PHYSICS

CLASS 2ND YEAR

CHAPTER 11. ELECTROSTATIC

DAY 1:

ELESTROSTATIC:

"The Study Of Charge At Rest Is Called Electrostatic".

Two Kinds Of Charge

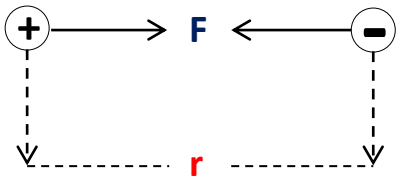
- Same Charge Repels Each Other.
- Different Charge Attract Each Other.

COLUMB'LAW:

STATEMENT:

"The Magnitude of Electrostatic Force Is Directly Proportional To Product Of Charges And Inversely Proportional To The Square Of The Distance Between Them"

GRAPHICALLY:



MATHEMATICALLY:

$$F_c \propto q_1 q_2 \quad \text{----------} \quad \text{(i)}$$

$$F_c \propto 1/r^2 \quad \text{----------} \quad \text{(ii)}$$

Combine Equation (I) & (II).

$$F_c \propto q_1 q_2/r^2 \quad \text{.....} \quad \text{(iii)}$$

$F_{vac} = K\, q_1\, q_2/r^2$ ..... (iv)

Were 'K' Is The Constant Of Proportionality. This Is Called Columb's Constant.

The Constant K Represent in the Term of Permittivity of Free Space.

$K=1/4\pi\varepsilon_o$

Its Value Is:

$K=9.0*10^9\ Nm^2/C^2$

Were Permittivity Is =

$\varepsilon_o = 8.85*10^{-12}\ C^2/Nm^2$.

COLUMB'S LAW IN MATERIAL MEDIA:

If Introduce a Medium b/w The Charges the Electrostatic Force Decrease With 'ε_r' Which Is Called Relative Permittivity or Dielectric Constant.

$F_{med} = 1/4\pi\varepsilon . q_1\, q_2/r^2$ ..... (v)

$\varepsilon_r = \varepsilon/\varepsilon_o$ ..... (vi)

PUT EQUATION (VI) IN EQ (v).

$F_{med} = 1/4\pi\varepsilon_r\varepsilon_o .\ q_1\, q_2/r^2$ ..... (vii).

$F_{med} = 1/\varepsilon_r .\ 1/4\pi\varepsilon_o . q_1\, q_2/r^2$

$F_{med} = 1/\varepsilon_r .\ F_{vac}$.

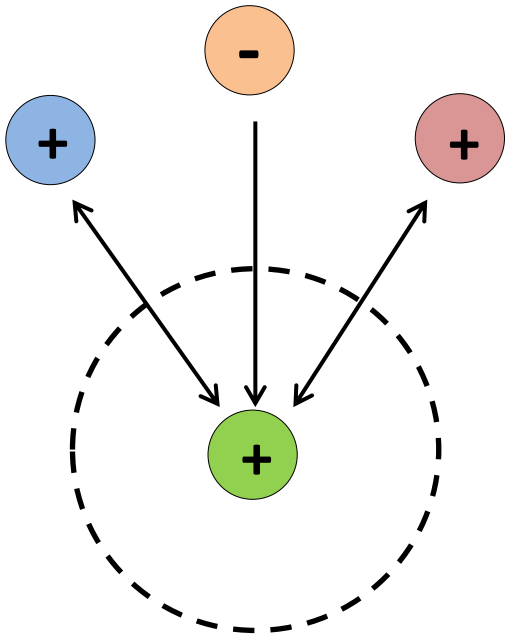
$F_{vac} > F_{med}$.

COMPLETE THIS TOPIC

ELECTRIC FIELD:

"The Space or Region around the Charge Were One Charge Exert Force on the Other Charge".

- Force May Be Repulsive Or Attractive.



ELECTRIC FIELD INTENSITY:

"Force Experience per Unit Positive Test Charge is Called Electric Field Intensity".

- It Is Denoted By 'E'.

$E = F/ q_o$ ..... (i)

Unit is: E = Newton/Columb = N/C.

ELECTRIC INTESITY NEAR AN ISOLATED POINT CHARGES:

$E = F / q_o$ ..... (i)

According To the Columb's Law

$F = K\, q\, q_o / r^2$ ..... (ii)

Put Equation (Ii) In Equation (I)

$E = K\, q\, q_o / r^2 / q_o$

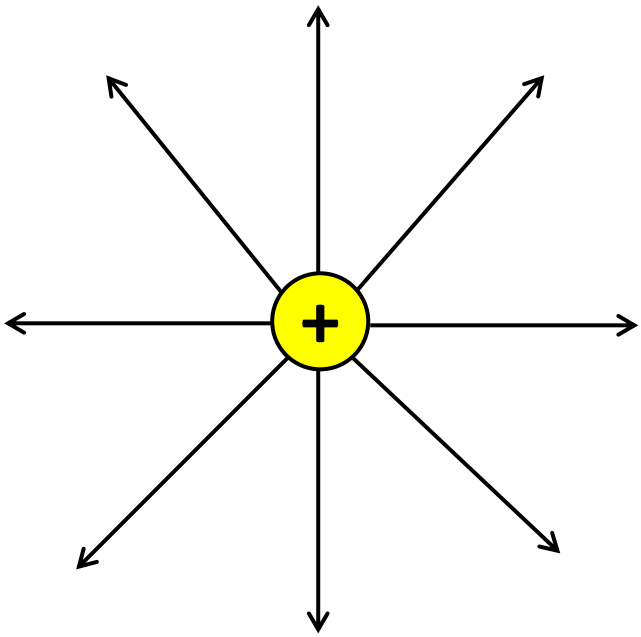
$E = K\, q / r^2$ ..... (iii).

COMPLETE THIS TOPIC

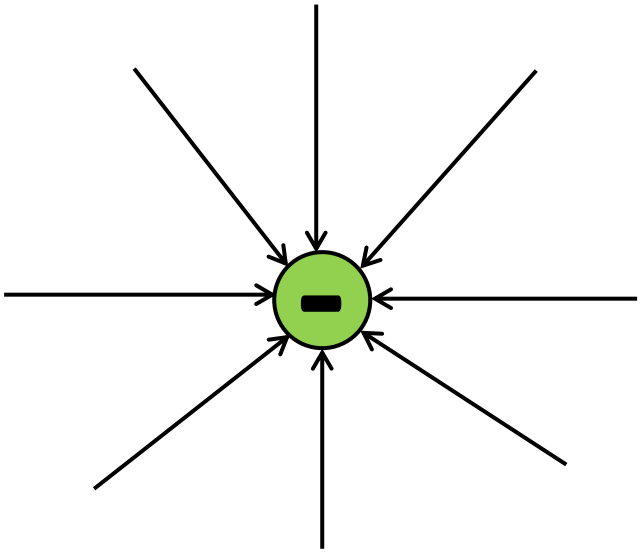
ELECTRIC FIELD LINES:

"Electric Field Lines Are Drown In Order To Specify The Direction Of Electric Field Lines".

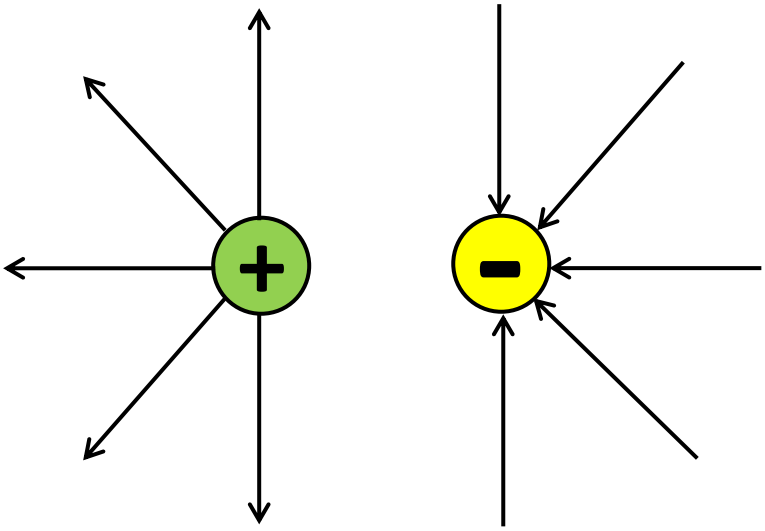
E.F.L DUE TO +VE CHARGE:



E.F.L DUE TO –VE CHARGE:



E.F.L DUE TO DIFFERENT CHARGE:



POINTS:

- E.F.L Lines Originated From +Ve And Terminating On –Ve.
- E.F.L Don't Cross Each Other B/C Electric Intensity Have Only One Direction At Any Given Point.
- E.F.L Are Closer To Each Other Were The Field Is Strong And Are Further Apart Were The Field Is Weak.
- E.F.L Are Uniformly Spaced In A Region Were The Field Is Uniform.
- The Tangent To The Given Line Give The Direction Of That Point.
- E.F.L Are Imaginary But Electric Field Exist.

COMPLETE THIS TOPIC

ELECTRIC FLUX:

"The Number Of Lines Passing Through Any Surface Is Called Electric Flux".

It Is Denoted By "Φ".

$$\Phi = E.A$$

$$\Phi = EA \cos \theta.$$

Electric Flux Depends Upon:

- Electric Intensity
- Normal Of The Area
- Angle B/W This.

MAXIMUM FLUX:

"If The Angle B/W Electric Intensity And Normal Of Area Is 0° Or Parallel To Each Other Then The Flux Will Be Maximum".

$$\Phi = EA \cos \theta \ldots\ldots\ldots (I)$$

$$\Phi = EA \cos 0°.$$

$$\Phi = EA.$$

MINIMUM FLUX:

"IF THE ANGLE B/W ELECTRIC INTENSITY AND NORMAL OF AREA IS 90° OR PARPENDICULAR TO EACH OTHER THEN THE FLUX WILL BE MIXIMUM".

$$\Phi = EA \cos \theta \ldots\ldots\ldots (I)$$

$$\Phi = EA \cos 90°.$$

$$\Phi = 0.$$

GUASS'S LAW:

STATEMENT:

"The Net Electric Flux Through A Close Surface Is Equal To The Sum Of All Charges Enclosed On It Divided By The Permittivity Of Free Space".

$$\Phi_{net} = q/\varepsilon_o \ldots\ldots\ldots\ldots \text{(i)}$$

EXPLANATION:

In Order To Calculate Electric Flux Through A Close Surface First Of All We Divide It Into Small Pitches. Each Pitches Like A Flat Surface.

The Net Electric Flux Through A Close Surface Is Given By:

$$\Phi_{net} = \Phi_1 + \Phi_2 + \Phi_3 + \ldots\ldots\ldots\ldots\ldots + \Phi_n.$$

$$\boldsymbol{\Phi_{net} = E_1 A_1 \cos\theta + E_2 A_2 \cos\theta + E_3 A_3 \cos\theta + \ldots\ldots\ldots + E_n A_n \cos\theta.}$$

So Cos Θ =0 Because Electric Lines Of Force And Normal Of Area Is Parallel To Each Other.

$$\boldsymbol{\Phi_{net} = E_1 A_1 + E_2 A_2 + E_3 A_3 + \ldots\ldots\ldots + E_n A_n.}$$

Hence, Electric Intensity Is Same It All That Point.

$$\boldsymbol{\Phi_{net} = E\,(A_1 + A_2 + A_3 + \ldots\ldots\ldots\ldots\ldots + A_n).}$$

$$\boldsymbol{\Phi_{net} = E\,(\text{Area of The Sphere})}$$

We Know That:

$E = 1/4\pi\varepsilon_o q/r^2$.

AREA OF SPHARE IS $= 4\pi r^2$

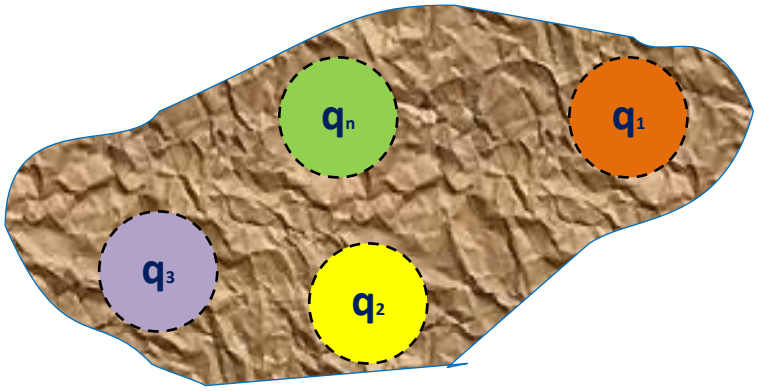
$\Phi_{net} = 1/4\pi\varepsilon_o q/r^2 (4\pi r^2)$

$\Phi_{net} = q/\varepsilon_o$ ..... (i)

GUASS'S LAW WITH GUASSION SURFACE:

In Order To Calculate Electric Flux Through Irregular Surface

Enclosing Charge Q_1, Q_2, Q_3,……, Q_n. Then The Net Electric Flux Through A Close Surface Is:



$$\Phi_{net} = \Phi_1 + \Phi_2 + \Phi_3 + \ldots\ldots\ldots\ldots + \Phi_n.$$

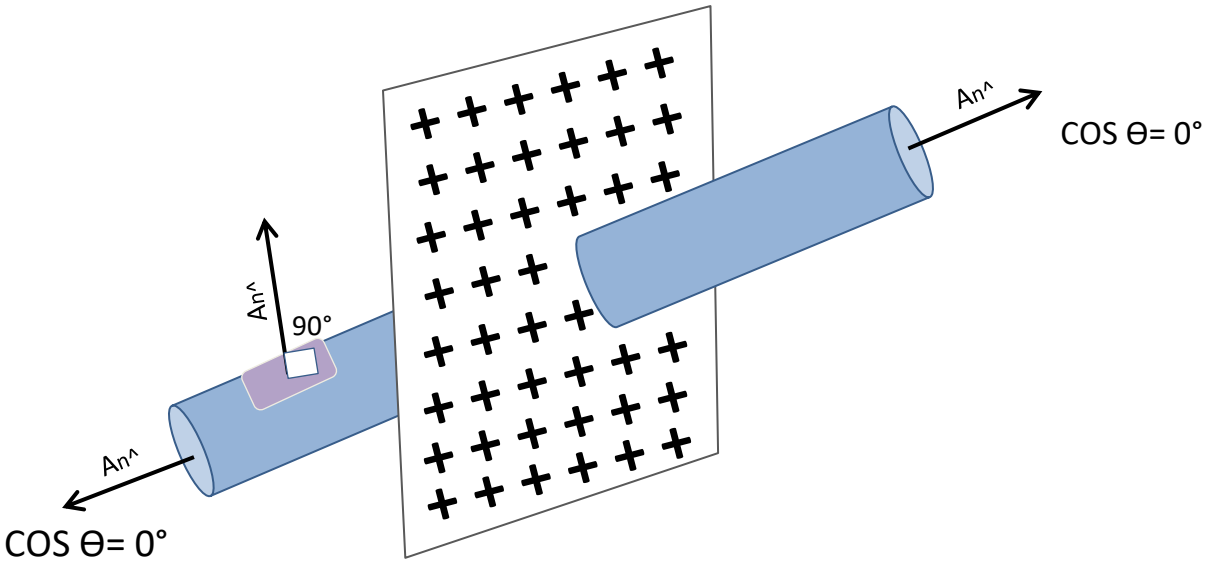
$$\Phi_{net} = q_1/\varepsilon_o + q_2/\varepsilon_o + q_3/\varepsilon_o + \ldots\ldots\ldots\ldots + q_n/\varepsilon_o.$$

$$\Phi_{net} = 1/\varepsilon_o (q_1 + q_2 + q_3 + \ldots\ldots\ldots\ldots + q_n)$$

"The Net Electric Flux through a Close Surface Is $1/\varepsilon_o$ Time Enclosing Point Charge on It"

APPLICATION OF GUASS'S LAW:

ELETRIC FIELD INTENSITY DUE TO INFINITE SHEET OF CHARGES:



ELECTRIC FLUX THROUGH SURFACE (i):

$\Phi = EA \cos 0°$

$\Phi = EA$ (COS 0°=1)

ELECTRIC FLUX THROUGH SURFACE (ii):

$\Phi = EA \cos 0°$

$\Phi = EA$ (COS 0°=1)

ELECTRIC FLUX THROUGH SURFACE (iii):

$\Phi = EA \cos 90°$

$\Phi = 0$ (COS 90°=0)

THE NET ELECTRIC FLUX IS:

$\Phi_{net} = \Phi_1 + \Phi_2 + \Phi_3.$

$\Phi_{net} = EA + EA + 0.$

$\Phi_{net} = 2EA$ ..... (i).

ACCORDING TO THE GUASS'S LAW:

$\Phi_{net} = q/\varepsilon_o$ ..... (ii).

ACCORDING TO THE CHARGE DENSITY:

$\sigma = q/A \quad , \quad q = \sigma * A$ .....(iii).

PUT EQ (iii) IN (i).

$\Phi_{net} = \sigma * A /\varepsilon_o$ .....(iv)

COMPARE EQ (i) & (iv)

$2EA = \sigma * A /\varepsilon_o$

$E = \sigma * A /2A\varepsilon_o$

$E = \sigma /2 \varepsilon_o$ ..... (v).

ELECTRIC INTENSITY DUE OPPOSITELY CHARGE PLATE: