Unit Five: Charge, Electric Fields, Electrical Energy, Potential Difference and Electrical Power

Charged objects have an electric field

→ Field lines always point away from ⊕ and toward ⊖ (What would a "+" do?)

→ a charged object attracts the opposite charge & neutral

→ Charge is equally distributed over 2 objects → $\frac{\text{total charge}}{\#\text{ of objects}}$

→ ONLY electrons are transferred

→ Charge is conserved → net charge remains the same

- If like charges are pushed together (against the field work is done) Potential increases
- Potential E becomes kinetic or electrical energy

- Current is measured in Amperes → C/s
- Resistance is low for "short, fat, cold, gold" if temp ↑, R ↑ (no equation)

If energy is calculated with elementary charge it is measured in eV's $1\,eV = 1.6\times10^{-19}\,J$

If energy is calculated with Coulomb's ($W = qV$) is measured in CV or Joules

Ohm's Law – $V = IR$

$$\frac{V}{I \mid R}$$

$$I = \frac{V}{R} = I = \frac{V}{\frac{\rho L}{A}} \simeq I = \frac{VA}{\rho L}$$

Current and resistance are inverse so anything that is direct to R (ρ & L) is inverse to I
inverse to R is direct to I

Equations

$F_e = Eq$ (for uniform field... parallel plates

$F_e = \frac{kq_1q_2}{r^2}$ For point charges $k = 8.99\times10^9\,Nm^2/C^2$

$1e = 1.6\times10^{-19}\,C$ elementary charge = proton or electron

to convert into C $\times 1.6\times10^{-19}\,C$
to convert to e $\div 1.6\times10^{-19}\,C$

– elementary charges must be whole #'s (can't split an "e")

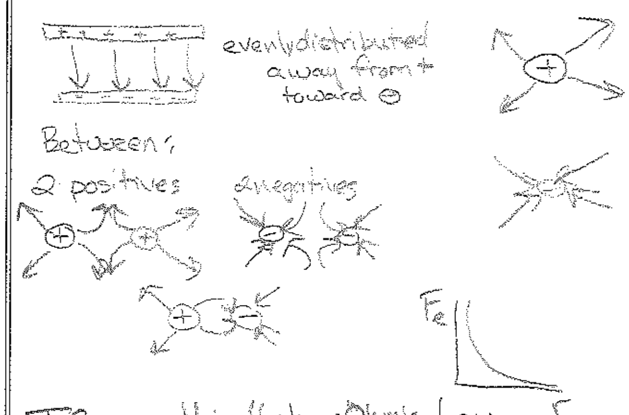
Divide charge in C & make sure whole # of e's

$V = \frac{W}{q}$ or $W = Vq$ → eV, VC = J

$I = \frac{q}{t}$ where q is in Coulombs & t in seconds

$R = \frac{\rho L}{A} = \frac{\rho L}{\pi r^2}$ $V = IR$ if charge is given in elementary or electrons convert to C

$P = \frac{W}{t} = VI = I^2R = \frac{V^2}{R}$



If something "obeys Ohm's Law" means "R" is constant

For power graphs – you must identify the constant

Unit Five: Electric Circuits and Magnetic Fields

Circuits:

Ammeters measure current → setup in series "Inside"

Voltmeters measure potential difference → setup in parallel "outside"

The resistance of wires in a circuit is zero ✱

Series Circuits

Single path for current to flow

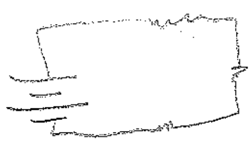
Current is the same throughout: $I_T = I_1 = I_2 = I_3$

Potential difference is split

$V_T = V_1 + V_2 + V_3$

Resistance sums

$R_{eq} = R_1 + R_2 + R_3$



Parallel Circuits

alternate Paths for current to flow

$I_T = I_1 + I_2 + I_3$

Potential difference is equal in each branch

$V_T = V_1 = V_2 = V_3$

Req: Inverse of sum of inverses

$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

The addition of a resistor in parallel lowers Req and increases current

Req is always lower than lowest resistor

Junction Rule

The current that enters a junction of wires must equal the amount that exits

IN	OUT
5A	11A
9A	? ← 3A
14A	

Magnetic fields

Away from North toward South

"What a north compass needle would do"

A charged particle has an electric field if moving creates a magnetic field

and vice versa

Equations

Series

$I_T = I_1 = I_2 = I_3$

$V_T = V_1 + V_2 + V_3$

$R_{eq} = R_1 + R_2 + R_3$

Parallel

$I_T = I_1 + I_2 + I_3$

$V_T = V_1 = V_2 = V_3$

$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

	V	I	R	P
R_1				
R_2				
R_3				
Total