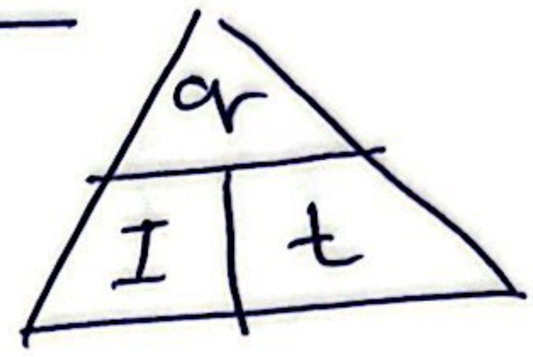
MR: Samch Ali
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G-12 Advance
Term II

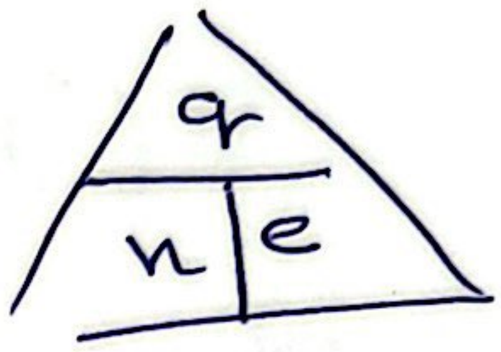
Chapter(5)
Resistance and Current

## Electric Current I

$$I = \frac{q_r}{t}$$




$$q_r = ne$$




$n \Rightarrow$ number of Charge

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

- IF $q_r$ given as a function of time

$$I = \frac{dq_r}{dt}$$

- IF I given as a function of time

$$q_r = \int_{ti}^{ti} I\,dt$$

Remember

① $1\,C \equiv A \cdot S$

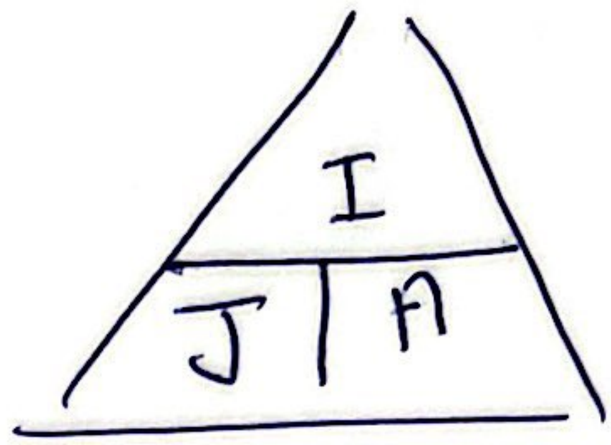
② $mAh \xrightarrow{\times 3.6} C$

$C \xrightarrow{\div 3.6} mAh$

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## (2) Current density J

$$J = \frac{I}{A}$$




J ⇒ Current density A/s

(Solid Conductor) $A = \pi r^2$

(Hollow Conductor) $A = \pi (r_o^2 - r_i^2)$

$r_o$ ⇒ outer radius (m)

$r_i$ ⇒ inner radius (m)

Note

① $$I = \int \vec{J} \cdot d\vec{A}$$

② $$\frac{J_1}{J_2} = \frac{A_2}{A_1} = \frac{r_2^2}{r_1^2}$$

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## (3) Resistance and Resistivity

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

$R \Rightarrow$ resistance $\Omega$

$\rho \Rightarrow$ resistivity $\Omega m$

$A \Rightarrow$ Area $m^2$

$A = \pi r^2$

$$\rho = \frac{E}{J}$$

$E \Rightarrow$ electric Field N/C

$J \Rightarrow$ Current density

$$\frac{R_1}{R_2} = \frac{L_1}{L_2}$$

$$\frac{R_1}{R_2} = \frac{r_2^2}{r_1^2}$$

Note

(1) $\sigma = \frac{1}{\rho}$

$\sigma \Rightarrow$ Conductivity $\Omega^{-1} m^{-1}$

(2) $G = \frac{1}{R}$

$G \Rightarrow$ Conductance $\Omega^{-1}$

$\Omega^{-1} \equiv S$

(Seimens)

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## (4) Electromotive Force $V_{emf}$

is the potential diffrence that produced by battery

### Ohm's Law

$$R = \frac{\Delta V}{I}$$




Note

- Source of electromotive force is Battery
- Generator also a Source of electromotive Force

---

## (5) Electric Circuits

Combination (Series + Parallel)

### Series Circuit

$R_{eq} = R_1 + R_2 + \cdots$

$I_t = I_1 = I_2 = \cdots$

$V_t = V_1 + V_2 + \cdots$

For identical resistance

$$R_{eq} = nR$$

### Parallel Circuit

$$R_{eq} = \left[\frac{1}{R_1} + \frac{1}{R_2} + \cdots\right]^{-1}$$

$I_t = I_1 + I_2 + \cdots$

$V_t = V_1 = V_2 = \cdots$

For identical resistance

$$R_{eq} = \frac{R}{n}$$

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## (6) Electrical Power

$$P = \frac{U}{t} = IV = I^2R = \frac{V^2}{R}$$

P ⇒ Power (w)  1w ≡ J/s

U ⇒ electrical energy (J)

1 J = w · s

t ⇒ time (sec)

I ↑ $_{OR}$ V ↑  P ↑  Brightness ↑

## Cost of electricity

Cost = $P_{kw} \times t_{hr} \times$ price of kwh

Cost: Fils, DH

price of kwh: Fils, DH

w $\xrightarrow{\div 1000}$ kw

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# Chapter 6

## Direct electric Circuit

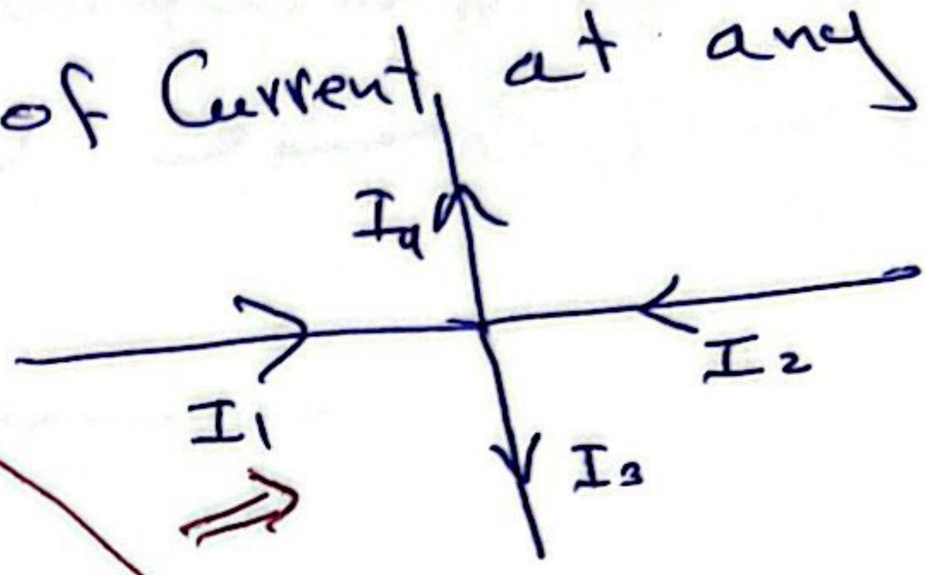
### Kirchoff's Rules

#### Kirchoff's First Law " Junction rule "
" Current Law "

The total Current entering to a Junction equal to total Current leaving the Junction "

OR

total algebric Sum of Current at any Junction is Zero




$$I_1 + I_2 = I_3 + I_4$$

$$I_1 + I_2 - I_3 - I_4 = 0$$

Note Kirchoff's First law acheive Law of Conservation of Charge.

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(7)

## Kirchoff's Second Law "Loops Rule"

the Algebric sum of electric potential along closed loop is equal Zero

- Kirchoff's Second Law acheive the Law of Conservation of energy.

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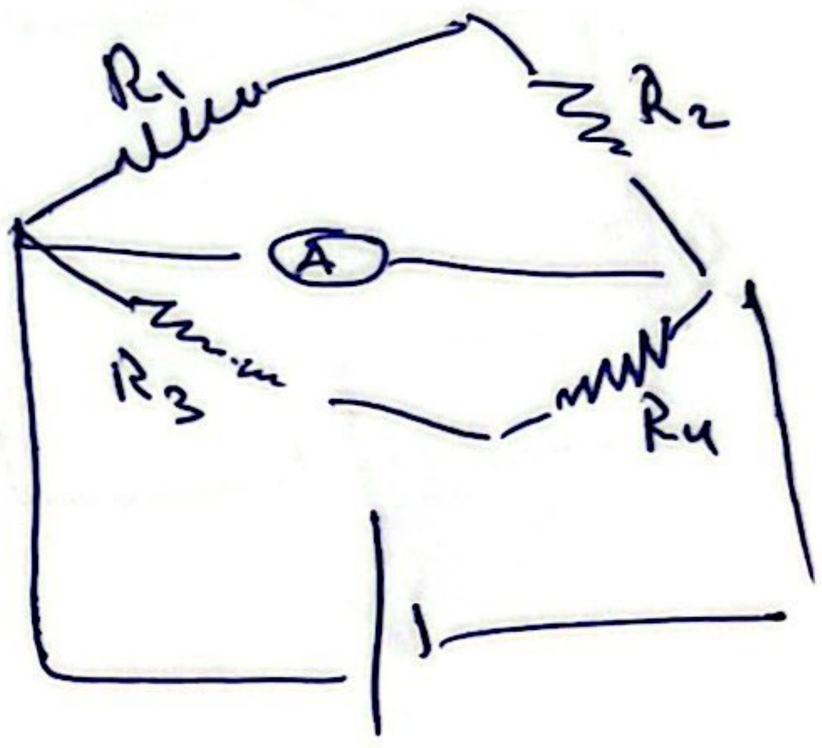
## Wheatestone bridge

IF Ammeter reading Zero, It means the circuit at balance

$$\frac{R_1}{R_2} = \frac{R_3}{R_4}$$

OR

$$\frac{R_1}{R_3} = \frac{R_2}{R_4}$$




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(8)

## (2) Ammeters and Voltmeter

**Ammeter** (A) ⇒ Adevice use to measure the electric Current I

- It Connected in Series

**Voltmeter** (V) ⇒ Adevice use to measure the potential diffrence V

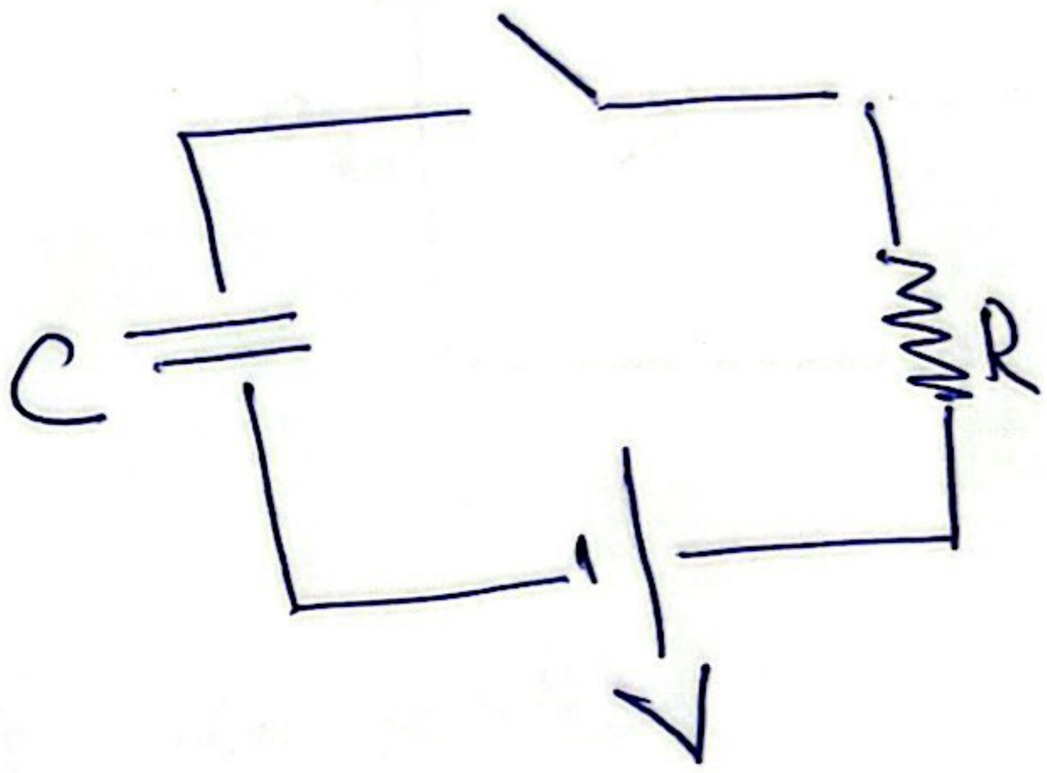
- it Connected in Parallel

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## (3) RC Circuit

time Constance $\tau$

$$\tau = RC$$




Maximum electric charge $q_m$

$$q_m = CV$$

$$I_m = \frac{V}{R}$$

R ⇒ resistance Ω

V ⇒ potential diffrenca (V)

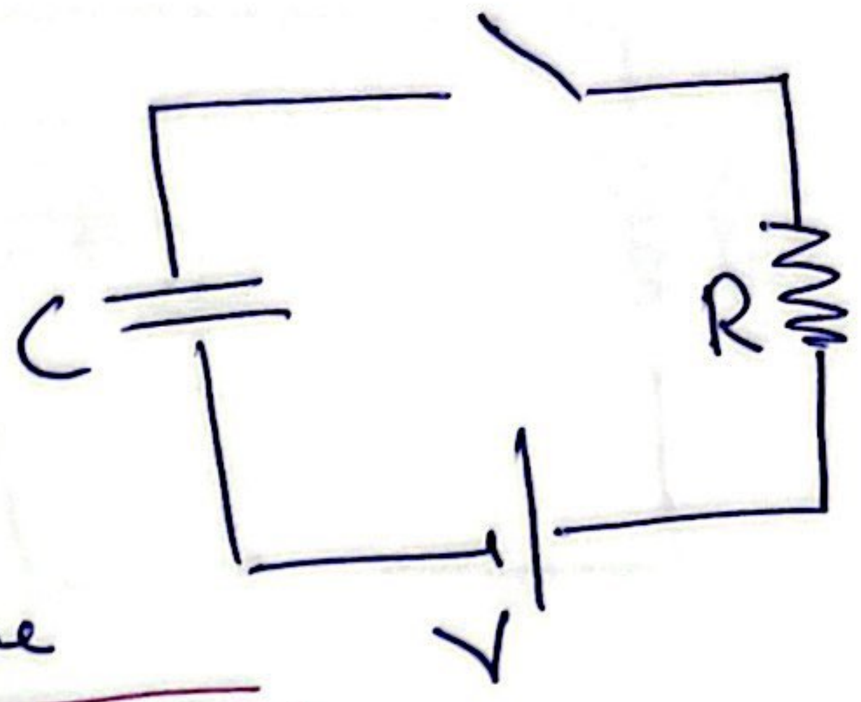
C ⇒ Capacitance (F)

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(9)

# ① Charging of Capacitor

When switch close It means the circuit in Charging



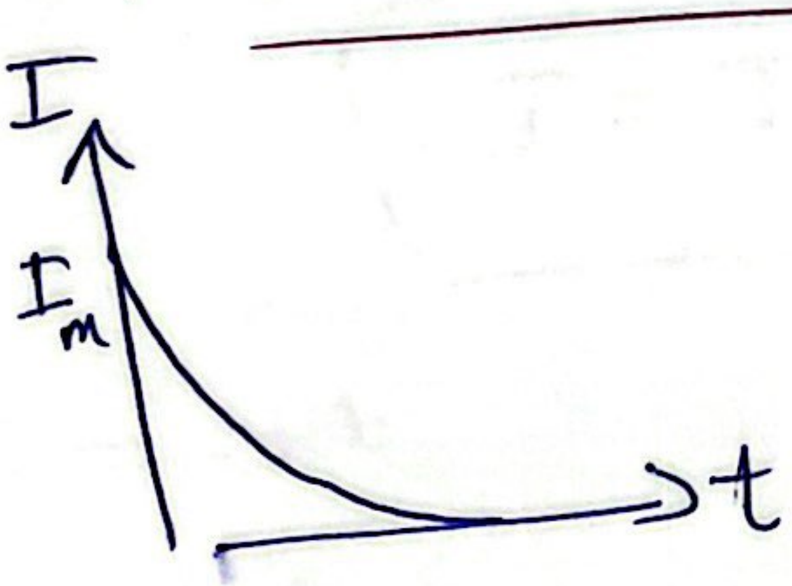

## (A) Change of Charge with time

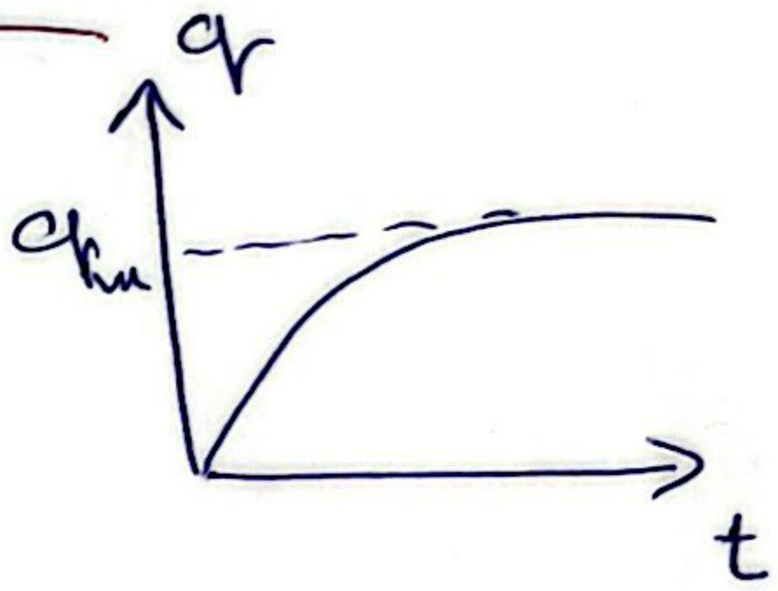
$$q = q_m (1 - e^{-t/\tau})$$

$q \Rightarrow$ Amount of Charge at time t

## (B) Change of Current with time

$$I = I_m e^{-t/\tau}$$




## Note

Charging

① At moment of Close switch

$\Downarrow$

$t = 0 \Rightarrow q = 0 \Rightarrow I = I_m = \frac{V}{R}$

② After long time

$\Downarrow$

$t = \infty \Rightarrow q = q_m \Rightarrow I = 0$

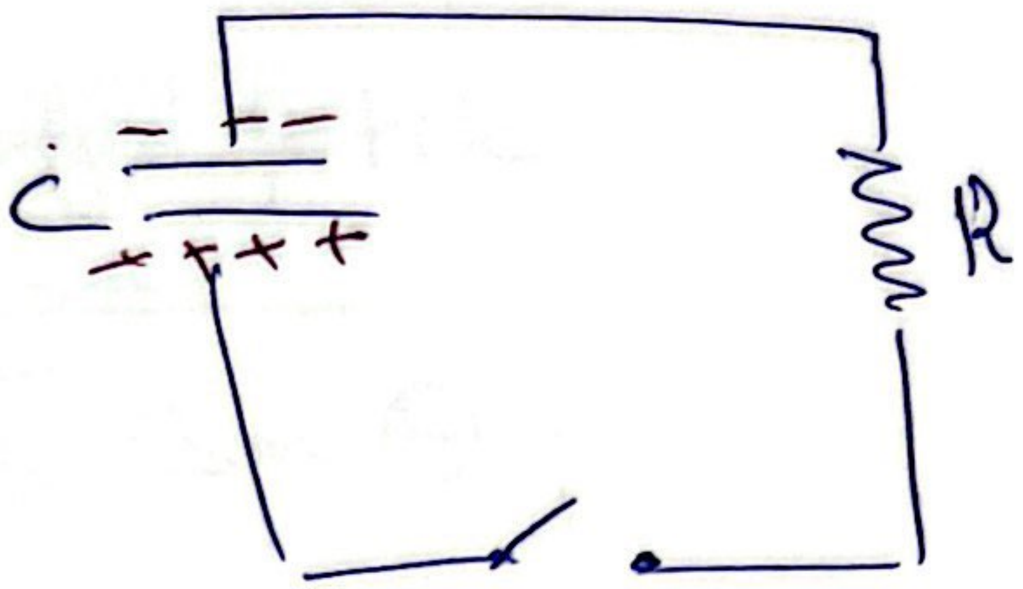
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## ② During Discharging

when switch close

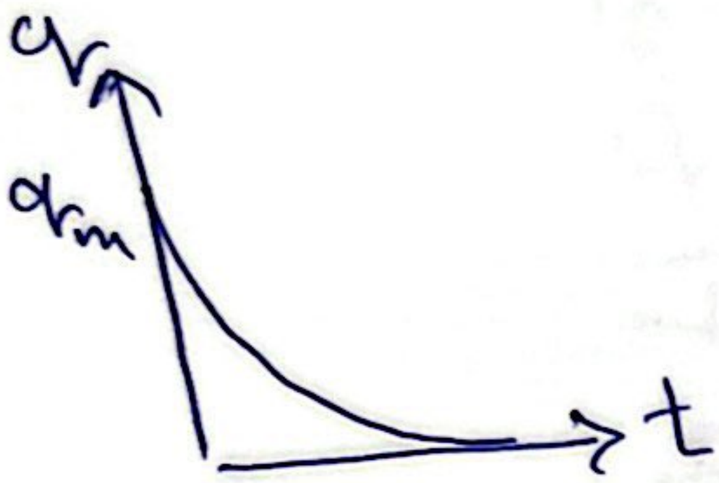
⇓

Circuit in discharging



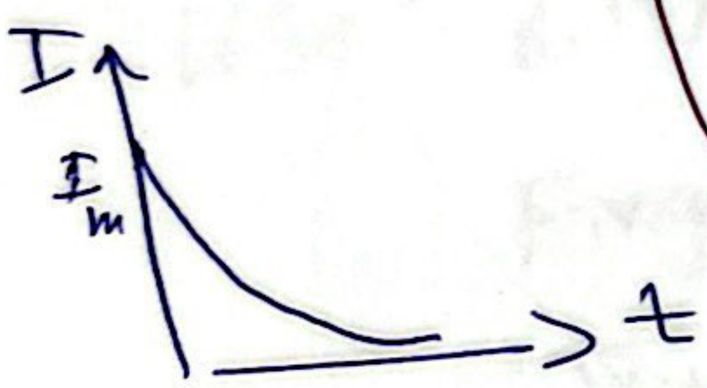

① Change of charge with time

$$q = q_m e^{-t/\tau}$$




② Change of Current with time

$$I = I_m e^{-t/\tau}$$




Note

Discharging

- At moment of closing

$t = 0 \Rightarrow q = q_m \Rightarrow I = I_m = \frac{V}{R}$

- After long time

$t = \infty \Rightarrow q = 0 \Rightarrow I = 0$

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# Chapter (7)
# Magnetism

## (1) Magnetic Force on Charged particle

$$\vec{F}_B = q\,\vec{V}\,\vec{B}\sin\theta$$

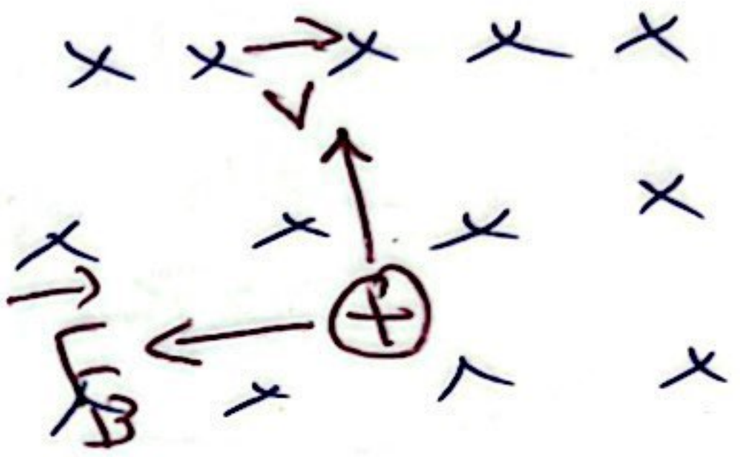
$\vec{F}_B \Rightarrow$ magnetic Force on charge (N)
$q \Rightarrow$ Amount of charge (C)
$\vec{V} \Rightarrow$ velocity of charge m/s
$\theta \Rightarrow$ Angle between $\vec{B}$ , $\vec{V}$

To determine the direction of $\vec{F}_B$ we

Use RHR

Fingers $\Rightarrow \vec{B}$

Thumb $\Rightarrow \vec{V}$




بينما تخرج القوة من باطن اليد اذا كانت الشحنة موجبة
و من ظهر اليد اذا كانت الشحنة سالبة

Note

$$B = \frac{F}{V q} = \frac{N}{C \cdot m}$$

$$1\,T = \frac{N}{A \cdot m} \equiv N A^{-1} m^{-1}$$

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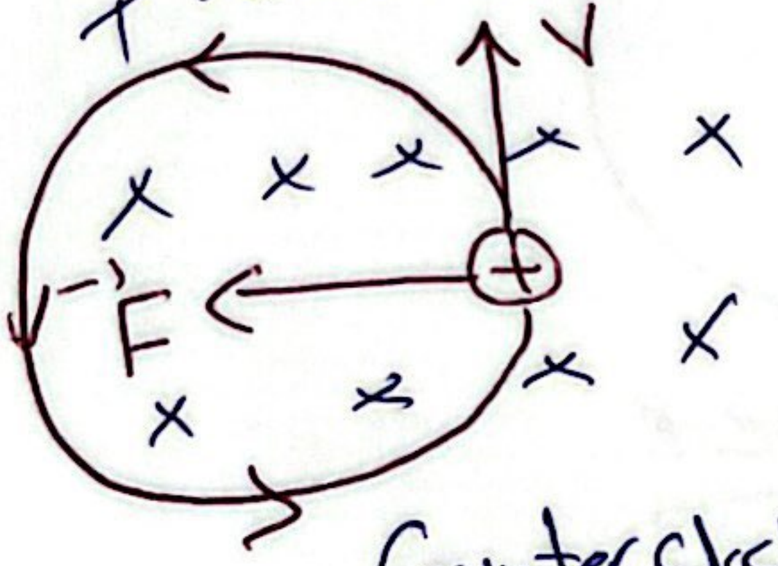
(12) Movement of Charge in magnetic Field

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① IF Charge enter parallel to magnetic Field ($\theta = 0$) It will not effect by magnetic Force and It will move in Straigh Line

② IF Charge enter perpendicular to Magnetic Field ($\theta = 90°$), It will move in Circle motion, the radius r

$$r = \frac{mv}{qB}$$




.. لتحديد اتجاه الدوران
سد راسي $\vec{V}$ الى راسي $\vec{B}$ بأقصر طريقه مع عقارب الساعة / عكس

③ IF the Charge enter with angle $\theta$, It will move in helical motion,

$$r = \frac{mv\sin\theta}{qB}$$

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## (3) Magnetic Force on Current-Carrying Wire

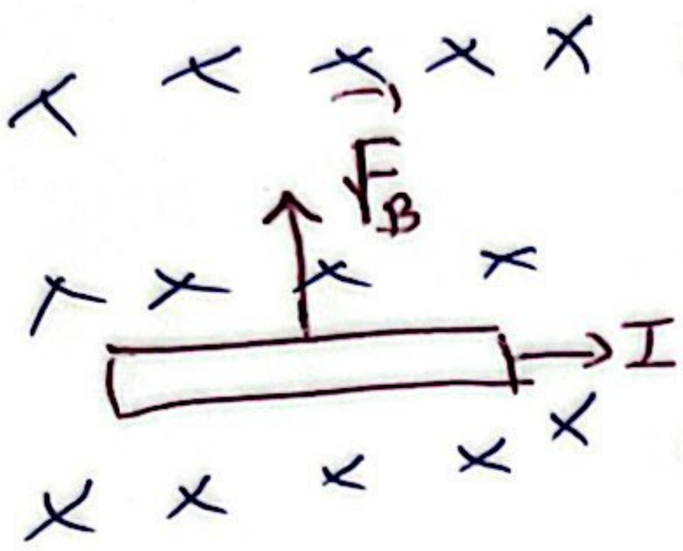
$$\vec{F}_B = BIL \sin\theta$$

$I \Rightarrow$ electric Current (A)

$L \Rightarrow$ length of wire (m)

$\vec{B} \Rightarrow$ magnetic Field (T)

$\theta \Rightarrow$ Angle between $\vec{B}$, wire (I)




لإيجاد اتجاه $\vec{F}_B$ نستخدم RHR

Fingers $\Rightarrow \vec{B}$

Thumb $\Rightarrow$ I

بينما تخرج $\vec{F}_B$ من باطن اليد فقط

Notes

(1) $l = n\pi d$

$d \Rightarrow$ diameter

$n \Rightarrow$ number of turns

(2) At equilibrium

$F_B = F_g$

$BIL = mg$

(3) $\vec{B} = \frac{F}{IL}$

$1T = \frac{N}{Am} \Rightarrow NA^{-1}m^{-1}$

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## (4) Magnetic torque on Current-Carrying Loop

$$\vec{\tau} = BIAN\sin\theta$$

$\vec{\tau}$ ⇒ magnetic torque N.m

N ⇒ number of turns

$\theta$ ⇒ Angle between $\vec{B}$, $\vec{n}$

$\vec{n}$ ⇒ normal Unit vector

Note: IF given angle between loop, $\vec{B}$ we take Complementary angle

e.g: IF loop make 30° with Field $\vec{B}$

$\theta = 60°$

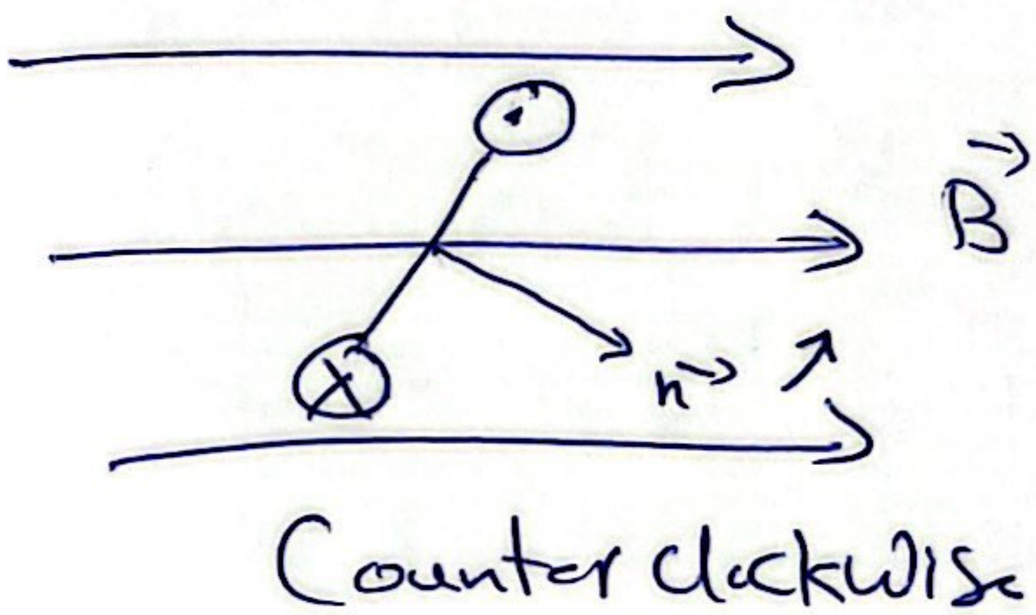
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لتحديد اتجاه الدوران

① نحدد اتجاه $\vec{n}$ باستخدام RHR حيث يشير الابهام ⇐ $\vec{n}$ ، والاصابع ⇐ $\vec{I}$

② نأخذ أقصر طريق لنلف من $\vec{n}$ إلى $\vec{B}$ (Clockwise / Counter clockwise)

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# Chapter(8)
# Magnetic Fields

## (1) Biot-Savart Law

describe the diffrential magnetic Field $\vec{dB}$ That due to Current I passing through wire element $\vec{ds}$

$$\vec{dB} = \frac{\mu_0 I \vec{ds}\,\hat{r}}{4\pi r^2} = \frac{\mu_0 I \vec{ds}\,\sin\theta}{4\pi r^2}$$

$\mu_0 \Rightarrow$ Magnetic Permeability of Free Space

$$\mu_0 = 4\pi \times 10^{-7}\ T\,m\,A^{-1}$$

$I\vec{ds} \Rightarrow$ Current element

$\theta \Rightarrow$ Angle between position vector $\vec{r}$ and Current element $\vec{ds}$

$r \Rightarrow$ distance to wire (m)

**Note**

- The diFFrential magnetic Field $\vec{dB}$ is always Perpendicular both of position vector $\vec{r}$ and element vector $\vec{ds}$

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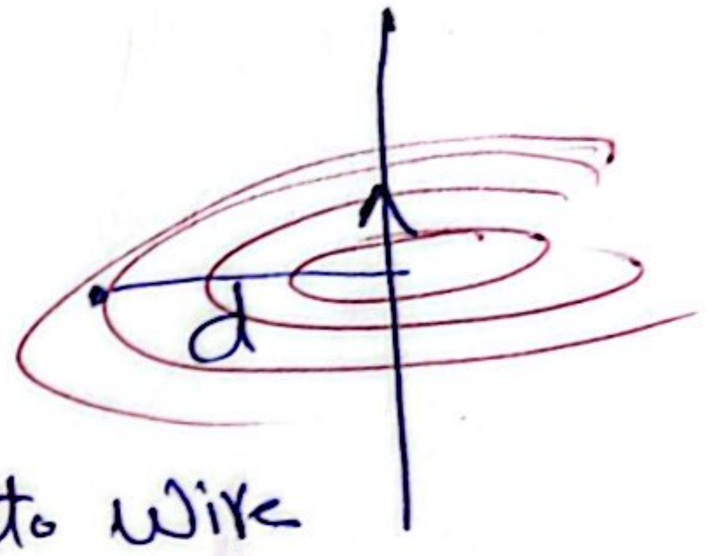
# (8-2) Magnetic Field due to electric Current

الجزء المطلوب

## Magnetic Field due to Current-Carrying Wire

- The magnetic Field of Wire given by

$$\vec{B} = \frac{\mu_0 I}{2\pi d}$$



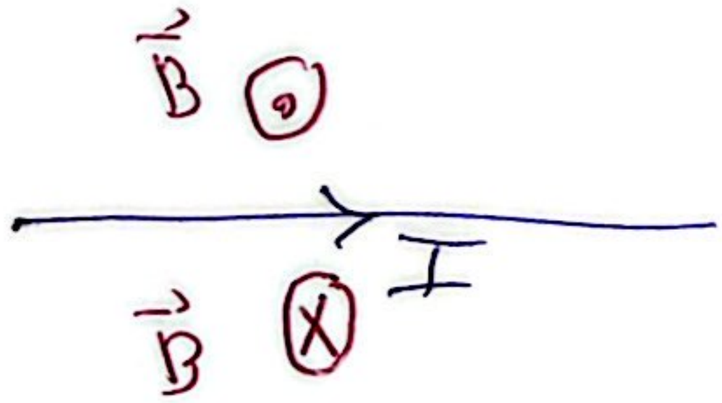

$d \Rightarrow$ Perpendicular distance to wire

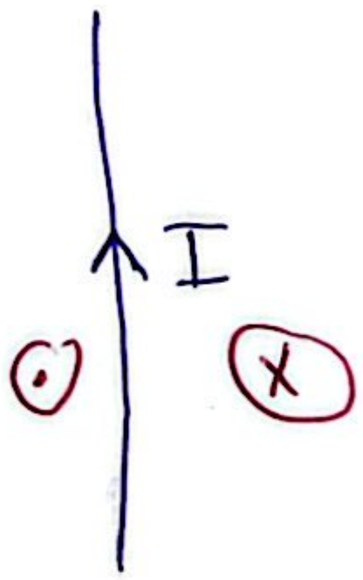
- The direction of Magnetic Field give by

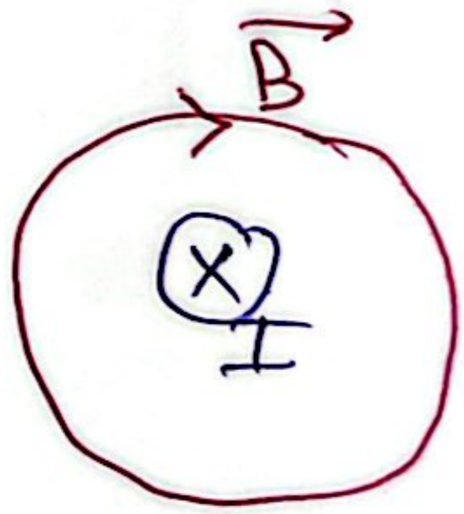
R H R

Thum $\Longrightarrow$ Current I

Fingers $\Longrightarrow$ Magnetic Field $\vec{B}$




تم بحمد الله وتوفيقه
م/ سلاع علي
0554819102

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