Definition

Electric Field

- Field is an area where an object experienced force
- > *Electric field is the field where a stationary charge experienced force*
- Gravitational field is the field where an mass experienced force

Electric field strength

- $E = \frac{F}{Q}$
- > *Force per **unit** positive charge/charge **placed into field***
- This is a scaler when the definition gives postive charge in the field, and is a vector when no specific charge is given
- The charge must be the charge placed into field
- Unit: $N/C = Kgms^{-2}/As = KgA^{-1}ms^{-3}$
- In Uniform field **ONLY** $E = -\frac{V}{d}$, minus sign must be shown, alternative unit is V/m

Uniform Field

- > *Electric Field strength is same in every point*
- Parallel line with same distance(Electric Field Strength), so when shown distance must be same
- When a charged particle moves right angle with in it, it can be modeled as a projectile motion

Non-Uniform Field

- > *Electric field strength is not the same in every point*
- distance between field line changes

Current

- > *As phenomenon: Directed motion of Charges*
- > *As variable: Rate of flow of Charges*
- $I = \frac{Q}{t}$
- real direction of current: from negative to postive
- Conventional direction of current: from postive to negative
- In a conductor

Voltage

- $V = \frac{E}{Q}$
- > *Energy per unit charge*
- Unit: $J/C = Nm/C = Kgms^{-2}m/As = Kgm^2A^{-1}s^{-3}$
- $p.d. = \frac{E}{Q}$
- > *Energy converted from electric to other form to move the charge per unit charge*
- $\varepsilon = \frac{E}{Q}$
- > *Energy converted from other form to electric to move the charge in a complete circuit per unit charge*
- > *1 Volt is such a voltage that use 1J of energy to move 1C of charge*
- Across a component

Resistance

- $R = \frac{V}{I}$
- > *Resistance is the ratio of voltage over current*
- unit: $\Omega = Kgm^2A^{-2}s^{-3}$
- actually it is a properties of materials and is not affect by voltage and current
- Actual formula: $R = \rho\frac{L}{A}$
- of a conductor

Power

- > *Power is rate of energy transfer ($P = \frac{E}{t}$)*
- $P = \frac{E}{t} = \frac{VQ}{t}$

- $P = IV = I^2 R = \frac{V^2}{R}$
- for one variable resistance when internal resistance appeared: the internal resistance must be the same resistance to the variable resistance to have the maximum power in external resistor

Electric Energy

- > *Power per unit time*
- $P = \frac{E}{t} t = IVt = I^2 Rt = \frac{V^2}{R} t$

Concept

Electric field line

- Arrows from Postive(+) to Negative(-)[1]
- Must touch with both plate/object[1]
- Minimum 4 line must shown[1]
- In uniform field distance must be same(1)
- In non-uniform field distance must change(1)
- The electric field line direction indicate the charge on both side and thus provide indication when a particles moves in it require identification(+ attracts - and vice versa)

Charge is quantised

- Charge is discreate
- All the charge must be a whole number of charge of fundamental charge
- $e = 1.6 * 10^{-19} C$

DC and AC

- DC(direct current): Charges (electrons in metals and ions in electrolytes)
- AC(alternative current): Electrion move backward and forward

Measuring EMF(ε) and internal resistor

1. connect the circuit with variable resistance

- read the terminal p.d. and I
- Plot the graph of V to I and change the variable resistor
- $\varepsilon = IR(terminal\ p.d.) + Ir(lost\ volts)$
- if R decrease, then I increase, Ir increase and IR decrease because ε is the same

- $\varepsilon = V + Ir \Rightarrow V = -Ir + \varepsilon$

2. Use Potential meter

- Read from sensitive gaivanometer when moving jockey on potentiometer wire and measure AY(read from meter ruler) where it is 0
- $E_X = \frac{AY}{AB} * E_0$
- or you can compare the $E_X \& E_y$

Kirchhoff's Law

- > 1^{st} *Kirchhoff's law: total current into junction into total current out of junction*

- > 2^{nd} *Kirchhoff's law: the sum of IR = ε*

Ammeter's and Voltmeter's resistances

- Ammeter's resistance as small as possible
- Votlmeter's resistance as large as possible

Derivation

Drift Velocity

- $I = nqVA = nAve$ (naive without I)
- n = charge density = $\frac{N}{V}$ Unit: m^{-3}
- Derivation: $I = \frac{Q}{t}(definition) = \frac{Ne}{t} = \frac{nVe}{t} = \frac{nALe}{t} = nAve$
- $V \propto I$ and $V \propto \frac{1}{A}$

Potential Divider

- $V_{out} = \frac{R_2}{R_1+R_2} * V_{in}$
- step 1: $I = \frac{V_{in}}{R_1+R_2}$
- step 2: $V_{out} = I * R_2 = \frac{R_2}{R_1+R_2} * V_{in}$
- they are used in direct sensing devices

Parall and Series ciruct

- Parall
- Series