Electric Current

Columb(C) charge: fundamental particle of matter $\{Q = ne\}$ charge
↳ +tive, -tive (++, -- repel note of e^-
+-, -+ attract)

Static Electricity: deals with electric charges at rest while the current electricity deals with charges in motion

Ampere(A) Electric Current Rate of flow of electric charge
(I) $\{I = Q/t\}$ (scalar)
∴ charge on $\{1\ e^-$ is $= 1.6 \times 10^{-19}\ C\}$
(1 Ampere is said when 1 Columb of charge flows through any cross section in 1 second.

Volts (V) Potential Difference: work needed to move a charge from one point to another a.k.a voltage
$\{(V) = \frac{W}{Q}\}$ (work done) (charge)

∴ flow of electric current is opposite to flow of electr
electrons flow -tive to +tive
electric current flow from +tive to -tive

Electric circuit: a closed path along with electri current flows.

Symbols

+||-	battery cell	—WW—	resistor
		—WW—	variable resistor
+|||-	battery	—⌒—	electric bulb
		+(A)-	ammeter
—( )—	switch off	+(V)-	voltmeter
—(•)—	switch on		

Ohm's Law: the current through a conductor is directly proportional to the voltage across the two points provided external conditions are constant

$(I \propto V)$

$\boxed{V = IR}$ (resistance)

m (Ω) * Resistance: interruptors in current flow.
(R) (property of conductor to resist flow of curren

⇒ factors on which resistance depends.

$R \propto \frac{1}{A}$ (area) $R \propto l$ (length)

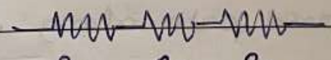
$R \propto$ material $R \propto$ tempreture
(resistivity) (ρ) Ωm

resistance offered by a material wire of 1m length and $1m^2$ area (cross section).

$\boxed{R = \rho \frac{l}{A}}$

Series Resistance connection

connection in one line (horizontal)



$\boxed{R_S = R_1 + R_2 + R_3}$

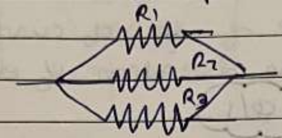
final R is more than individuals.

- I is constant
- V is different

$\boxed{V_S = V_1 + V_2 + V_3}$

Parallel Resistance connection

connection in splitted parallel connection



$$\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

· current in splitted (diff)

$$I_P = I_1 + I_2 + I_3$$

· voltage is same

. final R is less than any individual R.

Heating Effect of current:

$H \alpha I^2$

$H \alpha R$ so $H = I^2 R t$ = $H = IVt$ = $H = \frac{V^2}{R} t$

$H \alpha t$

watt power = $\frac{W}{T}$ = $\frac{V^2}{R} \frac{t}{t}$ = $\frac{V^2}{R}$ = IV = $I^2 R$

rate at which electricity is consumed.

commercial unit: 1kwh = 3.6×10^6 (1000 × 60 × 60)

a.k.a units

Conductance: Ability of a material to allow flow of electric current.

Power:

power = $\frac{\text{workdone}}{\text{time}}$ = $\frac{\omega}{t}$ ($V = \omega / q$) = $\frac{Vq}{t}$

so $P = \frac{Vq}{t}$, $P = VI$

$H = Pt = VIt = I^2 R t$

v1 From ~~PDF~~ JA

ampere A Electric Current: rate of flow of current
(I) opposite to the direction of electron flow
Scalar $I = Q/T$

Ohm's Law
the potential difference between two points is directly proportional to electric current passing through them at constant temprature

$V \propto I$

volts (v) voltage ← $V = IR$ → resistance ohm (Ω)
I: Electric current, Ampere (A)

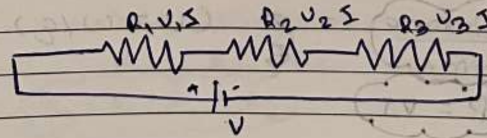
$R \propto l$ (length) m
$R \propto \frac{1}{A}$ (area) m^{-2}

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

$R \propto T$ (temprature) k
$R \propto \rho$ (resistivity) Ωm [$\rho = \frac{1}{\sigma}$]

v2 Resistor connections

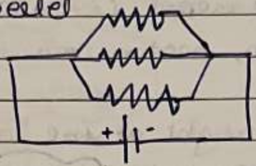
* 8 Resisters in Series



here, I is same for all by V is different,
so $V = V_1 + V_2 + V_3$ ($\because V = IR$)
$IR_{eq} = IR_1 + IR_2 + IR_3$
$R_{eq} = R_1 + R_2 + R_3$

$\because R_{eq}$ is always >> than every R_n...

In parallel

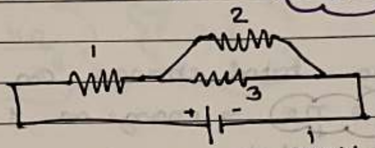


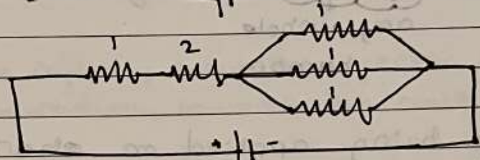
here, V is same of Rs.
But I splits so...
Req is smaller than every R_n

$I = I_1 + I_2 + I_3$ $\quad (I = V/R)$

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

V3 Solve this





$\boxed{\frac{1}{\Omega m}}$ or Conductivity: property of a material to allow flow of current through it.

Siemens/meter

$\boxed{(S/m)}$ (σ) it the constant property of the material

because $\frac{1}{\Omega} = S$ $\quad \sigma = \frac{1}{\rho}$

so geometrically $\sigma = \frac{L}{RA}$ (only for geometry)

Heating Effect of Current

$H = I^2Rt$

+tive p^+
-tive e^-

Electric Charge — oppo attract (+ -) / same repel (- -, + +)

property of electron, proton or neutron.

∴ when 2 electrons brought at the distance of 1 cm, force experience is 2.3×10^{-24} N

same force for protons too

charge on 1 $e^- = -1.6 \times 10^{-19}$ C

$1\ p^+ = 1.6 \times 10^{-19}$ C

calculating total charge on a body

charge ← $q = ne$ → charge on 1 e^- (1.6×10^{-19})

n → any whole number

Force being applied on charges :

↳ $F \propto q_1 q_2$ (multiplication of charges)

$F \propto \frac{1}{r^2}$ → radius between them

$F \propto \frac{q_1 q_2}{r^2}$

q_1 —r— q_2

$F = K \frac{q_1 q_2}{r^2}$

K → ~~column~~ coulomb's constant = 9×10^9

$K = \frac{1}{4\pi \varepsilon_0}$ → permittivity of space

permittivity is the measure of how much resistance is encountered when forming an electric field in a medium.

$\boxed{K \text{ unit} = \frac{Nm^2}{C^2}}$, $\boxed{\varepsilon_0 \text{ unit} = \frac{C^2}{Nm^2}}$

vector

E (N/C) Electric Field property of a electric charge carrying body

$$= \frac{\text{Electric force}}{\text{test charge}}$$

unit = $\boxed{\frac{N}{C}}$

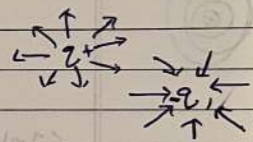
$$E = k\frac{q_1 q_0}{r^2 q_0} = \frac{kq}{r^2} = E$$

it is a vector quantity in direction of the electric force

$$\vec{E} = \frac{kq}{r^2} \qquad \vec{E} = \frac{\vec{F}}{q_0}$$

if q^+, E is radially away from center

q^-, E is radially towards the center



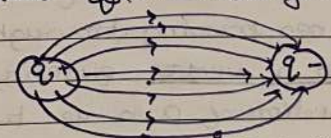
E only gets 0 when $r = \infty$ ... ($\because E = kq/r^2$) $\xrightarrow{} \infty$

E get ∞ when $r = 0$ ($E = kq/r^2$) $\to 0$

so, E↑ increase as we go closer

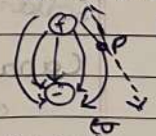
Properties Stated By michel Faraday...

1) electric field start from +charge and ends at -tive charge



P (what's direction of E?)

"they said draw a tangent, and it shows direction of E for that point" but direction toh koi bhi direction ki bana du...?! like



like this..

2) E don't make closed paths, like bidirections

3) E field lines don't intersect

Electric Potential / Electric Potential Difference

Electric Potential: work done per unit charge in bringing a positive test charge from ∞ to that point, against electric force.

$$\cancel{V = \frac{W_{ext}}{q_0}}$$

[Scalar] Electric Potential Difference: Different between electric potentials of two points,

$$V_A - V_B = \frac{W_{ext}}{q_0}$$ in opposite to the direction of electric field...

unit = $\boxed{J/C \text{ or volts}}$

(Integration wala kuch hai but it's too confusing)

$V = E r$ $\quad$ $V = \frac{Kq}{r}$

$\boxed{\frac{N m^2}{C}}$ $\boxed{Vm}$ Electric Flux: measure of total number of electric field lines passing through a given surface.

∵ Area is a vector quantity in physics.

↳ direction of area is ⊥ to the surface

$$\phi = \vec{E}.\vec{A} = E.A.\cos\theta$$

Scalar

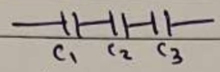
Capacitors —||—

ability of a conductor (or capitor) to store electric charge per unit potential difference.

so $C = \frac{Q}{V}$ $\quad$ $VC = Q$ $\quad$ unit: $\boxed{\text{Farad (F)}}$

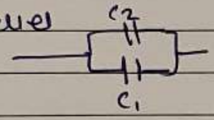
* Connections of capacitors

1. Series



$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$ (∵ voltage differs)
(∵ charge remains same)

2. Parellel



$C_{eq} = C_1 + C_2$ ∵ voltage remains same
∵ charge changes