store electric charge, consists of two conducting objects placed near each other but not touching.

$Q=CV$

$C=\varepsilon_o A/d$

- Measured in Farads (F)

Example #3

A)Calculate the capacitance of a capacitor whose plates are 25cmx5cm and are speedster by a 1.0 mm gap.

B) What is the charge on each plate if the capacitor is connected to a 12-V battery?

C) What is the electric field between the plates?

DIELECTRICS

- The capacitance can be raised further by inserting a dielectric between the plates.
- Advantages to this:
  - Has a higher breakdown voltage than air
  - Allows plates to be places together without touching
  - Increases capacitance by a factor of K

$C=K\varepsilon_o A/d$

- Storing electrical energy
- Energy stored=work done charging

$U_c=1/2QK$

$=1/2CV^2$

$=1/2Q^2/C$

Example #4

A camera flash unit stores energy in a 250μF capacitor at 300V. How much electrical energy can be stored?`

A. 0.112 J
B. 1.12 x 10^-2
C. 1.12 J
D. 2.25 J

Example #5

Value of k in coulomb's law depends upon

A. magnitude of two charges
B. Medium between two charges
C. Distance between charges
D. Both magnitude and distance between charges

Example #6

The presence of putting a dielectric between two plates of a capacitor results in

A. increased capacitance
B. constant capacitance
C. decreased capacitance
D. zero capacitance

Example #7

A dielectric k=2 is inserted between the plates of a 20 uF capacitor. Its capacitance will become....

A. 40 uF
B. 12 uF
C. 18 uF
D. 28 uF

Example #8

The change in potential energy of a unit charge between 2 points in an electric field is

A. Intensity
B. Permittivity
C. Potential difference
D. Fluc

SIX COMMON MISCONCEPTIONS

1. Remember to convert all units to SI before solving further.
2. Don’t confuse Electric Potential Energy with Electric Potential!
    a. Electric potential is potential energy per charge!!!! (measured in volts (V))
3. Static Electricity is not caused by friction, all that is required is the touching of metal plates between two plates to oppositely charge them
4. Electrostatics is not about "staticness," instead it's about charge and forces
5. The electrostatic force between two charged objects is independent of the distance between them (Not True!)
6. Electrons which are lost by an object are really lost (Conservation of Charge!)