Arbitrary*!

P12 - 8.0 - Electrostatics Review

Not a proton

$Assume\ test\ point$ "p" $= +1C$

Electric Charge : a property of matter that causes it to experience a force when placed in an electric/electromagnetic field. (Q ; C)

$1e^- = 1.6E-19C$

Coulomb : Unit of electrical charge, $C = 6.24E18\ e^-$ ($6\ quintillion\ electrons$)

Electric Field: A property of each <u>point in space</u> when charge is present in any form.

: → Uniform between two oppositely charged plates

$\vec{E} = \frac{kQ}{r^2}$ k ; $Coulomb's\ Constant$: Q ; $Quantity\ of\ Charge\ (C)$ r ; $Distance\ (m)$

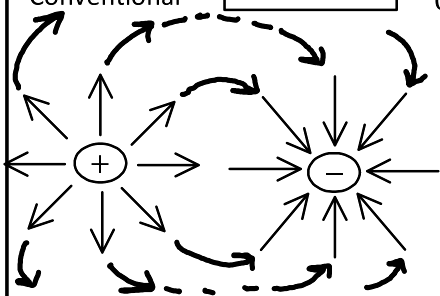
$k = 9.00 \times 10^9 \frac{Nm^2}{C^2}$

$\vec{E} = \frac{\vec{F}}{Q}$ $\vec{F}$; $Electrostatic\ Force\ (N)$ $Electric\ Field\ Strength\ \frac{N}{C}, \frac{V}{m}$

$g = \frac{\vec{F_g}}{m}$; $\vec{E} \sim^* g$; $Q \sim^* m$

$\vec{F} = \frac{kQQ}{r^2}$; N ; $k \sim^* G$

Conventional* $+ \rightarrow -$

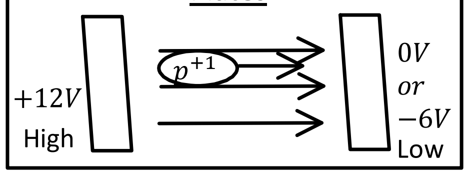


Coulombs Law :

Opposite Unlike Charges Attract. Like Charges Repel.*

+ve Work to overcome a Repulsive Force

Plates



Direction of Electric Field : Direction a Positve Charge would move. High Potential to Low.

A charge is surrounded by an electric field.
As a charge moves along an electric field line, work is done by the electrical force.
The energy gained or lost by this charge moving in the field is a form of potential energy. See way below.

Electric Potential : work (J) needed to move a unit charge ($1C$) between two points in an **electric** field.

($Volts : \frac{J}{C} = V$) : Or work done in carrying a unit charge from infinity to any point. ($a \approx 0^*$)

Potential to do work.

At a Point

$V = \frac{kQ}{r}$; $\frac{J}{C} = V$; $Potential, Volts$

$1\ V\ is\ one\ joule\ (Nm)\ per\ coulomb.\ 1\ joule\ moves\ 1C\ across\ 1\Delta V.$

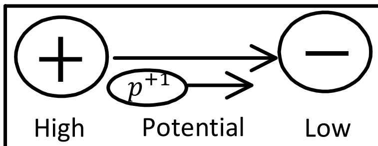
$1\ V, is\ the\ potential\ to\ do\ work,$ $to\ move$ 6.24E18 e^{-1} (electrons) (1C), 1m, with 1N of Force, using 1J of energy.

Voltage : the difference in electrical potential between two points.
((ΔV : V) Electric Potential Difference)

At a Distance

$\Delta V = \frac{\Delta E_p}{Q}$; $Potential\ Difference, Voltage\ V, \frac{J}{C}$

ΔV ; $Potential\ Difference\ (Voltage\ V)$
E_p ; $Potential\ Energy\ (see\ below)$



E_k of a test charge would increase when going from a higher potential to a lower potential

<u>+ve charges move towards a low potential</u>, away from high potential
− ve charges move towards a high potential, away from a low potential

∈ : emf (V)
Electromotiveforce
(Circuitry)
$ie.$ 12 $Battery$

Electric Potential Energy : Energy needed to move a charge against an Electric Field $E_p = \frac{kQQ}{r}$; J

A stationary charge will produce an electric field in the surrounding space.
If the charge is moving a magnetic field is also produced.
An electric field can also be produced by a changing magnetic field.

Magnetism

Electromagnetic Field: A property of space caused by an electric charge.

P12 - 8.0 - Electrostatics Formulas Review

Theory $1C = 6.24E18\ e^-$ $1e^- = 1.6E-19C$

$\vec{E} = \frac{\vec{F}}{Q}$; *Electric Field Strength* $\frac{N}{C}, \frac{V}{m}$

$\vec{F} = \vec{E}Q$

Total $V_T = V_A + V_B$

$\Delta V = \frac{\Delta E_p}{Q}$; *Potential Difference, Volts* $V, \frac{J}{C}$

>1 Charge

$\Delta V = V_f - V_i$

$V_{AB^*} = V_A - V_B$ (Potential Between A & B)

$\vec{F} = \frac{kQ_1Q_2}{r^2}$ $\vec{E} = \frac{kQ}{r^2}$ $E_p = \frac{kQ_1Q_2}{r}$

Fixed Charge: $V = \frac{kQ}{r}$, $V = \vec{E}r$

Plates: $\Delta E_p = \vec{F}d$, $\Delta V = \vec{E}d$

$F_c = F_@$; *Orbit*

Force

$\vec{F_g} = mg$; N

$g = \frac{F_g}{m}$; $\vec{E} \sim^* g$

$\vec{F_g} = \frac{GMm}{r^2}$ $\times r$

$\div m$

$g = \frac{GM}{r^2}$; $\vec{E} \sim^* g$; $Q \sim^* m$

Energy

$W = \vec{F}d$; J, Nm

$E_p = -\frac{GMm}{r}$; J

$W = \vec{F}d$

$E_p = \left(\frac{GMm}{r^2}\right)d$

$E_p = \frac{GMm}{r}$

$\vec{E} = \frac{kQ}{r^2} = \vec{E}r = V = \frac{kQ}{r}$

$\frac{kQ}{r^2} \times Q \times r = \vec{E}\not{Q}r = \Delta^* V\not{Q} = E_p$

$\Delta E_p = \Delta VQ$

$\frac{kQQ}{r_f} - \frac{kQQ}{r_i} = \left(\frac{kQ}{r_f} - \frac{kQ}{r_i}\right)Q$

Useful Substitutions

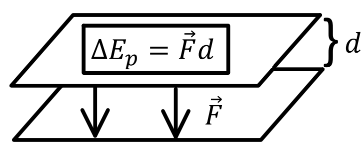
Coulombs Law : Electrostatic Force - Between two charged particles

$\vec{F}$; *Electrostatic Force* E_p ; *Potential Energy*

$W = \Delta E = \int \vec{F}d\vec{r}$

$\vec{F} = \frac{kQQ}{r^2}$; N $\times r$ $E_p = \frac{kQQ}{r}$; J

; *no* $+/-$ Logic ; $+/-$ *in formula*



$W = \vec{F}d$

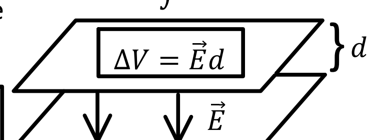
$\div Q$ $\div Q$

$V_\infty = 0$

Point in Space

$V = \int \vec{E}d\vec{r}$ Parallel Plates

$\vec{E} = \frac{kQ}{r^2}$; $\frac{N}{C}$ $\times r$ $V = \frac{kQ}{r}$; $\frac{J}{C} = V$; *Potential*



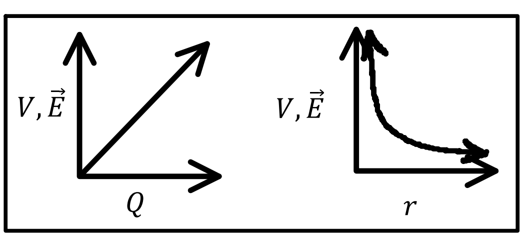
$\times Q$ $\times Q$

Potential to do work.

$\vec{F} = \vec{E}Q$ $\times r$ $\Delta E_p = \Delta VQ$

$\int = Area = \vec{@}d$

Calculus



VED is EFD!