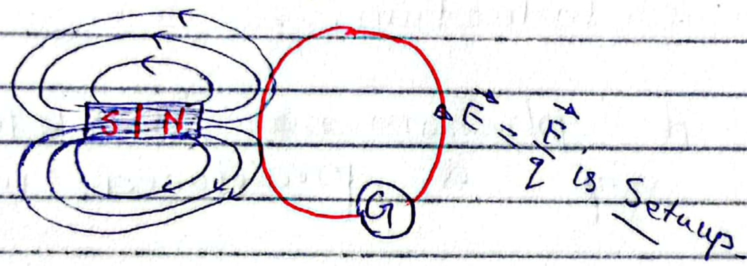
CH # 14

02 NOV 2017

Electromagnetic Induction:-

$$\boxed{\begin{aligned} \phi &= \vec{B}\cdot\vec{A} \\ \phi &= BA\cos\theta \\ \left(\frac{\Delta\phi}{\Delta t}\right) &= \varepsilon \end{aligned}}$$

In 1831, Micheal Faraday prove experimantly that whenever there is change in magnetic flux, there is Induced emf in the coil.



* Faraday Law lighted the whole world.

Change in magnetic flux is responsible for Induced Emf.

For Induce emf:-

(i) Change in magnetic flux is necessary

(ii) Flux linkage with coil is also necessary.

* P

Electromagnetic Induction:

[Current is induced due to relative motion of coil and magnet]

"A phenomena in which induced emf is produced in a coil due to relative motion of magnet and coil is called Electromagnetic Induction.

Def: A phenomena in which induced emf is produced in a coil due to change in magnetic flux linking with the coil is called Electromagnetic Induction.

Exam Ques

Faraday's Law of Electromagnetic Induction:

1. This Law States that "The magnitude of Induced emf produced in a Coil is dirrectly proportional to the time

rate of change of magnetic flux", linking with the coil.

OR,

(2) This Law States that "the magnitude of Induced emf produced in a coil is equall to the negative time rate of change of magnetic flux, linking with the coil.

Mathematically:-

$$\epsilon \propto \frac{\Delta\phi_m}{\Delta t}$$

$$\epsilon = K\frac{\phi_m}{\Delta t}$$

$\boxed{K = 1}$

$$\epsilon = \left(\frac{\phi_m}{\Delta t}\right)$$

$$\boxed{\epsilon = -\left(\frac{\phi_m}{\Delta t}\right)} \quad \text{I}$$

The negative Sign comes from linz law.

$$\epsilon = -N\left(\frac{\phi_m}{\Delta t}\right)$$

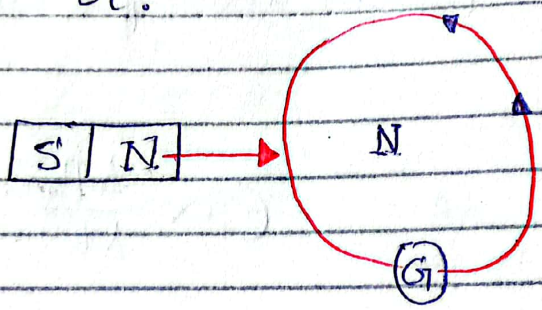
N = number of turn...

Flux linkage = $N\phi_m$

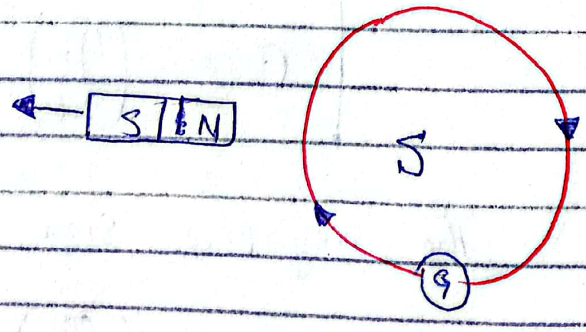
03 NOV 2017

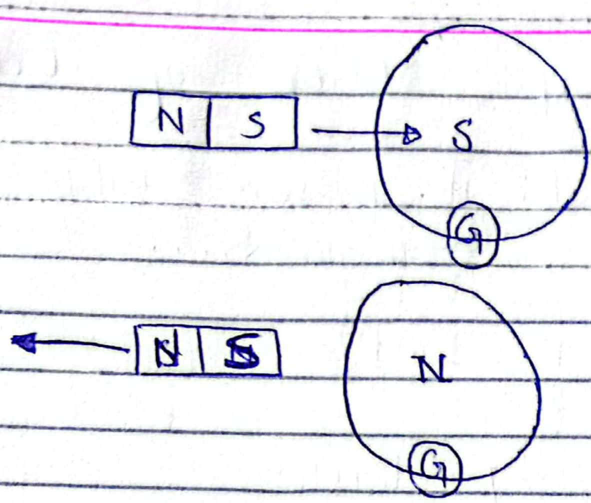
Lenz's Law:-

This Law States that "the Induced Current in a coil is always produced in Such a way that it will Oppose, by its magnetic field, the change in magnetic flux producing it."



* From Direction of magnetic field we Can determine direction of Current.
* The Current in above Case will be in Anti-Clockwise direction.





* Lenz's Law Satisfy / obey Law of Conservation of energy.

* lenz's law is natural Law.

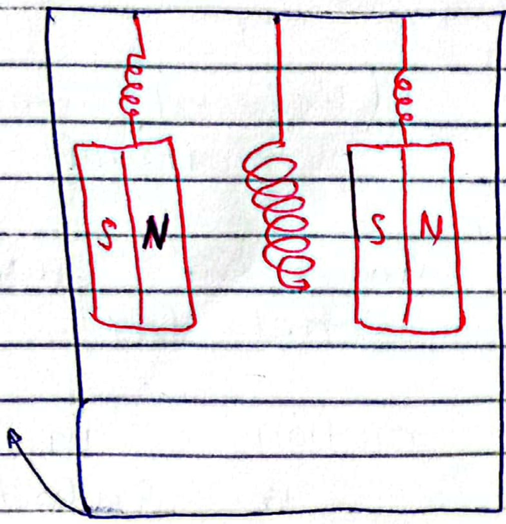
* We can also determine the Dirrection of Induced current by Right hand fleming rules.

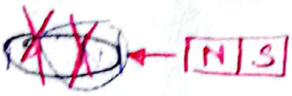
Sesmometre :-

A device by which we can detect / measure the Intensity of earthquick.

Electromagnetic Sesmometre

* From the magnitude of Induced emf; due to change in magnetic flux the Intensity of Earthquick can be determined.





Sesmomology : Study of Earthquick.

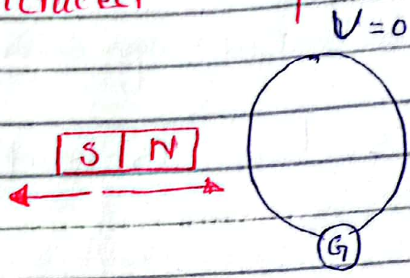
Sosmologist : A person who Study earth quick....

04 NOV 2017

1. Statically Induced emf :

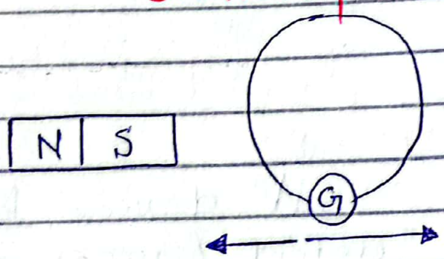
2. Dynamically Induced emf :

(I) Coil at Rest
(II) Magnet is moved



Statically Induced emf :

(I) Magnet at rest
(II) Coil is moved...



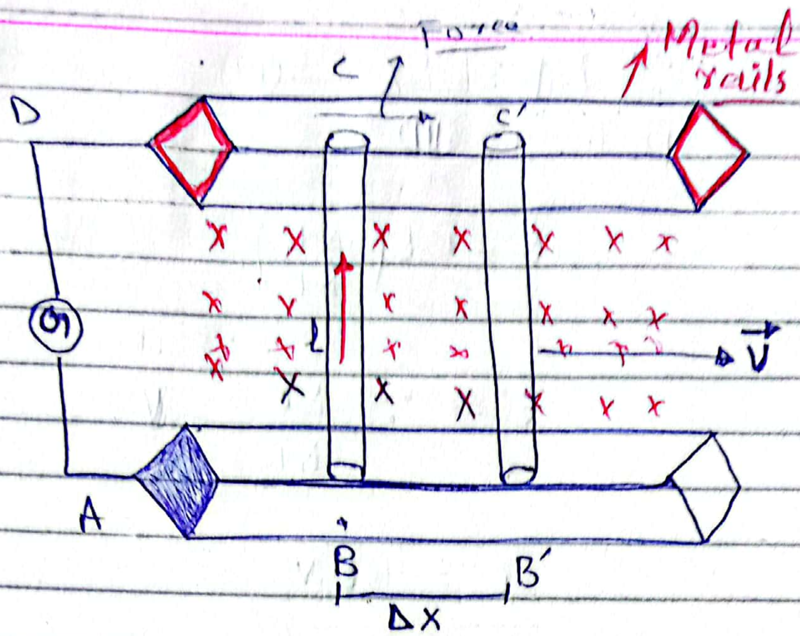
Dynamically Induced emf

Exam Ques

Motional emf : "Dynamically (Induced emf is Called motional emf.")

OR,

An emf induced in a conductor due to its motion in a magnetic field is Called Motional emf.



* Emf is induced in the loop due to changing area...

$$\mathcal{E} = \frac{-N(\Delta\phi)_m}{\Delta t}$$ Lenz or Faraday law.

$N = 1$ (loop is one)

$$\mathcal{E} = -\left(\frac{\Delta\phi_m}{\Delta t}\right) \quad \text{(I)}$$

$\because \phi_m = \vec{B} \cdot \vec{A}$

$\phi_m = BA\cos\theta$

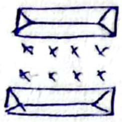
$\theta = 180^\circ$ (B/w B and vector Area).

$$\phi_m = -BA \quad \text{(II)}$$

put (II) in (I)

$$\mathcal{E} = -\frac{\Delta}{\Delta t}(-BA)$$

$$\mathcal{E} = B\left(\frac{\Delta A}{\Delta t}\right) \quad \text{(III)}$$ (Because ϕ changes due to A.)



$\because \Delta A = L\Delta x$ — (IV)

put in (III) :

$$\mathcal{E} = BL\left(\frac{\Delta x}{\Delta t}\right)$$

$$\because \frac{\Delta x}{\Delta t} = V$$

$$\mathcal{E} = BLV$$

$$\boxed{\mathcal{E}_m = VBL}$$

$\mathcal{E}_m$ = motional emf.

V = velocity of conductor in magnetic field.

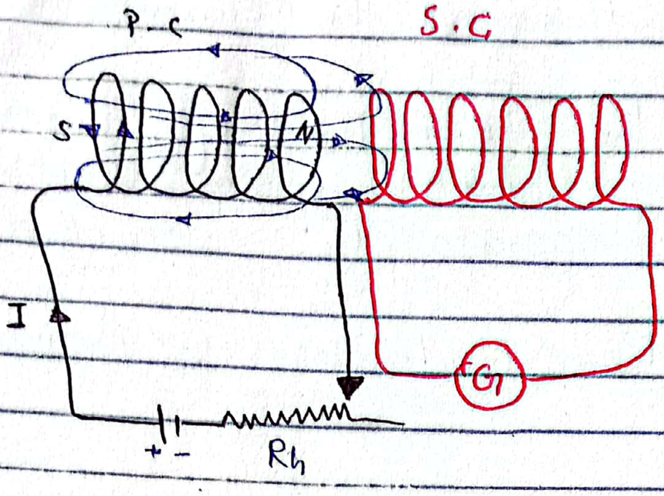
B = magnetic field (constant)

L = length of conductor (constant).

06 NOV 2017:

Mutual Induction:-

A phenomena in which an Induced emf is produced in a Secondry Coil by changing the Current (magnetic ~~flux~~ flux) in the priminy coil is ~~Induced emf.~~ Called Mutual induction.



$B = \mu_0 I$

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

$\phi_m = \vec{B} \cdot \vec{A}$

$\mathcal{E} = -N\left(\frac{\phi_m}{\Delta t}\right)$

$$\mathcal{E}_s \propto \frac{\Delta I_P}{\Delta t}$$

$$\mathcal{E}_s = -M\left(\frac{\Delta I_P}{\Delta t}\right) \quad \text{(1)}$$

M is constant, which is Called Co-efficient of Mutual Induction.

$$M = -\frac{\mathcal{E}_s}{\left(\frac{\Delta I_P}{\Delta t}\right)}$$

M (coefficient of M.I) ive ratio of Induced emf in Secondary coil to the rate of change of Current in primary coil.

$M = H$ (Henry)

$$1H = \frac{1V}{\left(\frac{1A}{1s}\right)}$$

* Negative Sign Shows the lenz's law.

* If we Increase the Current in primary Coil, the Direction of Current in primary and Secondary Coil will be opposite to each other.

* When Current decreases in primary Coil

As, we have:

$$E_s = -N_s\left(\frac{\Delta \phi_m}{\Delta t}\right) \longrightarrow (III)$$

$$E_s = -\frac{\Delta}{\Delta t}\left(N_s \phi_m\right) - (II)$$

$$(I) \Rightarrow E_s = -\frac{\Delta}{\Delta t}\left(M I_p\right) \longrightarrow (IV)$$

Compare (III) and (IV):

$$-\frac{\cancel{\Delta}}{\cancel{\Delta t}}\left(M I_p\right) = -\frac{\cancel{\Delta}}{\cancel{\Delta t}}\left(N_s \phi_m\right)$$

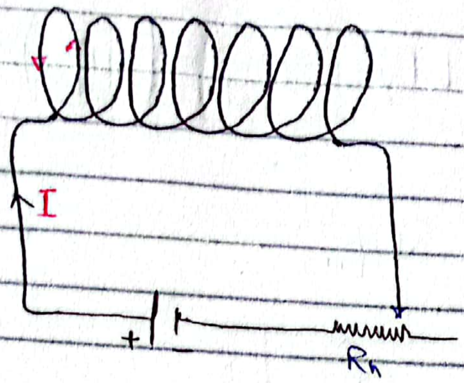
$$\boxed{M = \frac{N_s \phi_m}{I_p}}$$

Another equation for coefficient of mutual induction

Coefficient of mutual induction

SELF INDUCTION:- A phenomena in which an Induced emf is produced in a coil by changing the Current (magnetic flux) in the Same Coil is Called Self

Induction.



$$\mathcal{E} \propto \left(\frac{\Delta I}{\Delta t}\right)$$

$$\mathcal{E} = -L\left(\frac{\Delta I}{\Delta t}\right) \text{ --- } (1)$$

$$\mathcal{E} = -\frac{\Delta}{\Delta t}(LI) \text{ --- } (1)$$

L = coefficient of ~~Mut~~ Self Induction

$$L = -\frac{\mathcal{E}}{\left(\frac{\Delta I}{\Delta t}\right)}$$

$$1H = \frac{1V}{\left(\frac{1A}{1s}\right)}$$

From Faraday law :

$$\mathcal{E} = -N\left(\frac{\Delta \varphi_m}{\Delta t}\right)$$

$$\mathcal{E} = -\frac{\Delta}{\Delta t}(N\varphi_m) \text{ --- } (2)$$

(1) $\Rightarrow$ $\mathcal{E} = -\frac{\Delta}{\Delta t}(LI)$ (3)

Compare ② and ③

$$-\frac{\cancel{\Delta}}{\cancel{\Delta t}}(LI) = -\frac{\cancel{\Delta}}{\cancel{\Delta t}}(N\phi_m)$$

$$LI = N\phi_m$$

$$\boxed{L = \frac{N\phi_m}{I}}$$

Co-efficient of Mutual Induction (M):

Depends Upon:

1. No of turns (N_s).
2. Area of Secondry Coil (A)
3. Closeness of the two Coil.
4. Nature of the Coil (Material) "of the Coil"

07 NOV 2017

Exam Ques

A.C Generator :-

1. Def: A device which convert mechenical energy Into electrical energy is Called A.C Genrator.

* It is a Source of emf.

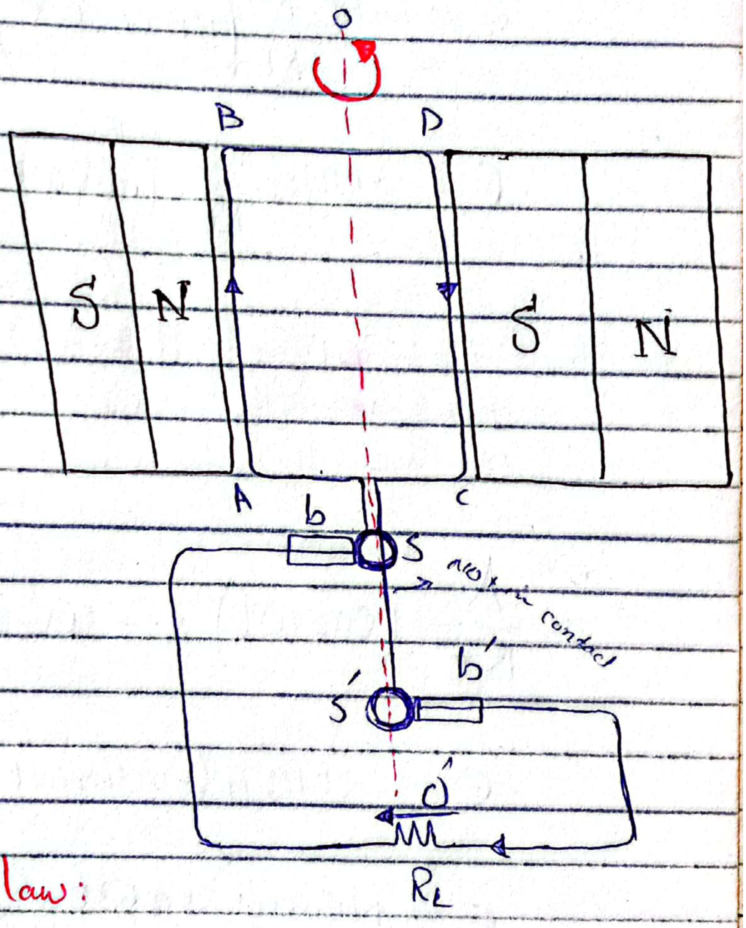
2. Principle :-

It works on Faraday's Law of electromagnetic Induction.

3. Construction : (i) permanent magnetic field (ii) Rectangular coil (iii) Slip rings (iv) Two carbon brushes (v) load Resistance. (Pan, Regenerator

4. Theory of working

5. Graphical Representation:



Applying Faraday's law:

$$\mathcal{E} = -N\left(\frac{\Delta \phi_m}{\Delta t}\right) \text{———} (i)$$

$$\phi_m = \vec{B} \cdot \vec{A}$$

$$\phi_m = BA\cos\theta \text{———} (ii)$$

In Ac-generator we change θ.

As $\omega = \frac{\theta}{t}$

$\theta = \omega t$ —— (III)

$\phi_m = BA\cos\omega t$ —— (IV)

Put in (I):

$$\mathcal{E} = -N \frac{\Delta}{\Delta t}\left(BA\cos\omega t\right)$$

$$\mathcal{E} = -NBA \frac{\Delta}{\Delta t}\left(\cos\omega t\right) \text{ —— (V)}$$

we Replace ($\theta = \omega t$) because we determine, the change in $\mathcal{E}$ with respect to time.

Derivitives:

$$\because \frac{\Delta}{\Delta t}\left(\cos\omega t\right) = -\omega\sin\omega t \text{ —— (VI)}$$

$$\mathcal{E} = -NBA(-\omega\sin\omega t)$$

$$\mathcal{E} = NBA\omega\sin\omega t$$

$$V = NA\omega B\sin\omega t \text{ —— (VII)}$$

when $\omega t = 90^\circ$

$V = V_0$ (max)

(VII) $\Rightarrow$ $V_0 = NA\omega B\sin(90^\circ)$

$V_0 = NA\omega B$ —— (viii)

put eq (viii) in (vii)

$$\boxed{V = V_0 \sin\omega t} \text{ —— (ix)}$$

~~Sta~~ Sanocidal AC voltage, beacuse it depends on $\sin\omega t$.

Dividing b.s of eq ix by R...

$$\frac{V}{R} = \frac{V_0}{R}\sin\omega t$$

$$\boxed{I = I_0 \sin\omega t}$$

Sanocydal AC Current: vary both in magnitude and direction:

GRAPH:-

$I = I_0 \sin\omega t$

(i) when $\omega t = 0°$

$\boxed{I = 0}$

(ii) when $\omega t = 90°$

$I = I_0$

(iii) when $\omega t = 180°$

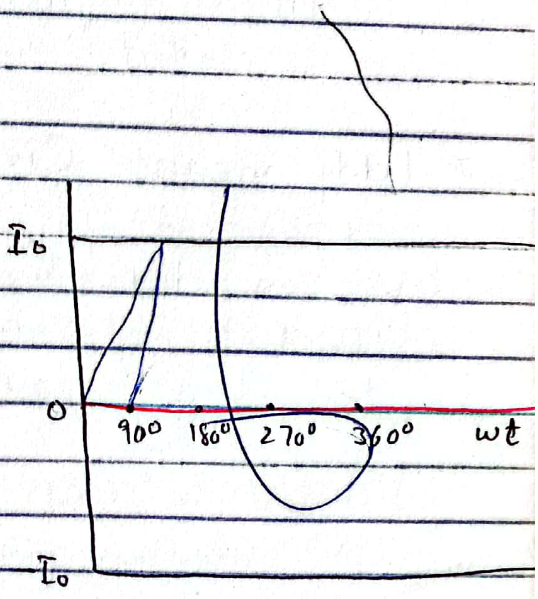
$I = 0$

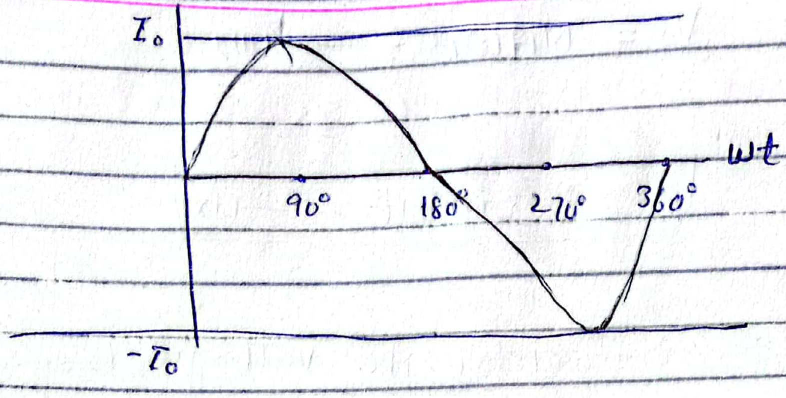
(iv) when $\omega t = 270°$

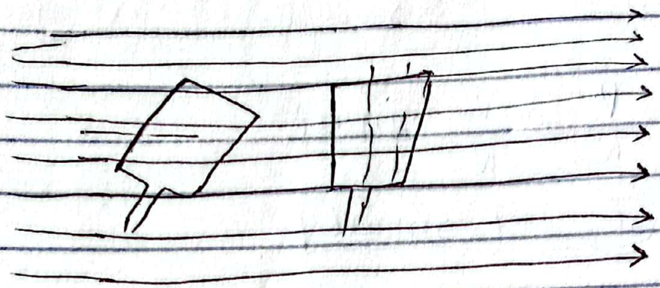
$I = -I_0$

(v) when $\omega t = 360°$

$I = 0$





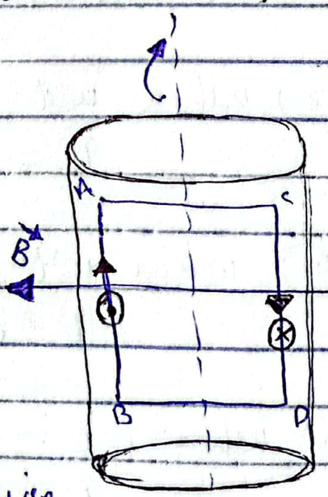


08 NOV 2017

Eddy Currents :- Currents produced in metals due to change of magnetic flux, when they are moved in magnetic fields are called eddy currents.

* Eddy means Circulating.

We can determine the Dirrection of current by lenz law.

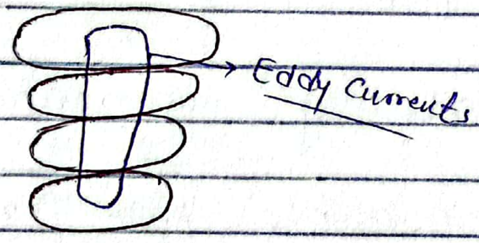


① If the coil is rotating in clockwise direction - opposing torque will be in Anti-clockwise direction.

1) From Side AB:
Magnetic field of current (eddy) is ~~in~~ out of paper, It is possible when current move from BA.
Same rule is applied to another Side.

* Energy loss in the metal occure due to eddy Currents.

* Eddy Currents can be minimize by Special designig.



AC - MOTOR :-

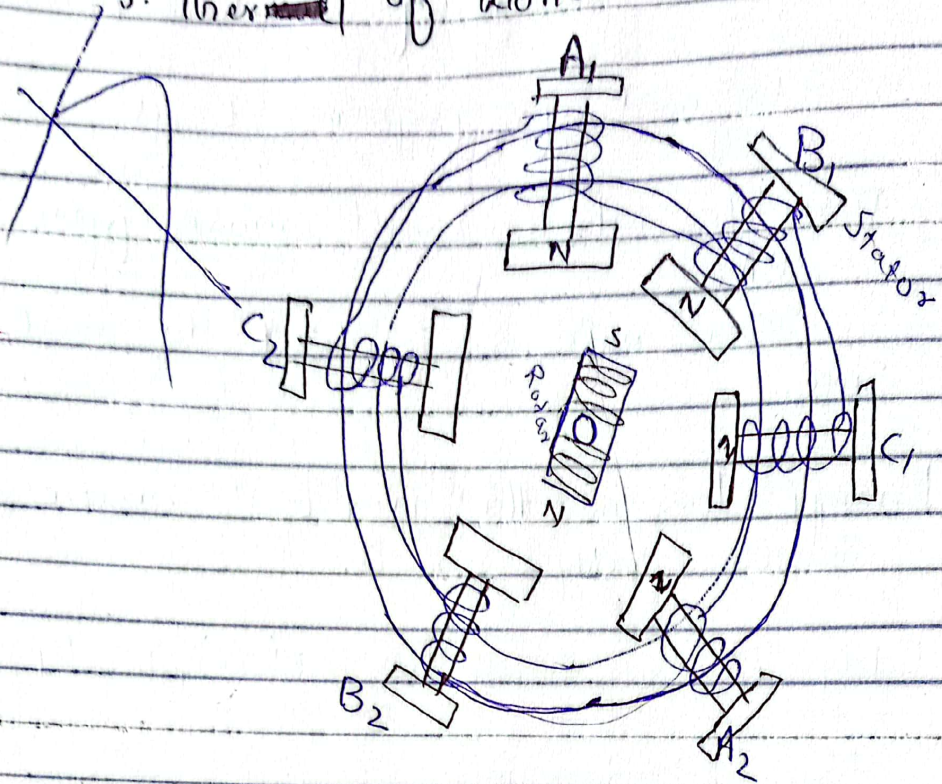
1. Def: A device which converts Electrical energy into mechanical energy is called AC Motor...

2. principle:- Basic principle of AC Motor is Electromagnetic Induction.

3. Construction: Two things:
(I) Stator:- which is Static.

(II) Rotor:- which rotates.

5. Theory of work:-



$B = \mu_0 n I$

* Rotating magnetic field is responsible for rotating the rotor.

09 NOV 2017

Transformer :-

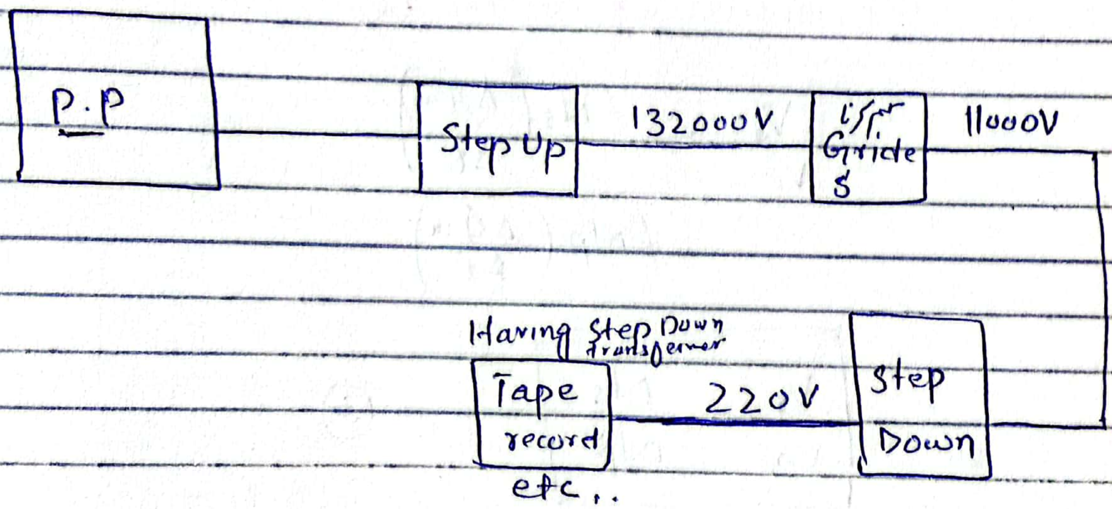
(I) Def: A device which converts Low AC-voltage into high AC-voltage or High AC voltage into low is called transformer.

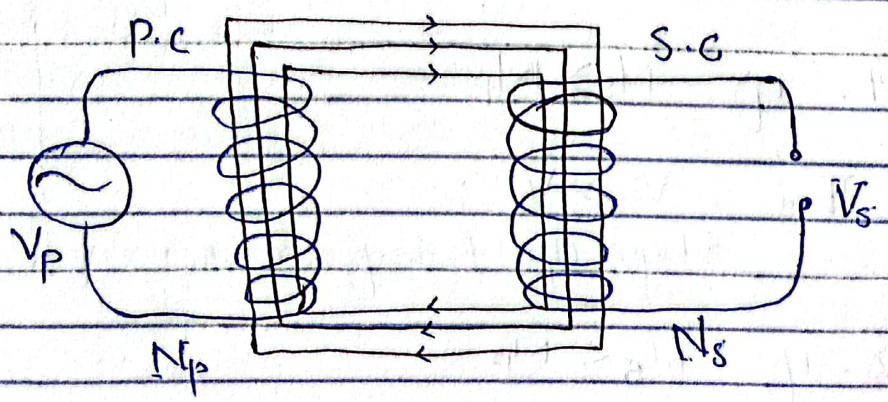
② principle :

Mutual induction...

③ Construction : ① primiry coil and Secondry coil ⓘ core of transformer.

④ Theory and working





$$E_s = -N_s\left(\frac{\Delta\phi_m}{\Delta t}\right)$$

$$\downarrow$$

$$V_s = -N_s\left(\frac{\Delta\phi_m}{\Delta t}\right) \quad \text{--- (1)}$$

$$E_p = -N_p\left(\frac{\Delta\phi_m}{\Delta t}\right)$$

$$\downarrow$$

When there is no resistance Induce emf will be equall to

$$V_p = -N_p\left(\frac{\Delta\phi_m}{\Delta t}\right) \quad \text{--- (2)}$$

Divide eq (1) by (2) :

$$\frac{V_s}{V_p} = \frac{\cancel{-}N_s\left(\frac{\cancel{\Delta\phi_m}}{\cancel{\Delta t}}\right)}{\cancel{-}N_p\left(\frac{\cancel{\Delta\phi_m}}{\cancel{\Delta t}}\right)}$$

$$\boxed{\frac{V_s}{V_p} = \frac{N_s}{N_p}} \quad \text{--- (3)}$$

Equation of transformers:-

$$\frac{20}{10} = \frac{40}{20}$$

Bcz radio is Same

1. If $N_s > N_p$

Then $V_s > V_p$

Step up transformer:

2. If $N_s < N_p$

then $V_s < V_p$

Step down transformer: -

For An Ideal transformer:

$$P_{in} = P_{out} \quad (\because P = IV)$$

$$\overset{H}{I_p}\overset{L}{V_p} = \overset{L}{I_s}\overset{H}{V_s} \quad \text{— (4)}$$

A device which convert low AC voltage and High AC current into High AC voltage and low AC current is Called transformer.

$$\boxed{\frac{V_s}{V_p} = \frac{I_p}{I_s}} \quad \text{— (5)}$$

compare (3) and (4):

$$\boxed{\frac{I_p}{I_s} = \frac{N_s}{N_p}} \quad \text{— (5)}$$

Ratio b/w Currents is equall to inverse ratio of turns....

High voltage = low current...
low voltage = High Current...

Energy losses in transforms:-

1. leakage of flux:- Flux leakage is responsible for energy loss.

2. Resistance of winding:-

More Resistance = More energy loss and vice versa.

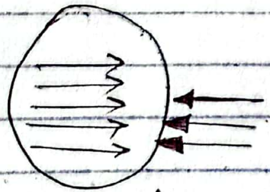
3. Eddy Currents:-

Eddy Currents are responsible for energy losses in transformers.

4. Hysterise: (Detail in another ch):

Megnetization and demagnetision of Iron core occur.

So Some energy is loss in this form...

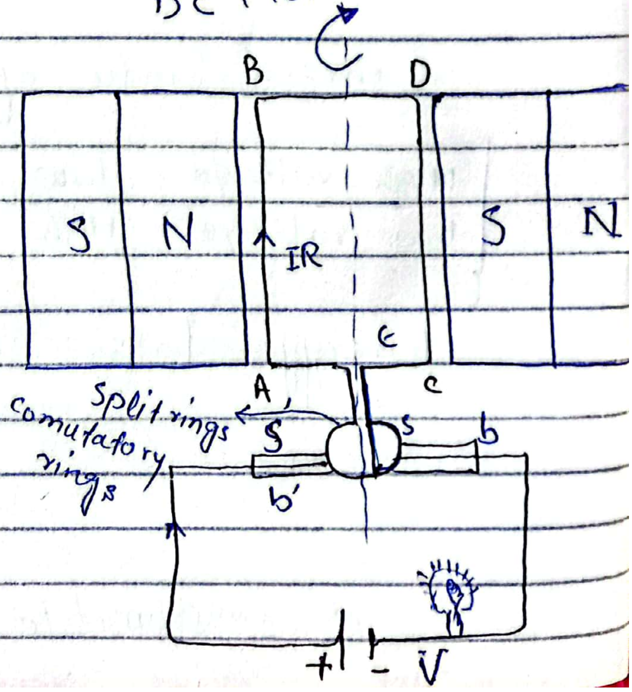


Aligment and disaligment of magnetic lines.-

10 NOV 2017

Back emf:-

DC Motor



Back emf : opose the emf of battery

$$V = \epsilon + IR$$

$$\underbrace{IR}_{\text{It will rotate the Coil.}} = V - \epsilon$$

$$\boxed{I = \frac{V - \epsilon}{R}}$$

In Generator, ϵ is not back emf beacuse, we produce emf in generator.

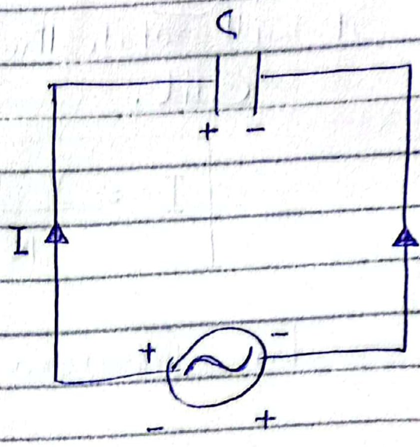
* In Motors, Induced emf is Called back emf beacuse we don't want to produce emf, we apply emf to motors.

* Back Motor effect: when Current is produced in a Coil, this Current opposes the motion of Coil this is called Back motor effect, in generators...

Capacitor in AC circuit:-

$$V = V_0 \sin\omega t \quad \text{---(1)}$$

$$Q = CV \quad \text{---(11)}$$



$$Q = CV_0 \sin\omega t \quad \text{---(3)}$$

$$I = \frac{\Delta Q}{\Delta t} \quad \text{---(4)}$$

$$I = \frac{\Delta}{\Delta t}(CV_0 \sin\omega t).$$

$$I = CV_0 \frac{\Delta}{\Delta t}(\sin\omega t) \quad \text{---(5)}$$

(Derivitives)

$$\frac{\Delta}{\Delta t}(\sin\omega t) = \omega\cos\omega t \quad \text{---(6)}$$

$$I = CV_0\omega \cos\omega t \quad \text{---(7)}$$

When $\omega t = 0^\circ$, $I = I_0$

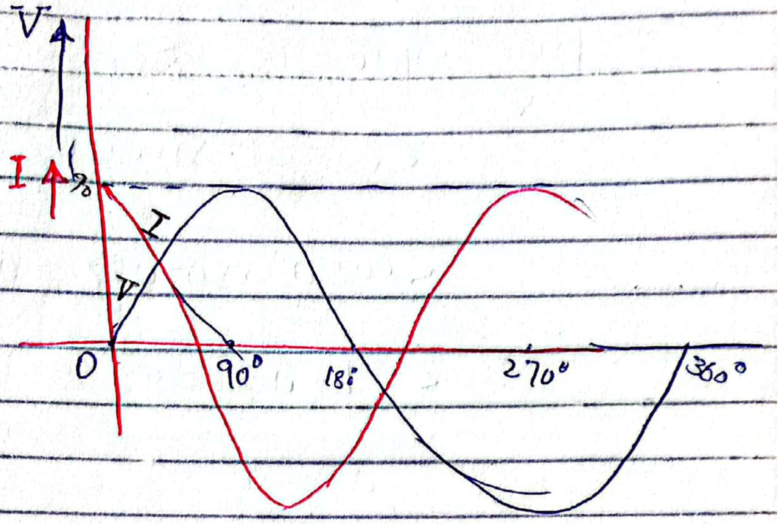
$$I_0 = CV_0\omega\cos(0^\circ)$$

$$I_0 = CV_0\omega \quad \text{---(8)}$$

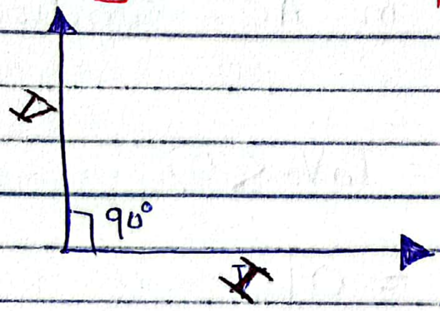
$$I = I_0 \cos\omega t \quad \text{---(9)}$$

There is a phase differrence of 90° b/w I and

V. They are not in phase.



Phasor Diagram For Capacitor.



Average power dissipated in Capacitor:-

$$\langle P \rangle = \langle IV \rangle \quad \text{—— (I)}$$

$$V = V_0 \sin \omega t$$
$$I = I_0 \cos \omega t$$

$$\langle P \rangle = \langle I_0 \cos \omega t \cdot V_0 \sin \omega t \rangle$$

$$\langle P \rangle = I_0 V_0 \langle \cos \omega t \cdot \sin \omega t \rangle \quad \text{—— (II)}$$

$$\langle \cos \omega t \cdot \sin \omega t \rangle = 0$$

The average value of $\cos\omega t \cdot \sin\omega t = 0$.

The average value of $\cos\omega t \cdot \sin\omega t$ per cycle is Zero.

$$\langle \cos\omega t \cdot \sin\omega t \rangle = 0$$

$$\langle \cos 0^\circ \cdot \sin 0^\circ \rangle = 0$$

$$\langle 1 \cdot 0 \rangle = 0$$

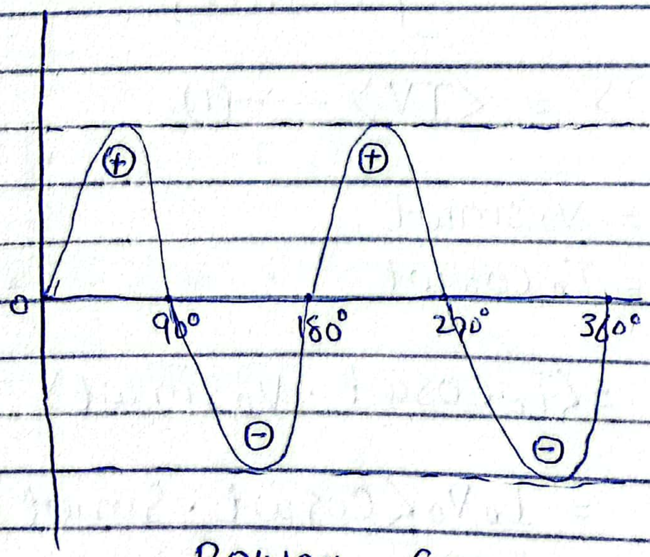
$$0 = 0$$

* Capacitor in DC = Insulator
* Capacitor in AC = Conductor

$$\langle P \rangle = I_0 V_0 \langle 0 \rangle$$

$$\boxed{\langle P \rangle = 0}$$

Power Wave of Capacitor:



Power Curve.

$$\langle P \rangle = \frac{\cancel{+} + \cancel{-} + \cancel{+} + \cancel{-}}{4}$$

$$\boxed{\langle P \rangle = 0}$$

Reactance of Capacitor/ Capacitive Reactance :-

The opposisson offered by a Capacitor to the flow of AC Current is Called Reactance, of capacitor...

* Represented by X_c.

$$V_{rms} = I_{rms} X_c \qquad (R = X_c)$$

$$X_c = \frac{V_{rms}}{I_{rms}} \quad \text{——— (1)}$$

$$\left.\begin{aligned} V_{rms} &= 0.707\, V_0 \\ I_{rms} &= 0.707\, I_0 \end{aligned}\right] \text{——— (*)}$$

put in (1):

$$X_c = \frac{\cancel{0.707} V_0}{\cancel{0.707} I_0}$$

$$X_c = \frac{V_0}{I_0} \quad \text{——— (2)}$$

PTO

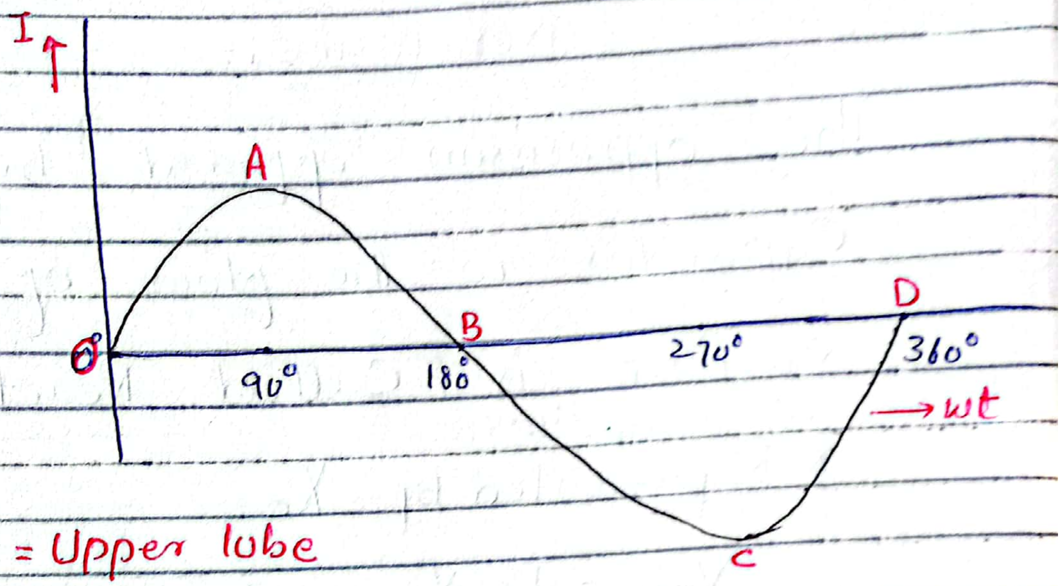
Lo

14 NOV 2017

Mean, Mean Square and Root mean Square Values of A.C Quantities:-

$V = V_0 \sin \omega t$ —— (I) Sinusidal AC voltage

$I = I_0 \sin \omega t$ —— (II) Sinusidal AC Current



OAB = Upper lobe

BCD = lower lobe

Mean value of AC currents is Zero:

$$\langle I \rangle = \frac{\text{Area of the lobe OAB} + (-\text{Area of lobe BCD})}{2}$$

$\langle I \rangle = 0$

OR $\langle V \rangle = 0$

Mean power dissipation of AC is not Zero.

$\langle P \rangle =$ [redacted] $\langle I^2 \rangle R$ —— (III)

$\langle I^2 \rangle \rightarrow$ mean Square val

$\langle P \rangle = \frac{\langle V^2 \rangle}{R}$ —— (IV)

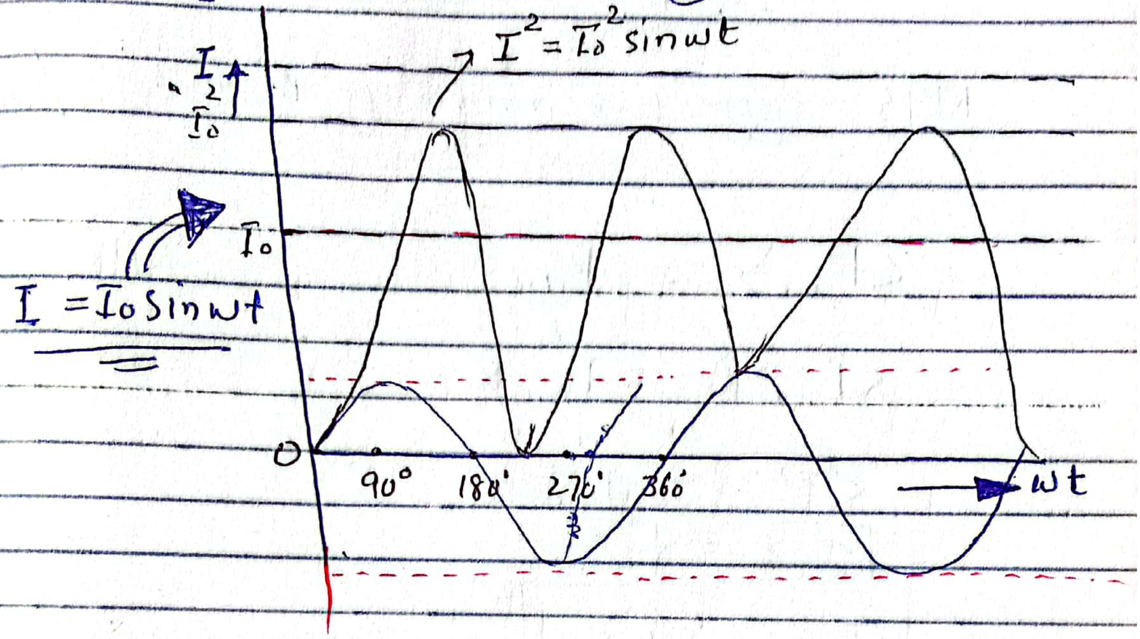
$\langle I \rangle^2$ = Square of mean = 0

$\langle I^2 \rangle$ = mean square value $\neq 0$

Taking Squre of (I) and (II):

$$V^2 = V_0^2 \sin^2 \omega t \quad \text{--- (V)}$$

$$I^2 = I_0^2 \sin^2 \omega t \quad \text{--- (VI)}$$



$$\langle I^2 \rangle = \frac{0 + I_0^2}{2}$$

$$\langle I^2 \rangle = \frac{I_0^2}{2} \neq 0$$

Mean Square value of AC is not zero.

$$\langle I^2 \rangle = \frac{I_0^2}{2}$$

Taking Square Root on b.s:

$$\sqrt{\langle I^2 \rangle} = \sqrt{\frac{I_0^2}{2}}$$

$$I_{rms} = \frac{I_0}{\sqrt{2}}$$

$$\boxed{I_{rms} = 0.707\, I_0}$$

CamScanner

$\sin^2\phi$ $-(\sin\phi)$
$\sin\phi^2$ $\pm$

$$\boxed{V_{rms} = 0.707 V_0}$$

I_{rms} a little bit greater then I.

RMS = effective value of AC voltage/current

$$\langle P_{a.c} \rangle = P_{d.c}$$

$$\langle I^2 \rangle \cancel{R} = I_{d.c}^2 \cancel{R}$$

$$\langle I^2 \rangle = I_{d.c}^2$$

$$\sqrt{\langle I^2 \rangle} = \sqrt{I_{d.c}^2}$$

$$\boxed{I_{rms} = I_{d.c}}$$

I_{rms} = effective value of AC.

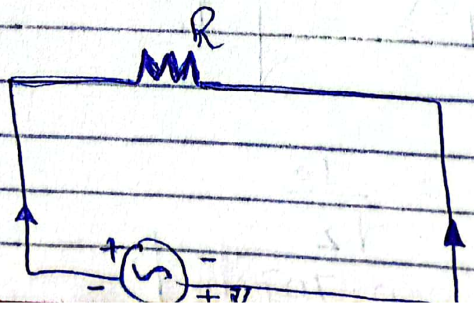
I_{rms} = ...

15 NOV 2017

Singel element A.C Circuits:-
Having only one circuit element. ① capacitor, R or inductor.

① Resistor in A.C Circuit:- OR

(AC through Resistor):-

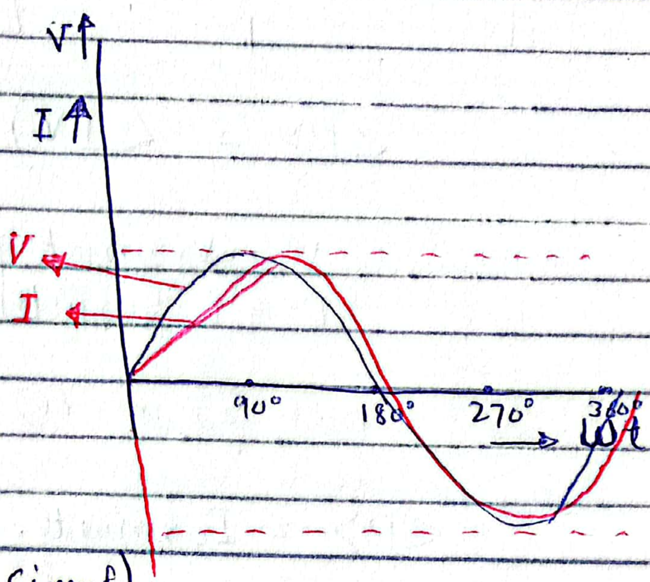


$V = V_0 \sin\omega t$ ——— ①

Dividing eq ① by R.

$$\frac{V}{R} = \frac{V_0}{R} \sin\omega t$$

$I = I_0 \sin\omega t$ ——— ②



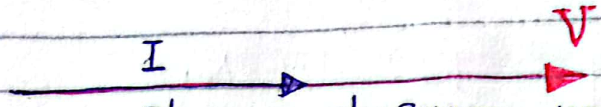
*In Resistor (in AC Circuit)

There is no phase difference in voltage and current because they are Inphase.

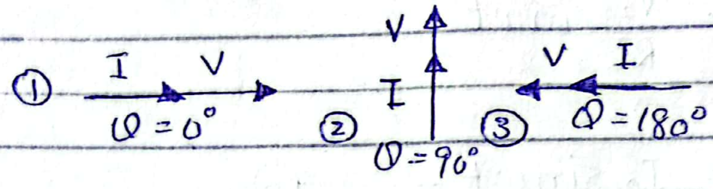
Phase difference is Zero;

* V and I are Called phasors. Because they ~~are~~ vary with phase angel. →

* AC voltage and Current are also Called Rotating vectors...



Phasor diagram for Resistor in AC



Average power dissipated in Resistors:

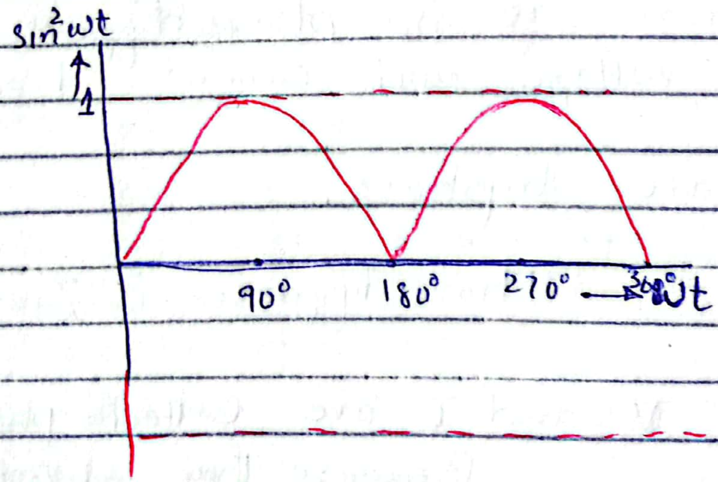
$$\langle P \rangle = \langle IV \rangle \quad \text{——①}$$

$$\left.\begin{aligned} V &= V_0 \sin\omega t \\ I &= I_0 \sin\omega t \end{aligned}\right] \text{——②}$$

put ② in ①.

$$\langle P \rangle = \langle I_0 \sin\omega t \cdot V_0 \sin\omega t \rangle$$

$$\langle P \rangle = I_0 V_0 \langle \sin^2\omega t \rangle \quad \text{——③}$$



$$\langle \sin^2\omega t \rangle = \frac{0+1}{2}$$

$$\langle \sin^2\omega t \rangle = \frac{1}{2} \quad \text{——④}$$

Put eq (4) in eq (3):

$$\langle P \rangle = I_0 V_0 \times \frac{1}{2}$$

$$= \frac{I_0 V_0}{\sqrt{2} \times \sqrt{2}}$$

$$= 0.707 I_0 \times 0.707 V_0$$

$$\boxed{\langle P \rangle = I_{rms} V_{rms}}$$

$\langle P \rangle$ = effective value of I X effective value of V.

In Resistor AC and AV are Inphase, So power dissipation will take place...

$I = I_0 \cos wt$ — (x)

$I = C V_0 w \cos wt$ — (y)

~~I~~ Comparing x and y,

$$I_0 \cancel{\cos wt} = C V_0 w \cancel{\cos wt}$$

$I_0 = C V_0 w$ — (3)

Put in (2) $\Rightarrow X_c = \frac{V_0}{I_0}$

$$X_c = \frac{\cancel{V_0}}{C \cancel{V_0} w}$$

$$X_c = \frac{1}{\omega C} \text{ ——— } (4)$$

$$\because \omega = \frac{2\pi}{T}$$

$$\omega = 2\pi f$$

$$\boxed{X_c = \frac{1}{2\pi f C}}$$

$$\boxed{X_c \propto \frac{1}{f}}$$

Difference b/w Resistance (R) and Reactance (X_c) is that :

* Resistor does not depend upon frequancy.

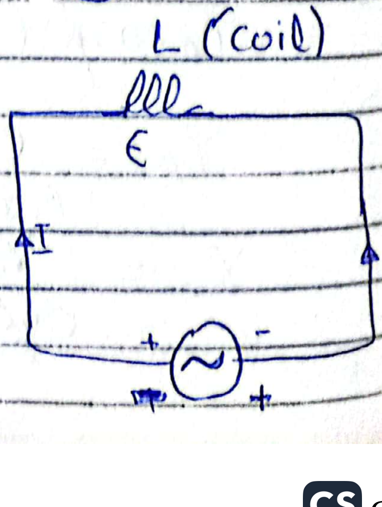
* Reactance depends upon frequancy.

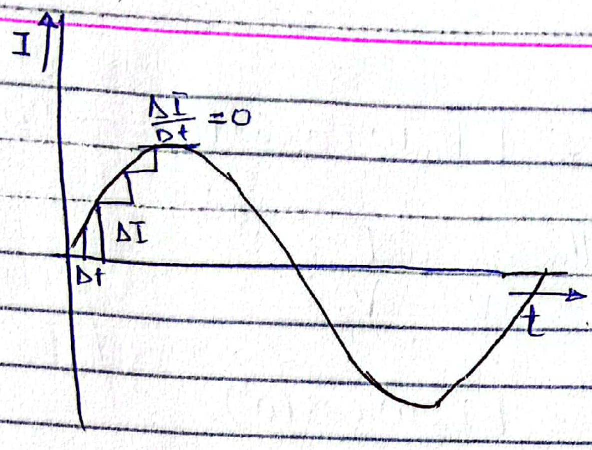
17 Nov 2017

<u>Inductor</u> in <u>AC</u> <u>Circuit</u> :-

$$I = I_0 \sin \omega t \text{ ——— } (1)$$

A Coil with negligible resistance and Large Inductance Self Induction is called Inductor.





$$\epsilon = L\left(\frac{\Delta I}{\Delta t}\right)$$

At Start current is minimum, but $\left(\frac{\Delta I}{\Delta t}\right)$ is large/maximum i.e Induced emf is maximum.

* In Inductance the voltage is leading the current.

$$\epsilon = L\left(\frac{\Delta I}{\Delta t}\right)$$

$$V = L\left(\frac{\Delta I}{\Delta t}\right) \text{ --- } ②$$

put ① in ②:

$$V = L\frac{\Delta}{\Delta t}\left(I_o \sin \omega t\right)$$

$$V = L I_o \frac{\Delta}{\Delta t}\left(\sin \omega t\right)$$

$$\because \frac{\Delta'}{\Delta t}\left(\sin \omega t\right) = \omega \cos \omega t$$

Derivatives

$$V = LI_0 \omega \cos \omega t \quad \text{— (5)}$$

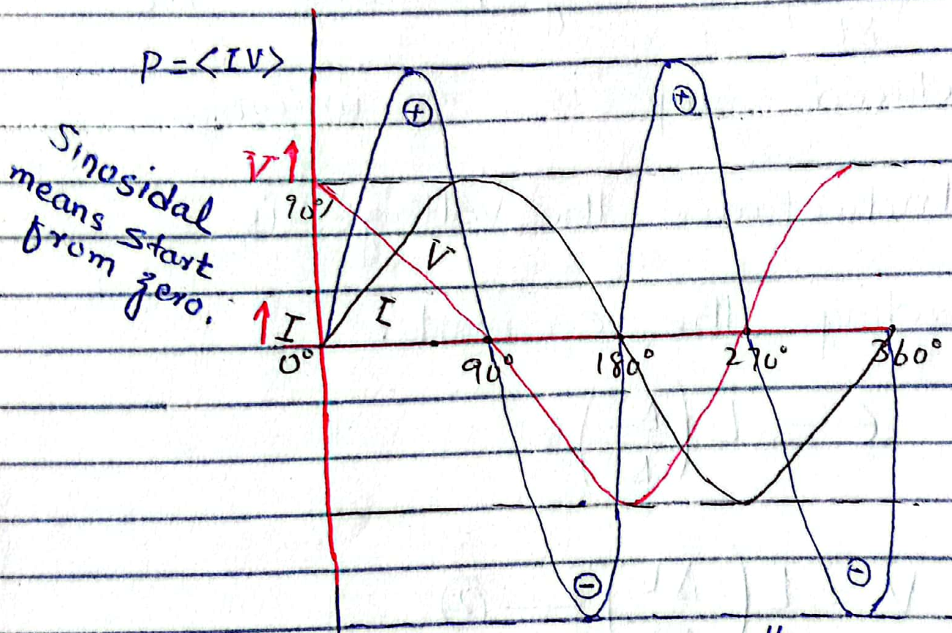
When $\omega t = 0^\circ$

$V = V_0$

$$V_0 = LI_0 \omega \cos(0^\circ)$$

$$V_0 = LI_0 \omega \quad \text{—— (6)}$$

$$\boxed{V = V_0 \cos \omega t} \quad \text{— (7)}$$



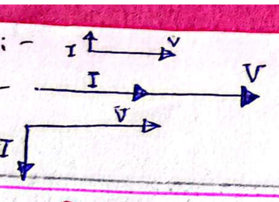
It is clear from the graph that In Inductor, the voltage is ~~leak~~ leading the Current by an angel of 90°.

* There is phase difference.

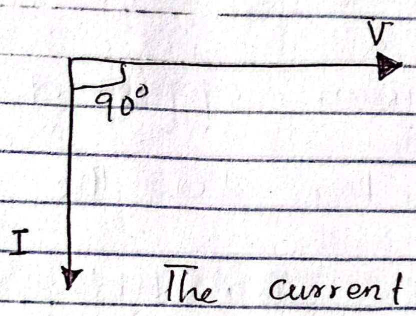
Capacitor :-

Resistor :-

Inductor :-



Phassor Diagram for Inductor:



Voltage is leading or current is lagging.

The current (I) is lagging the voltage.

Average power Loss in Inductor:-

$$\langle P \rangle = \langle I V \rangle$$

In Inductor:

$$I = I_0 \sin\omega t$$

$$V = V_0 \cos\omega t$$

$$\langle P \rangle = \langle I_0 \sin\omega t \cdot V_0 \cos\omega t \rangle$$

$$\langle P \rangle = I_0 V_0 \langle \sin\omega t \cdot \cos\omega t \rangle$$

$$\langle P \rangle = I_0 V_0 \langle 0 \rangle$$

$$\boxed{\langle P \rangle = 0}$$

* Inductor store energy in Magnetic field.

Capacitor: $u = \frac{1}{2} \epsilon E^2$

Reactance of Inductor (Inductive Reactance:-

The opposisson offered by an Inductor to the flow of AC, is called Inductive reactance "X_L".

$$V_{rms} = I_{rms} X_L \quad (R = X_L)$$

$$X_L = \frac{V_{rms}}{I_{rms}} \text{ ——— } (1)$$

$$X_L = \frac{0.\cancel{707} V_o}{0.\cancel{707} I_o}$$

$$X_L = \frac{V_o}{I_o} \text{ ——— } (2)$$

$$V = V_o \cos\omega t$$
$$V = L\omega I_o \cos\omega t$$

Compare them

$$V_o \cancel{\cos\omega t} = L\omega I_o \cancel{\cos\omega t}$$

$$V_o = L\omega I_o \text{ ——— } (3)$$

$$X_L = \frac{L\omega \cancel{I_o}}{\cancel{I_o}}$$

$$X_L = L\omega$$

$$\omega = 2\pi f$$

$$\boxed{X_L = 2\pi f L} \qquad X_c = \frac{1}{\omega C} = \frac{1}{2\pi f C}$$

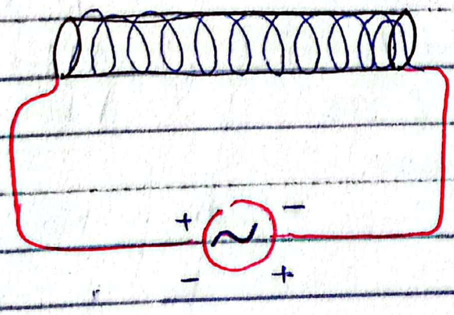
Inductor and capacitor are Inverse of each other.

When we apply DC to Capacitor:

In Case of DC, Inductive Reactance (X_L) is Zero...

In case of DC, Capactive reactance has Infinite value...

Inductive choke:- It is an arrangment in which a copper wire is wounded upon an Iron core such that it supplies a constant AC to a circuit without any energy loss.



$$B = \mu n I$$

$$U_m = \frac{1}{2}\frac{B^2}{\mu}$$

28 NOV 2017

Impedence :- (Z)

The combined opposisson offered by Resistor, capacitor and Inductor to the flow of AC is Called Impedence.

$$V_{rms} = I_{rms} Z.$$ $(R = Z \text{ (impedence)})$

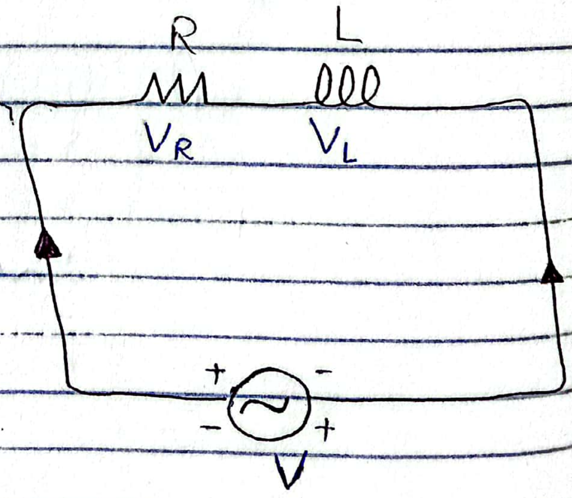
$$Z = \frac{V_{rms}}{I_{rms}}$$

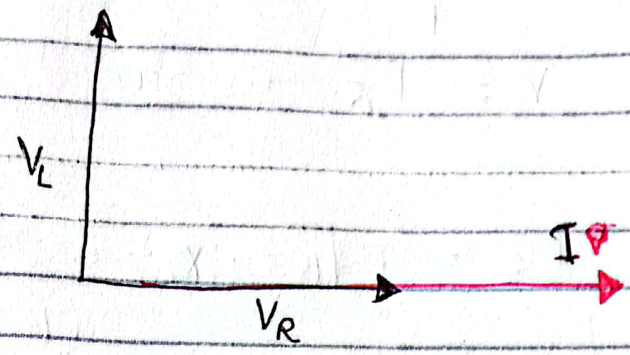
$$Z = \text{ohm}$$

* Diamenssionaly X_L, X_c and R having Same unit (ohm).

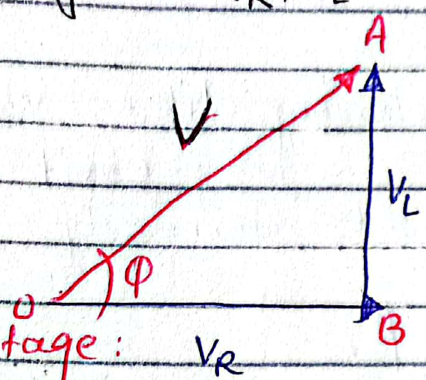
RL Series AC Circuit :-

* Current in Series remains constant, So we take I as refrence phasor.





By Adding: $V = V_R + V_L$



① Applied voltage:

In ΔOAB: By palthagorous theorm:

$$(OA)^2 = (OB)^2 + (AB)^2$$

$$V^2 = (V_R)^2 + (V_L)^2 \quad \text{—— ①}$$

$$\because \left.\begin{aligned} V_R &= IR \\ V_L &= I X_L \end{aligned}\right] \quad \text{—— ②}$$

Put ② in ①:

$$V^2 = (IR)^2 + (I X_L)^2$$

$$V^2 = I^2 R^2 + I^2 X_L^2$$

$$V^2 = I^2 (R^2 + X_L^2)$$

$$\boxed{V = I\sqrt{R^2 + X_L^2}} \quad ③$$ Applied voltage.

② Impedence:-

$$V = IZ \quad \text{—— ④}$$

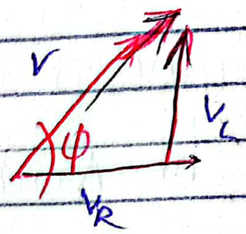
$$\cancel{I}Z = \cancel{I}\sqrt{R^2 + X_L^2}$$

$$\boxed{Z = \sqrt{R^2 + X_L^2} \quad \text{—— ⑤}} \qquad \boxed{|A| = \sqrt{A_x^2 + A_y^2}}$$

Impedence.

Z, is behaving like vector, that's why we can't determined it directly by $Z \neq R + X_L$

③ Angel (φ) :-



$$\tan\phi = \frac{V_L}{V_R}$$

$$\text{Or } \phi = \tan^{-1}\left(\frac{V_L}{V_R}\right) \quad \text{—— ⑥}$$

$$\phi = \tan^{-1}\left(\frac{\cancel{I}X_L}{\cancel{I}R}\right)$$

$$\phi = \tan^{-1}\left(\frac{X_L}{R}\right) \quad \text{—— ⑦}$$

④ power Factor:-

$$\cos\phi = \frac{V_R}{V} \quad \text{—— ⑧}$$

$$\cos\phi = \frac{\cancel{I}R}{\cancel{I}Z}$$

$\frac{V}{I}$

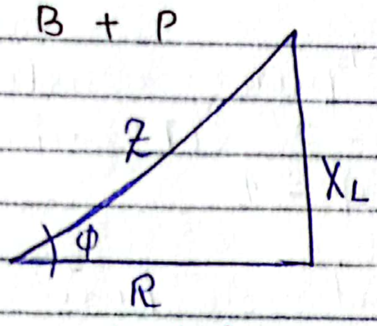
$Z = \frac{V}{R}$

$$\boxed{\cos\varphi = \frac{R}{Z}} \quad \text{— (9)}$$

From eq (5) we can draw Impedence triangel...

$$Z = \sqrt{R^2 + X_L^2}$$

$H = B + P$



We can calculate:

(I) Z (Impedence)

(II) φ (Angel (phase angel))

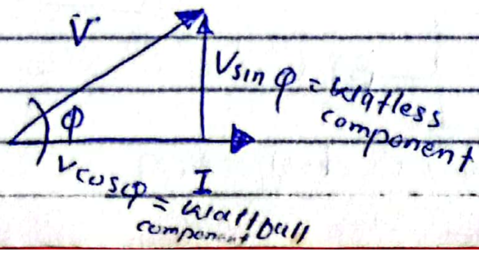
(III) Cos φ (Power Factor) From Impedence triangel...

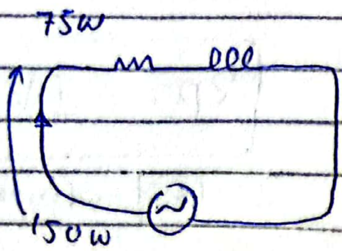
$\cos\varphi = R/Z$

Power Factor:-

It is ratio of same Quantites, having no unit.

$$P.F = \frac{\text{Power dissipated}}{\text{power Supplied}}$$





$$P \cdot F = \frac{\cancel{IV}\cos\phi}{\cancel{IV}}$$

$$\boxed{P \cdot F = \cos\phi}$$

$\cos\phi$ is a diminssionless number...

∵ IF circuit is pure resistive circuit.

$\phi = 0^\circ$ (I and V are in phase).

$\cos\phi = 1$

∵ IF circuit is pure Inductive/capaci

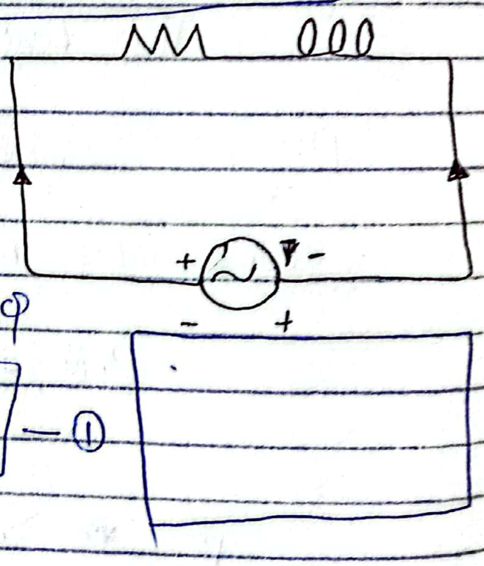
$\phi = 90^\circ$ (I and V are out of phase.)

$\cos(90^\circ) = 0$ $\boxed{\cos\phi = 0}$

20 NOV 2017

power dissipation In RL series AC Circuit :-

$\boxed{(\because \langle P \rangle = I_{rms} V_{rms} \cos\phi)}$



$$\langle P \rangle = \frac{I_0 V_0}{2} \cos\phi$$

$$= \frac{I_0}{\sqrt{2}} \times \frac{V_0}{\sqrt{2}} \cos\phi$$

$$= 0.707 I_0 \times 0.707 V_0 \cos\phi$$

$$\boxed{\langle P \rangle = I_{rms} \cdot V_{rms} \cos\phi} \text{ — } ①$$

$$\boxed{\langle P \rangle = IV\cos\phi} \text{ — } ②$$

Instantinous power dissipation...

As

$$V = IZ$$

$$\cos\varphi = \left(\frac{(\text{Base})}{(\text{Hypotenous})}\right)$$

$$\cos\varphi = \frac{R}{Z}$$

put these values in eq (2):

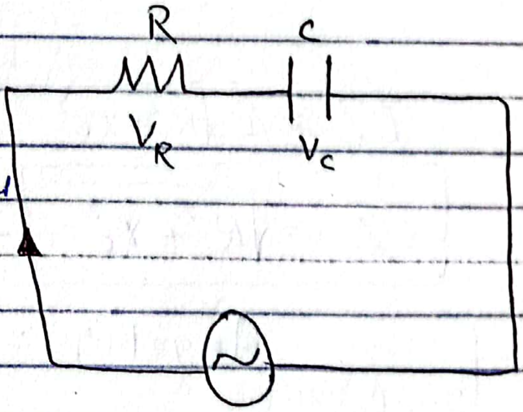
$$\langle P \rangle = I(I\cancel{Z})\frac{R}{\cancel{Z}}$$

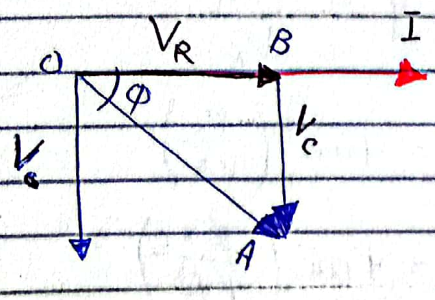
$$\boxed{\langle P \rangle = I^2 R}$$

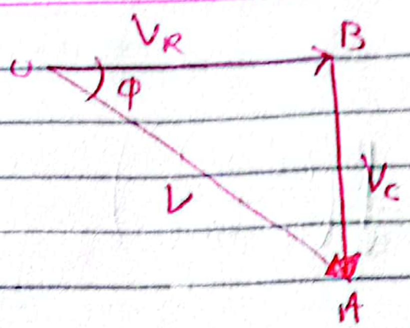
It shows that the power is dissipated by resistor in RL Series Circuit.

RC Series AC Circuits:-

In RC Series the voltage lags behind the current by angel of φ.







In ΔOAB:

$$V^2 = V_R^2 + V_c^2 \quad \text{—— (1)}$$

$$V_R = IR$$

$$V_c = IX_c$$

$$\Rightarrow V^2 = \sqrt{(IR)^2 + (IX_c)^2}$$

$$\boxed{V = I\sqrt{(R^2 + X_c^2)}} \quad \text{—— (2)}$$

$$V = IZ$$

$$\cancel{I}Z = \cancel{I}\sqrt{R^2 + X_c^2}$$

$$\boxed{Z = \sqrt{R^2 + X_c^2}} \quad \text{—— (3)}$$

Angel (φ) :-

In ΔOAB,

$$\tan\varphi = \frac{V_c}{V_R}$$

$$\varphi = \tan^{-1}\left(\frac{V_c}{V_R}\right)$$

$$\varphi = \tan^{-1}\left(\frac{\cancel{I}X_c}{\cancel{I}R}\right)$$

$$\varphi = \tan^{-1}\left(\frac{X_C}{R}\right) \quad \text{—— (4)}$$

Power Factor:-

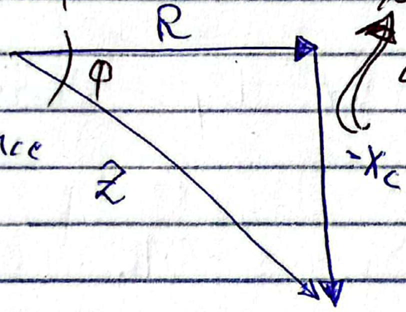
$$\cos\varphi = \frac{V_R}{V}$$

$$\cos\varphi = \frac{\cancel{I}R}{\cancel{I}Z}$$

$$\boxed{\cos\varphi = \frac{R}{Z}} \quad \text{—— (5)}$$

Impedence triangel..

We can Calculate from the Impedence triangel.



To indeate that the Impende triangel is for RC circut. -y direction.

(i) Z

(ii) $\tan\varphi$ or Simple φ (Phase angel).

(iii) $\cos\varphi$ (Power Factor).

Average power dissipation in RC circuit:-

$$\langle P \rangle = \frac{I_0 V_0}{2}\cos\varphi$$

$$\langle P \rangle = \frac{I_0}{\sqrt{2}} \times \frac{V_0}{\sqrt{2}}\cos\varphi$$

$$\langle P \rangle = I_{rms} \cdot V_{rms}\cos\varphi$$

$\langle P \rangle = IV\cos\varphi$ —— (1)

$V = IZ$

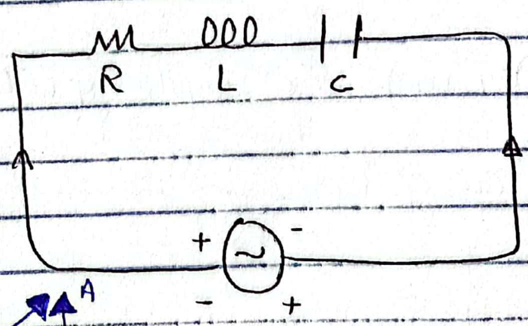
Put in (1):

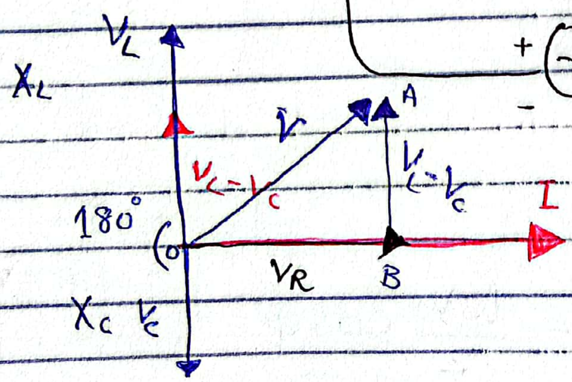
$\Rightarrow \langle P \rangle = I(I\cancel{Z})\left(\frac{R}{\cancel{Z}}\right)$

$\boxed{\Rightarrow \langle P \rangle = I^2 R}$

Which also shows that In RC circuit the power is dissipated by Resistor....

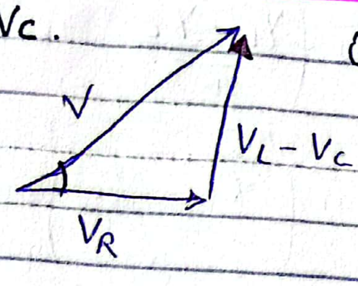
RLC Series Ac Circuit:



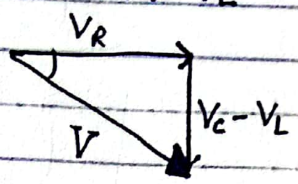


* Voltage across Inductor and Capacitor In RLC Circuit are out of phase by an angel of 180°.

(I) When $V_L > V_C$.



(II) When $V_C > V_L$



$$V^2 = V_R^2 + (V_L - V_C)^2 \quad \text{—— (1)}$$

$$V = IR$$

$$V_L = IX_L$$

$$V_C = IX_C$$

$$V^2 = V_R^2 + (IX_L - IX_C)^2$$

$$V = I\sqrt{(R^2 + (X_L - X_C)^2}$$

$$\boxed{V = I\sqrt{R^2 + (X_L - X_C)^2}} \quad \text{—— (2)}$$

$$V = IZ$$

$$\cancel{I}Z = \cancel{I}\sqrt{R^2 + (X_L - X_C)^2}$$

$$\boxed{Z = \sqrt{R^2 + (X_L - X_C)^2}} \quad \text{—— (3)}$$

$$\tan\varphi = \frac{V_L - V_C}{V_R}$$

$$\varphi = \tan^{-1}\left(\frac{V_L - V_C}{IR}\right) \quad \text{—— (4)}$$

$$\varphi = \tan^{-1}\left(\frac{IX_L - IX_C}{IR}\right)$$

$$\phi = \tan^{-1}\left(\frac{X_L - X_C}{R}\right)$$

$$\boxed{\phi = \tan^{-1}\left(\frac{X_L - X_C}{R}\right)} \quad — 6$$

Power Factor:-

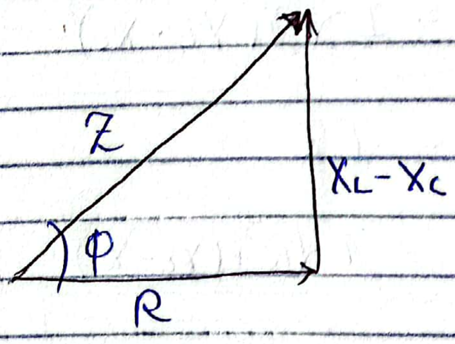
$$\cos\phi = \frac{V_R}{V}$$

$$\cos\phi = \frac{\cancel{I}R}{\cancel{I}Z}$$

$$\boxed{\cos\phi = R/Z \quad — (7)}$$

Impedence triangel:

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$



(1) if $X_L > X_C \Rightarrow$

(2) $X_L < X_C$

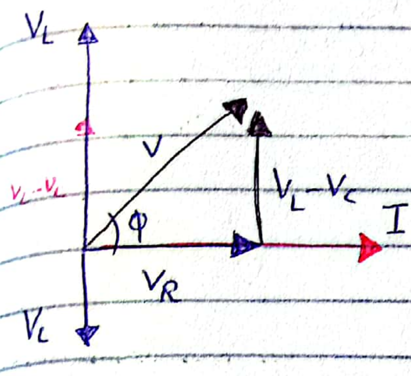
(3) $X_L = X_C$

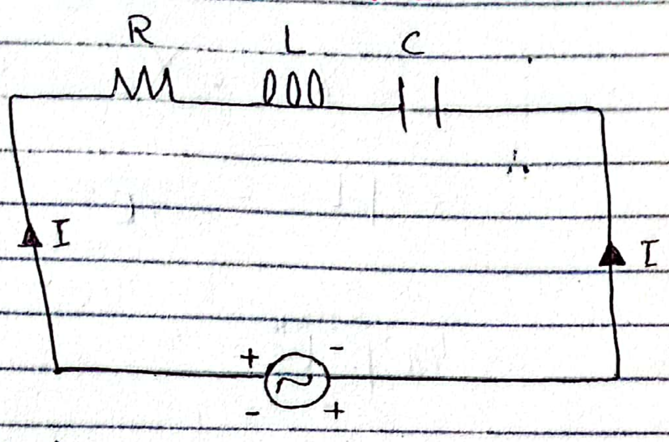
(4) $X_L - X_C > 0$

(5) $X_L - X_C < 0$ means X_L is less then X_C.

21 Nov 2017.

RLC - Series Resonance A·C Circuit:





As we Know that:

$$Z = \sqrt{R^2 + (X_L - X_c)^2} \text{ —— (I)}$$

$$Z = I \cdot V$$

$$I = \frac{V}{Z} \text{ —— (II)}$$

As we Know that:

$$X_L = 2\pi f L$$

$$X_c = \frac{1}{2\pi f C}$$

When we Increase f, X_L Increases and X_c decreases. At a particular frequancy $X_L = X_c$ This frequancy is called resonance frequancy.

X_L	X_c
0	10
1	9
2	8
3	7
4	6
5	5
6	4
7	3
8	2
9	1
10	0

$\because$ when $f = f_0$ → Reasonance frequancy...

$$X_L = X_C$$

$$2\pi f_0 L = \frac{1}{2\pi f_0 C}$$

$$4\pi^2 f_0^2 LC = 1$$

$$f_0^2 = \frac{1}{4\pi^2 LC}$$

$$\boxed{f_0 = \frac{1}{2\pi}\frac{1}{\sqrt{LC}}}$$

When Reasonance takes place,
i.e $X_L = X_C$

and $X_L - X_C = 0$

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

eq ① $\Rightarrow$ $Z = \sqrt{R^2 + 0}$

$$\boxed{Z = R}$$

When Reasonance takes places Circuit becomes resistive,

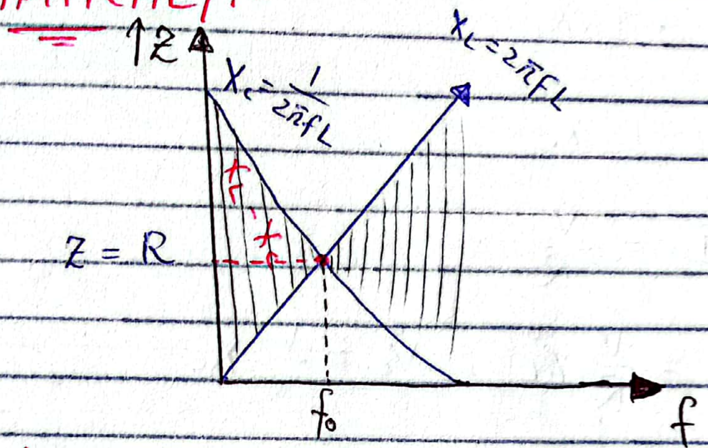
* When Reasonance takes place Impedence becomes minimum and Current becomes maximum.

eq ② $\Rightarrow$ $I = \frac{V}{Z}$

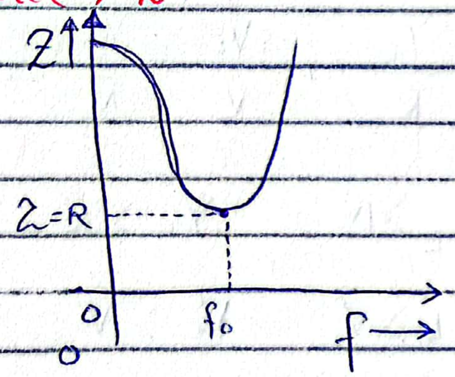
$$I_0 = \frac{V}{R} \quad \text{— ③}$$

The frequency at which Current becomes mixinum, or Impedence become minimum is Called Reasunance frequency.

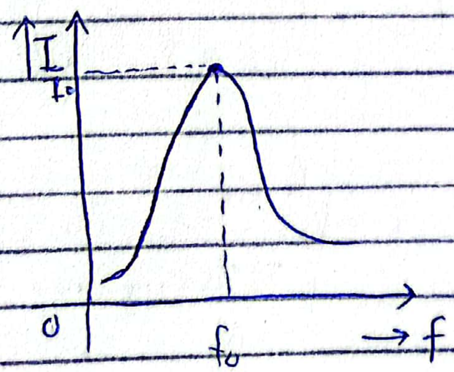
GRAPHICALY:-



For Impedence, Z:



For Current, I:



When Reasonance take place, voltage across Inductor is equall to voltage across resistor.

$$\dot{V}_L = \dot{V}_C$$

$$\dot{V}_L = I_0 \dot{X}_L$$

$$V_c = I_0 X_c$$

As $I_0 = \frac{V}{R}$

$$\dot{V}_L = \frac{V}{R}\dot{X}_L , \quad \dot{V}_c = \frac{V}{R}\dot{X}_c$$

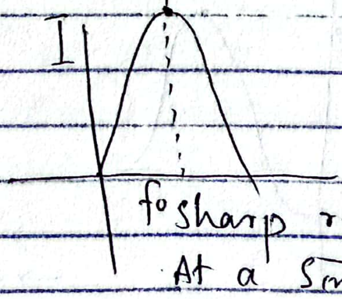
$$\frac{\dot{V}_L}{V} = \frac{\dot{X}_L}{R} , \quad \frac{\dot{V}_c}{V} = \frac{\dot{X}_c}{R}$$ → Quality Factor.

$\because \dot{X}_L > R , \quad \dot{X}_c > R$

$$\dot{V}_L > V , \quad \dot{V}_c > V$$

$\frac{\dot{V}_L}{V} = Q$ (Quality Factor).

$\frac{\dot{V}_x}{V} = Q$

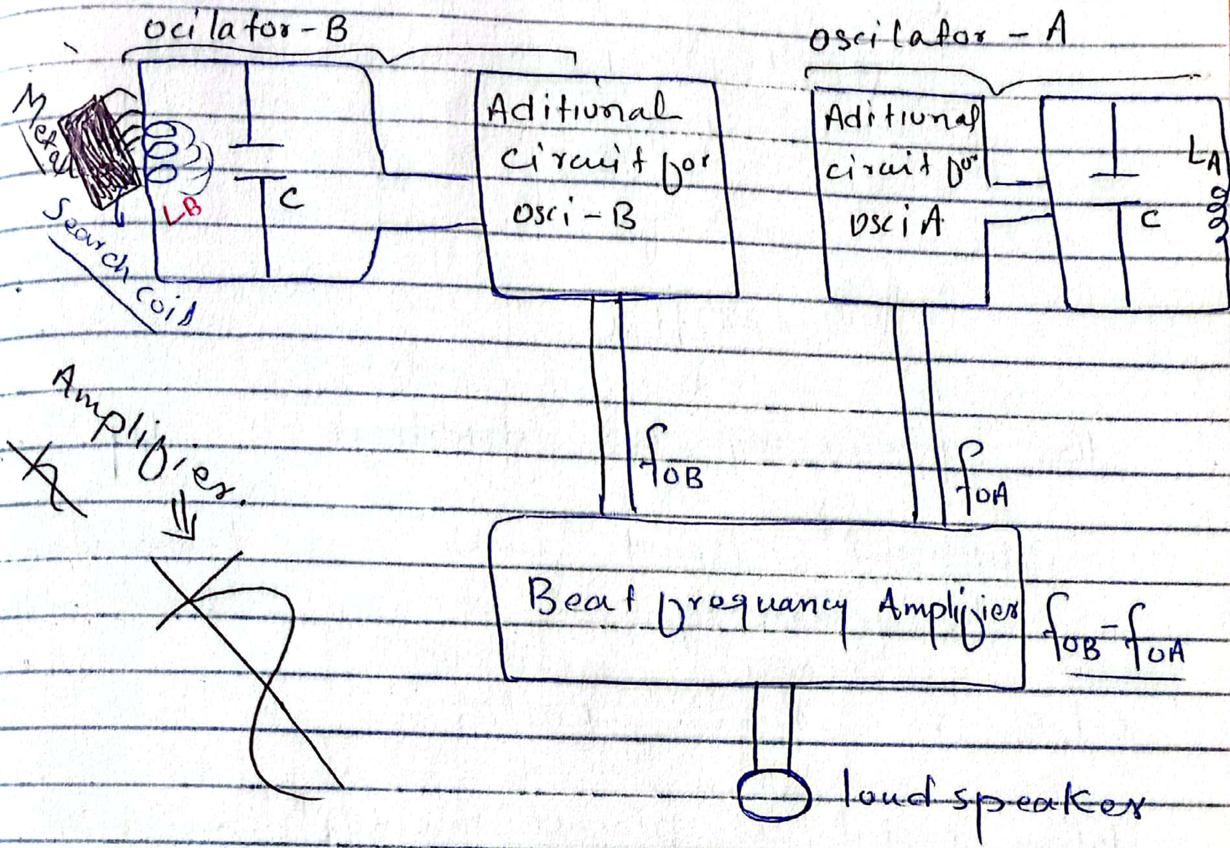


f_0 sharp reasonance

At a Singel value of frequancy reasonance takes place

22 NOV 2017

principle of Metal Detectors:



* Devices by which metals are detected.

* Energy ocilate b/w two points in LC Circuit.

* Energy ocilate b/w Inductor and Capacitor. i.e Between Magnetic energy and electric energy.

* This Ocilators have Specific frequancy. i.e (No. of vibration b/w L and C.

The

This frequency is given by:

$$f_{OA} = \frac{1}{2\pi}\frac{1}{\sqrt{L_A C}}$$

$$f_{OB} = \frac{1}{2\pi}\frac{1}{\sqrt{L_B C}}$$

This frequency is absorbed by Additional circuit and is transferred to frequency

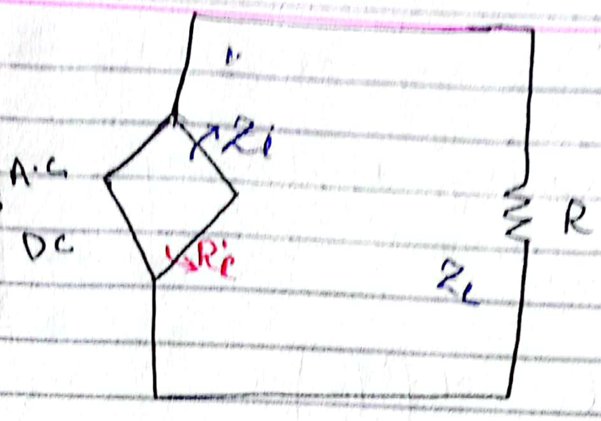
* L_B is Search coil.

When metal is placed in its magnetic field, it changes magnetic flux. or leakage of magnetic flux, So L_B (Self induction) decreases and Hence f_{OB} Increases, thus $f_{OB} - f_{OA}$ Increases → loud speaker will produce Sound.

Maximum power transfer:- or Maximum power transfer theorm:-

In cases of DC:-

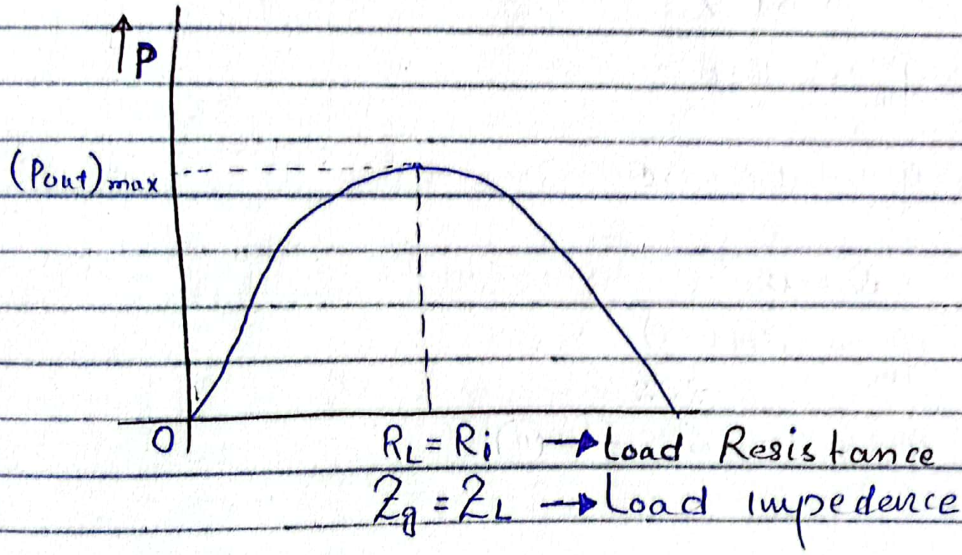
When $R_i = R$
The Battery will provide maximum power to circuit



Z_i or Z_g → Impedance of generator

when $Z_g, Z_i = Z_L$

The Source will provide maximum power to the load.



23 NOV 2017

Maxwell's Equations (Electromagnetic Waves):

(1) Changing magnetic field (magnetic flux produces Electric field.

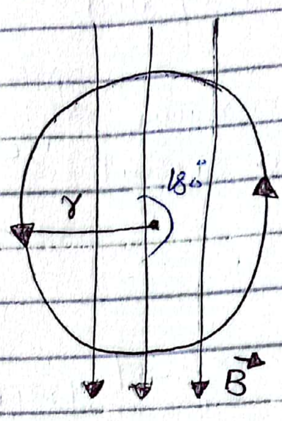
(2) Changing Electric field (electric flux)

Maxwell's

↑

produces magnetic field.

According to Faraday law:



$$\mathcal{E} = -N\left(\frac{\Delta \varphi_m}{\Delta t}\right)$$

$N = 1$

$$\mathcal{E} = -\left(\frac{\Delta \varphi_m}{\Delta t}\right)$$

$$V = -\left(\frac{\Delta \varphi_m}{\Delta t}\right) \text{ --- (I)}$$

$$\varphi_m = \vec{B} \cdot \vec{A}$$

$$\varphi_m = BA\cos\theta$$

$$\theta = 180^\circ$$

$$\varphi_m = BA(-1)$$

$$\varphi_m = -BA \text{ --- (II)}$$

put eq (II) in (I).

$$V = -\frac{\Delta}{\Delta t}(-BA)$$

$$\boxed{V = A\frac{\Delta B}{\Delta t} \text{ --- (III)}} \quad (\because A \text{ is constant})$$

We know that:

$$V = \frac{W}{q} \text{ --- (IV)}$$

$$W = \vec{F_e} \cdot \vec{d}$$

$$W = F_e d \cos\theta$$

$$W = F_e d \cos(0^\circ)$$

$\cos(0^\circ) = 1$

$$W = F_e d \text{ --- } (V)$$

$F_e = qE$

$d = 2\pi r$

$$\Rightarrow W = qE(2\pi r) \text{ --- } (VI)$$

put eq (VI) in (IV)

$$V = \frac{\cancel{q}E(2\pi r)}{\cancel{q}}$$

$$V = E(2\pi r) \text{ --- } (VII)$$

Equate (III) and (VII):

$$E(2\pi r) = A\left(\frac{\Delta B}{\Delta t}\right)$$

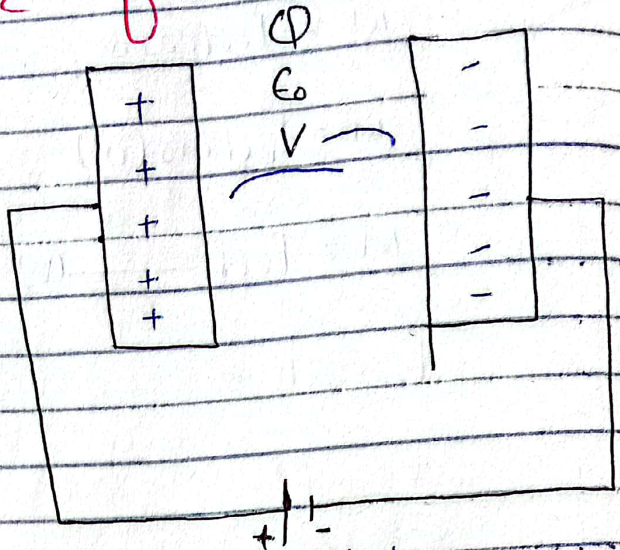
$$\boxed{E = \frac{A}{2\pi r}\left(\frac{\Delta B}{\Delta t}\right)}$$

$$\boxed{E = \frac{1}{2\pi r}\left(\frac{\Delta \varphi_m}{\Delta t}\right)}$$

Maxwell 1st equation

Whenever you change B there will be E.

2. changing electric field produces magnetic field:



$Q = CV$ — ①

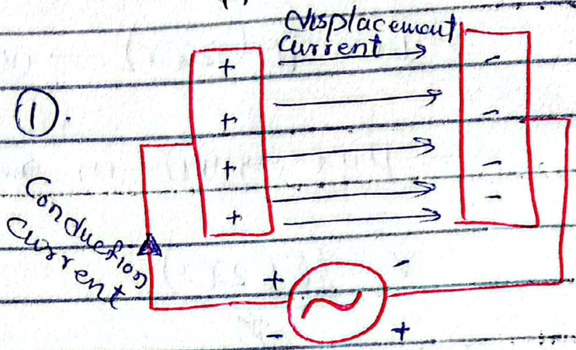
$C_{vacum} = \frac{A\epsilon_0}{d}$ — ②

$E = \frac{V}{d}$ $\left(E = \frac{-\Delta V}{\Delta r}\right)$

$V = Ed$ — ③

put ② and ③ in ①.

$Q = \frac{A\epsilon_0}{\cancel{d}}\left(E\cancel{d}\right)$



$Q = A\epsilon_0 E$ — ④ charge Store on capacitor

In Case of AC: there is Current b/w plates (Electromagnetic waves are generate

$I = \frac{\Delta Q}{\Delta t}$ — ⑤

$I = \frac{\Delta}{\Delta t}\left(A\epsilon_0 E\right)$

$I = \epsilon_0 A\left(\frac{\Delta E}{\Delta t}\right)$ — ⑥ $I = \frac{\epsilon_0 \Delta(\Phi)}{\Delta t}$

displacement current

$\frac{\Delta\Phi}{\Delta t}$ equivalent to I

The I produce magnetic field in capacitor which can be calculated from Ampere law

$$B = \frac{\mu_0 I}{2\pi r} \quad \text{——— (7)}$$

$$B = \frac{\mu_0 \epsilon_0 A}{2\pi r}\left(\frac{\Delta E}{\Delta t}\right)$$

$$\boxed{B = \frac{\mu_0 \epsilon_0 A}{2\pi r}\left(\frac{\Delta E}{\Delta t}\right)} \Rightarrow \boxed{B = \frac{\mu_0 \epsilon_0}{2\pi r}\left(\frac{\Delta \phi_e}{\Delta t}\right)}$$

Induced magnetic field

Maxwell 2nd equation:

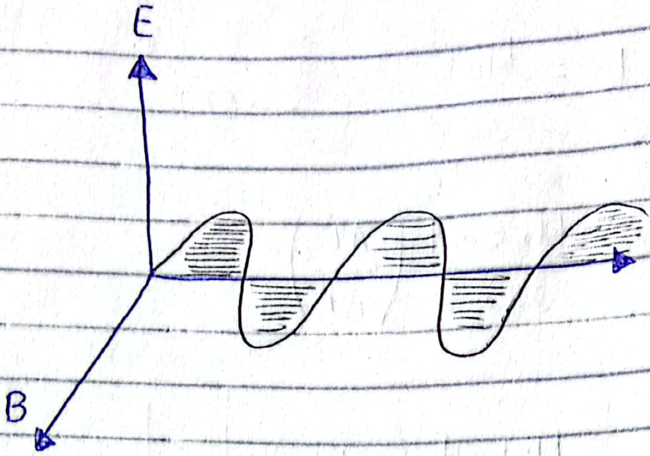
* When a charge particle is moving with uniform velocity → it is associated with constant E and B and vice versa.

* Electromagnetic waves are emitted when a charge particle is accelerated or decelerated...

Velocity of Electromagnetic Waves:-

As $$E = \frac{A}{2\pi r}\left(\frac{\Delta B}{\Delta t}\right) \quad \text{—— (1)}$$

$$B = \frac{\mu_0 \epsilon_0 A}{2\pi r}\left(\frac{\Delta E}{\Delta t}\right) \quad \text{—— (2)}$$



Varying E produce B.

And varying B produce E.

* E, B and propagation of waves are perpendicular to each other.

Velocity of Electromagnetic Waves:

$$E = \frac{A}{2\pi r}\left(\frac{\Delta B}{\Delta t}\right) \quad \text{---} (1$$

$$B = \frac{\mu_0 \epsilon_0 A}{2\pi r}\left(\frac{\Delta E}{\Delta t}\right) \quad \text{---} (2$$

Divide ① by ② :

$$\frac{E}{B} = \frac{A}{2\pi r}\left(\frac{\Delta B}{\Delta t}\right) \div \frac{\mu_0 \epsilon_0 A}{2\pi r}\left(\frac{\Delta E}{\Delta t}\right)$$

$$= \frac{A}{2\pi r}\left(\frac{\Delta B}{\Delta t}\right) \times \frac{2\pi r}{\mu_0 \epsilon_0 A}\left(\frac{\Delta t}{\Delta E}\right)$$

$$= \frac{\cancel{A}}{\cancel{2\pi r}} \frac{\cancel{\Delta}}{\cancel{\Delta t}}\left(B\right) \times \frac{\cancel{2\pi r}}{\mu_0 \epsilon_0 \cancel{A}} \frac{\cancel{\Delta t}}{\cancel{\Delta}}\left(\frac{1}{E}\right)$$

$$\boxed{\frac{E}{B} = \frac{1}{\mu_0 \epsilon_0}}\left(\frac{B}{E}\right)$$

$$\frac{E}{B} = \frac{N}{C} \div \frac{N}{C\left(\frac{m}{s}\right)}$$

$$= \frac{\cancel{N}}{\cancel{C}} \div \frac{N}{C} \times \frac{m}{s}$$

$$= \frac{\cancel{N}}{\cancel{C}} \times \frac{\cancel{C}}{\cancel{N}} \times \frac{m}{s}$$

$$\boxed{\frac{E}{B} = \frac{m}{s}}$$

$$\boxed{\therefore \frac{E}{B} = v}$$

Maxwell got the Nobel prize

$$\Rightarrow \left(\frac{E}{B}\right)^2 = \left(\frac{1}{\mu_0 \epsilon_0}\right)$$

$$\Rightarrow v = \frac{1}{\sqrt{\mu_0 \epsilon_0}}$$

As, $\mu_0 = 4\pi \times 10^{-7} \left(\frac{Wb}{A \cdot m}\right)$

$\epsilon_0 = 8.85 \times 10^{-12} \left(\frac{C^2}{Nm^2}\right)$

$$v = \frac{1}{\sqrt{(4\pi \times 10^{-7})(8.85 \times 10^{-12})}}$$

$$\boxed{v = 3 \times 10^{8}\ m/s} \approx C$$

~~v = 8.85 × 10~~

"Light is also electromagnetic In Nature.

Electromagnetic Waves...

γ-rays — X-rays — U.V — Vis — IR — M-Ws · R·W $\longrightarrow \lambda$

λ - Decreases	λ - ~~Decre~~ Increases
f - Increases	f - Decreases
E = Increases	E = Decreases

$$\boxed{c = f\lambda}$$

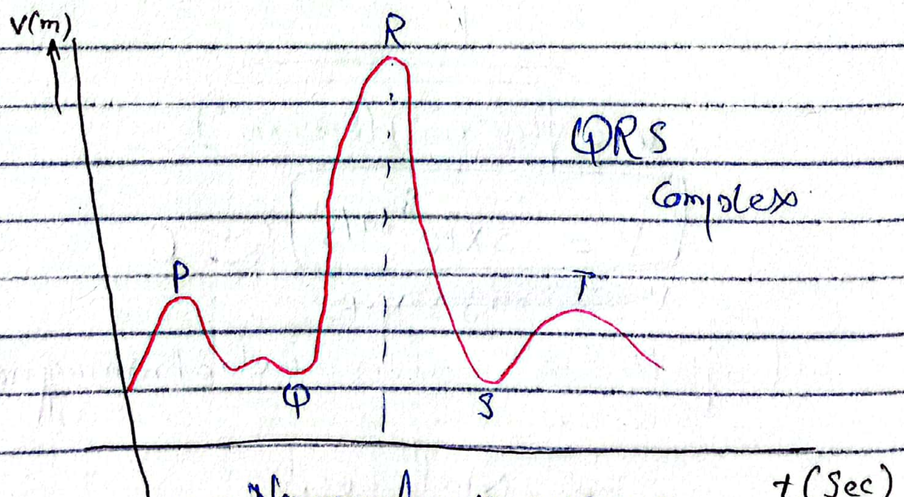
* Velocity of all electromagnetic waves remain constant.

γ-rays	X-rays	UV-rays	Vis	IR	M·Ws	Radio
$\lambda < 10nm$	0.01nm – 10nm	1nm — 400nm	400nm — 700nm	0.7µm – 1mm	1mm – 1m	$\lambda > 1m$

25 NOV 2017

Electrocardiogram (ECG):-

The graphical representation of the electrical activity of the heart is called ECG.



Normal person

MCQ # 2 :

$$I_o = 5\sqrt{2}A$$

$\langle I^2 \rangle$?

$$\langle I^2 \rangle = 0 + \frac{I_o^2}{2}$$

$$\langle I^2 \rangle = \frac{I_o^2}{2}$$

$$\langle I^2 \rangle = \frac{(5\sqrt{\cancel{2}})^{\cancel{2}}}{\cancel{2}}$$

$$\langle I^2 \rangle = (5)^2$$

$$\boxed{\langle I^2 \rangle = 25}$$

MCQ #3

$$f_0 = \frac{1}{2\pi}\frac{1}{\sqrt{LC}}$$

$$f_0 = \frac{1}{2\pi}\frac{1}{\sqrt{\cancel{4}L\frac{C}{\cancel{4}}}}$$ = f_0 will remain Same

MCQ # 7 :

$$v = 20\sin(157t)$$

$$v = V_0 \sin \omega t$$

$$v = V_0 \sin 2\pi f t$$

$$V_0 \sin 2\pi f t = 20 \sin(157t)$$

$$V_0 = 20$$

$$\sin 2\pi f t = \sin(157t)$$

$$2\pi f \cancel{t} = 157 \cancel{t}$$

$$2\pi f = 157$$

$$f = \frac{157}{6.28}$$

$$\boxed{f = 25 Hz}$$