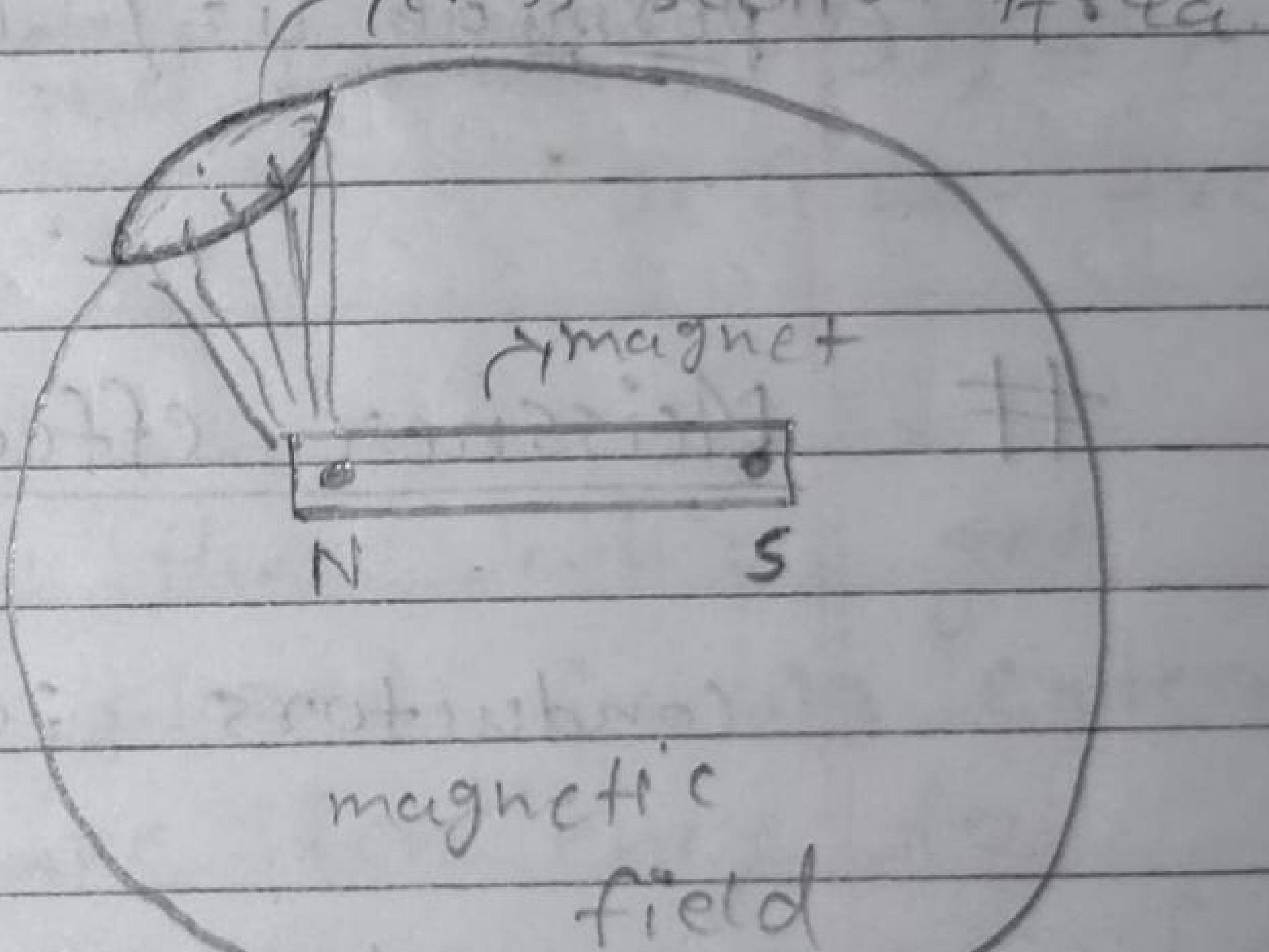
Q.1 What do you understand by magnetic flux?

Q.2 What is the meaning of electromagnetic induction?

Q.3 Write the Farraday's (Faraday's) law's of electromagnetic induction.

Ans. 1 **Magnetic Flux** :- The total no. of magnetic lines of the force normally passing through the unit cross section area of the magnetic field is called magnetic flux, represented by ϕ or ϕ_m.



where,
A → cross section Area
B → Magnetic field.

$$\boxed{\phi = \vec{B} \cdot \vec{A}}$$

$$\boxed{\phi = BA \cos\theta}$$

SI unit :- Weiber (Wb)
C.G.S. Unit :- Maxweld (max)

quantity :- scalar quantity

$$\boxed{1\ \text{Wb} = 10^8\ \text{max}}$$

$\because \quad \phi = BA \quad \{\text{when } \theta = 0^\circ\}$

$\Rightarrow \quad B = \dfrac{\phi}{A}$

$\Rightarrow \quad B = \dfrac{\text{Wb}}{m^2}$

$$\Rightarrow \boxed{B = \text{Tesla} = N/Am}$$

Dimensional formula :-

$$\boxed{\phi = ML^2T^{-2}A^{-1}}$$

$$\boxed{B = ML^0T^{-2}A^{-1}}$$

Ans.2. Electromagnetic Induction :-

whenever the relative motion b/w magnet and coil the linked magnetic flux of the coil is changed causes of this electromotive force is induced this phenomena is called the Electromagnetic Induction. If the Galvanometer is or circuit is closed connected then flowing current is called induced current.

Ans.3. There is 2 ~~law's of~~ Faraday's law of electromagnetic induction :-

(i) Electromagnetic current is produced untill the magnet comes in rest. It means whenever magnet is move near the coil then the induced current is produced in the coil.

(ii) Produced induced current is directly proportional to the rate of change of magnetic flux (ϕ_m)

self inductance

$\Rightarrow$ $\boxed{\mathcal{E} \propto \frac{d\phi}{dt}}$ where $\phi \rightarrow$ magnetic flux,
$I \rightarrow$ induced current.

$\Rightarrow$ $\mathcal{E} = -\frac{d\phi}{dt}$

Q.4 Define Lenz law for electromagnetic induction?

Q.5 What do you understand by self induction and self inductance?

Q.6 Derive an expression for self inductance for a solenoid.

Fleming Right hand Rule :-

According to the fleming right hand rule, if we strech our fore finger, middle finger and thumb such that they are mutually perpendicular to each other then thumb shows 'motion of the conductor', fore finger shows 'magnetic fied' then middle finger shows 'direction of induced current'.

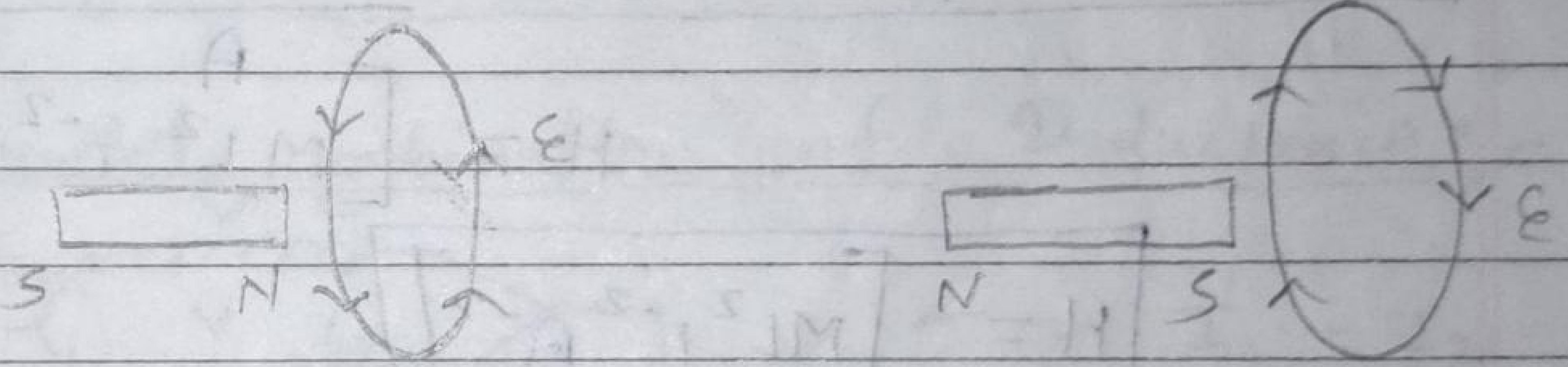
Ans.4 Lenz law :- According to lenz law, the direction of induced current is such that it always opposes the change which produces each.

This lenz law is similar to conservation of energy.

Lenz law :- The direction of induced current is such that it opposes the change or the cause which produces each.

or

Lenz law :- If we take north pole of magnet near the coil then direction of induced current is Anti clockwise And when we take south pole of a magnet near the coil then direction of induced current is clock wise.



Ans:- 5. Self induction :- ~~The~~ when the electric current passes through any coil ~~the~~ and change the flow of current then linked magnetic flux of the coil is changed this phenomena is known as self induction.

$$\phi \propto I$$

$$\phi = LI \quad \text{where } L \rightarrow \text{self inductance}$$

$$\boxed{L = \frac{\phi}{I}}$$ self inductance or inductance.

SI Unit of L :-

$$L = \frac{\phi}{I}$$

$$L = \frac{Wb}{Ampere}$$

$$L = \text{Henary } (H)$$

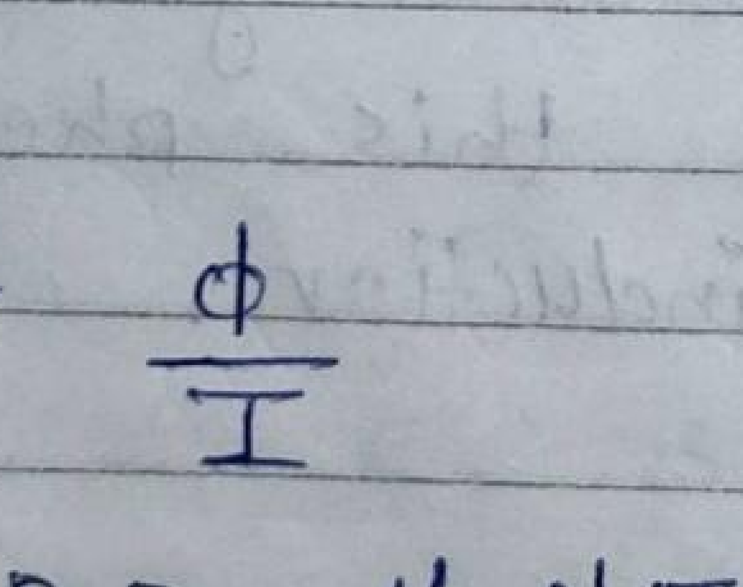
<u>Henary</u> :- The ratio of weiber and Ampere is known as Henary.

<u>Dimensional formula</u> :- $H = \frac{ML^2T^{-2}A^{-1}}{A}$

$$H = [ML^2T^{-2}A^{-2}]$$

$$\boxed{H = [ML^2T^{-2}A^{-2}]}$$

<u>Ans. 6</u>



$\Rightarrow L = \frac{\phi}{I}$

$\because B = \mu_0 N I$

$\Rightarrow L = \frac{NBA}{I}$ {for Solenoid}

$\Rightarrow L = \frac{N(\mu_0 N I)A}{I}$

$\Rightarrow L = \mu_0 n N A$

$\because N = nl$

$\Rightarrow L = \mu_0 n(nl)A$

$\Rightarrow \boxed{L = \mu_0 n^2 l A}$

$\because n = \frac{N}{l}$

$\Rightarrow L = \mu_0 \frac{N^2}{l^2} l A$

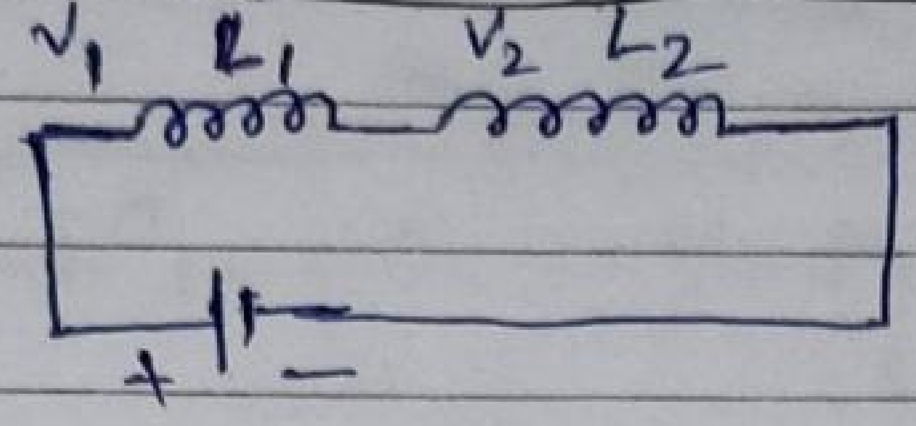
$\Rightarrow \boxed{L = \frac{\mu_0 N^2 A}{l}}$

$\Rightarrow \phi \propto I$

$\Rightarrow \phi = LI$

$\Rightarrow e = -\frac{d\phi}{dt} \Rightarrow \boxed{e = -L\frac{dI}{dt}}$

Series combination of Inductance :-



$V = e = -L\frac{dI}{dt}$

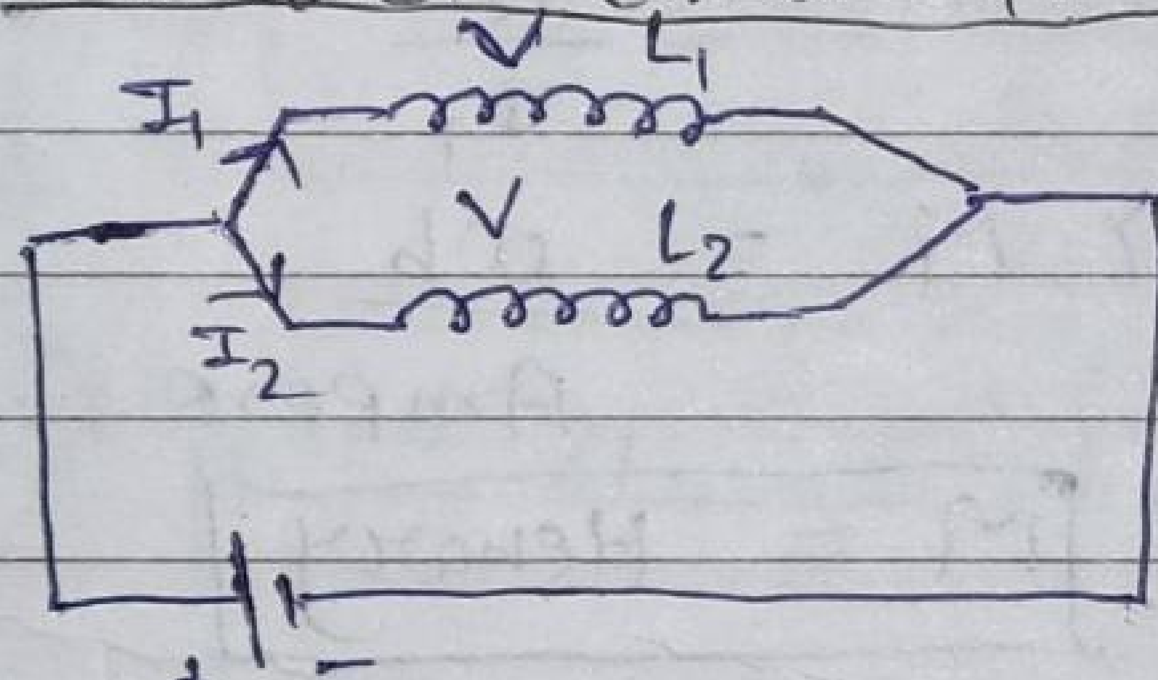
$\because V = V_1 + V_2$

$\Rightarrow -L\frac{dI}{dt} = -L_1\frac{dI}{dt} + \left(-L_2\frac{dI}{dt}\right)$

$\Rightarrow -L\frac{dI}{dt} = -\frac{dI}{dt}\left(L_1 + L_2\right)$

$\Rightarrow \boxed{L = L_1 + L_2}$ where $L \rightarrow$ inductance.

Parallel combination of Inductance :-



$I = I_1 + I_2$

$\because V = e = -L\frac{dI}{dt}$

$\Rightarrow \frac{dI}{dt} = \frac{-e}{L}$

$\Rightarrow I = \int -\frac{e}{L}\, dt$

$\Rightarrow I = \frac{-e}{L}\int dt$

$\Rightarrow \boxed{I = \frac{-et}{L}}$

Now,

$\Rightarrow I = I_1 + I_2$

$\Rightarrow \frac{-et}{L} = \frac{-et}{L_1} + \left(\frac{-et}{L_2}\right)$

$\Rightarrow \frac{-et}{L} = -et\left(\frac{1}{L_1} + \frac{1}{L_2}\right)$

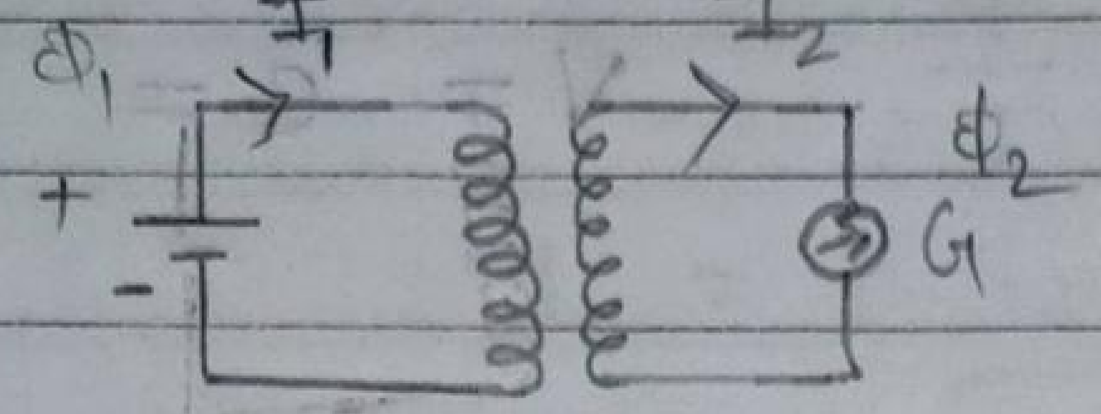
$\Rightarrow \boxed{\frac{1}{L} = \frac{1}{L_1} + \frac{1}{L_2}}$

where,

$L \rightarrow$ inductance.

Q.7. What is mutual ~~induction and~~ induction and mutual inductance?

Ans.7. →



$$\phi_2 \propto I_1$$

$$\phi_2 = M I_1 \quad \text{where } M \rightarrow \text{mutual inductance.}$$

$$\boxed{M = \frac{\phi_2}{I_1}}$$

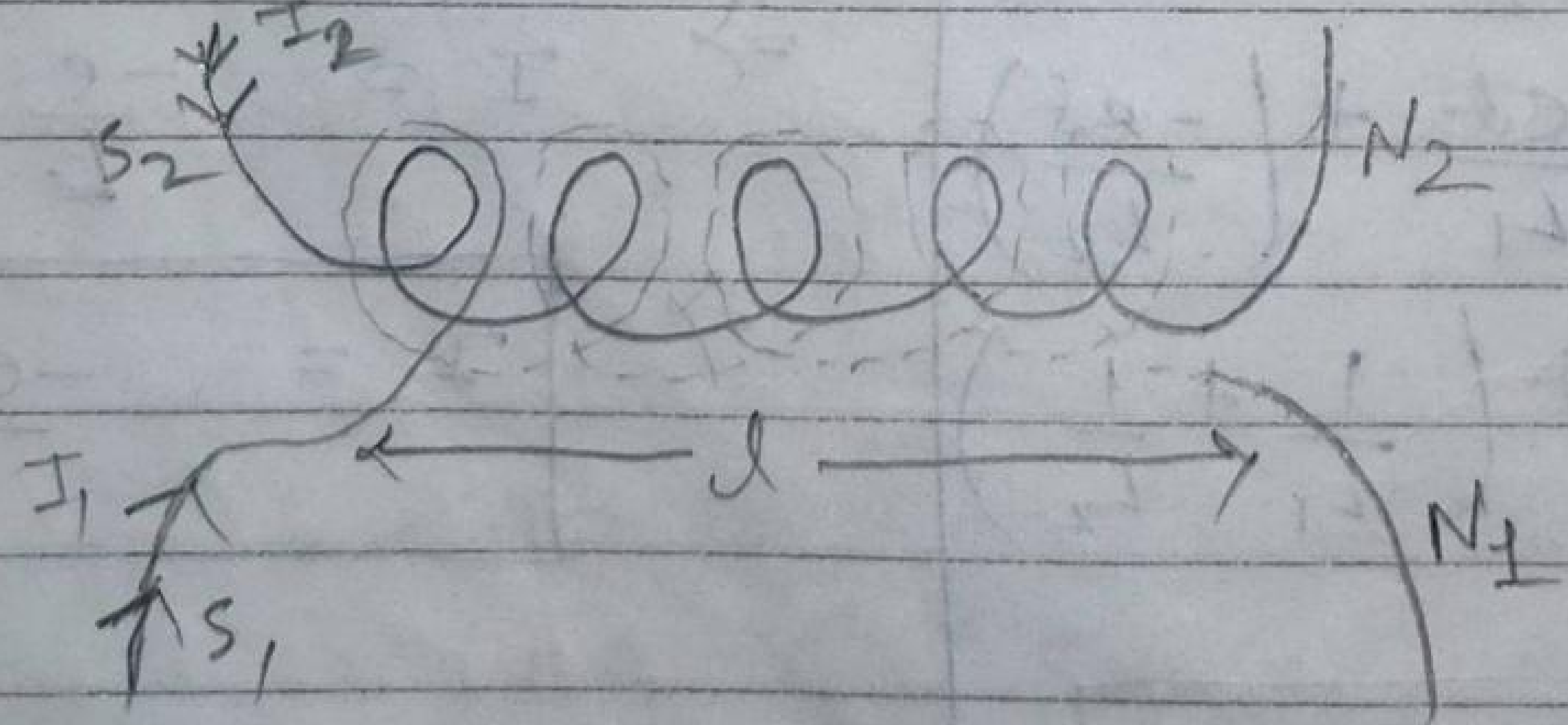
<u>unit of M:-</u>

$$\Rightarrow M = \frac{\phi_2}{I_1}$$

$$\Rightarrow M = \frac{Wb}{Ampere}$$

$$\Rightarrow \boxed{M = \text{Henary}}$$

Mutual inductance for coaxial current carrying solenoid:-



$\because N = nl$

$$\Rightarrow M_{12} = \frac{\phi_2}{I_1} = \frac{B_2 A}{I_1} = \frac{N_2 \mu_0 n_1 I_1 A}{I_1}$$

$$= \frac{N_2 (\mu_0 n_1 \cancel{I_1}) A}{\cancel{I_1}}$$

$$= \mu_0 N_2 n_1 A$$
$$= \mu_0 n_2 l n_1 A \qquad [\because N_2 = n_2 l]$$
$$= \mu_0 n_1 n_2 A l$$
$$\Rightarrow \boxed{M_{12} = \frac{\mu_0 N_1 N_2 A}{l}}$$

$$M_{21} = \frac{\phi_1}{I_2}$$
$$= \frac{\mu_0 B_2 A}{I_2}$$
$$= \frac{N_1 \mu_0 n_2 I_2 A}{I_2}$$
$$= \mu_0 N_1 n_2 A$$
$$\boxed{M_{21} = \frac{\mu_0 N_1 N_2 A}{l}}$$

$$\boxed{M_{12} = M_{21} = M}$$

Q.8. What do you mean by motional electro-motive force and find out their formula.

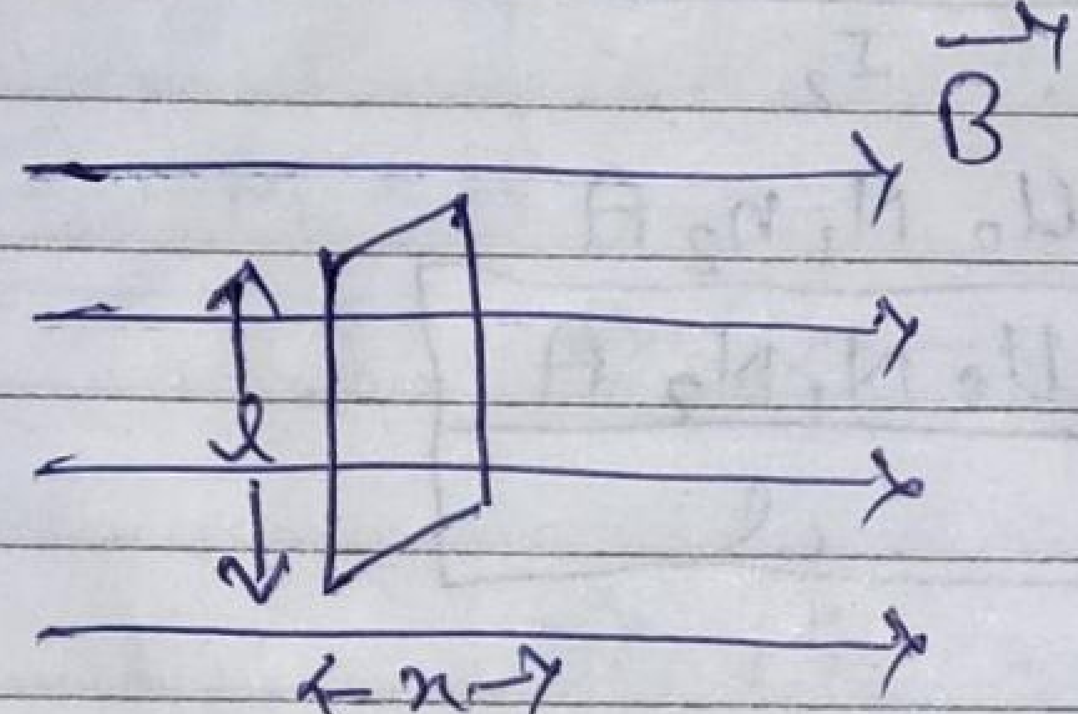
Q.9 What is Eddy current? write it's application.

Ans. 9. → Eddy current is induced current.
→ Eddy current is also called "focault current."

Suddenly change of rate of relative motion in magnet and coil then induced current is called eddy current.

Application :- i) used for emergency break in train.

Ans.8. The electromotive force due to motion is called motional electromotive force.



$$\Rightarrow e = \frac{d\phi}{dt}$$

$$\Rightarrow e = \frac{d(BA)}{dt}$$

$$\Rightarrow e = B\frac{dA}{dt}$$

$$\Rightarrow e = B\frac{d(l \times x)}{dt}$$

$$\Rightarrow e = Bl\frac{dx}{dt}$$

$$\Rightarrow \boxed{e = Blv}$$

where, $e \rightarrow$ electromotive force

$v \rightarrow$ velocity

$l \rightarrow$ lenght of coil

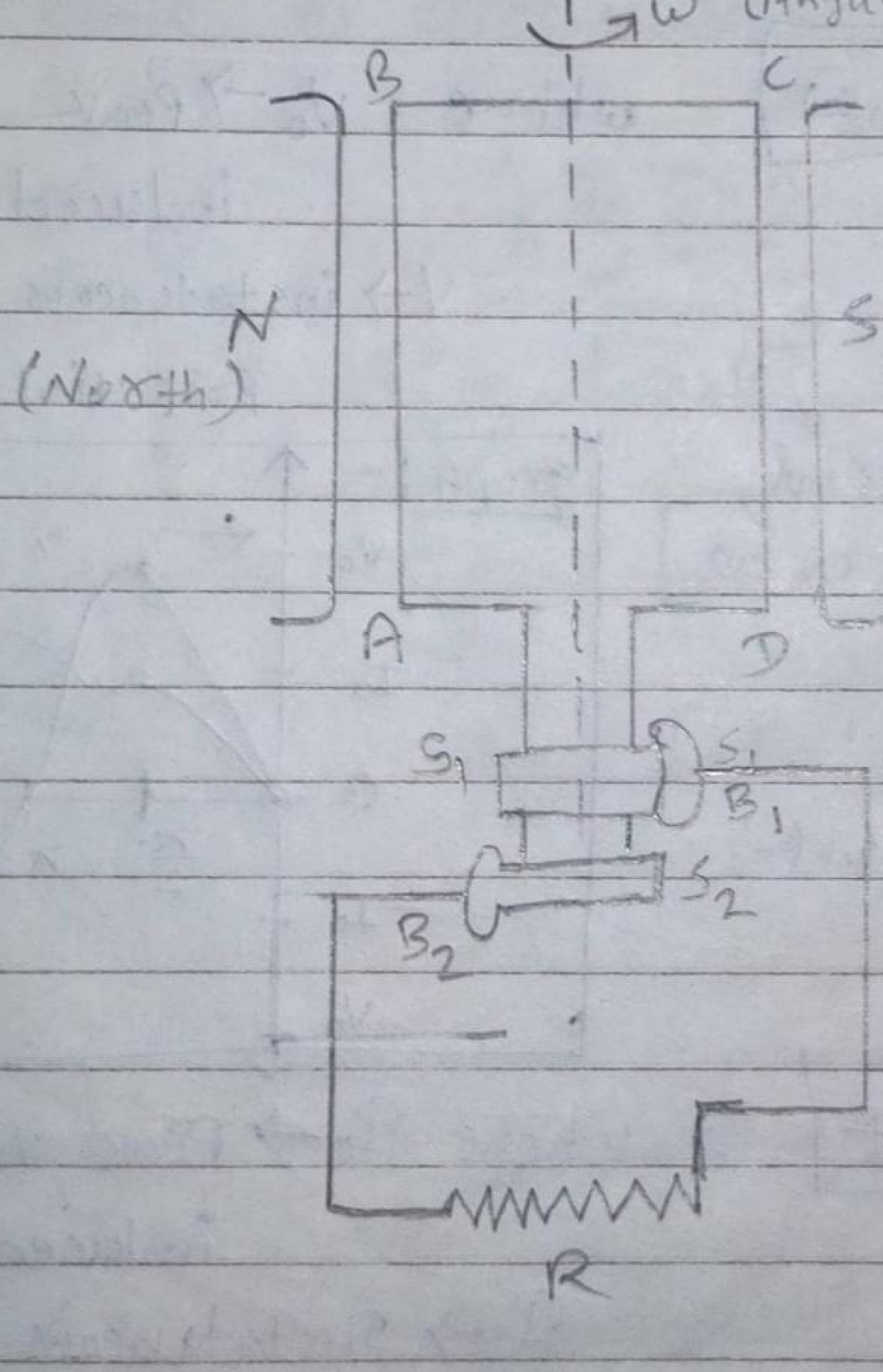
$B \rightarrow$ magnetic field.

Q.10 What is dynamo (A.C. generator)? explain it's principle.

Q.11 With the help of graph define Alternating current.

Ans. 10. A dynamo is a electrical device which converts the mechanical energy into electrical energy, this device is known as the Dynamo.

Dynamo is work on the Electromagnetic Induction



$S_1, S_2 \rightarrow$ slip ring

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

$$\boxed{\theta = \omega t}$$

$$\Rightarrow V = e = -\frac{d\phi}{dt}$$

$$\Rightarrow V = e = -\frac{d}{dt}(NBA\cos\theta)$$ $\left\{ \because \phi = BA\cos\theta \right.$ for no. of terms, $\left. \phi = NBA\cos\theta \right\}$

where, $N \rightarrow$ no. of terms.

$$\Rightarrow V = e = -NBA\frac{d}{dt}\cos(\omega t) \quad [\because \theta = \omega t]$$

$$\Rightarrow V = e = -NBA(-\sin\omega t)\,\omega$$

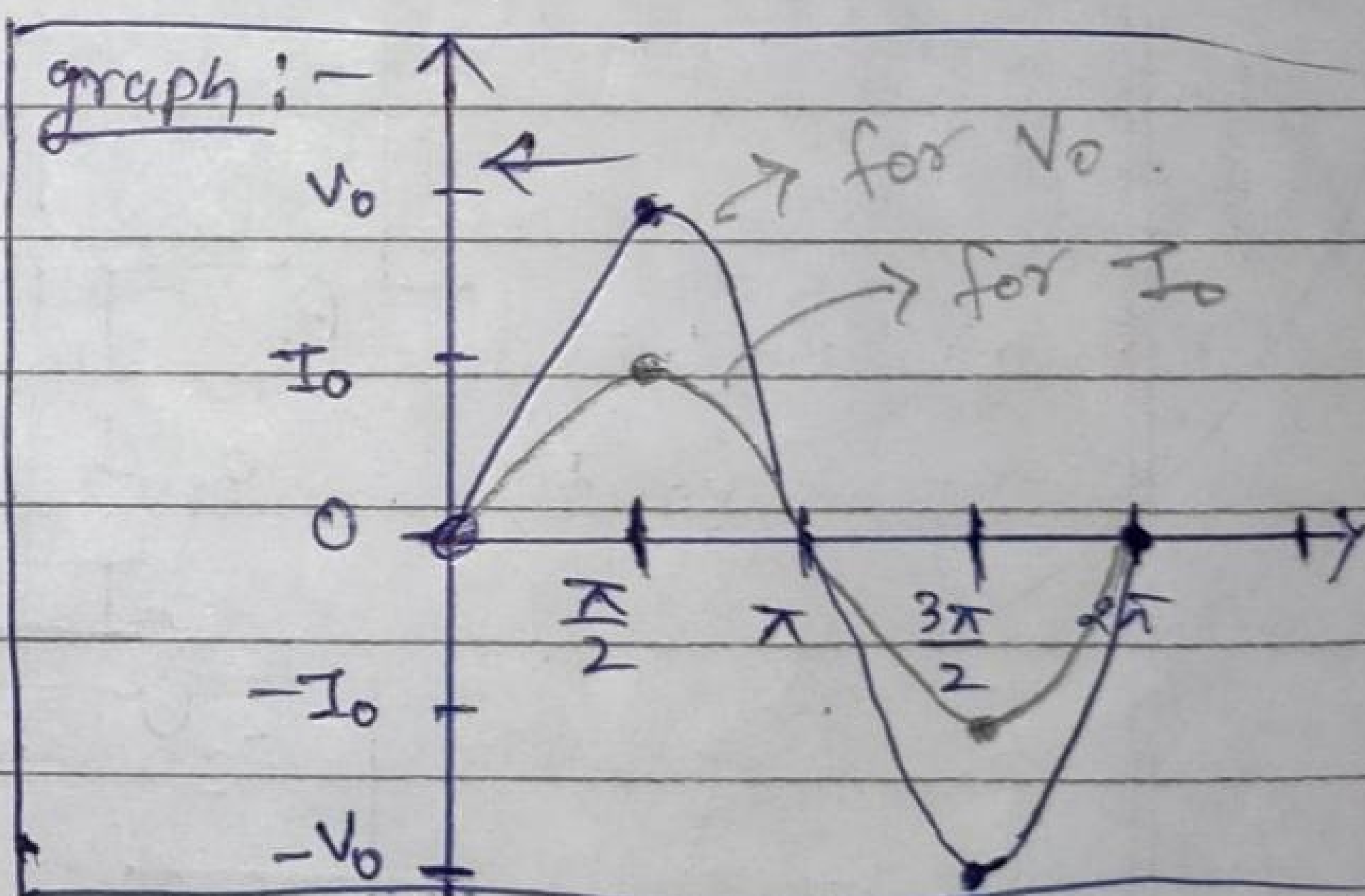
$$\Rightarrow V = e = NBA\omega \sin\omega t$$

$$\Rightarrow \boxed{V = V_0 \sin(\omega t)}$$ where $V_0 \rightarrow$ Peak value of induced E.m.f.

$V \rightarrow$ instataneous E.m.f or potential diff.

Now,

Alternating current,



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

$$\Rightarrow I = \frac{V_0 \sin(\omega t)}{R}$$

$$\Rightarrow \boxed{I = I_0 \sin\omega t}$$ where $I_0 \rightarrow$ Peak value of induced current.

$I \rightarrow$ Instataneous current.

$\omega t = 0$	$0°$	$90°$	$180°$	$360°$	$270°$	
V	0	V_0	$-V_0$	0	$-V_0$	
I	0	I_0	$-I_0$	0	$-I_0$	

Q.12 prove that the average value of Alternating current (A.C) in one cycle is zero.

Q.13. Find the average value of A.C current in half cycle.

Q.14 Why A.C. does not show magnetic effect and chemical effect also?

Q.15. Derive the formula for root mean square value of A.C.

Q.16. A.C. is more dangerous than D.C. why?

Alternating current :- The type of current in which magnitude and direction is continous change this current is Known as Alternating current.

Ans.12. $$I_{average} = \int_0^{2\pi} \frac{I_0 \sin\theta}{2\pi}$$

$$= -\frac{I_0}{2\pi}\left[\cos\theta\right]_0^{2\pi}$$

$$= \frac{-I_0}{2\pi}\left[\cos 2\pi - \cos 0\right]$$

$$= \frac{-I_0}{2\pi}\left[1-1\right]$$

$$= 0$$

Ans. 13 $$I_{average} = \int_0^{\pi} \frac{I_0 \sin\theta}{\pi}$$

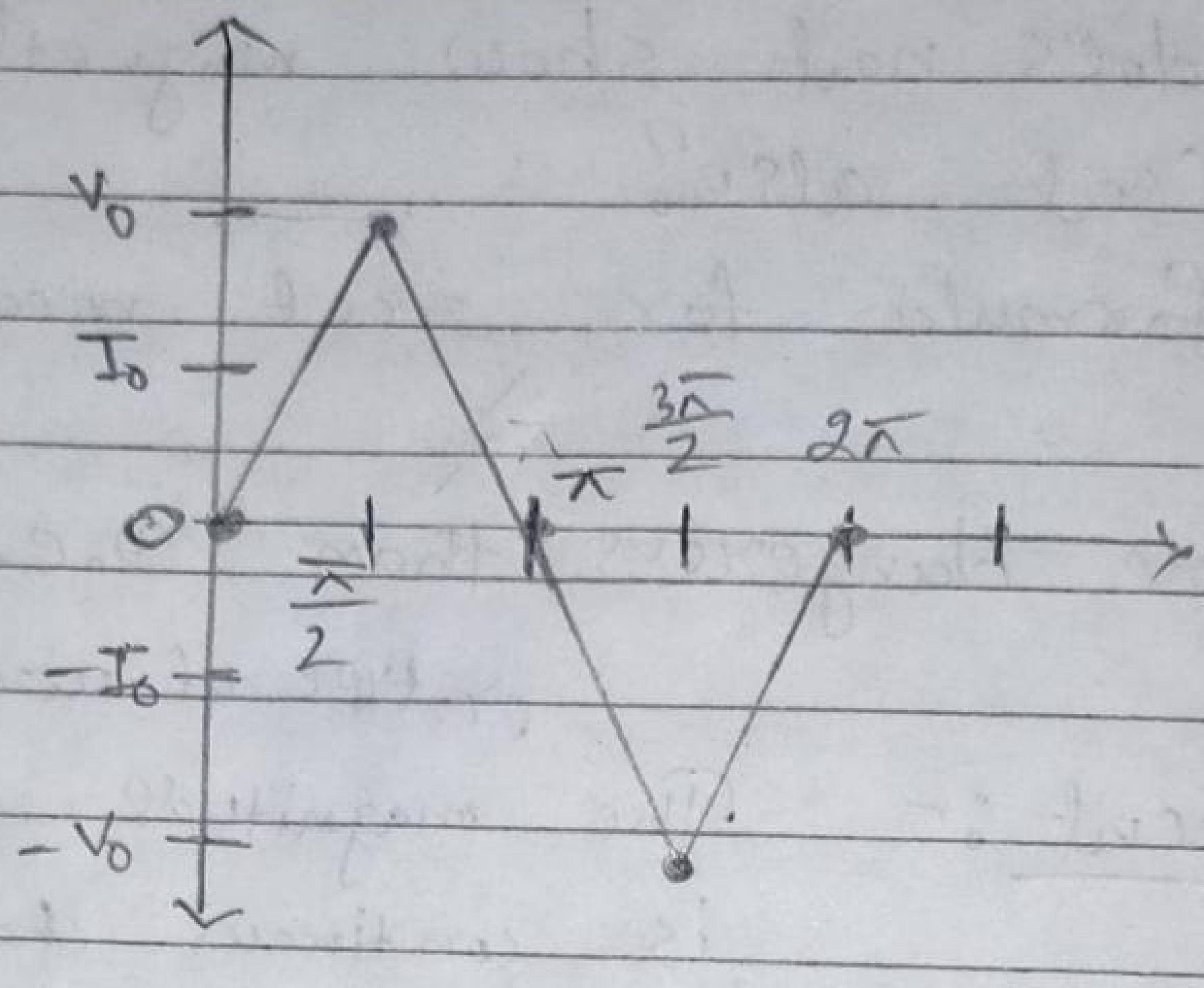
$$= \frac{I_0}{\pi}\left[-\cos\theta\right]_0^{\pi}$$

$$= -\frac{I_0}{\pi}\left[\cos\pi - \cos 0^\circ\right]$$

$$= \frac{-I_0}{\pi}\left[-1-1\right]$$

$$\boxed{I_{average} = \frac{2I_0}{\pi}}$$

Ans. 15. graph of A.C. :-



Magnetic effect for A.C. :-

in graph of A.C., the positive part represt North pole and negative part represent south pole so at position of 2π (complete 1 cycle) ~~posit~~ magnetic effect is zero because positive and negative part cancel each other.

Chemical effect for A.C. :-

in graph of A.C., positive part represent forward reaction and negative part represent backward reaction, when it complete one cycle mean in position of 2π the positive and negative part cancel each other hence also chemical effect is zero.

Ans. 15

Root mean square value $= \sqrt{\int \frac{(I_0 \sin \omega t)^2}{2\pi} d\theta}$

$$= \sqrt{\frac{I_0^2}{2\pi} \int (\sin^2 \omega t)\, d\theta}$$

$$= \sqrt{\frac{I_0^2}{2\pi} \int \sin^2\theta \, d\theta}$$

$$= I_0 \sqrt{\frac{1}{2\pi} \int \sin^2\theta \, d\theta}$$

$\because \cos 2\theta = 1 - 2\sin^2\theta$

$\Rightarrow -2\sin^2\theta = \cos 2\theta - 1$

$\Rightarrow 2\sin^2\theta = 1 - \cos 2\theta$

$\Rightarrow \sin^2\theta = \frac{1 - \cos 2\theta}{2}$

R.m.s. Value $= I_0 \sqrt{\frac{1}{2\pi} \int_0^{2\pi} \frac{1 - \cos 2\theta}{2}\, d\theta}$

$$= I_0 \sqrt{\frac{1}{4\pi} \int_0^{2\pi} (1 - \cos 2\theta)\, d\theta}$$

$$= I_0 \sqrt{\frac{1}{4\pi} \left[\int_0^{2\pi} 1\, d\theta - \int_0^{2\pi} \cos 2\theta \, d\theta\right]}$$

$$= I_0 \sqrt{\frac{1}{4\pi} \left[(\theta)_0^{2\pi} - \left(\frac{\sin 2\theta}{2}\right)_0^{2\pi}\right]}.$$

R.M.S Value $= I_0 \sqrt{\left[\left(\frac{\theta}{4\pi}\right)_0^{2\pi} - \left(\frac{\sin 2\theta}{8\pi}\right)_0^{2\pi}\right]}$

$$= I_0 \sqrt{\frac{2\pi}{4\pi} - \frac{\sin 2(2\pi)}{8\pi}}$$

$$= I_0 \sqrt{\frac{1}{2} - \frac{0}{8\pi}}$$

$$= I_0 \sqrt{\frac{1}{2}}$$

$$\text{R.M.S. value} = \frac{I_0}{\sqrt{2}}$$

Q.17 Define Reactance & Impedance.

Q.18 What is the effect on A.C. when a resistance is containing in A.C source?

Q.19. What is the effect on A.C. when a capacitance is containing in A.C. source?

Q.20 What is the effect on A.C. when a inductance is containing in A.C. source?

Ans. 17. Reactance & Impedance is the type of resistance with S.I unit ohm (Ω).

<u>representation</u>:-

Reactance → (X)
Impedance → (Z)

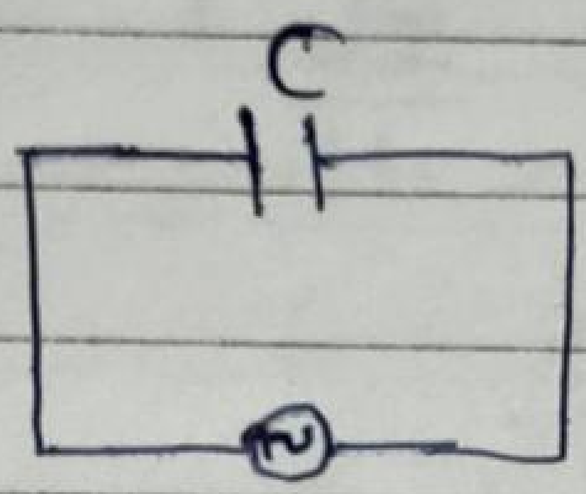
\# <u>Reactance</u> :- The resistance due to capacitance and Inductance is called Reactance.

\# <u>Impedance</u> :- The resistance due to ~~the~~ two or three ~~parameters~~ factors (Resistance, capacitance, inductance) that resistance is called Impedance.

Ans. 18 In A.C. there is no effect ~~by~~ the resistance.

D.C. is affected by the resistance.

Ans. 19



$\Rightarrow \quad V = V_0 \sin \omega t$

$$\because \quad I = \frac{dq}{dt}$$

$$= \frac{d(CV)}{dt}$$

$$= C\frac{dV}{dt}$$

$$= C\frac{d}{dt}(V_0 \sin \omega t)$$

$$= CV_0 \frac{d \sin \omega t}{dt}$$

$$= CV_0 (\omega \cos \omega t)$$

$$= \omega C V_0 \cos \omega t$$

$$= I_0 \cos \omega t$$

$$\Rightarrow \boxed{I = I_0 \sin\left(\omega t + \frac{\pi}{2}\right)}$$

In A.C. (source) when we connect ~~capacitance~~ capacitor then the current is ~~increasing~~ leading by $\frac{\pi}{2}$ phase diff.

$\Rightarrow \quad I = I_0 \sin\left(\omega t + \frac{\pi}{2}\right)$

where, $\quad I_0 = \omega C V_0$

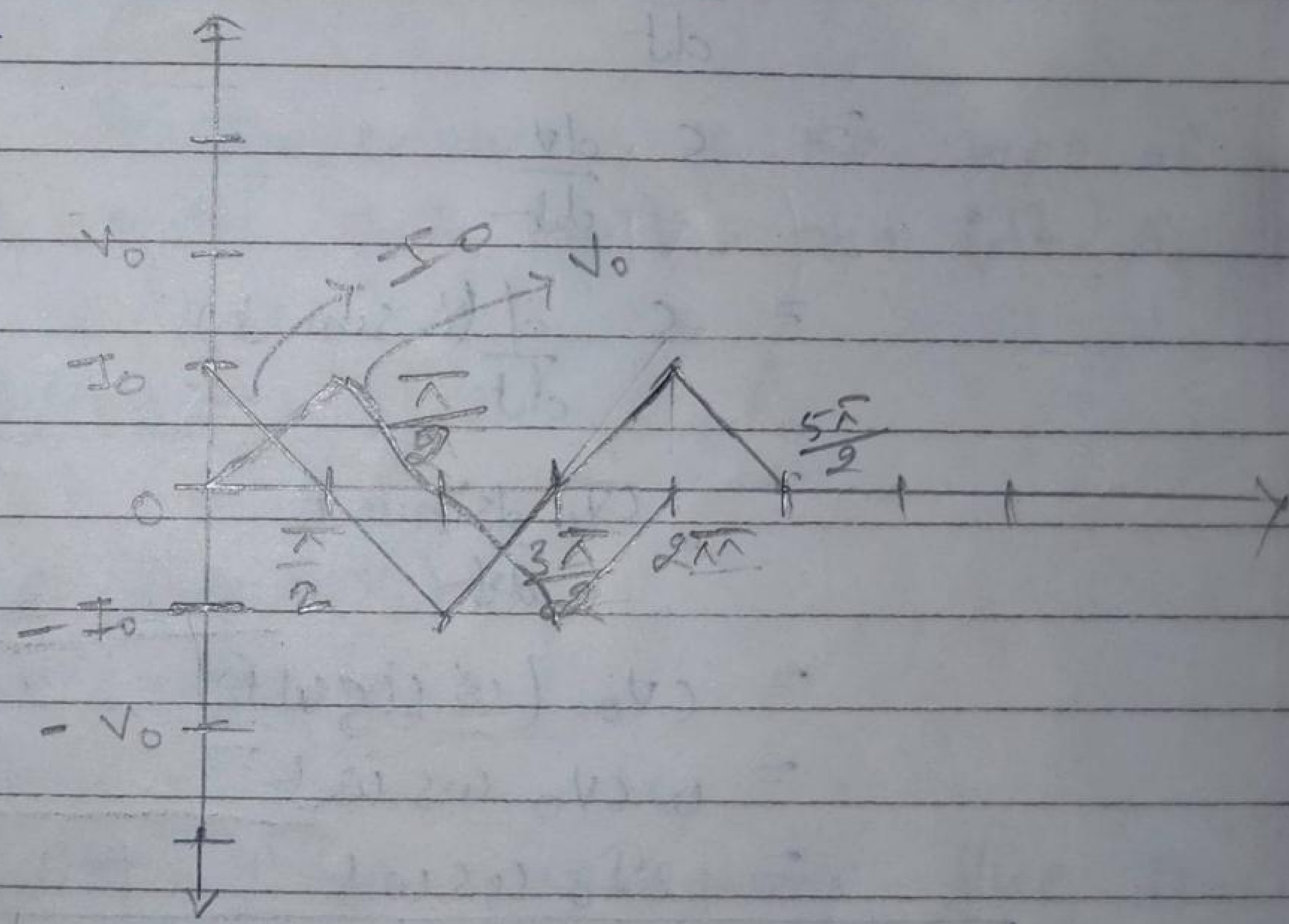
$\Rightarrow \quad \frac{I_0}{V_0} = \omega C$

$\Rightarrow \quad \frac{V_0}{I_0} = \frac{1}{\omega C}$

$\Rightarrow \quad \frac{V_0}{I_0} = \frac{1}{\omega C} = X_c$

$\Rightarrow \quad X_c = \frac{1}{\omega C} \quad$ (capacitive reactance.)

graph :-



Ans. 2a) $\because \quad V = e = L\dfrac{dI}{dt}.$

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

$\Rightarrow \quad V = L\dfrac{dI}{dt}$

$\Rightarrow \quad V = L\dfrac{d}{dt} I_0 \sin\omega t$

$\Rightarrow \quad V = L I_0 \cancel{\sin}(\cos\omega t)\,\omega$

$\Rightarrow \quad V = \omega L I_0 \cos\omega t$

$\Rightarrow \quad V = \omega L I_0 \sin(\omega t + 90^\circ)$

$\Rightarrow \quad V = V_0 \sin(\omega t + 90^\circ)$

In A.C. source when we connect inductor the the Potential diff. is leading by $\frac{\pi}{2}$ phase diff.

$\because \quad V = \dfrac{d\,LI}{dt}$

$\Rightarrow \quad \int V_0 \sin\omega t = LI$

$\Rightarrow \quad V_0\left[\dfrac{-\cos(\omega t)}{\omega}\right] = LI$

$\Rightarrow \quad -\dfrac{V_0}{\omega L}\cos\omega t = I$

$\Rightarrow \quad I = -I_0 \sin\left(\omega t + \dfrac{\pi}{2}\right)$

or

$\Rightarrow \quad I = I_0 \sin\left(\dfrac{3\pi}{2} - \omega t\right)$

$$\Rightarrow \frac{-V_0}{\omega L} \cos\omega t = I$$

$$\Rightarrow I = -I_0 \cos\omega t$$

$$\Rightarrow I = I_0 \sin(\omega t - 90^\circ)$$

$$\Rightarrow I = I_0 \sin(\omega t - 90^\circ)$$

Q.21 Why D.C. does not flowing through the capacitor but easily flows through the inductor why?

Ans.

Capacitive Reactance $(X_C) = \frac{1}{\omega C}$

ω (frequency) is zero in D.C.

$$X_C = \frac{1}{(0)C}$$

$$X_C = \frac{1}{0}$$

$$X_C = \infty$$

Resistance is infinity ~~in capacit~~ ~~D.C~~ through the conductor while D.C., therefore current can not easily flow.

$\Rightarrow$ inductive Reactance $(X_L) = \omega L$

$$= 0 L$$

$$= 0$$

Resistance $= 0$.

Resistance is zero ~~the~~ in inductance therefore current can flow easily through inductance while current is D.C.

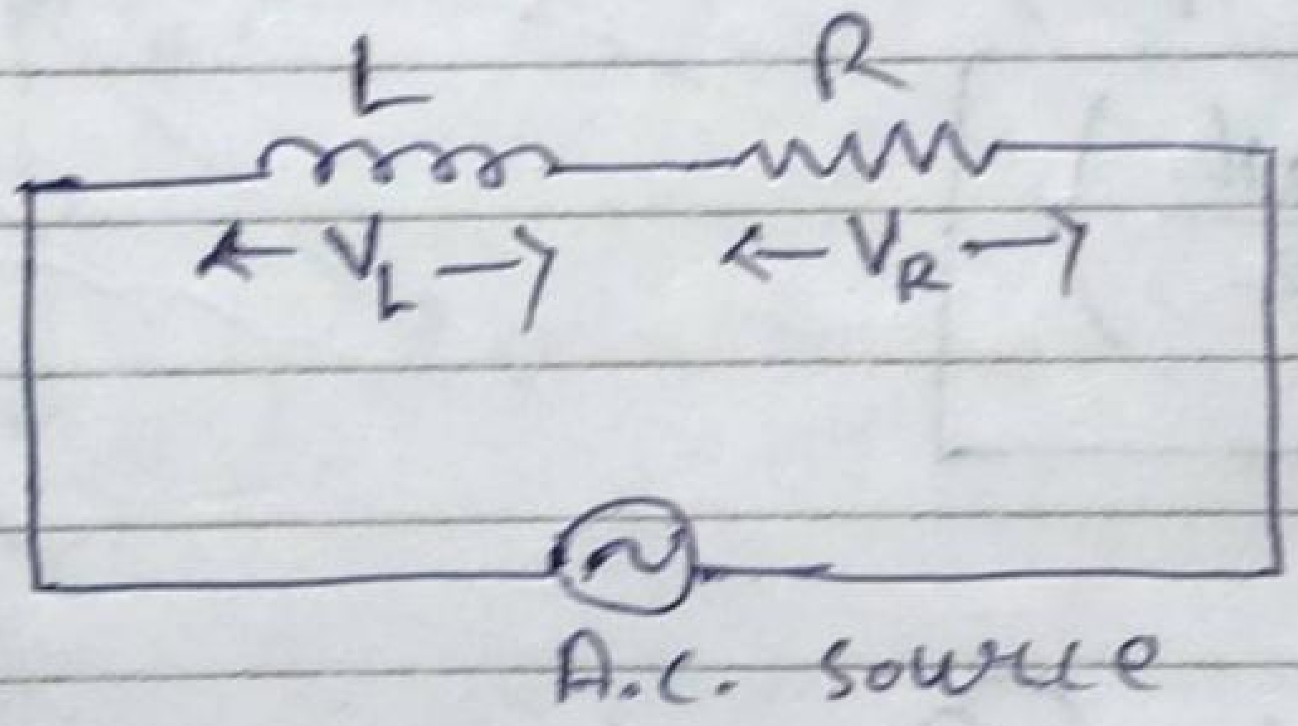
Q.22 What is L-R circuit? Derive the expression for impedance, maximum current and phase diff.

Q.23. What is C-R circuit? Derive the expression for the impedance, maximum current and phase diff.

Q.24 what is L-C circuit? Derive the expression for the impedance, maximum current and phase diff.

Q.25 what is L-C-R circuit? Derive the expression for impedance, maximum current and phase diff.

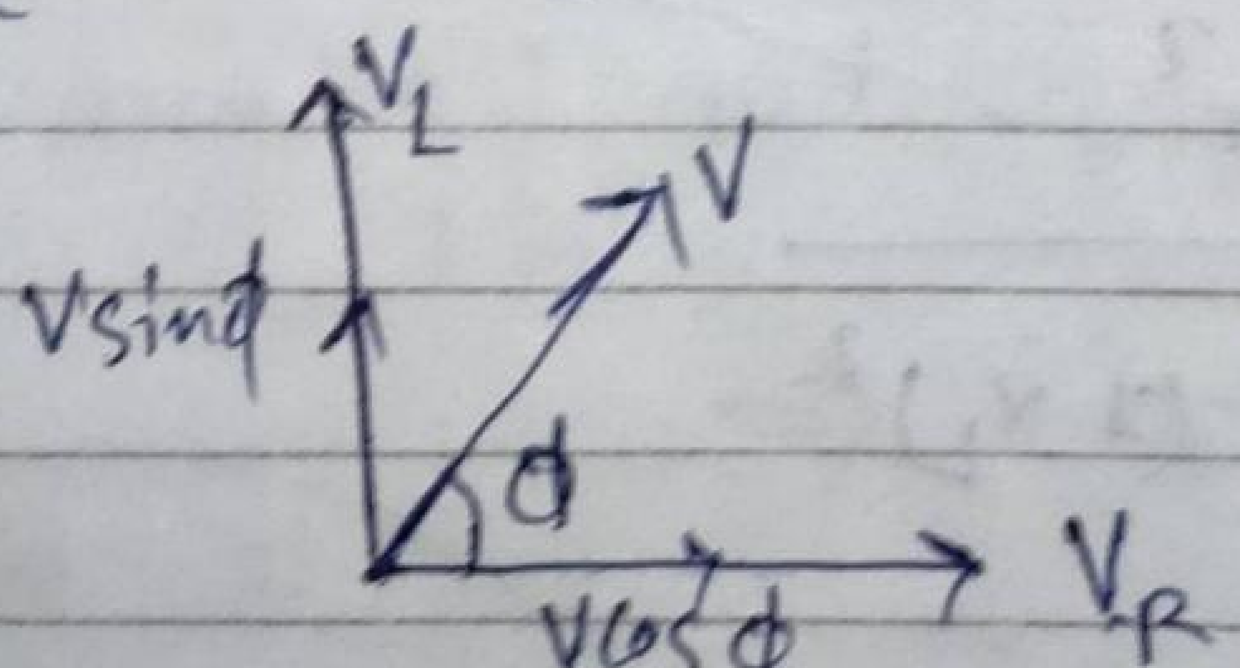
Ans.22.



$V_R = IR$

$V_L = IX_L$

$V_c = IX_C$



$$V_L = V\sin\phi \rightarrow (i)$$
$$V_R = V\cos\phi \rightarrow 2$$

Dividing (i) / (ii)

$$\Rightarrow \frac{V_L}{V_R} = \frac{V\sin\phi}{V\cos\phi}$$

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

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

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

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

$$\Rightarrow \boxed{\phi = \tan^{-1}\left(\frac{\omega L}{R}\right)}$$

Squaring and Adding (i) and (ii),

$$\Rightarrow V_L^2 + V_R^2 = V^2$$

$$\Rightarrow V = \sqrt{V_L^2 + V_R^2}$$

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

$$\Rightarrow \frac{V}{I} = \sqrt{R^2 + X_L^2}$$

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

Impedance

and,

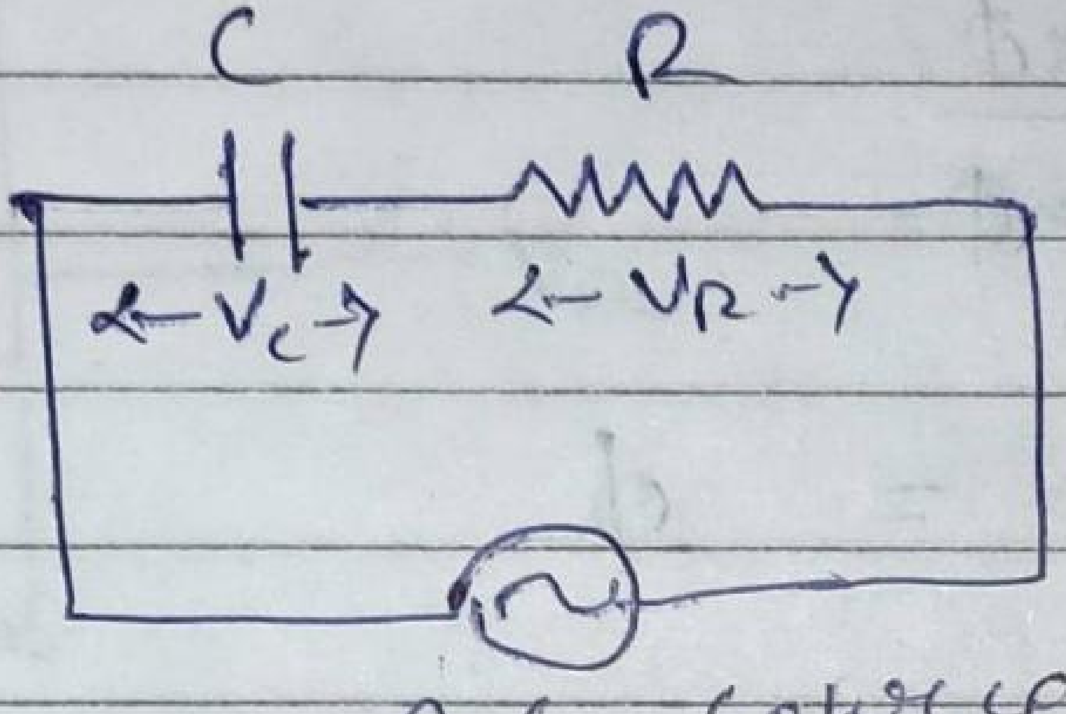
$$\Rightarrow \boxed{\text{Impedance } (Z) = \sqrt{R^2 + X_L^2}}$$

and,

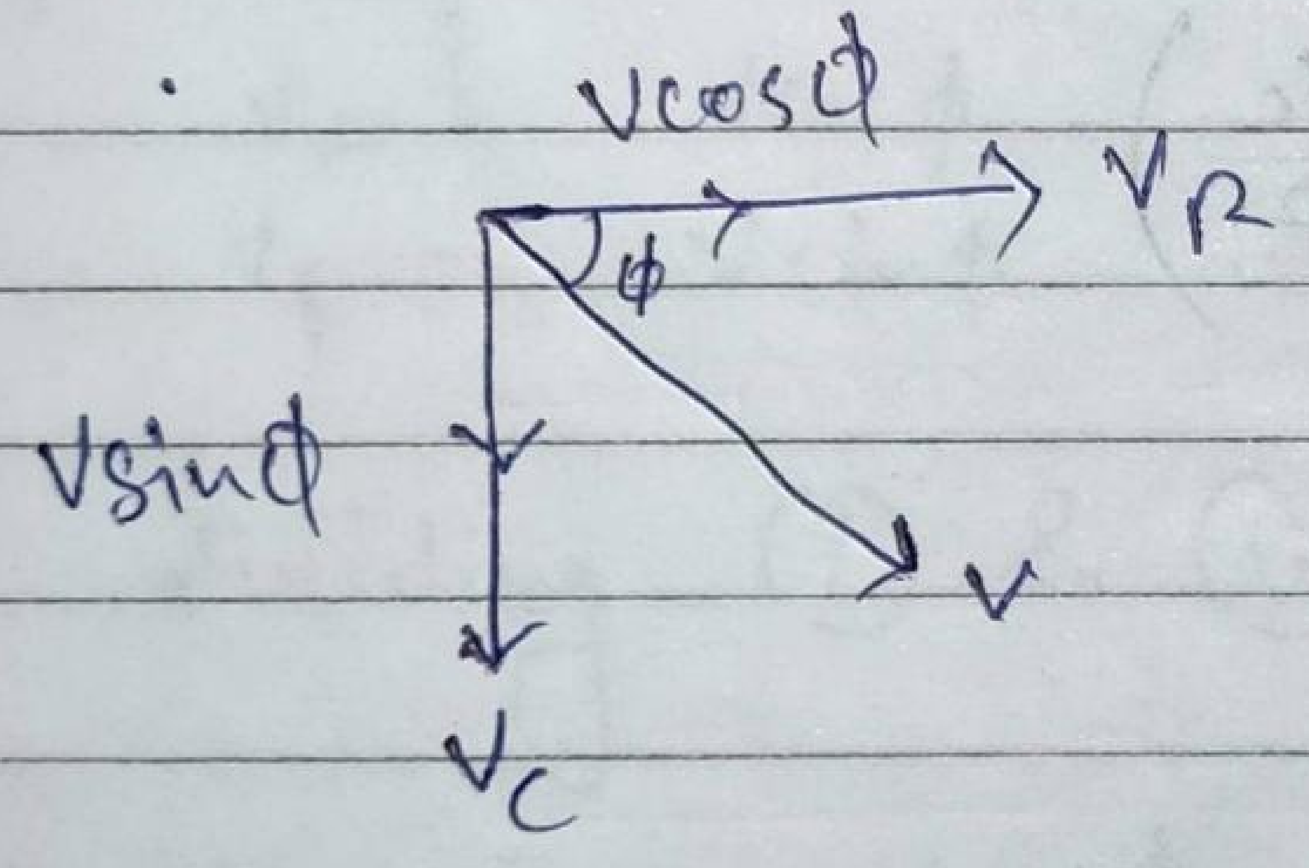
current $(I_0) = \dfrac{V_0}{R} = \dfrac{V_0}{Z}$

$$\boxed{I_0 = \frac{V_0}{\sqrt{R^2 + X_L^2}}}$$

Ans-23 ⟩



A.C. source



$V_R = IR$

$V_C = I X_C$

$V_L = I X_L$

- $V_R = V\cos\phi \rightarrow$ ①

$V_C = V\sin\phi \rightarrow$ ②

squaring and adding eqn ① & ②

$$\Rightarrow V_R^2 + V_C^2 = V^2$$

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

$$\Rightarrow \frac{V}{I} = \sqrt{R^2 + X_c^2}$$

$$\Rightarrow \boxed{Z = \sqrt{R^2 + X_c^2}}$$

dividing (i) & (ii),

$$\Rightarrow \frac{V_R}{V_C} = \frac{V\cos\phi}{V\sin\phi}$$

$$\Rightarrow \tan^{-1}\left(\frac{V_C}{V_R}\right) = \phi$$

$$\Rightarrow \phi = \tan^{-1}\left(\frac{IX_c}{IR}\right)$$

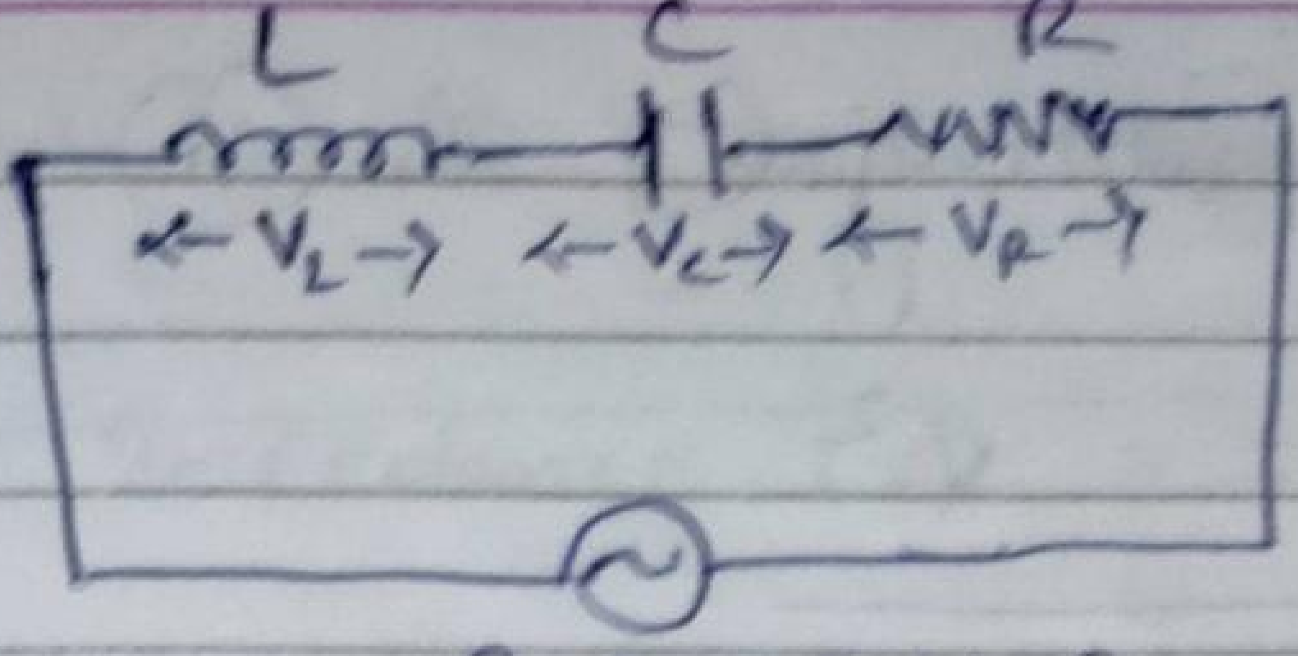
$$\Rightarrow \boxed{\phi = \tan^{-1}\left(\frac{X_c}{R}\right)}$$

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

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

$$\boxed{I = \frac{V}{\sqrt{R^2 + X_c^2}}}$$

Ans.25:



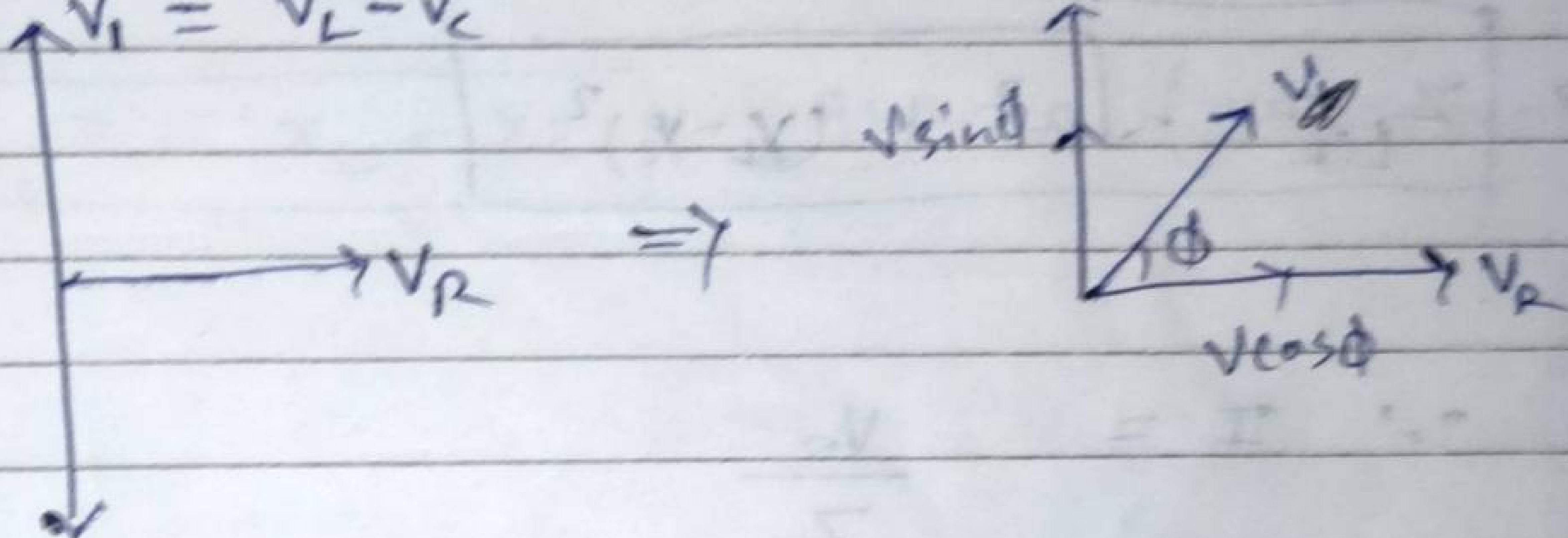
A.C. source.

$V_R = IR$

$V_C = IX_C$

$V_L = IX_L$

$V_1 = V_L - V_C$



$\Rightarrow \quad V_R = V\cos\phi \longrightarrow (1)$

$\Rightarrow \quad V_1 = V\sin\phi \longrightarrow (2)$

dividing (i) & (ii),

$\Rightarrow \quad \frac{V_R}{V_1} = \frac{V\cos\phi}{V\sin\phi}$

$\Rightarrow \quad \phi = \tan^{-1}\left(\frac{V_1}{V_R}\right)$

$\Rightarrow \quad \phi = \tan^{-1}\left(\frac{V_L - V_C}{V_R}\right)$

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

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

squarring and adding (i) & (ii)

$$\Rightarrow V_1^2 + V_R^2 = V^2$$

$$\Rightarrow V = \sqrt{V_R^2 + V_1^2}$$

$$\Rightarrow V = \sqrt{(IR)^2 + (X_L - X_C)^2}$$

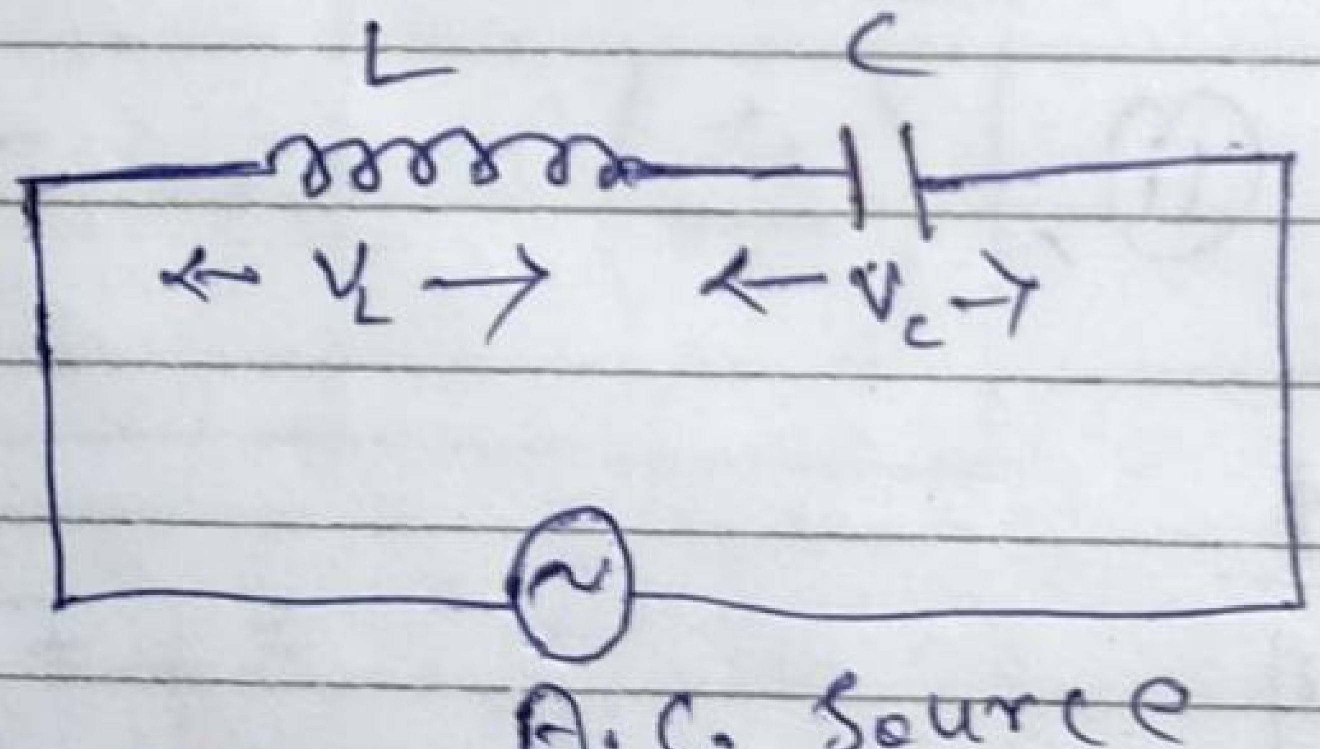
$$\Rightarrow \frac{V}{I} = \sqrt{R^2 + (X_L - X_C)^2}$$

$$\Rightarrow \boxed{Z_{LCR} = \sqrt{R^2 + (X_L - X_C)^2}}$$

$$\because I = \frac{V_0}{Z}$$

$$\boxed{I = \frac{V_0}{\sqrt{R^2 + (X_L - X_C)^2}}}$$ Ans.

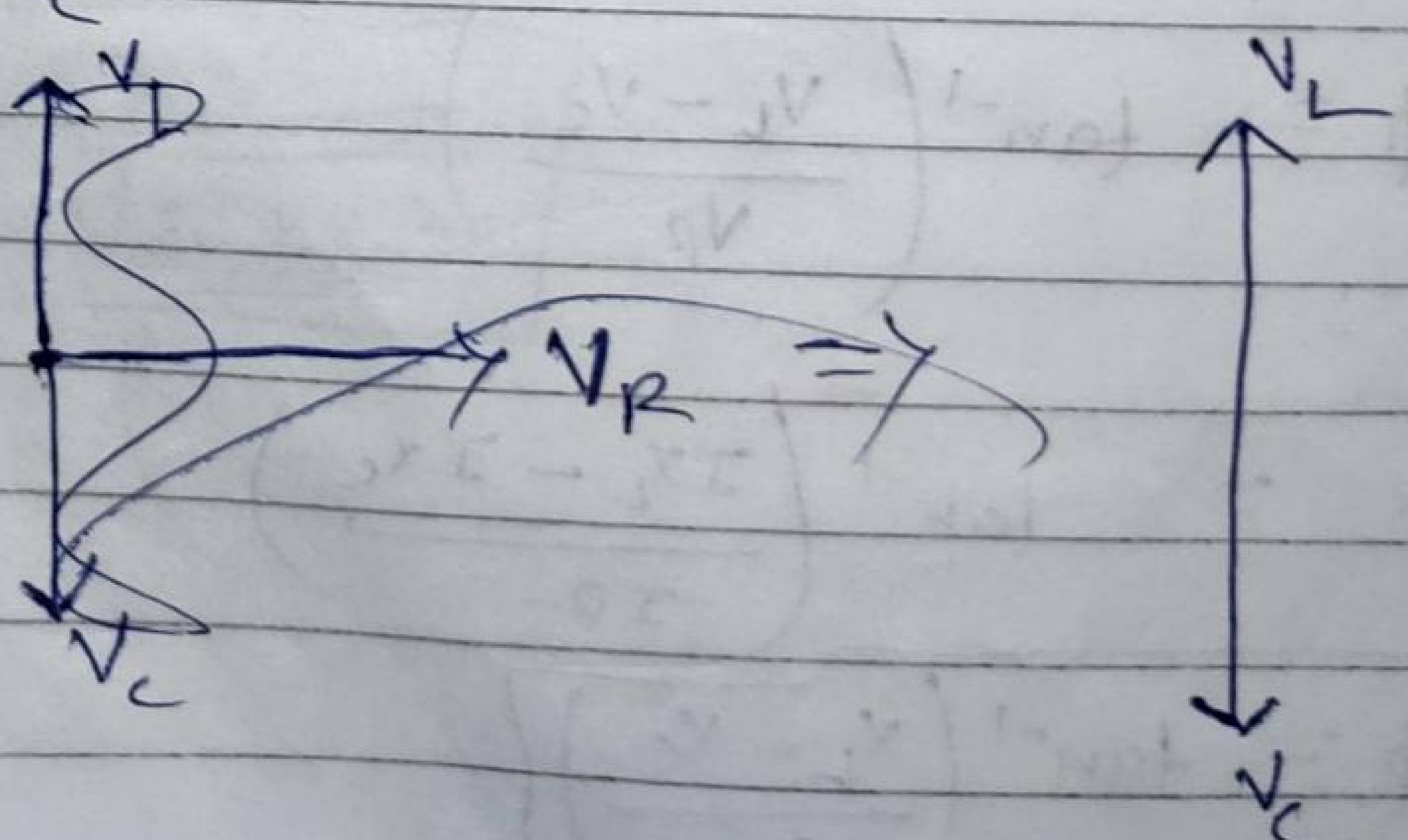
Ans. 24)



$V_R = IR$

$V_L = IX_L$

$V_C = IX_C$



$\Rightarrow V_R = V_L - V_C$.

$\Rightarrow V_R = IX_L - IX_C$

$\Rightarrow \frac{V_R}{I} = X_L - X_C$

$\Rightarrow \boxed{Z = X_L - X_C}$ <u>Ans.</u> (Impedence)

Q.26 What is Resonance circuit, Resonance current, Resonance frequency, Condition for Resonance.

Q.27 Derive the formula for resonance frequency.

Q.28 Write the principle of choke coil and derive the formula for power ~~D.C.~~ Dissipiate.

Ans.26. <u>Resonance current :-</u> The maximum current flowing in L.C.R circuit is called Resonance current.

<u>Condition for Resonance :-</u>

$$\Rightarrow \boxed{X_L - X_C = 0}$$

<u>Resonance frequency :-</u>

$$\Rightarrow X_L - X_C = 0$$
$$\Rightarrow X_L = X_C$$
$$\Rightarrow \omega L = \frac{1}{\omega C}$$
$$\Rightarrow \omega^2 = \frac{1}{LC}$$
$$\Rightarrow \omega = \frac{1}{\sqrt{LC}}$$

$$\because \omega = \frac{\theta}{t} = \frac{2\pi}{T} = 2\pi\nu$$

$\because \omega = 2\pi\nu$

$\Rightarrow \omega = \frac{1}{\sqrt{LC}}$

$\Rightarrow 2\pi\nu = \frac{1}{\sqrt{LC}}$

$\Rightarrow \boxed{\nu = \frac{1}{2\pi\sqrt{LC}}}$ This is called Resonance frequency.

Resonance circuit :- In L.C.R circuit, the phase difference b/w Voltage (V) and current (I) is zero or constant. this circuit is called Resonance circuit.

Ans.28) **Principle of choke coil :-** A pure inductor is used to control the alternating current.

formula for power dissipiate :-

$\Rightarrow P = VI$

$= V_o \sin\omega t \; I_o \sin(\omega t - \frac{\pi}{2})$

$= \frac{V_o I_o}{2} \, 2\sin\omega t \sin(\omega t - \frac{\pi}{2})$

$= \frac{V_o I_o}{2} \left[\cos\left\{\omega t - \left(\omega t - \frac{\pi}{2}\right)\right\} - \cos\left(\omega t + \omega t - \frac{\pi}{2}\right)\right]$

$\left[\because 2\sin A \sin B = \cos(A-B) - \cos(A+B)\right]$ is called potential

esented by "V", SI

$$= \frac{V_0 I_0}{2}\left[\cos\frac{\pi}{2} - \cos\left(2\omega t - \frac{\pi}{2}\right)\right]$$

$$= \frac{V_0}{\sqrt{2}} \cdot \frac{I_0}{\sqrt{2}}\left[\cos\frac{\pi}{2} - \cos\left(2\omega t - \frac{\pi}{2}\right)\right]$$

$$= V_{r.m.s} \cdot I_{r.m.s}\left[\cos\frac{\pi}{2} - \cos\left(2\omega t - \frac{\pi}{2}\right)\right]$$

$$= V_{r.m.s}\, I_{r.m.s}\left[\cos\frac{\pi}{2} - \cos\left(\omega t + \omega t - \frac{\pi}{2}\right)\right]$$

$$= V_{r.m.s}\, I_{r.m.s}\left[\cos\frac{\pi}{2} - \cos\left(2\omega t - \frac{\pi}{2}\right)\right]$$

$$= V_{r.m.s}\, I_{r.m.s}\left[\cos\frac{\pi}{2} + \cos\left(\frac{\pi}{2} - 2\omega t\right)\right]$$

$$\left[\because \cos(-\theta) = \cos\theta\right]$$

Average of $\cos\left(\frac{\pi}{2} - 2\omega t\right)$ is zero when completed full cycle.

$$\boxed{P = V_{r.m.s}\, I_{r.m.s}\left(\cos\frac{\pi}{2}\right)}$$

$$P = V_{r.m.s}\, I_{r.m.s}\,(0)$$

$$\boxed{P = 0}$$

There is no power dissipiate in which pure inductor is used.

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