

Module 2 Equation Sheet (you may use front and back of sheet)

Develop this equation sheet as you watch pre-lecture videos, attend lecture, and work homework.

DC-Circuit Kirchhoff's Rules

* Kirchhoff's Loop Rule - Valid for any KLR
closed loop circuit $\sum V = 0$

* Kirchhoff's Junction Rule - Valid at any KJR
junction of 3 or more wires. $\sum I = 0$

* KLR Requires a System of equations.

- Choose direction of current flow.
- outside into the loop.
- against current = positive
- going along current = negative.

$$\begin{bmatrix} I_1 & I_2 & I_3 \\ \text{Currents go here} \\ \text{then RREF 2nd} \\ \text{matrix} \\ 3 \times 4 \text{ matrix} \end{bmatrix} = \begin{bmatrix} V \\ V \\ V \end{bmatrix} \rightarrow \text{sum volts in loop.}$$

Coulomb's Law

Magnitude of the electrostatic force between any two charged particles.

$$\vec{F} = k \frac{q_1 q_2}{r^2} \quad k = 9 \times 10^9 \frac{N \cdot m^2}{C^2}$$

$q_1 \& q_2 = \text{charges in Coulombs}$
 $r = \text{distance between them.}$

Electric Potential Energy for a pair of charges.

$$U_E = k \frac{q_1 q_2}{r^2}$$

Electric Potential

$$V = \frac{U_E}{q_0} \quad \text{volts} = 1V = 1J/C$$

$$1eV = 1.602 \times 10^{-19} J$$

Capacitance in Farads

$$1F = \frac{1C}{1V}$$

Resistors in Series always have the same Current.

$$R_{eq} = R_1 + R_2 \dots R_n = \sum_{i=1}^n R_i$$

Resistors in Parallel have the same Voltage

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

Kirchoff's Rules

$$\text{Junction} = \sum I = 0$$

$$\text{loop} = \sum V = 0$$

Magnetic Field = \vec{B} units in Tesla = $1N/A \cdot m$; gauss $g = 10^{-4} T$

$$\vec{F} = q(\vec{v} \times \vec{B})$$

Two charges that are the same charge will repel.
opposite charges will attract.

Electric charge is measured in Coulombs C

Law of Conservation of Charge - sum of all charges in a closed system is 0.

Particle	Charge C	Mass kg	Conductors - move charge easily
proton p^+	$+1.602 \times 10^{-19}$	1.67×10^{-27}	
neutron n^0	0	1.67×10^{-27}	Insulators - do not move charge freely.
electron e^-	-1.602×10^{-19}	9.11×10^{-31}	

atoms gain charge by gaining or losing electrons.

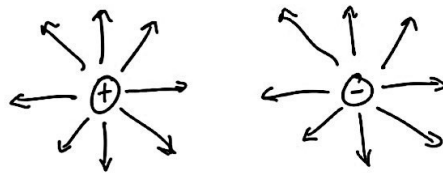
Charge Flow Rate = total charge / total time.

Electric Field - Disturbance in nearby charges; invisible.

Strength of field $E \rightarrow N/C$ Newton Coulombs on the charge q .

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

Electric field of a point charge = $|\vec{E}| = k \frac{q}{r^2}$



$$1 \text{ amp} = 1 \frac{C}{s}$$

$$\text{Power} = \text{Watt} = \frac{1}{2} \cdot \frac{C}{s} \cdot \frac{J}{C} = \frac{1}{2} \cdot W.$$

$$P = VI$$

$$\text{Ohms Law} = V = IR$$

Resistivity of Temperature

$$R = R_0 (1 + \alpha \Delta T)$$

R_0 = initial resistance

α = temperature coefficient.

ΔT = change in temperature.

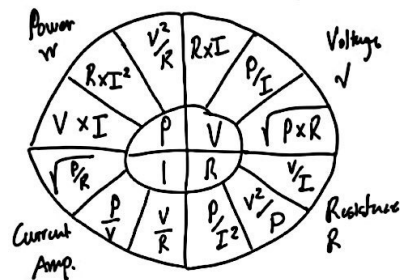
$$R = \text{ohms} \frac{\text{Volt}}{\text{amps}} = \Omega$$

$$R = \frac{\rho L}{A}$$

ρ = resistivity

A = area

L = length



Torque

$$\tau = IBA \sin \theta$$