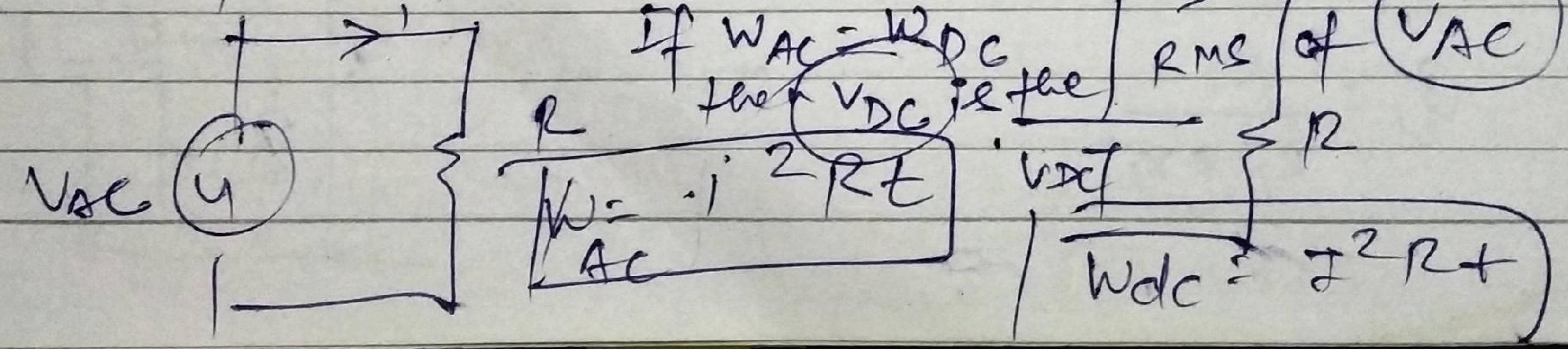
RMS value :

→ RMS value is defined based on the heating effect of the waveform.

→ The voltage at which heat dissipation in the ac ckt is equal to the heat dissipated in the dc ckt is called as RMS value provided both ac and dc have equal value of resistance and are operated for the same time.



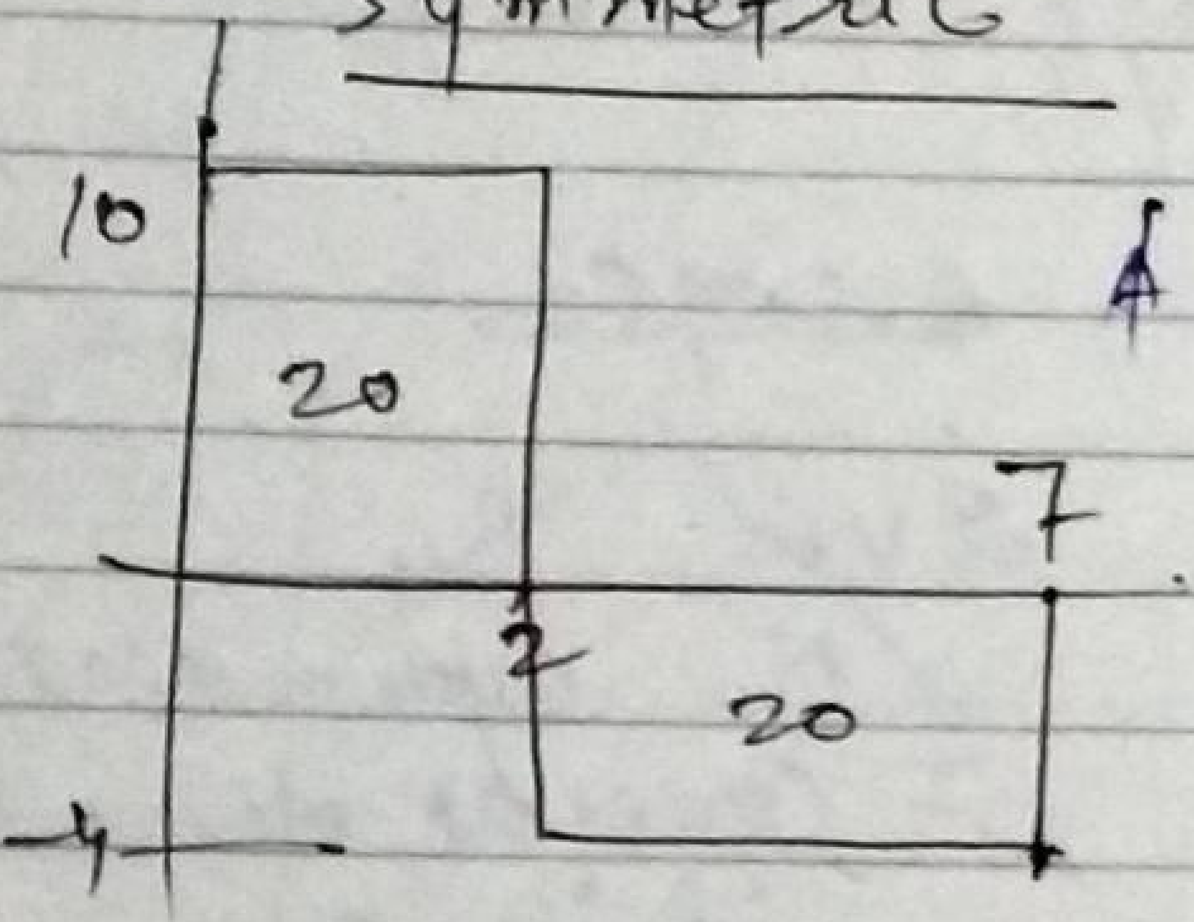
$$V_{RMS} = \sqrt{\left(\frac{1}{T}\int_0^T v^2 dt\right)} = \sqrt{\frac{1}{2\pi}\int_0^{2\pi} v^2 d\omega t}$$

Average Value :

→ It is based on the charge transfer in the ckt

→ The voltage at which charge transfer in an AC ckt is equal to the charge transfer in the dc ckt is called as Average value provided both AC and DC have equal value of Resistances and are operated for same time interval.

Symmetric

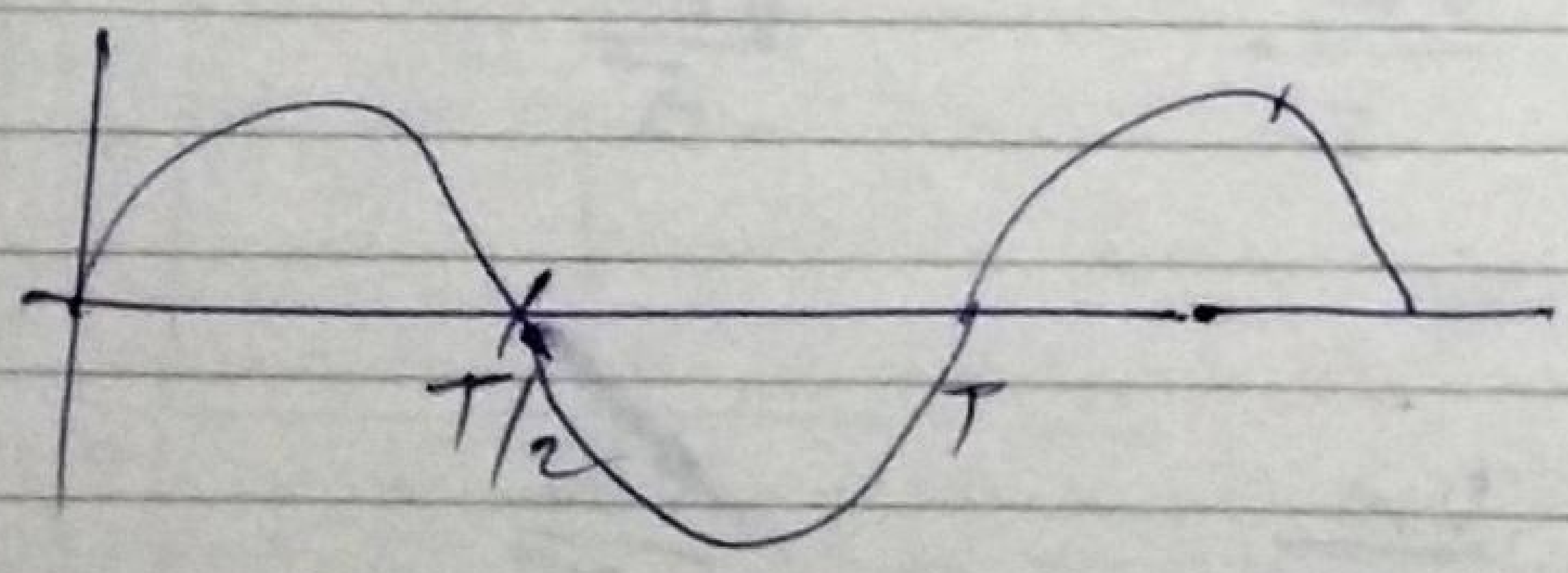


$|A_1| = |A_2|$ symmetric

$$V_{av} = \frac{1}{T/2}\int_0^{T/2} V dt$$

half cycle

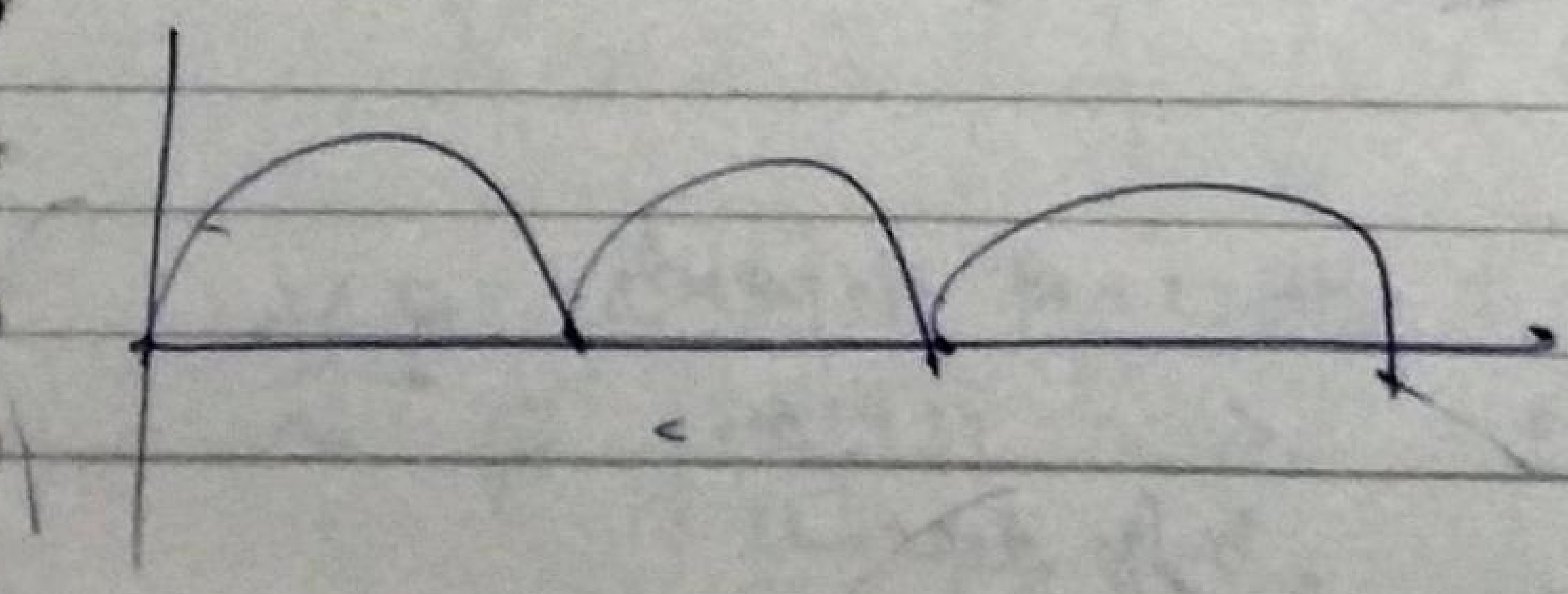
= 0 → full cycle



$$V_{av} = \frac{2}{\pi}\int_0^{\pi} V_m \sin\omega t \, (d\omega t)$$

$$V_{av} = \frac{V_m}{\pi}\left[-\cos\omega t\right]_0^{\pi}$$

$\boxed{V_{av} = \frac{2V_m}{\pi}}$



(a) 0

(b) $\frac{V_m}{\sqrt{2}}$

(c) $\frac{V_m}{\sqrt{3}}$

(d) $\frac{2V_m}{\pi}$

Unsymmetric -

$$\boxed{V_{av} = \frac{1}{T}\int_0^T v\,dt}$$

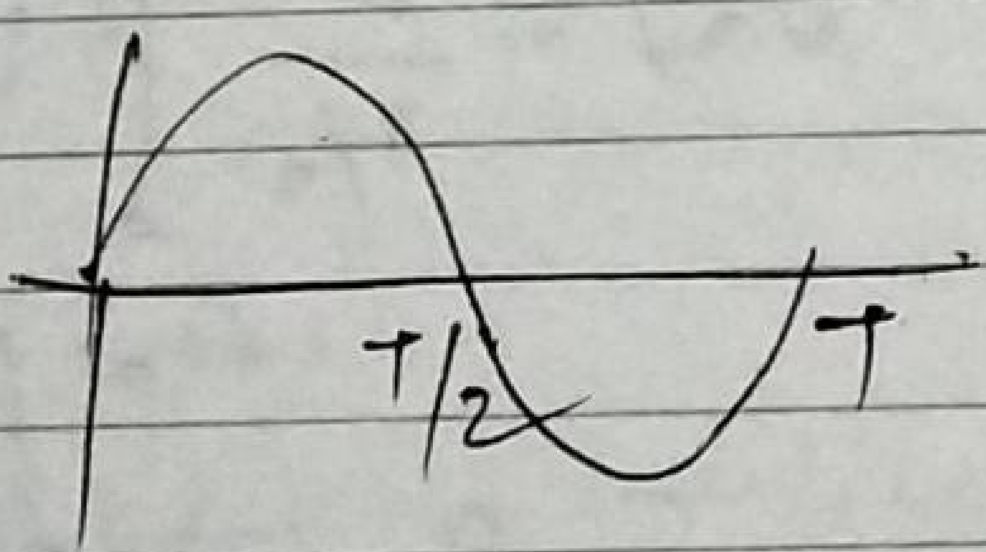
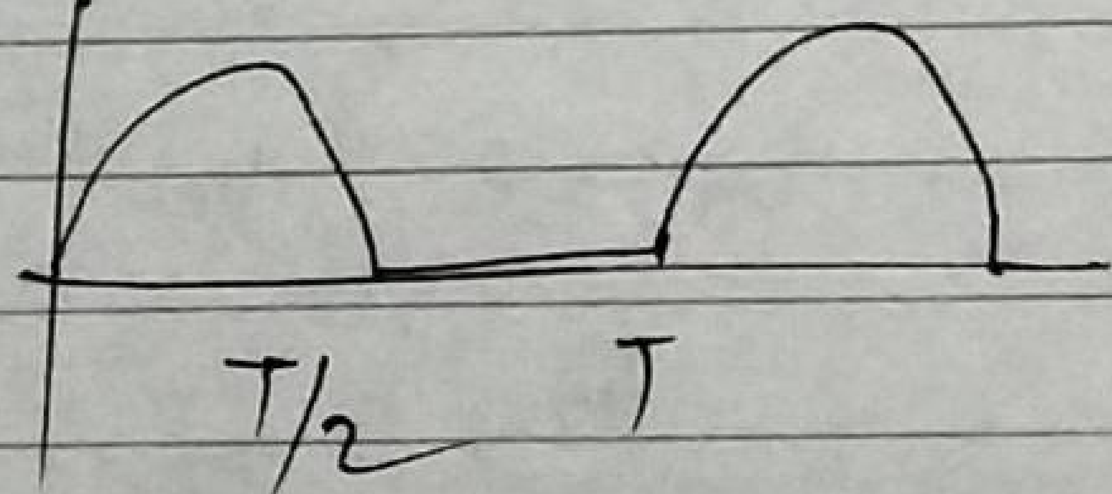
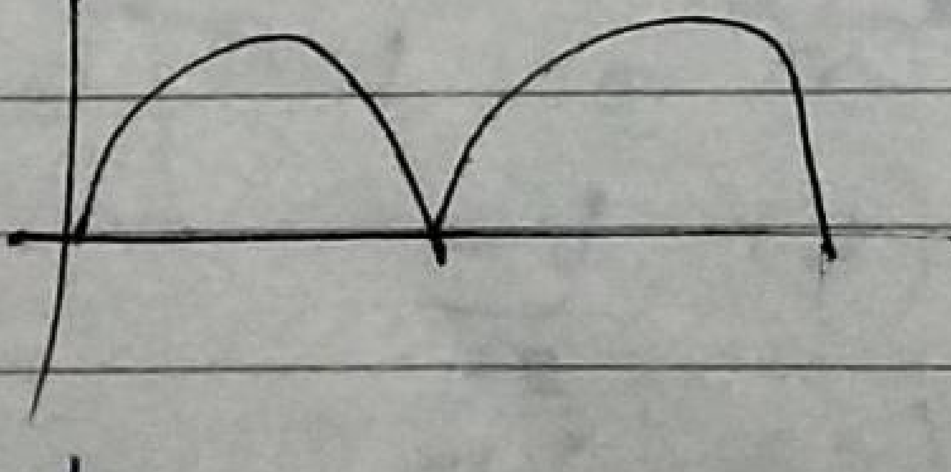
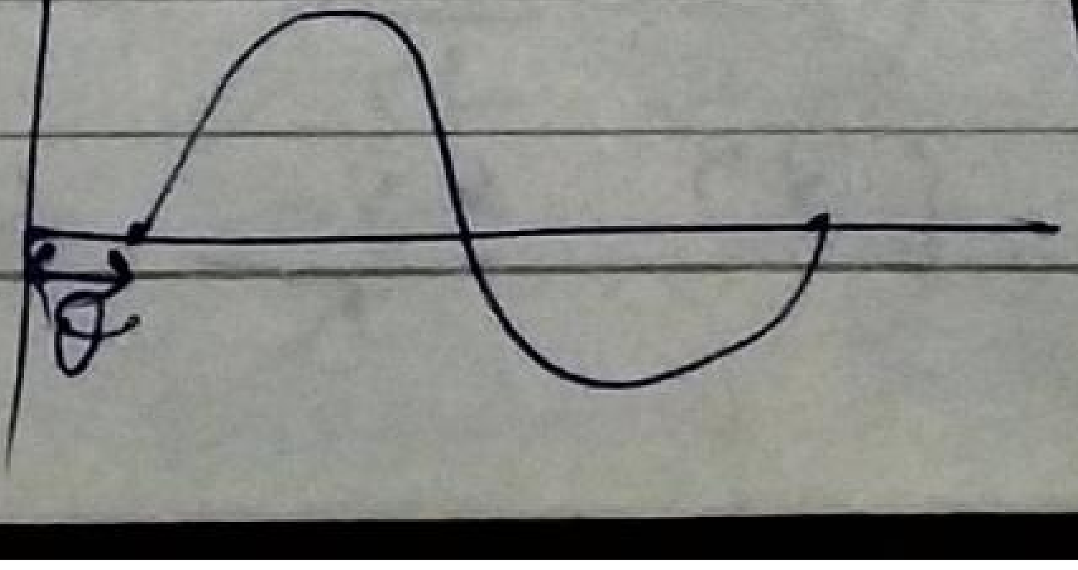
Form Factor :

→ It is the ratio of RMS value of the waveform to the average value of the waveform.

· Peak Factor :

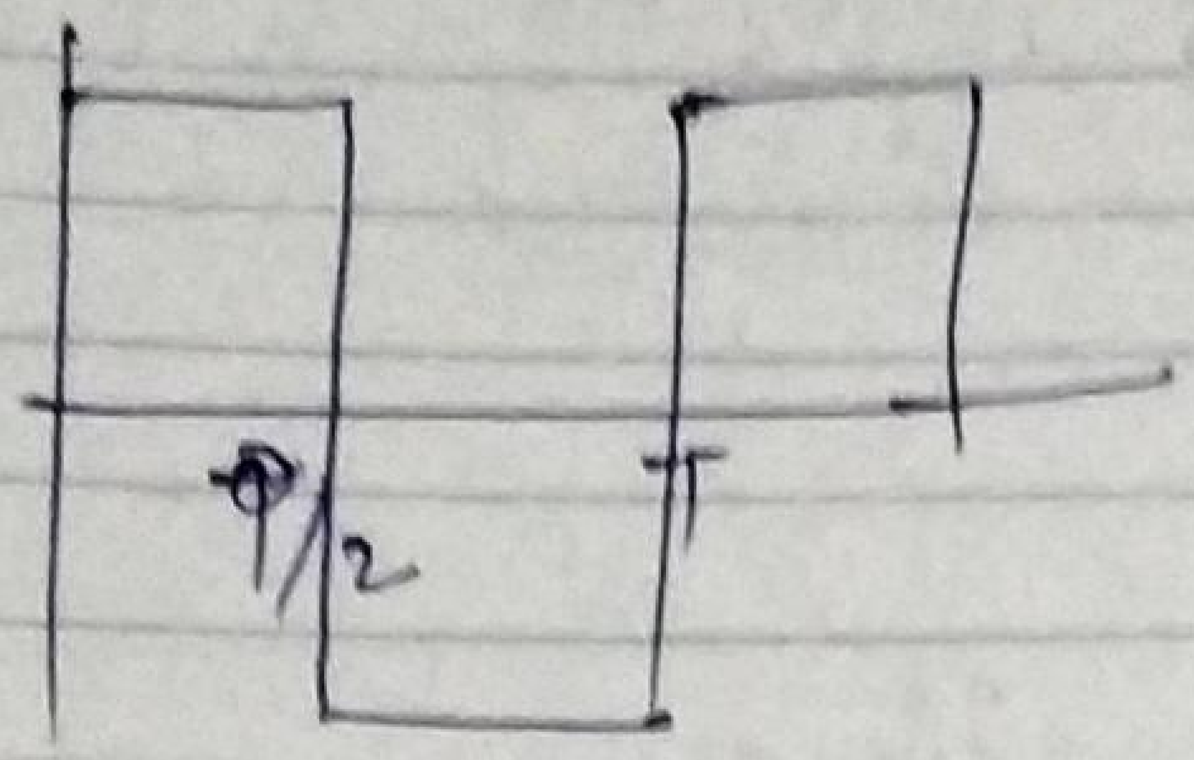
→ It is the ratio of Max. value of the waveform to RMS value of the waveform.

Calculate the RMS and Average values for the given w/F

		RMS	Average
(1)		$\frac{V_m}{\sqrt{2}}$	$\frac{2V_m}{\pi}$ By symmetric concept otherwise it is 0.
(2)		$\frac{V_m}{2}$	$\frac{V_m}{\pi}$
(3)		$\frac{V_m}{\sqrt{2}}$	$\frac{2V_m}{\pi}$
(4)		$\frac{V_m}{\sqrt{2}}$ does not depends. One shifting Only depends on heating.	$\frac{2V_m}{\pi}$

	RMS	Average
5	V_m	V_m
6	$\frac{V_m}{\sqrt{2}}$	$\frac{V_m}{2}$
7	$\frac{V_m}{\sqrt{3}}$	$\frac{V_m}{2}$
8	$\frac{V_m}{\sqrt{3}}$	$\frac{V_m}{2}$

5



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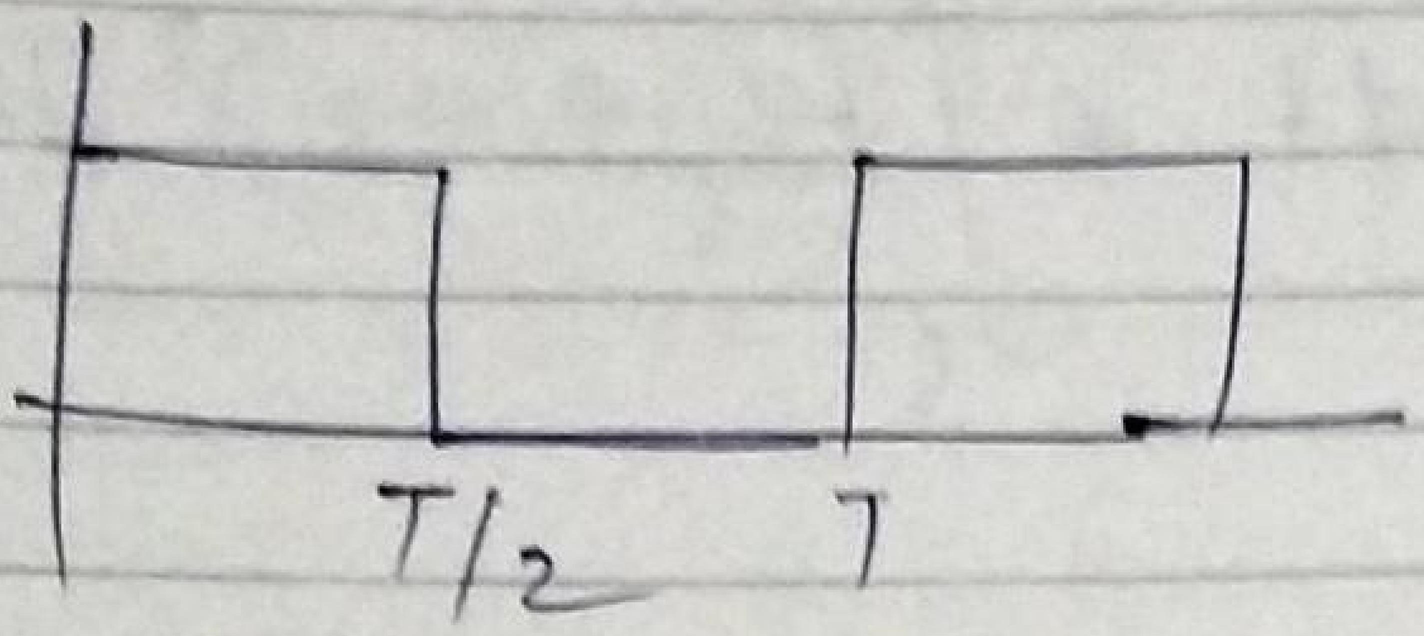

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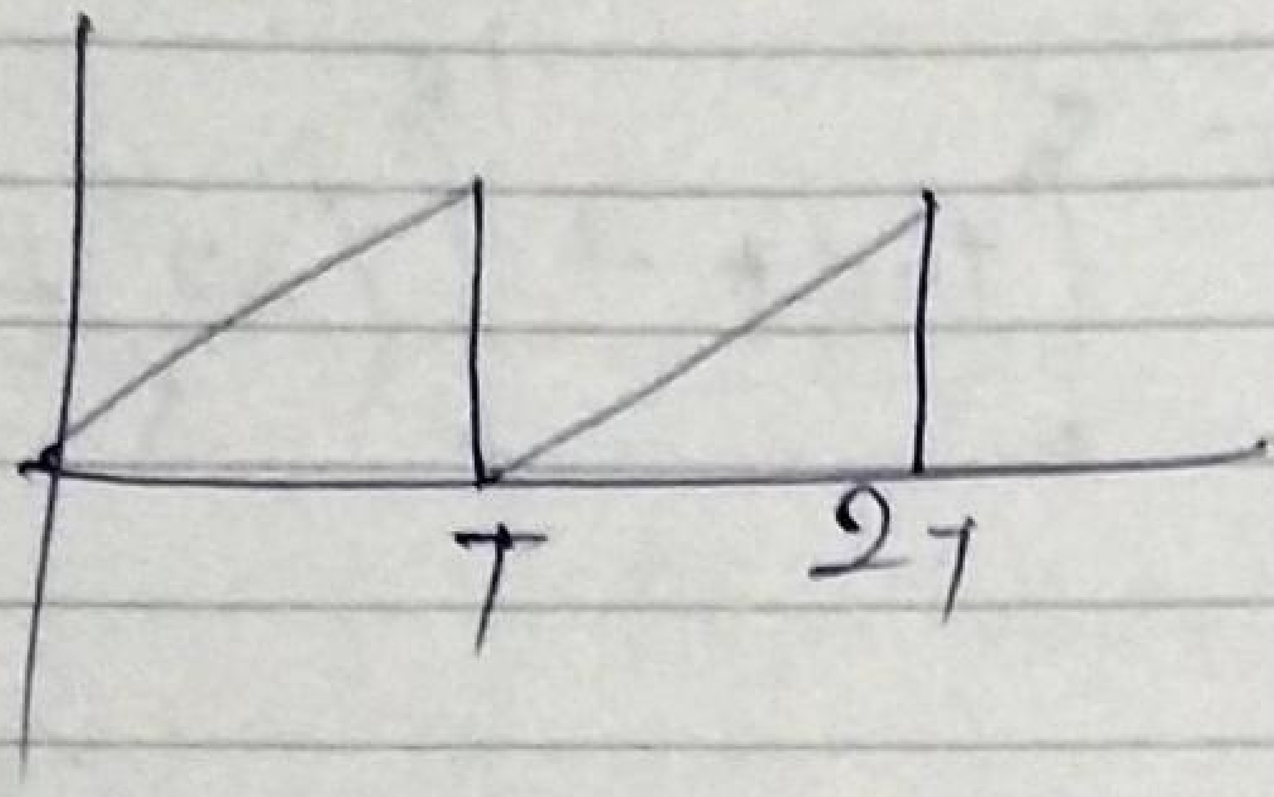

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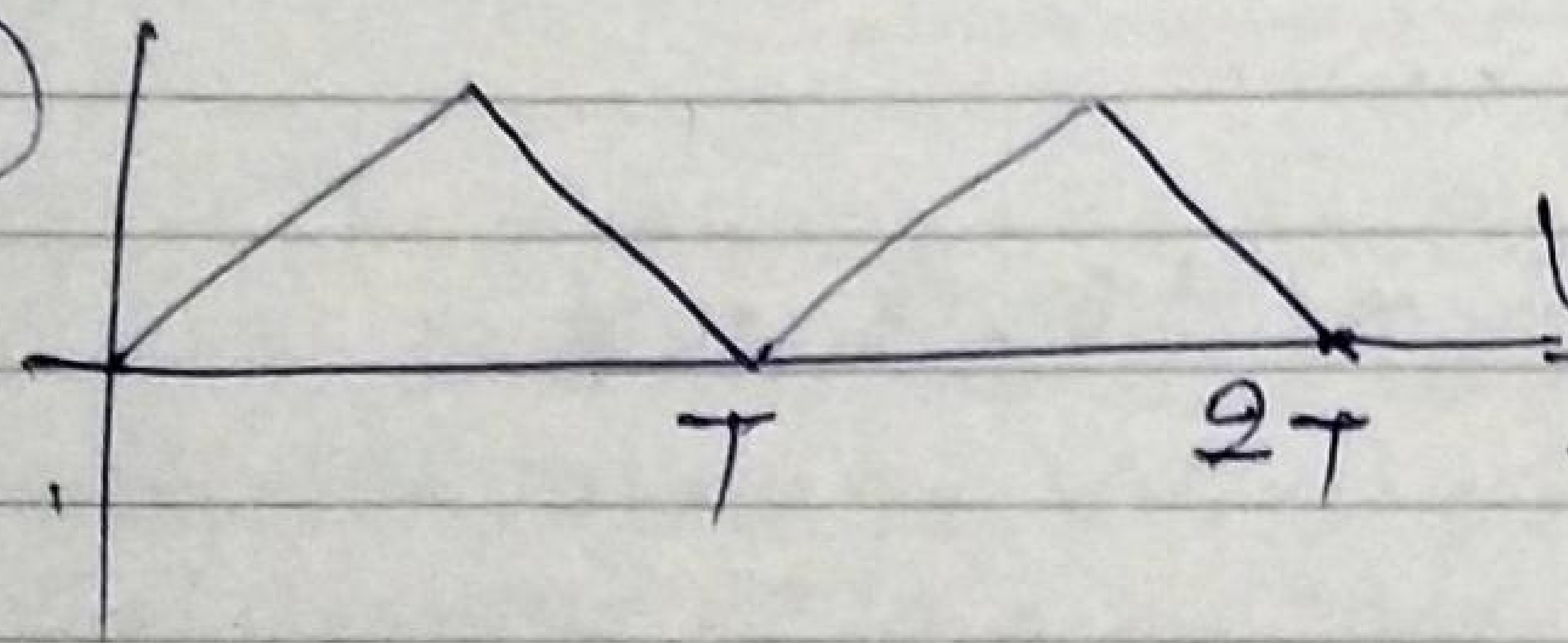

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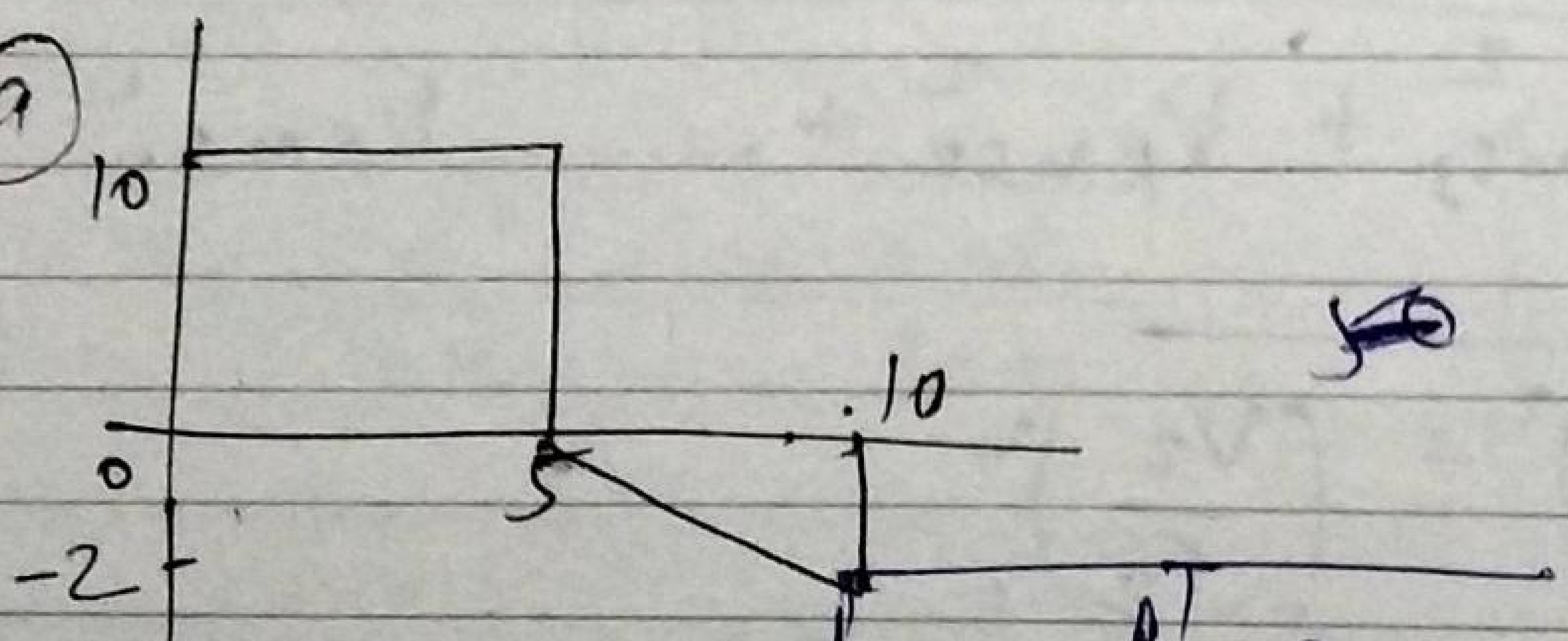


$$V_{rms} = \sqrt{\frac{1}{T}\int_0^T V^2 \, dt}$$

$v(t) = 10 \quad 0 \le t \le 5$

$y = mx + c$

$v(t) = -\frac{2}{5}t + c$ at $t = 5$ $v(t) = 0$

$0 = -\frac{2}{5}(5) + c$ $\boxed{c = 2}$

$v(t) = -\frac{2}{5}t + 2$

$$V_{rms} = \sqrt{\frac{1}{10}\left[\int_0^5 (10)^2 dt + \int_5^{10} \left(-\frac{2}{5}t + 2\right)^2 dt\right]}$$

$V_{rms} = 7.118$

$$V_{av} = \frac{1}{T}\int_0^T v\,dt = \frac{1}{10}\left[\int_0^5 10\,dt + \int_5^{10} \left(-\frac{2}{5}t + 2\right) dt\right]$$

$= 4.5$

Ques: $v(t) = \underline{V_0} + V_1 \sin \omega t + V_2 \sin 3\omega t$

$V_{av} = V_0$

$$V_{rms} = \sqrt{V_{RMS_1}^2 + V_{RMS_2}^2 + \ldots V_{RMS_n}^2}$$

$$= \sqrt{V_0^2 + \left(\frac{V_1}{\sqrt{2}}\right)^2 + \left(\frac{V_2}{\sqrt{2}}\right)^2}$$

Only applicable for different frequency

Ques:- $v(t) = V_0 + V_1 \sin(\omega t + \phi_1) + V_3 \sin(\omega t - \phi_2)$

$V_1 \angle \phi_1$ change in polarity $V_3 \angle -\phi_2$

$$v(t) = V_0 + (\underbrace{V_1 \angle \phi_1 + V_3 \angle -\phi_2})$$

$$= V_0 + V \angle \phi$$

Applicable only same frequencies are given.

$$v(t) = V_0 + V \sin(\omega t + \phi)$$

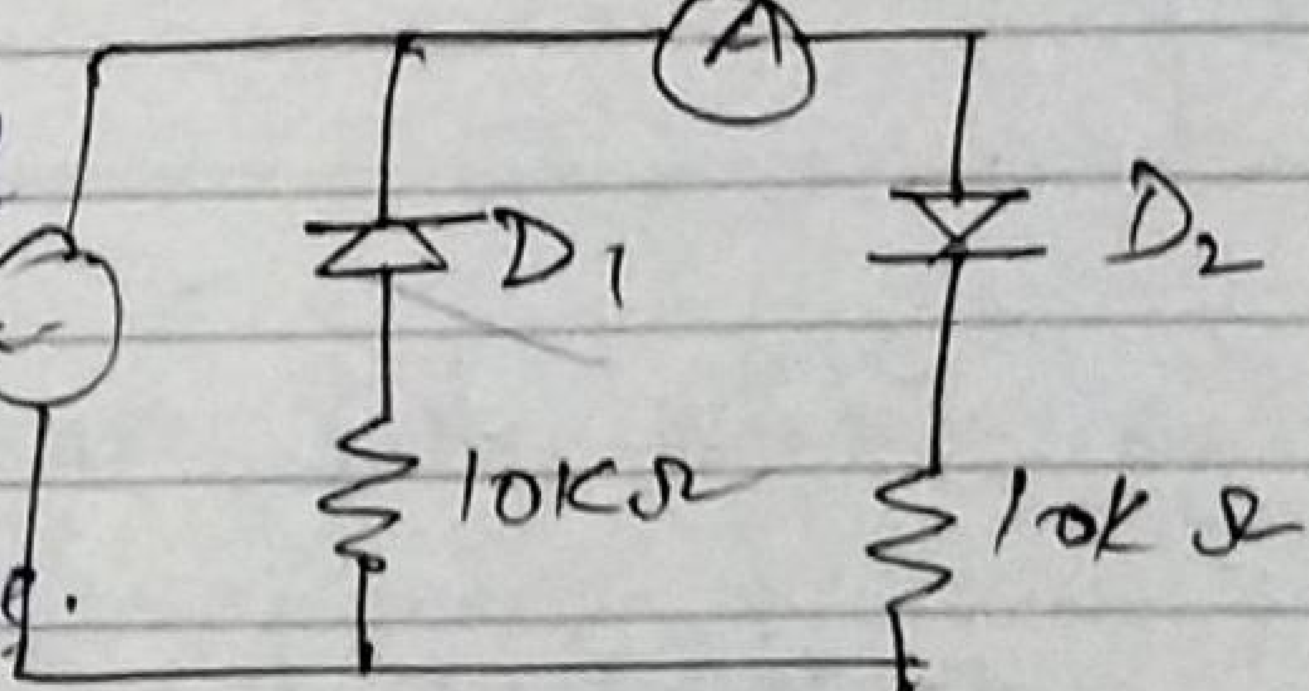
$$\boxed{V_{rms} = \sqrt{V_0^2 + \left(\frac{V}{\sqrt{2}}\right)^2}}$$

$$P_{RMS} = \frac{V_{rms}^2}{R} \Rightarrow \text{Real time system doesnot exist.}$$

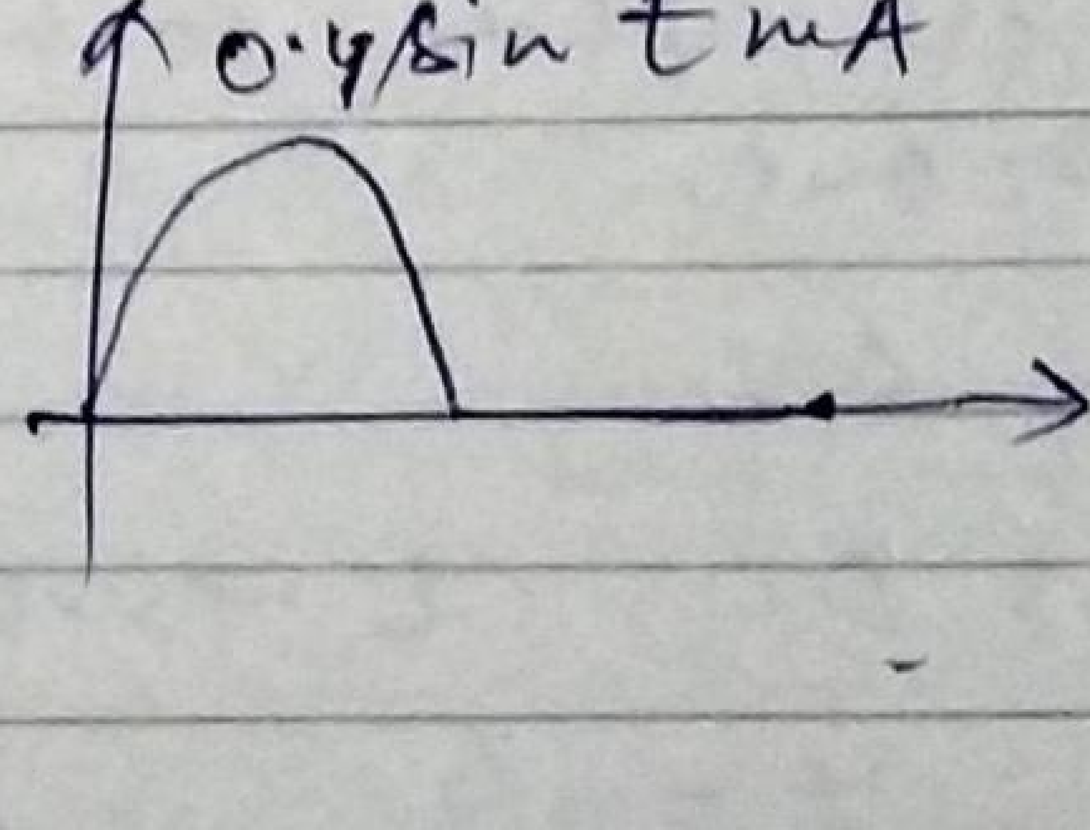
$$P_{av} = \frac{V_{RMS}^2}{R} \qquad P_{DC} = I_{av}^2 R$$

$$\boxed{P_{AC} = I_{RMS}^2 R}$$

Ques:- The given ckt is having ideal diodes and an Ametre which reads the average value find the reading of the Ameter.



$$I = \frac{v(t)}{10k} = \frac{4 \sin \omega t}{10k}$$



$$\boxed{I_{av} = \frac{0.4}{\pi} \text{ mA}}$$

Ques Find the power across the element if the voltage is

$$v(t) = 100 \sin \omega t + 40 \cos(30t - 30^\circ) + 5 \sin(50t + 45^\circ)$$

and the current through it is

$i(t) = 8\sin(\omega t + 10°) + 6\sin(3\omega t + 40°) + 2\cos(5\omega t - 120°)$

$v(t) = 100\sin\omega t + 40\cos(3\omega t - 30°) + 5\sin(5\omega t + 45°)$

$\Downarrow$

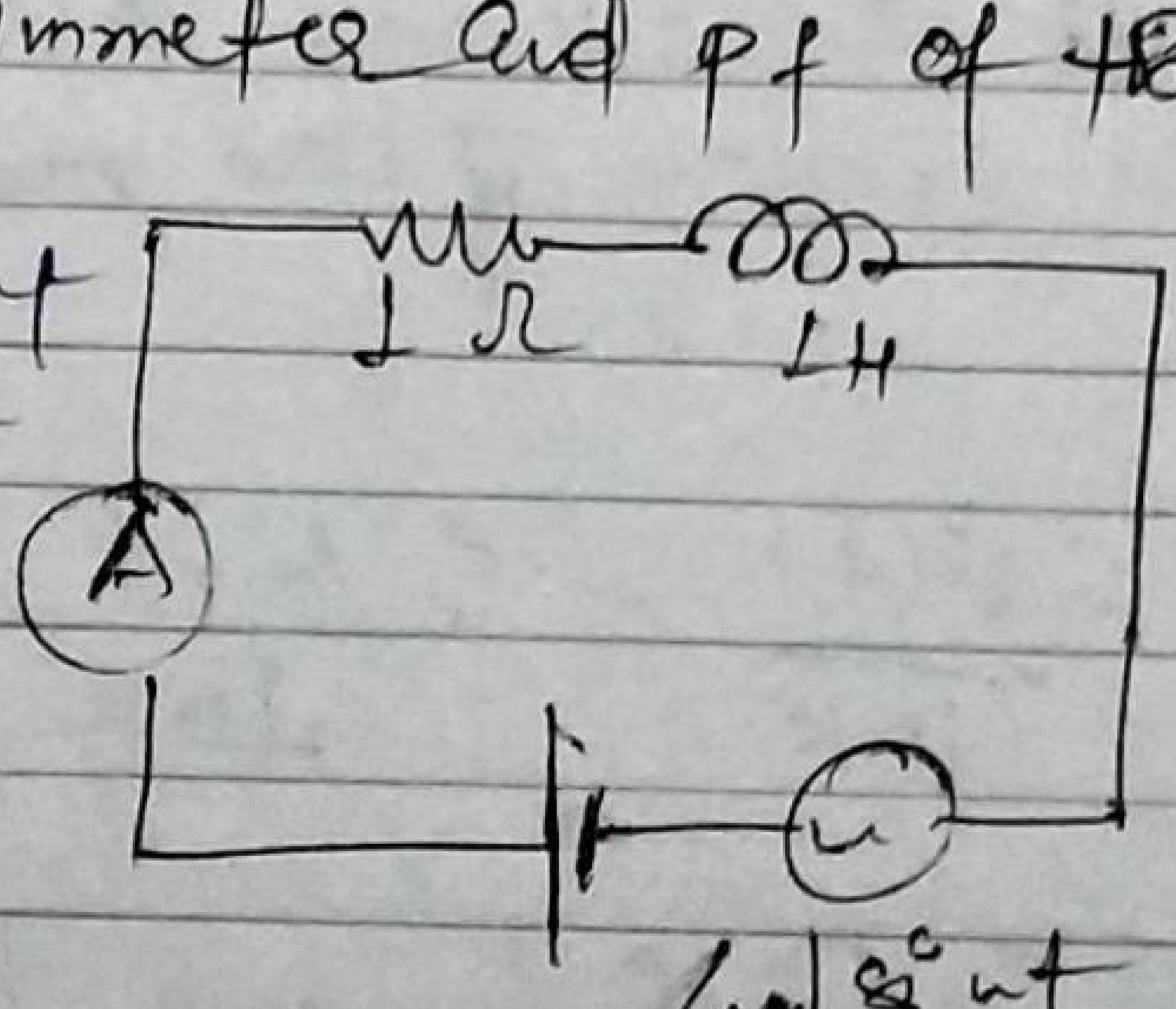
$40\sin(3\omega t + 60°)$

$i(t) = 8\sin(\omega t + 10°) + 6\sin(3\omega t + 40°) + 2\sin(5\omega t - 30°)$

$P_{av} = \frac{100}{\sqrt{2}} \times \frac{8}{\sqrt{2}} \times \cos(-10°) + \frac{40}{\sqrt{2}} \times \frac{6}{\sqrt{2}} \cos 20° + \frac{5}{\sqrt{2}} \times \frac{2}{\sqrt{2}} \cos 75°$

$\boxed{P_{av} = 507.98\,W}$

Ques Find the reading of the ammeter and pf of the ckt.



$\because$ the different frequency component are there so we take one by one.

Case 1:- 4V

AS DC $L \to S.C.$

$I = \frac{4}{1} = 4\,A$

Case 2 $\sin\omega t$

$Z = R + j\omega L = (1 + j)\,\Omega$

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* when ever different frequency component are there in the ckt we should take $pf = \frac{P}{S}$ we can't take $pf = \frac{R}{Z}$ bcz in each case Z is different.

$$I_{dc} = \frac{\frac{1}{\sqrt{2}}}{\sqrt{2}} = \frac{1}{2}\ A$$

$$I_{RMS} = \sqrt{I_{RMS_1}^2 + I_{RMS_2}^2}$$

$$= \sqrt{4^2 + \frac{1}{4}} = \sqrt{16.25}\ A$$

* $$pf\ (\cos\theta) = \frac{P}{S} = \frac{I_{rms}^2 R}{V_{rms} I_{rms}}$$

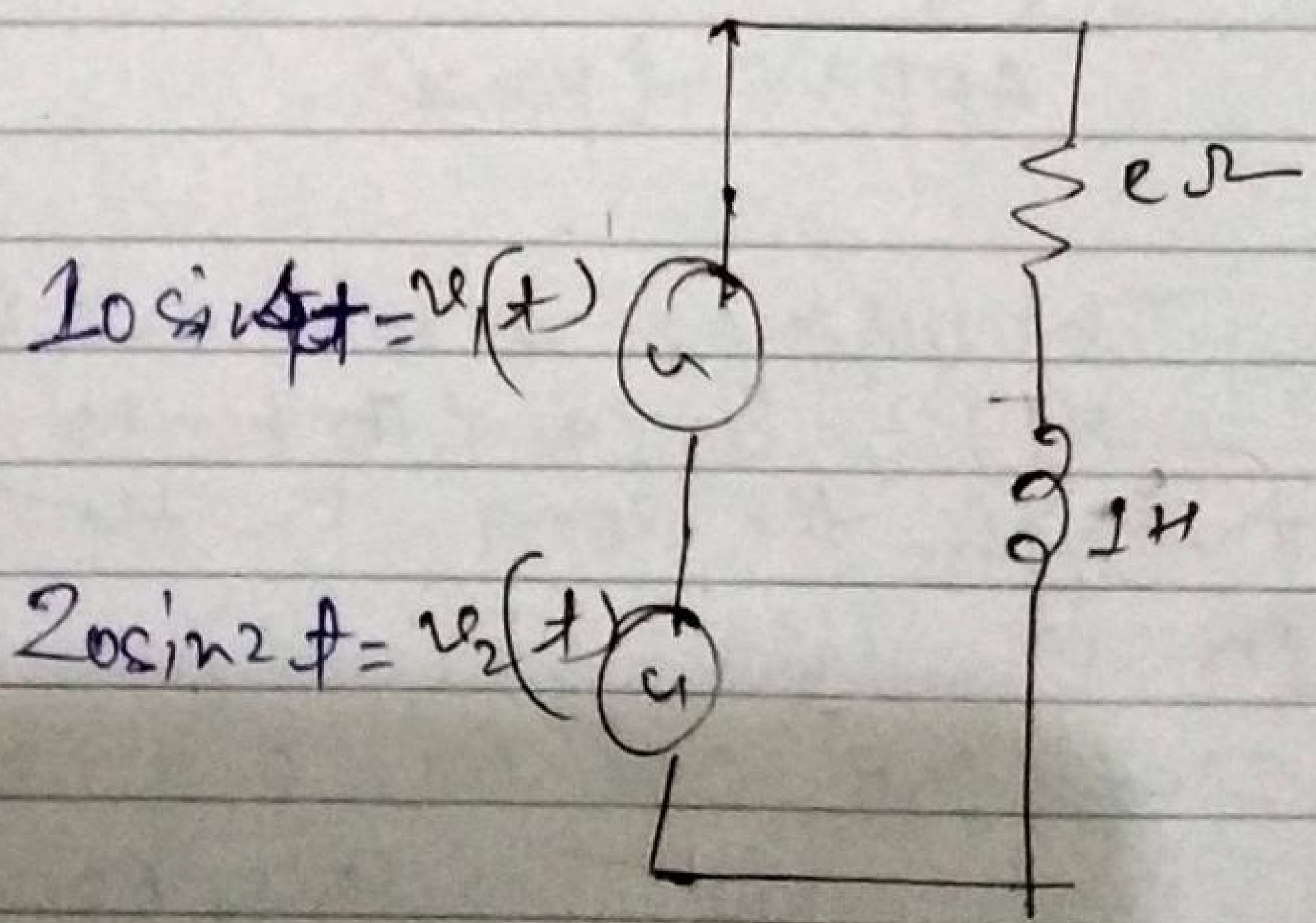
$$V_{rms} = \sqrt{(4)^2 + \left(\frac{1}{\sqrt{2}}\right)^2} = \sqrt{16.5}\ V$$

$$\cos\theta = \frac{\sqrt{16.25} \times 1}{\sqrt{16.5}} \qquad \boxed{\cos\theta = 0.9923}$$

$$\boxed{\theta = 7.07^\circ}$$

Ques:-

$$\cancel{V_{RMS} = \sqrt{\left(\frac{10}{\sqrt{2}}\right)^2 + \left(\frac{20}{\sqrt{2}}\right)^2}}$$



case(i):-

$v_1(t) = 10\sin 4t$

$Z = R + j\omega L$

$Z = 2 + 4j$

$$i_1(t) = \frac{10\sin 4t}{(2+j4)} = \frac{10\angle 0^\circ}{4.47\angle(63.43)}$$

$i_1(t)\ 2.23\sin(4t - 63.43^\circ)$

Case(ii) $v_2(t) = 20 \sin 2t$

$z = R + j10L$

$= 2 + 2j \quad z = 2\sqrt{2} \angle 45^\circ$

$$I = \frac{20 \sin 2t}{2\sqrt{2} \angle 45^\circ} = \frac{20 \angle 0}{2\sqrt{2} \angle 45^\circ} = \boxed{7.07 \sin (20t - 45^\circ)}$$

$$P_{av} = \frac{10}{\sqrt{2}} \times \frac{2.23}{\sqrt{2}} \times \cos(-63.43) + \frac{20}{\sqrt{2}} \times \frac{7.07}{\sqrt{2}} \times \cos(-45^\circ)$$

$= 55 \text{ W}$

Complex power : $S = V_{rms} I_{rms}^*$

$S = |S| \angle \theta$

$\downarrow$

Apparent power

Ques The voltage across the load is $v(t) = 60 \cos(\omega t - 10^\circ)$ and the current through the load in the direction of voltage drop is $i(t) = 1.5 \cos(\omega t + 50^\circ)$

1. Find the complex and apparent power
2. Real and reactive power.

$$V(t) = \frac{60}{\sqrt{2}} \angle (-10) \qquad i(t) = \frac{1.5}{\sqrt{2}} \angle 50^\circ$$

$S = V_{rms} I_{rms}^*$

$S = \frac{60}{\sqrt{2}} \angle(-10) \times \frac{1.5}{\sqrt{2}} \angle(-50)$

$S = 45 \angle -60^{\circ}$ $\quad |S| = 45\,VA$

$S = 45 \angle -60^{\circ}$

$= P + jQ$

$= \boxed{\underline{22.5_{W}}_{P}} + j \boxed{\underline{38.97\,VAR}_{Q}}$

P.

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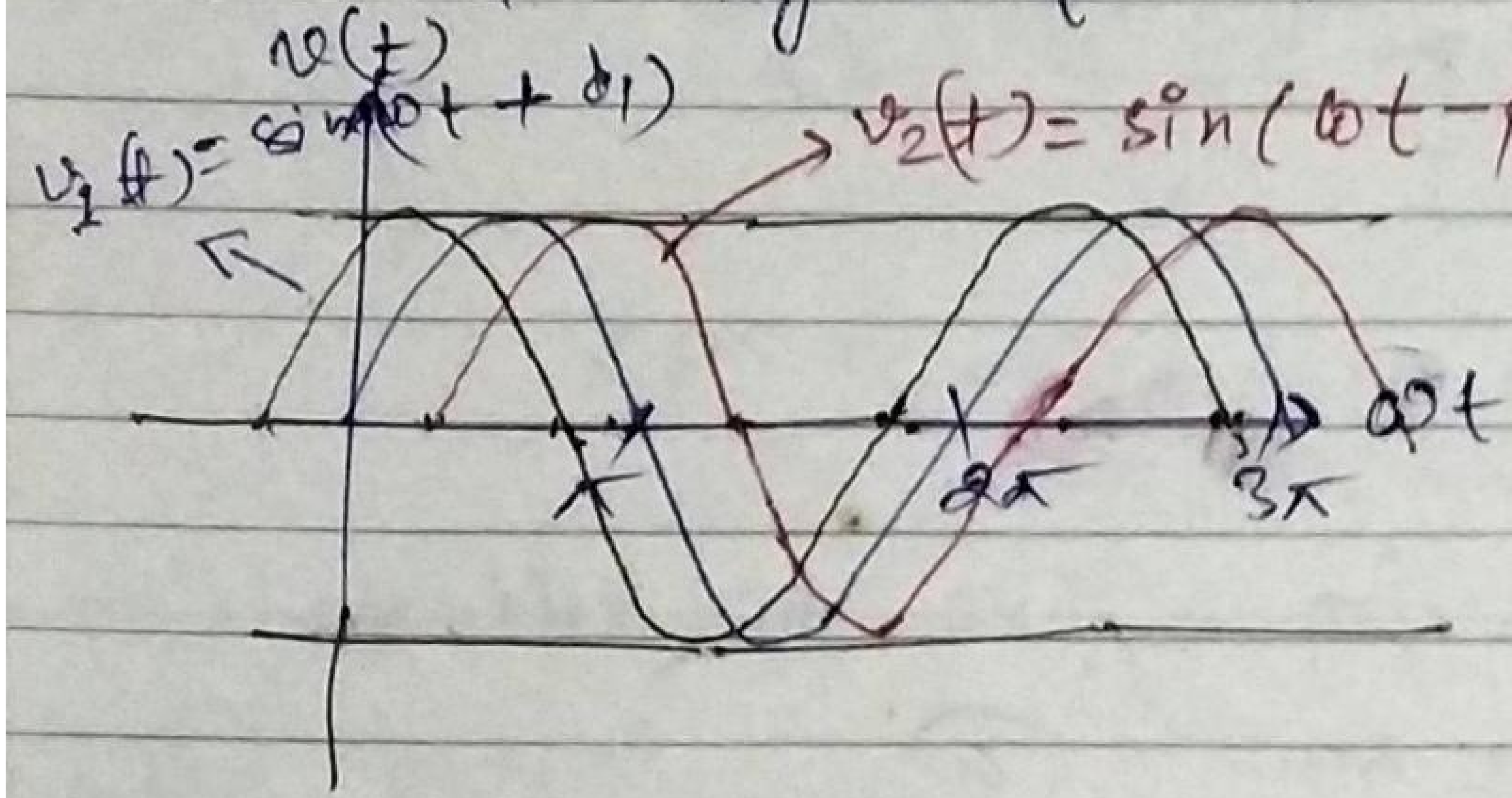
Sinusoidal Steady State Analysis :-

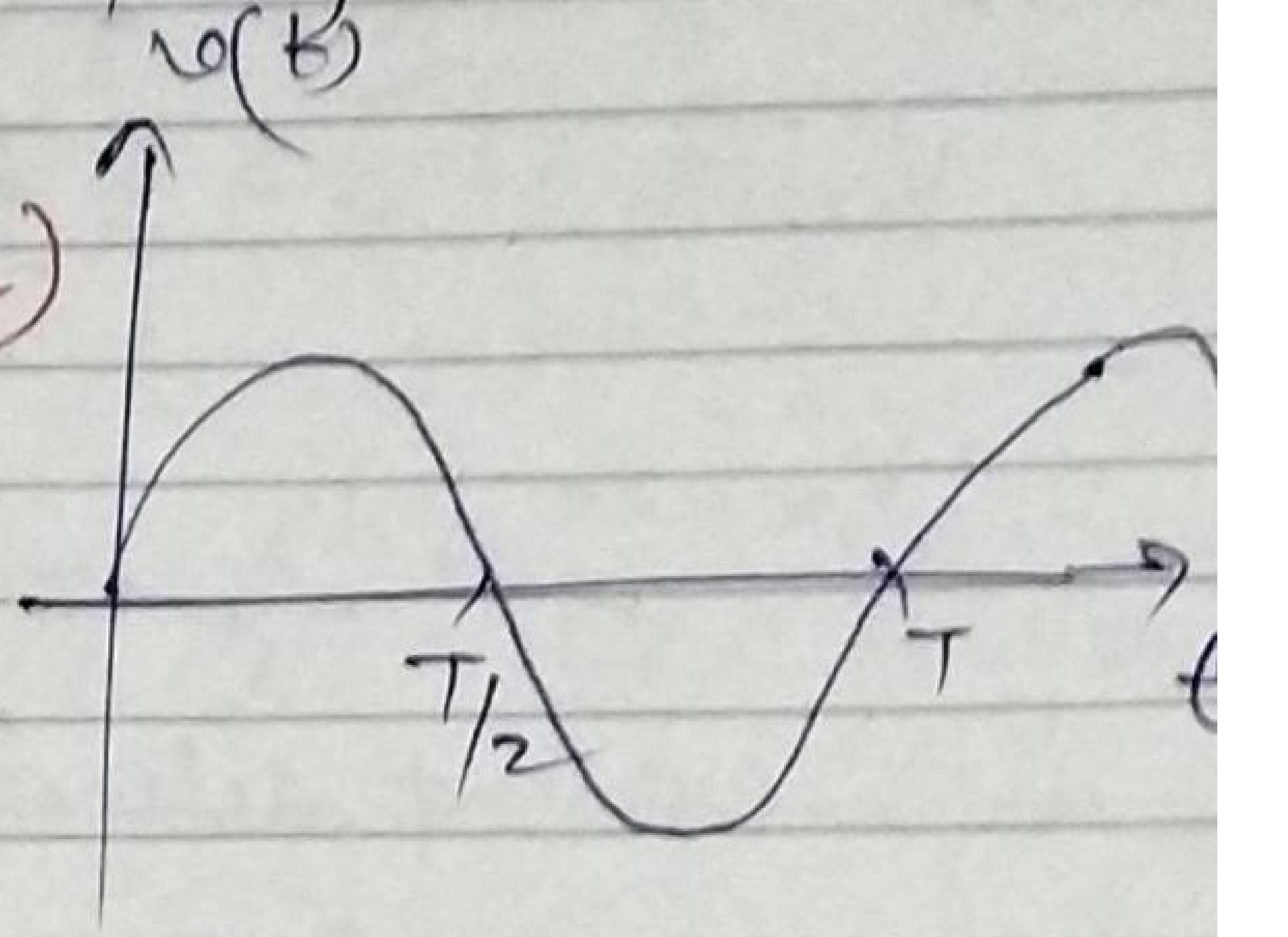
Sinusoidal → Sine, cosine

$v(t) = V_m \sin \omega t$ $V_m \rightarrow$ Max. amplitude

$\omega \rightarrow$ Angular frequency (Rad/sec)

$\omega t \rightarrow$ Argument



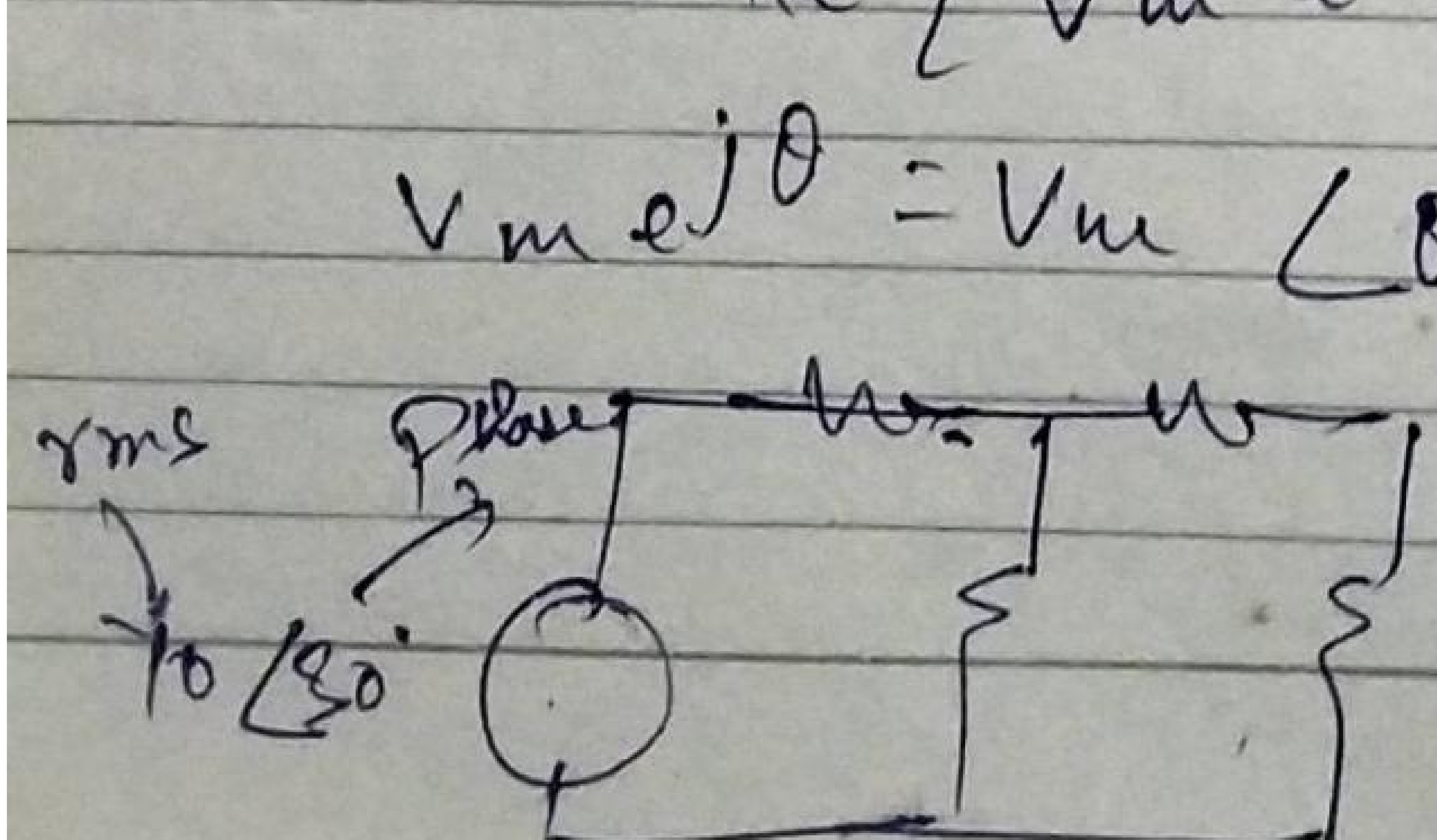


* We can compare to sinusoids providing that —
* Both v_1 and v_2 have same frequency.
* Both v_1 and v_2 are expressed in form of either sine function or cosine function.
* Both v_1 and v_2 are written with +ve amplitude

$$v(t) = V_m \cos(\omega t + \theta) = Re\{V_m e^{j(\omega t + \theta)}\}$$

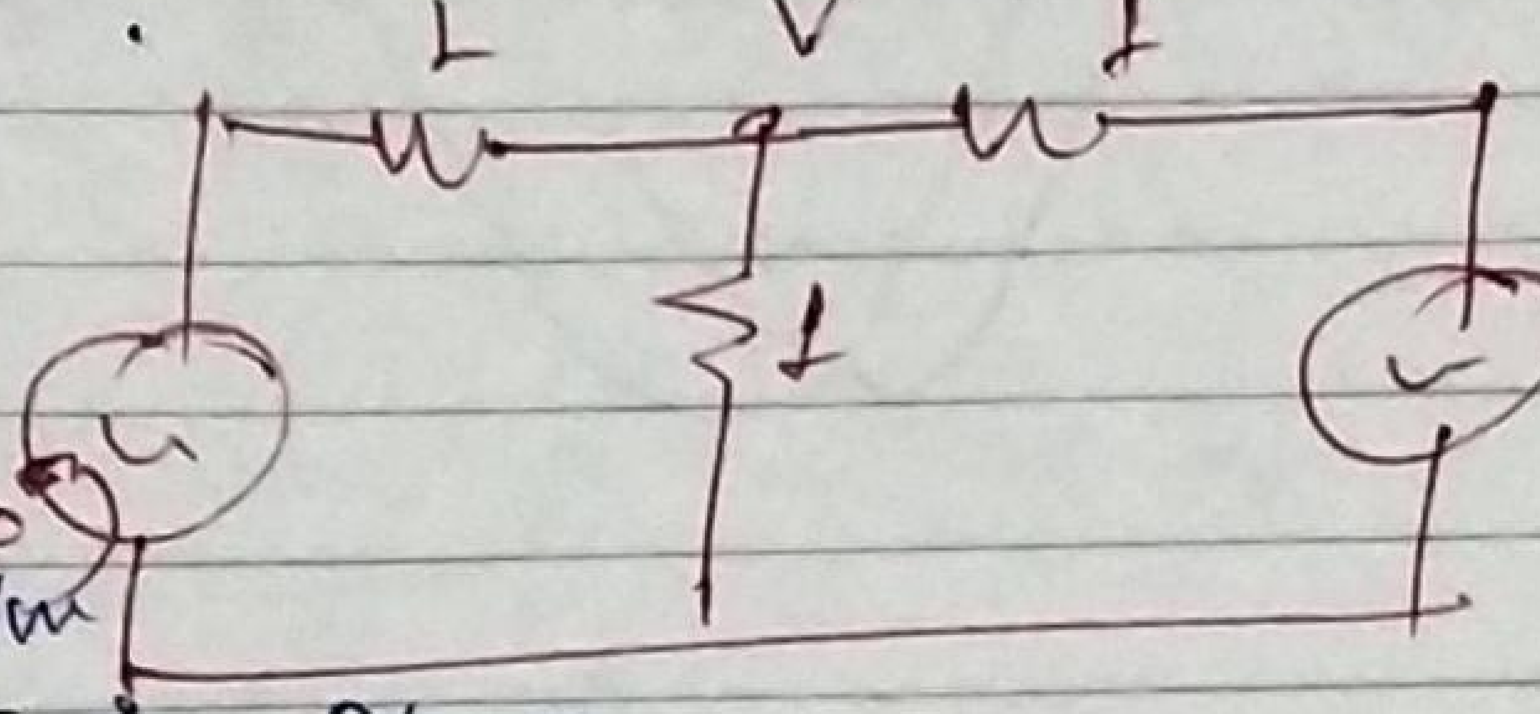
$$= Re\{V_m e^{j\theta} \cdot e^{j\omega t}\}$$

$$V_m e^{j\theta} = V_m \angle \theta.$$



$10\sqrt{2}\cos(\omega t + 30^\circ)$

$$e^{j\theta} = \cos\theta + j\sin\theta$$
$$= \sqrt{\cos^2\theta + \sin^2\theta}\;\angle \tan^{-1}\left(\frac{\sin\theta}{\cos\theta}\right) = 1\angle\theta$$



$10\sin(\omega t + 30^\circ)$ → V_m

$10\angle 30^\circ$ → phase

or

$\left(\frac{10}{\sqrt{2}}\right)\angle 30^\circ$ → phase, rms

$10\sin(\omega t + 45^\circ)$

$10\angle 45^\circ$ → V_m

rms $\left(\frac{10}{\sqrt{2}}\right)\angle 45^\circ$

$$\frac{V - 10\angle 30^\circ}{1} + \frac{V}{1} + \frac{V - 10\angle 45^\circ}{1} = 0$$

$$3V = 10\angle 30^\circ + 10\angle 45^\circ \qquad V = \boxed{\frac{20}{3}}\angle 37.5$$

V_m

$$\boxed{V = \underbrace{\frac{20}{3}}_{V_m}\sin(\omega t + \underbrace{37.5}_{\text{phase}})}$$

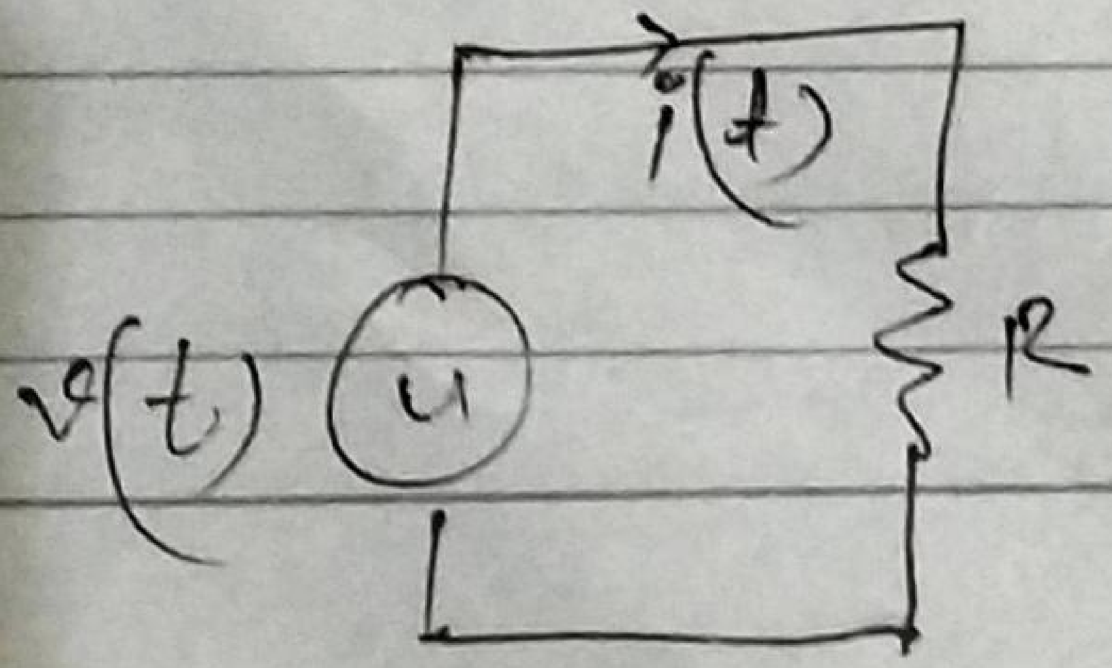
By supressing the time factor we transform the sinusoide from the time domain to phasor domain thus the phasor transform, transforms the sinusoidal signal from the time domain to the complex domain which is also called as the frequency domain.

$$e^{j\theta} = 1\angle\theta \qquad e^{j\omega t}$$

difference b/w $v(t)$ & $\bar{V}$:—

* $v(t)$ is the instantaneous or time domain represent-ation while $\bar{V}$ is the frequency or phasor domain representation.
* $v(t)$ is time dependent while $\bar{V}$ is not-
* $v(t)$ is always real while $\bar{V}$ is generally complex.

1- Resistor :-



$$v(t) = V_m \sin \omega t$$

$$i(t) = \frac{V_m \sin \omega t}{R}$$

$$i(t) = \frac{V_m}{R} \sin \omega t$$

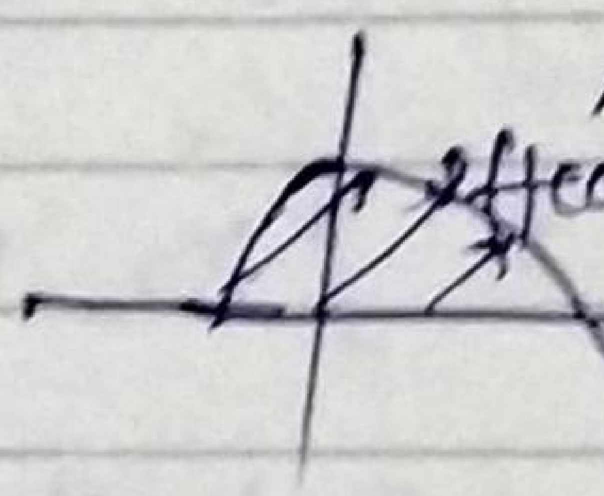
$$\xrightarrow{v(t)}\xrightarrow{} i(t)$$

$$P_{av} = \frac{1}{T}\int_0^T v(t)\cdot i(t)\,dt = \frac{1}{T}\int_0^T (V_m \sin\omega t)(I_m \sin\omega t)\,dt$$

$$= \frac{V_m I_m}{T}\int_0^T \sin^2\omega t\,dt = \frac{V_m I_m}{2T}\int_0^T (1-\cos 2\omega t)\,dt$$

$$= \frac{V_m I_m}{2T}\left[\underbrace{\int_0^T 1\,dt}_{\frac{V_m I_m}{2T}(T)} - \underbrace{\int_0^T \cos 2\omega t\,dt}_{0}\right]$$

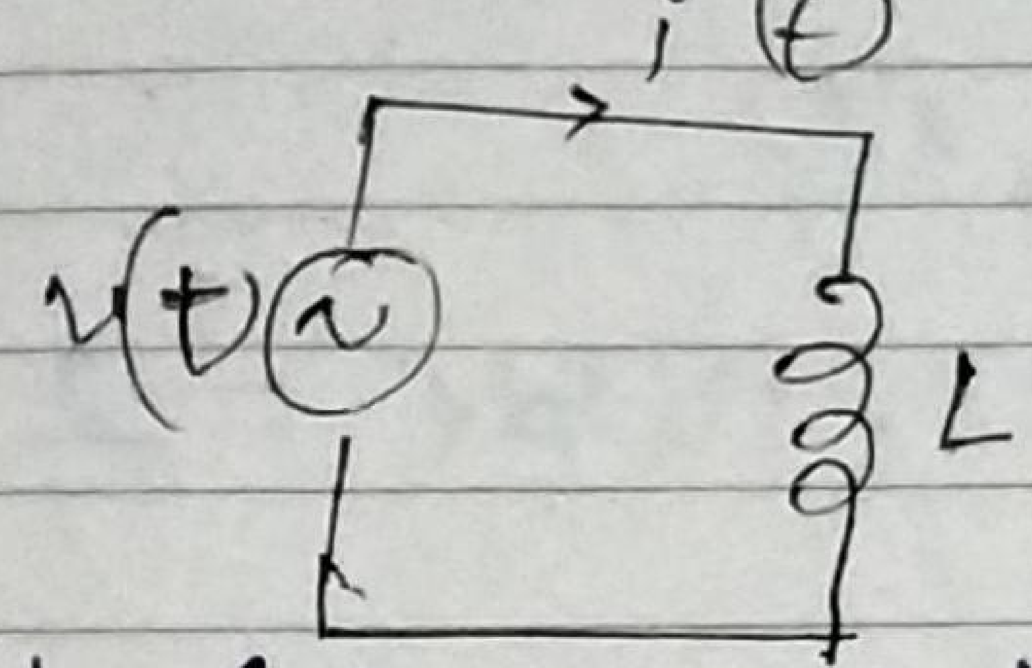
$$P_{av} = \frac{V_m I_m}{2} = \frac{V_m}{\sqrt{2}}\cdot\frac{I_m}{\sqrt{2}}$$



After integration effective area will be zero.

$$\boxed{P_{av} = V_{rms}\cdot I_{rms}}$$

2. Inductor :-

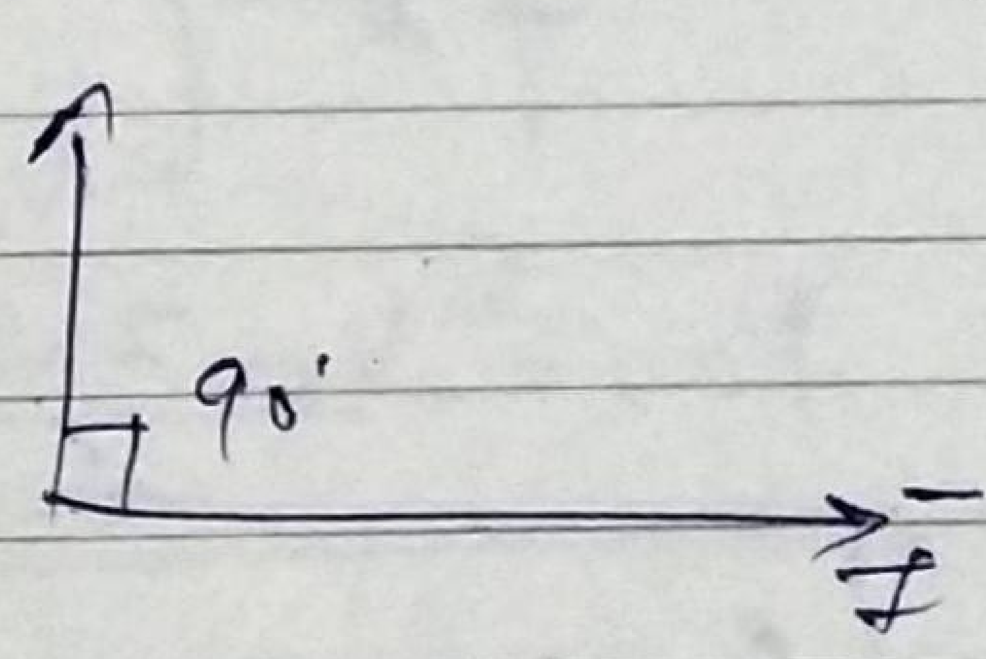


$i(t) = I_m \sin\omega t$

$v(t) = L\frac{di}{dt} = L\frac{d}{dt}(I_m \sin\omega t)$

$= L I_m \omega \cos\omega t = \omega L I_m \sin(\omega t + 90^\circ)$

$= \omega L I_m \sin(\omega t) \cdot j$



$v(t) = j\,\omega L\, I_m \sin\omega t$

$v(t) = j X_L I_m \sin\omega t$

$X_L \rightarrow$ Inductive Reactance

$X_L = \omega L$

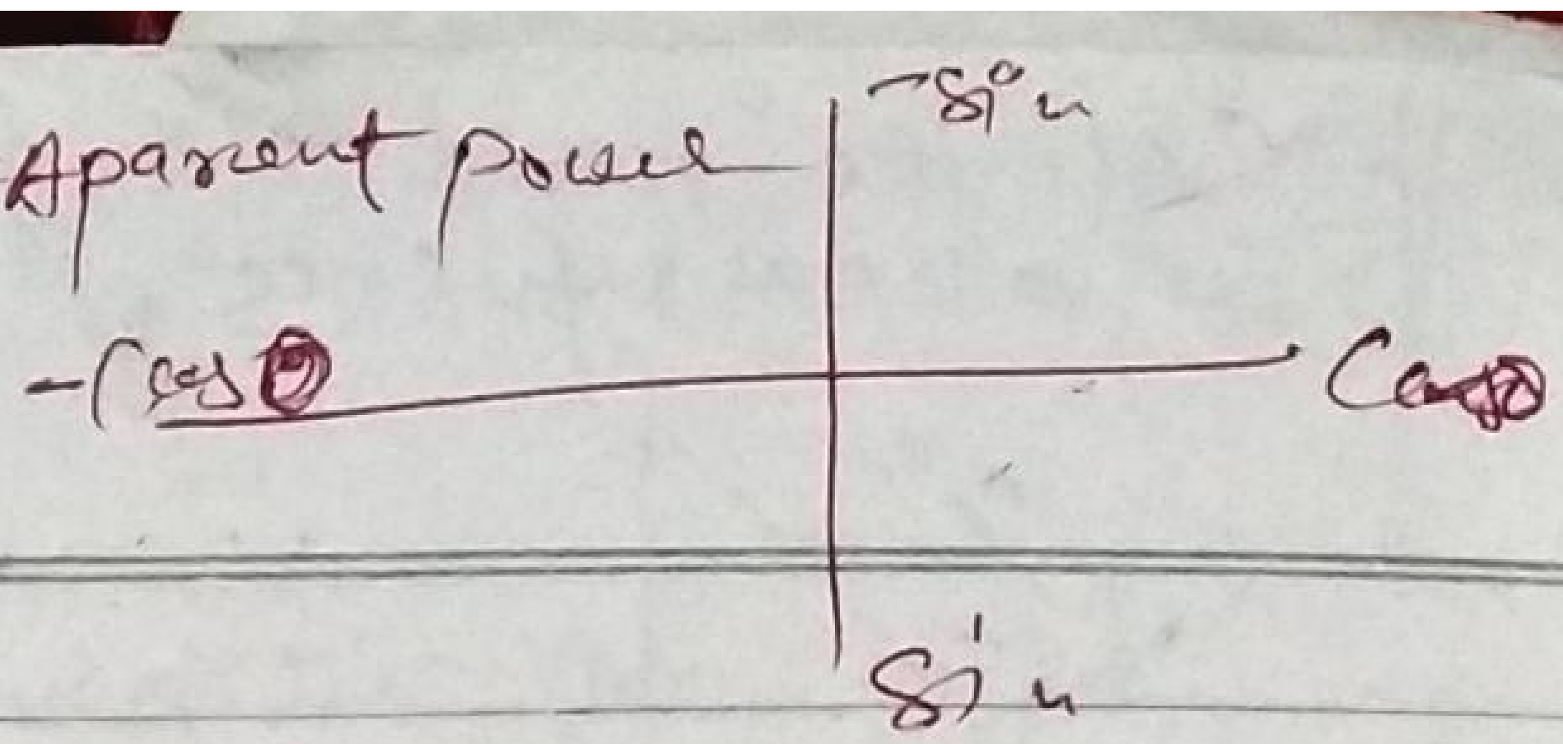
$P_{av} = \frac{1}{T}\int_0^T v(t)\, i(t)\, dt$

$= \frac{1}{T}\int_0^T V_m \cos\omega t \cdot I_m \sin\omega t\, dt$

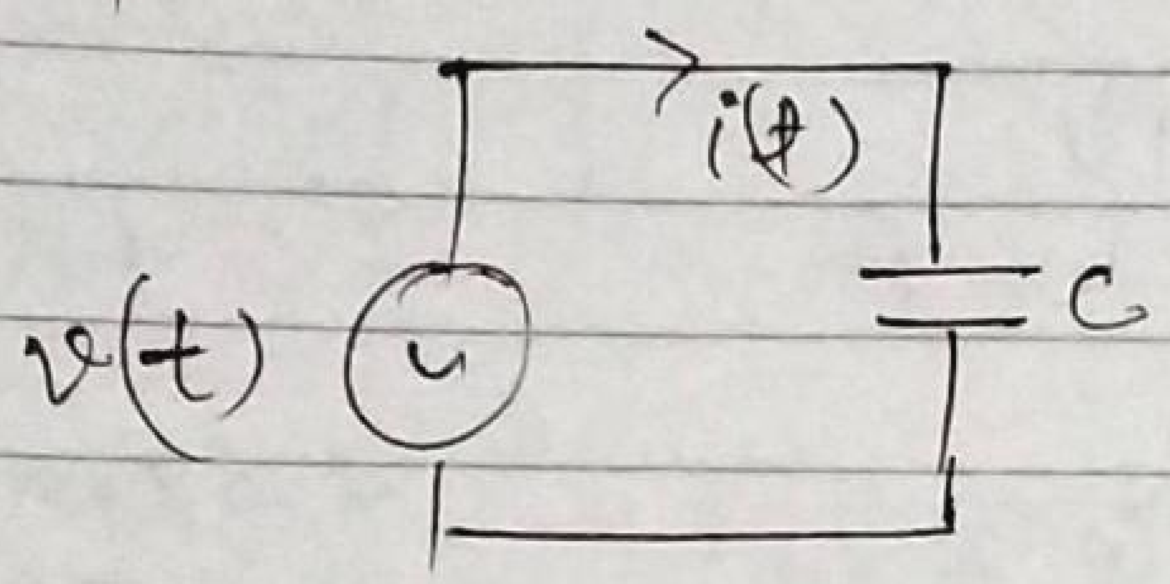
$= \frac{V_m I_m}{2T}\int_0^T \sin 2\omega t\, dt$

$\boxed{P_{av} = 0}$

magnitude of complex power = Apparent power



(3) <u>Capacitor</u>



$v(t) = V_m \sin \omega t$

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

$i = \omega C V_m \cos \omega t$

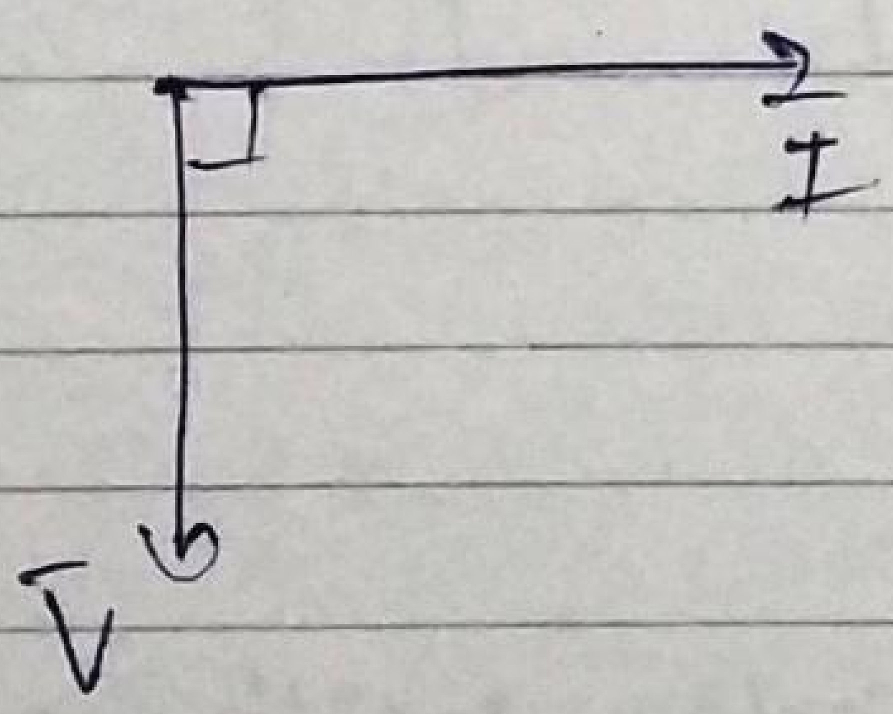
$i = \omega C V_m \sin(\omega t + 90°)$

$i = j\omega C V_m \sin \omega t$

$i = j\frac{1}{1/\omega C} V_m \sin \omega t$, $i = \frac{j}{X_C} V_m \sin \omega t$

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

$P_{av} = 0$



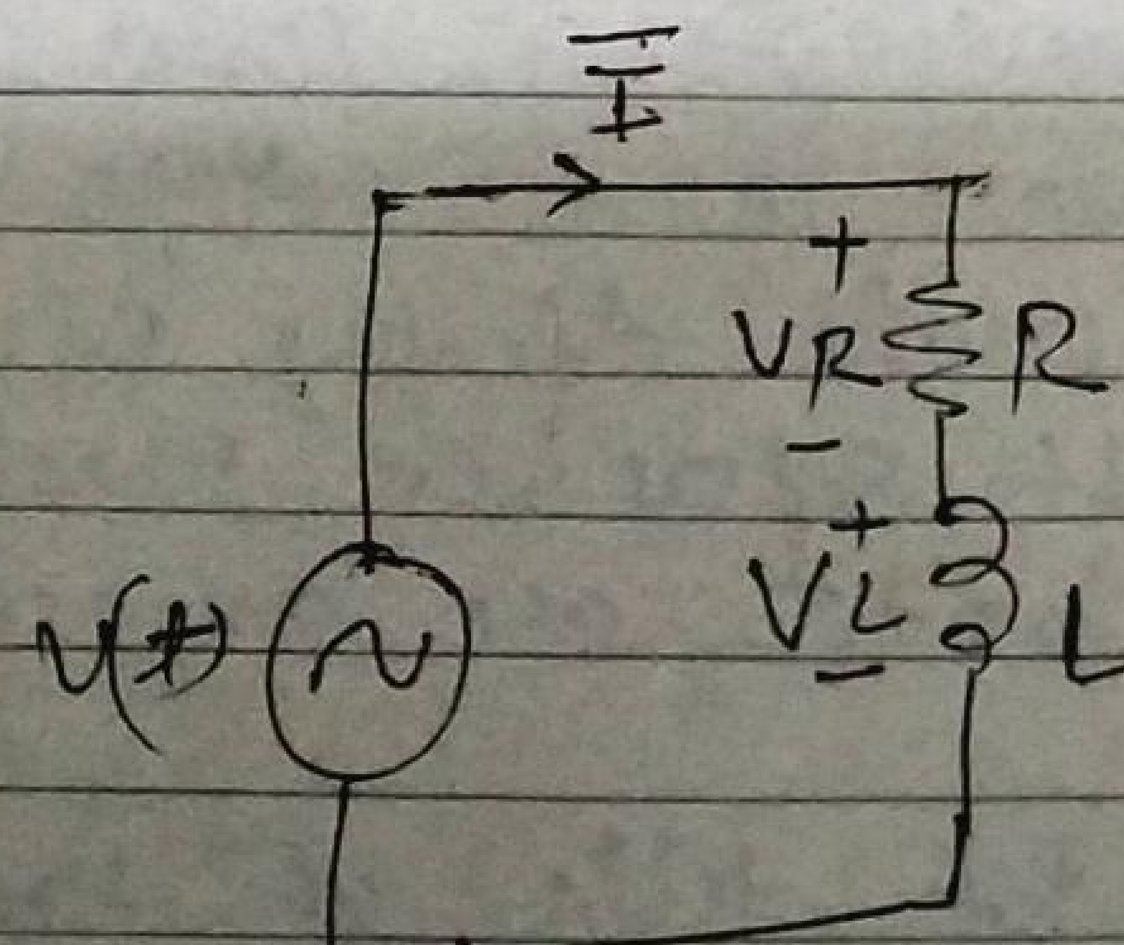
$\boxed{f_p = 2 f_{v/i}}$

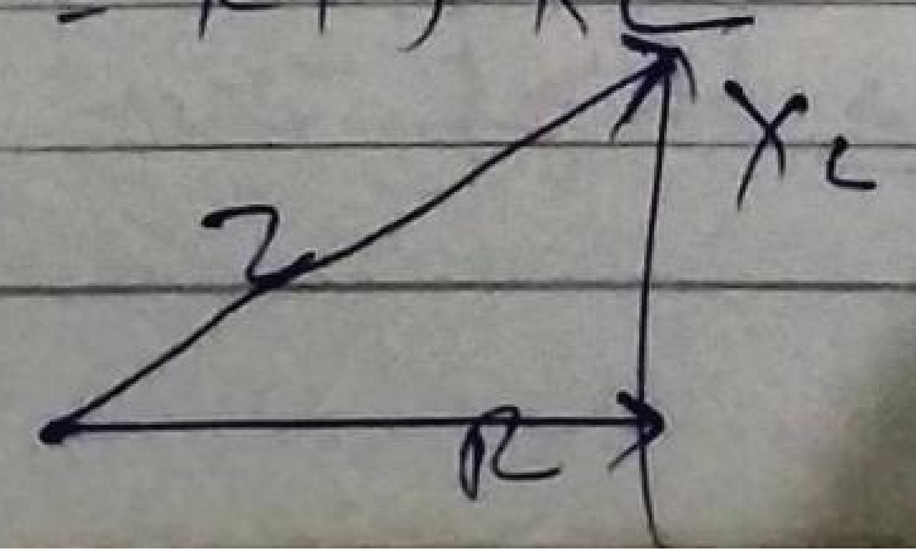
(4) <u>Series RL Ckt :-</u>

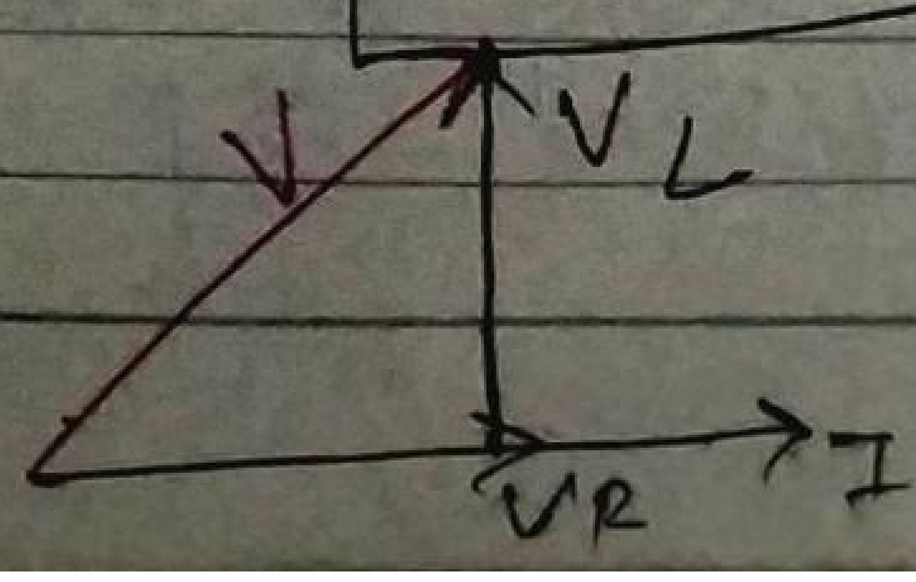
$\bar{V} = \bar{V_R} + \bar{V_L}$

$\bar{I} Z = \bar{I} R + \bar{I}(j X_L)$

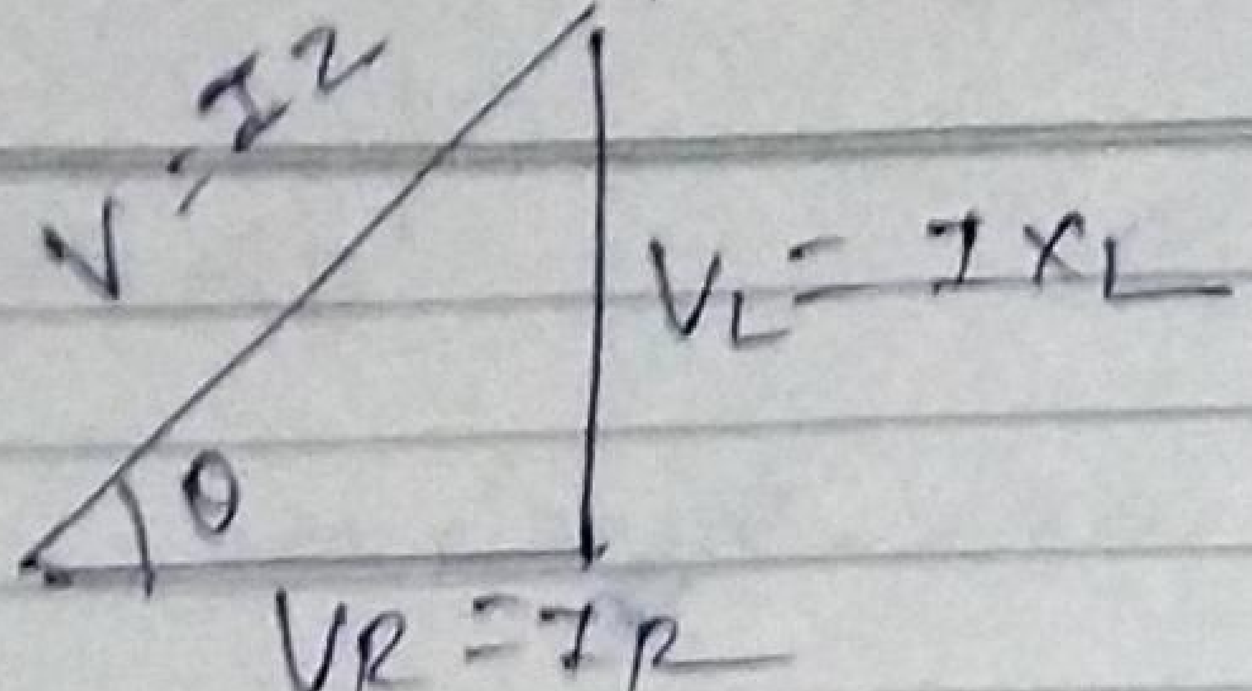
$Z = R + j X_L$

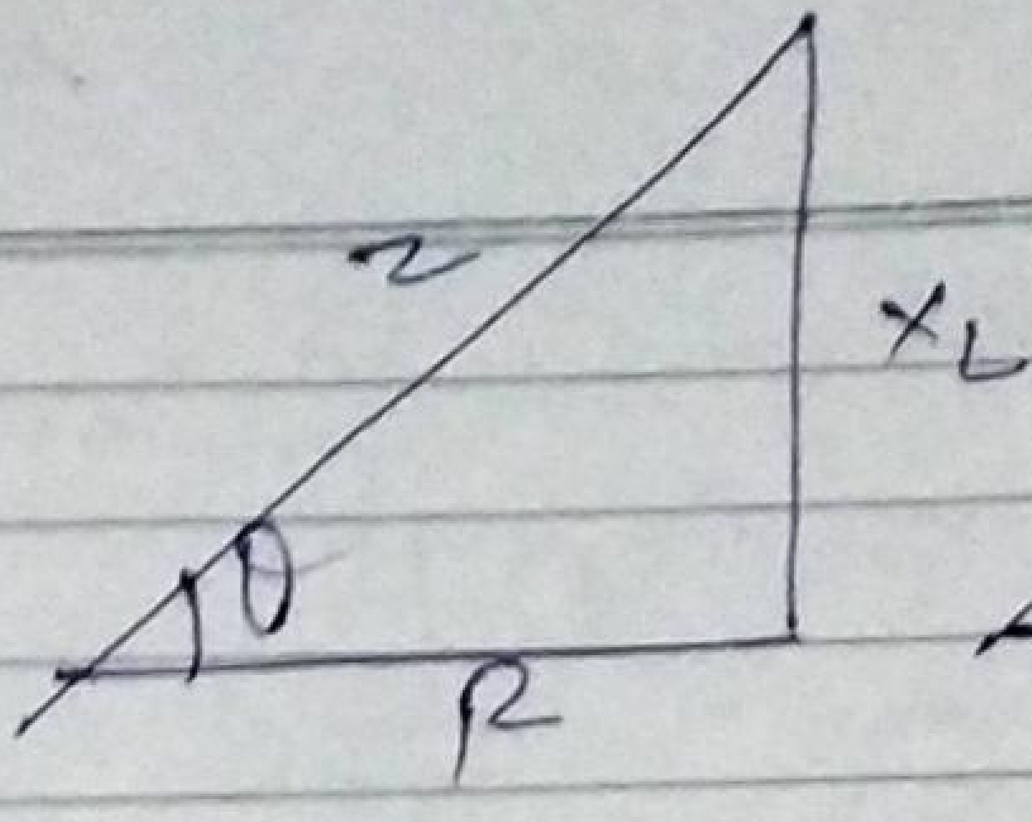


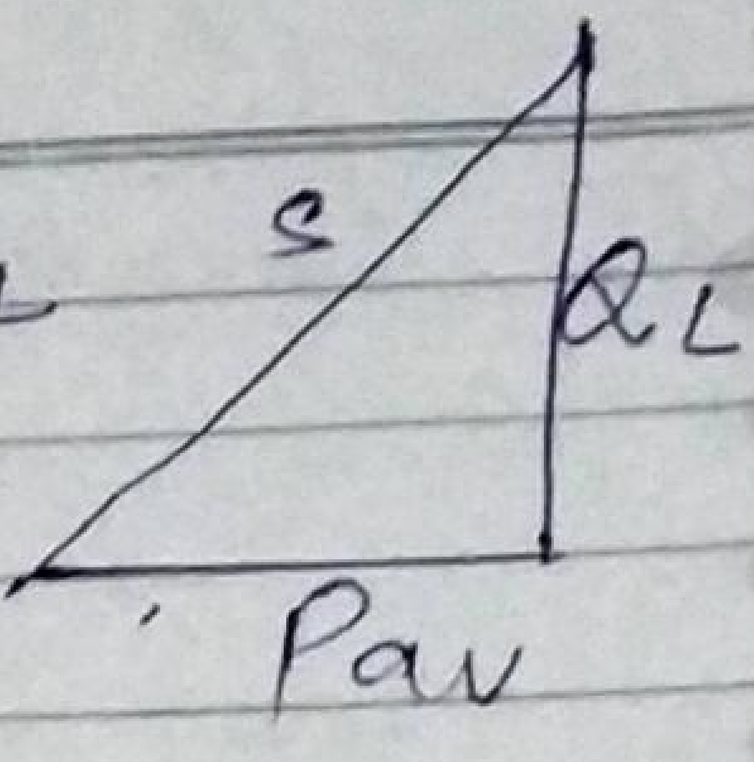




∵ All the loads are in || so voltage is same. ∴ we take as reference.







S → Aparanet power

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

$$\boxed{\theta = \tan^{-1}\left(\frac{V_L}{V_R}\right)}$$

$\cos\theta = \frac{V_R}{V}$ (lagging)

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

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

$\cos\theta = \frac{R}{Z}$ (lagging)

$S = \sqrt{P_{av}^2 + Q_L^2}$

$$\boxed{\theta = \tan^{-1}\frac{Q_L}{P}}$$

$\cos\theta = \frac{P}{S}$ (lagging)

$$P_{av} = \frac{1}{T}\int_0^T v(t)\, i(t)\, dt$$

$$= \frac{1}{T}\int_0^T V_m \sin(\omega t + \theta) \cdot I_m \sin\omega t \, dt$$

$$= \frac{V_m I_m \cos\theta}{2} = \frac{V_m}{\sqrt{2}} \times \frac{I_m}{\sqrt{2}} \cos\theta$$

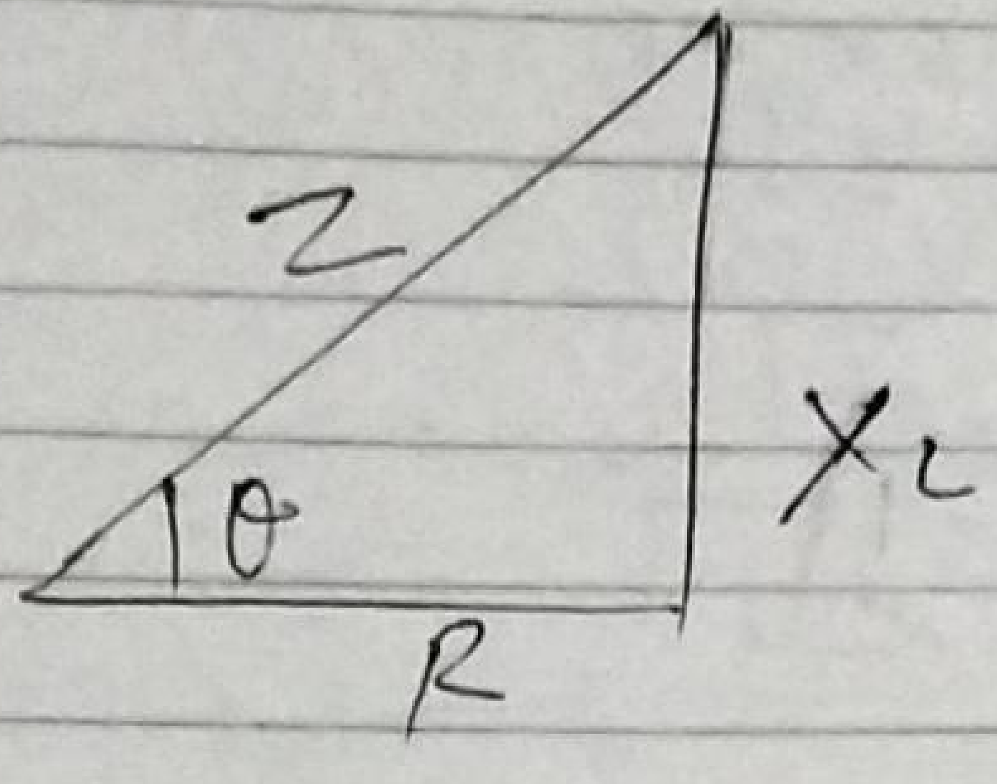
$$\boxed{P_{av} = V_{rms} I_{rms} \cos\theta}$$

Power factor :- power factor indicates position of current phasor w.r.t voltage phasor.

* While defining p.f. voltage is always taken as the reference phasor bcz in real time system loads are connected in parallel.

* pf tells us How much of Apparant power is utilized. If pf is high then active

power delivered to the load is also high.



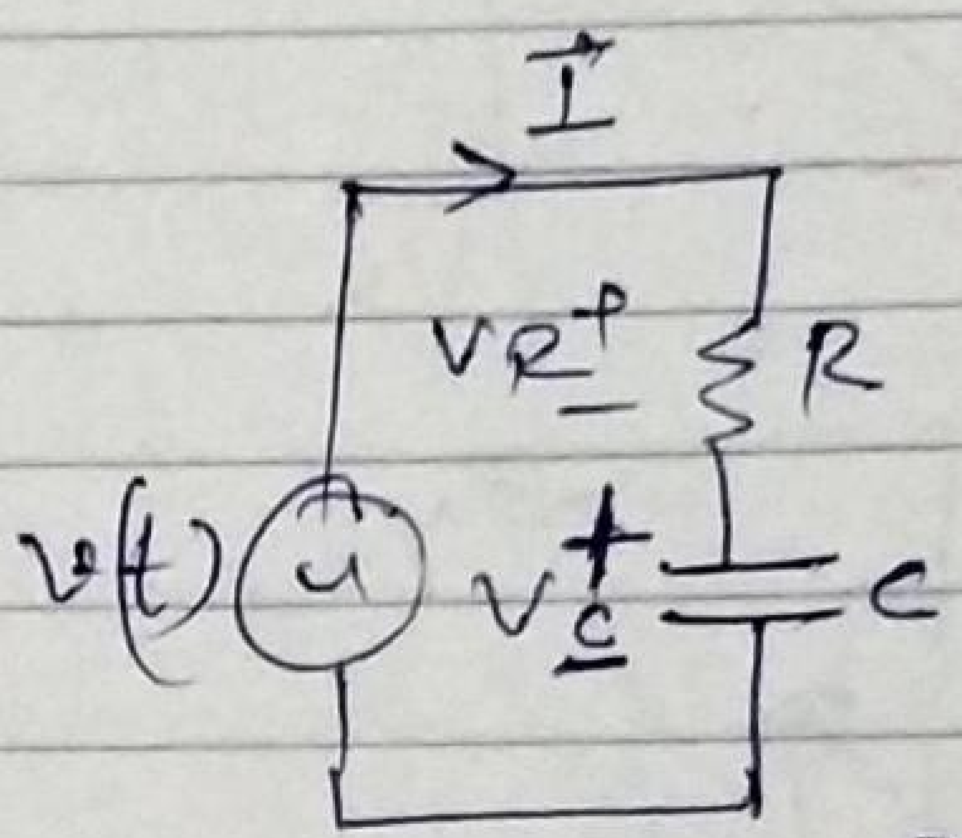
$\tan\theta = \frac{X_L}{R}$

$Z = 10 \angle(-45°)$

$I = \frac{V}{|Z|\angle\theta} = \frac{V}{|Z|}\angle(-\theta)$

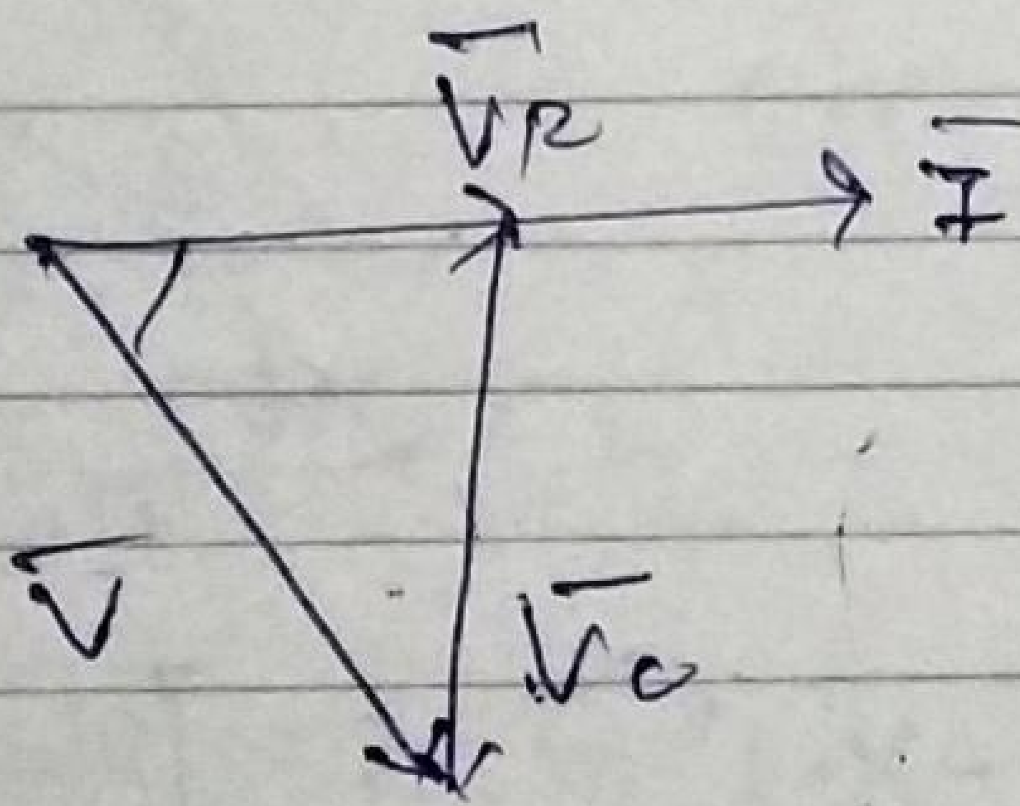
impedance angle and pf angle shows opposite nature.

(5) <u>Series RC ckt :</u>

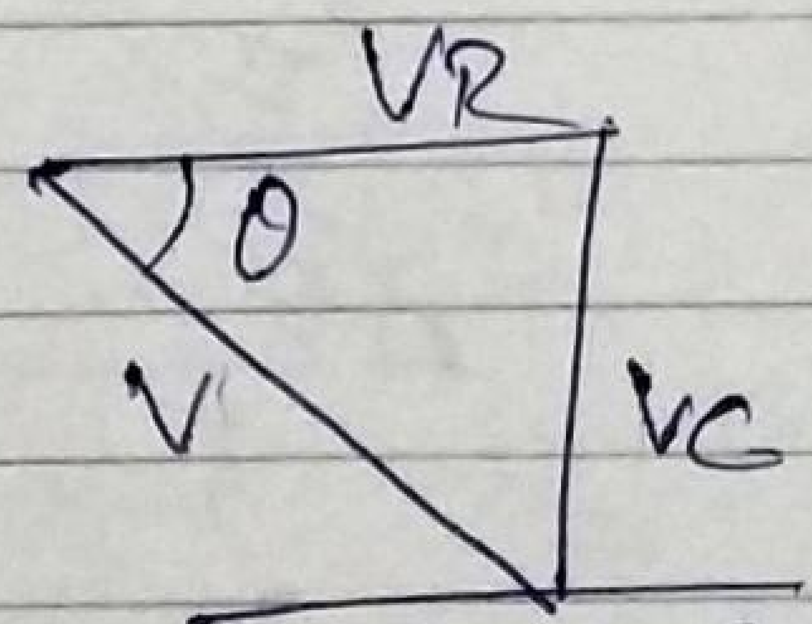


$\bar{V} = \bar{V_R} + \bar{V_C}$

$\bar{I}Z = \bar{I}R - jX_C\bar{I}$



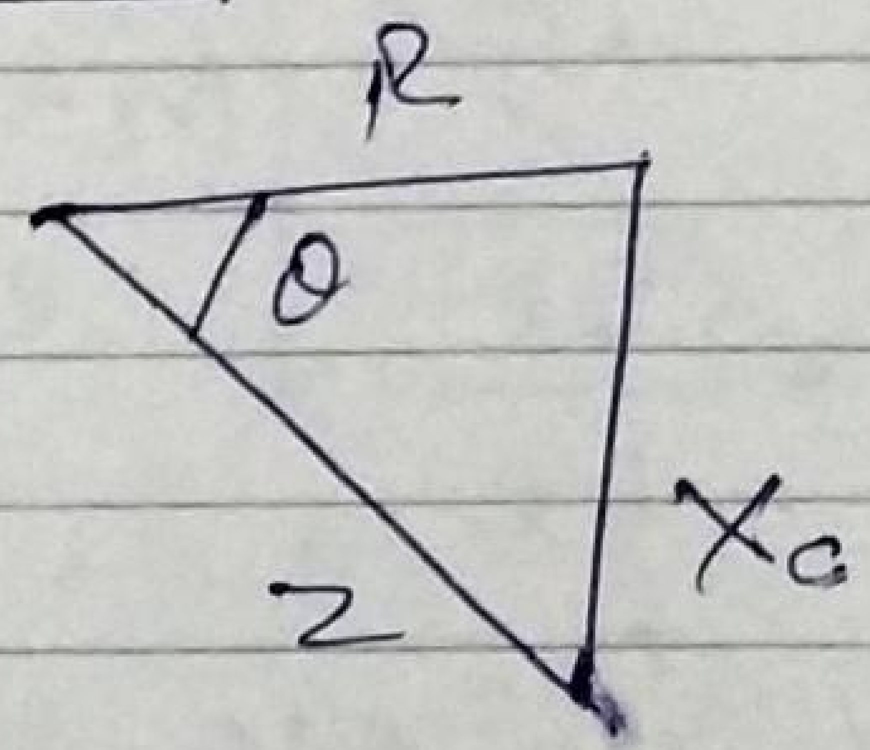
$Z = R - jX_C$



$V = \sqrt{V_R^2 + V_C^2}$

$\tan\theta = -\frac{V_C}{V_R}$

$\cos\theta = \frac{V_R}{V}$ (leading)

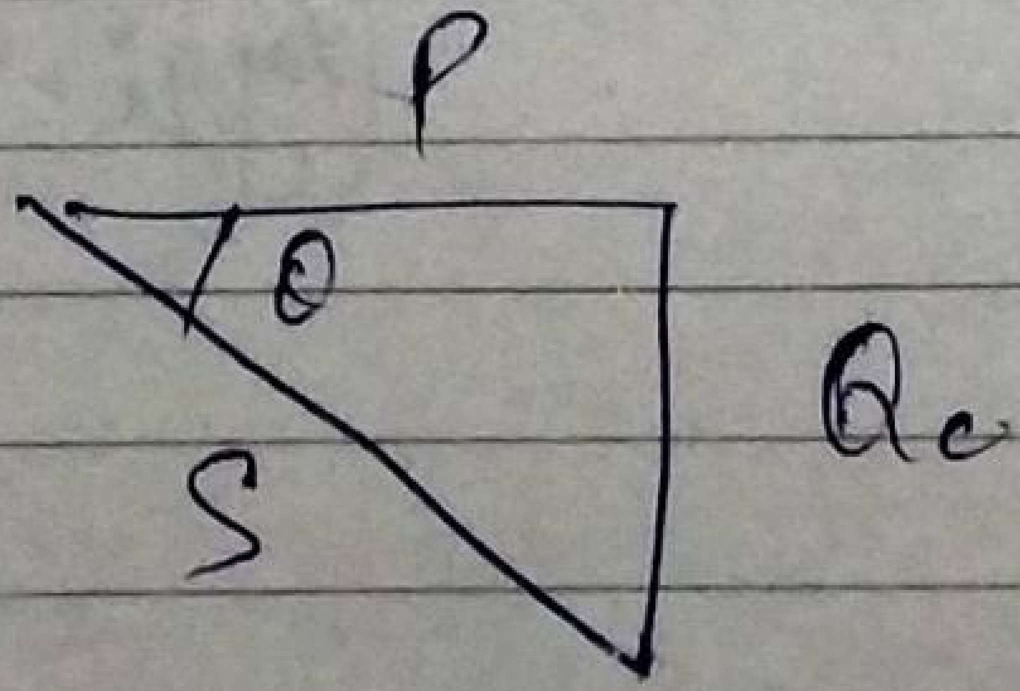


$Z = \sqrt{R^2 + X_C^2}$

$\tan\theta = -\frac{X_C}{R}$

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

(leading)



$S = \sqrt{P^2 + Q_C^2}$

$\tan\theta = -\frac{Q_C}{P}$

$\cos\theta = \frac{P}{S}$ (leading)

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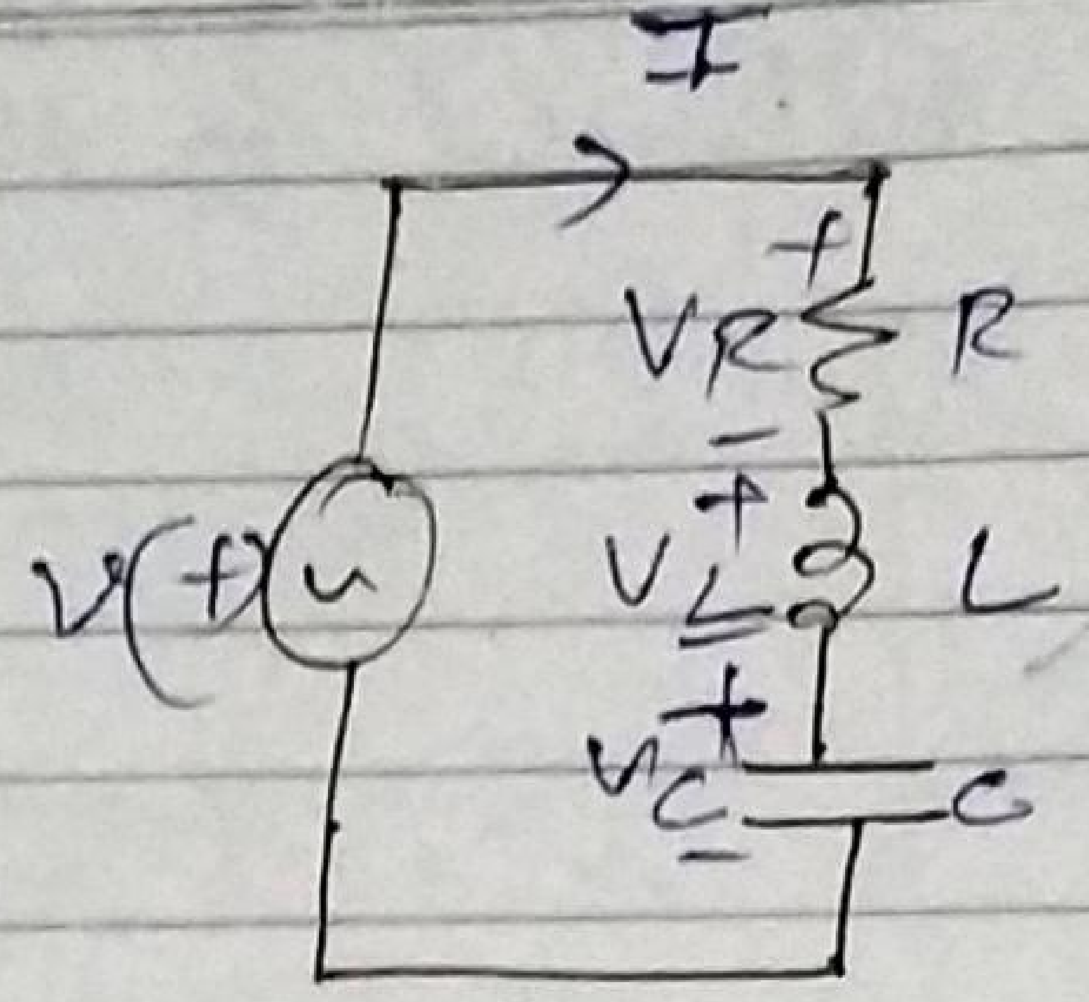
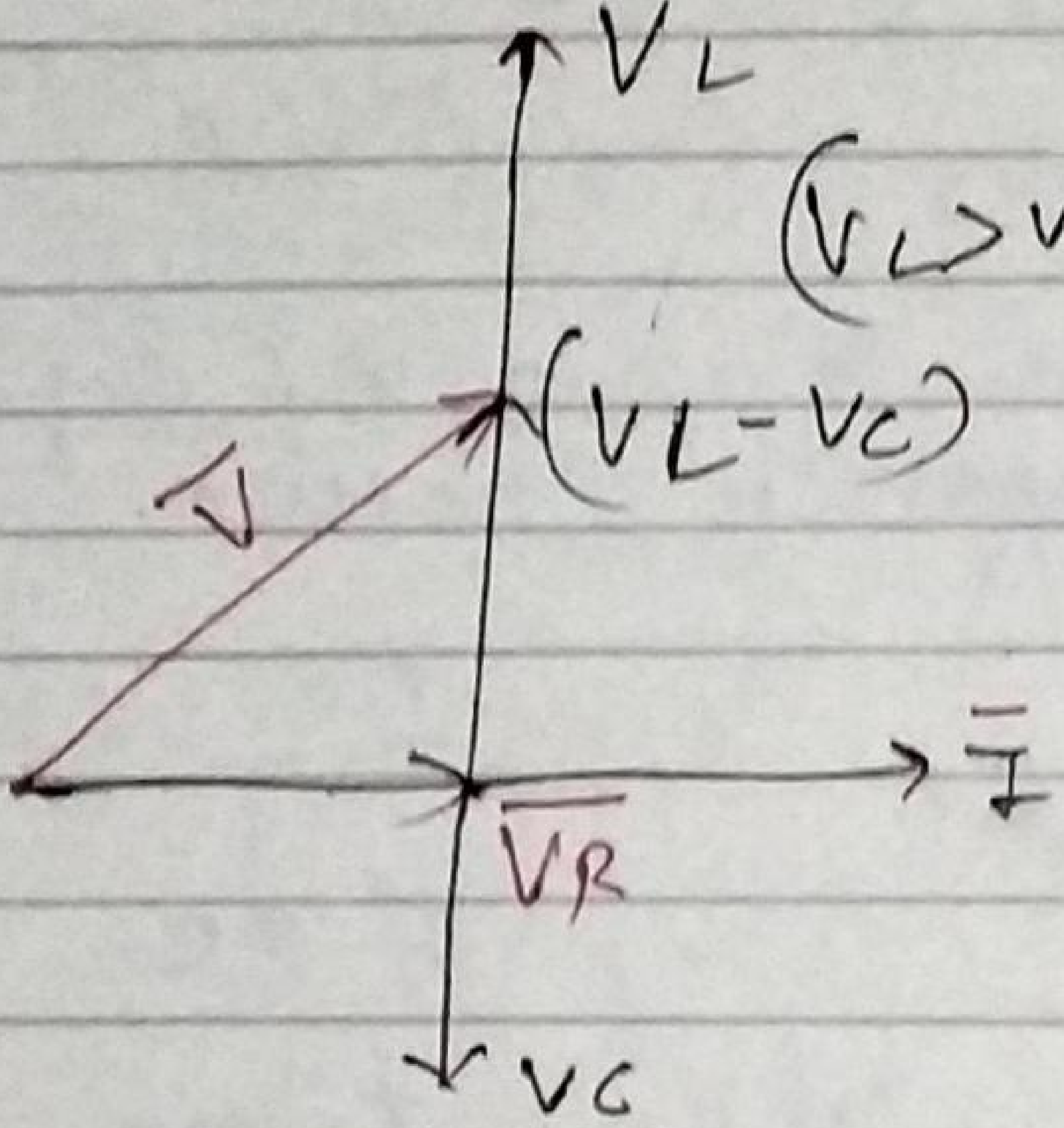
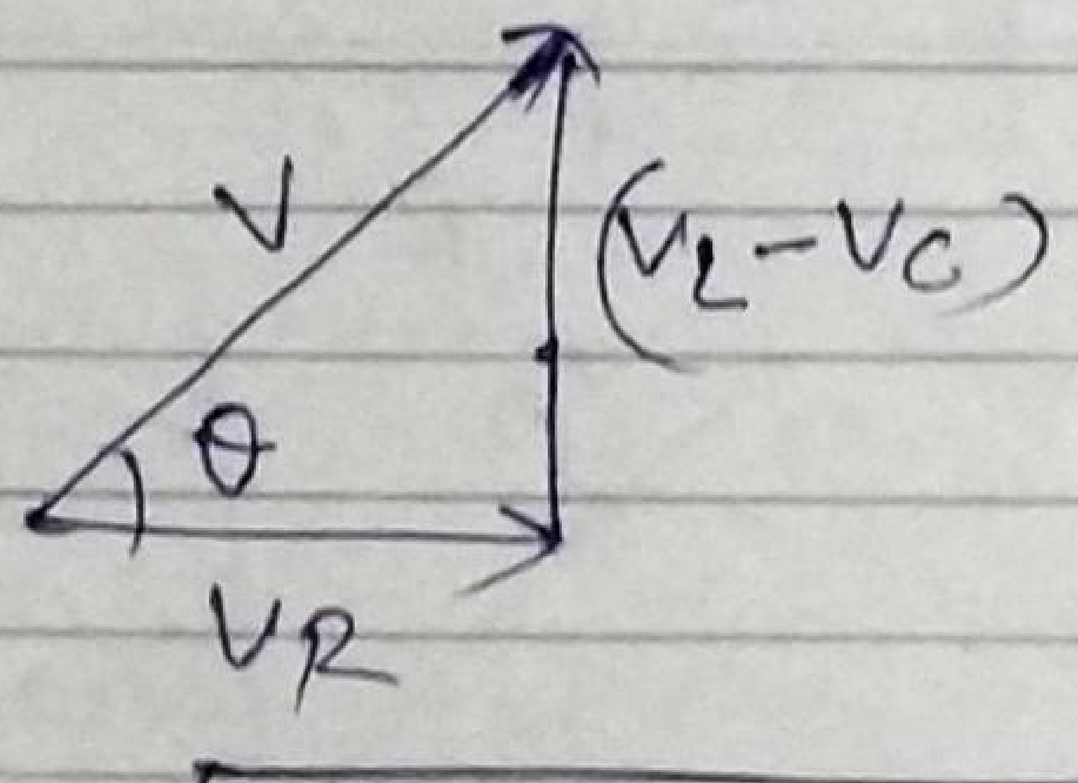
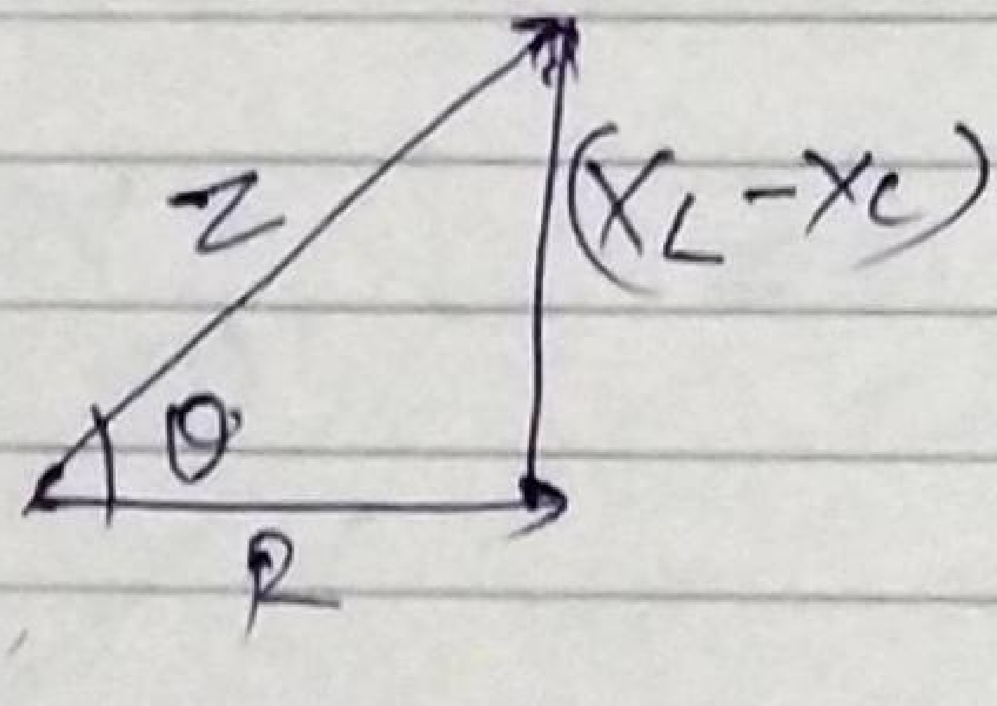
(6) Series RLC Ckt:-

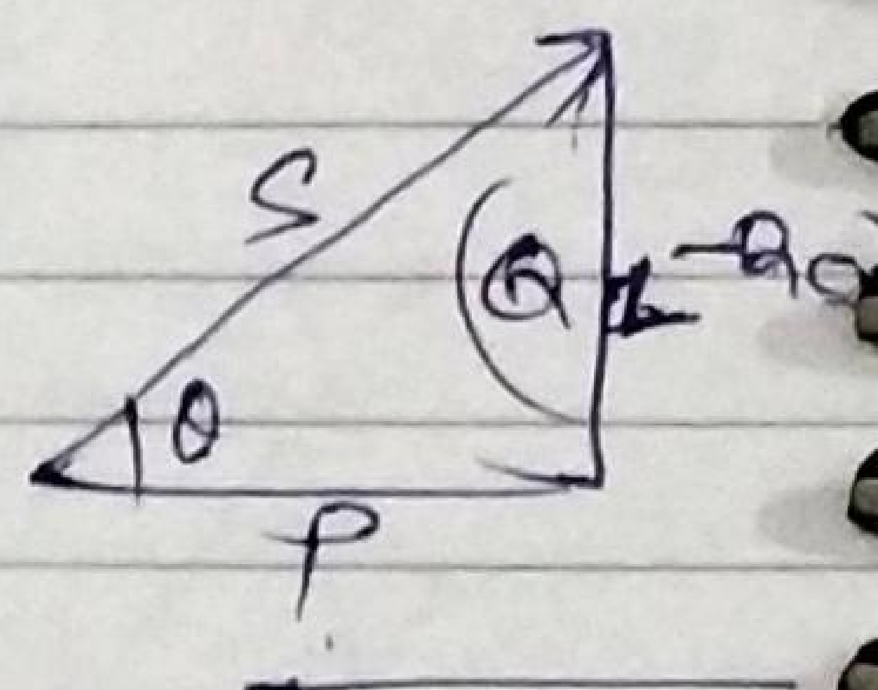
$\bar{V} = \bar{V}_R + \bar{V}_L + \bar{V}_C$











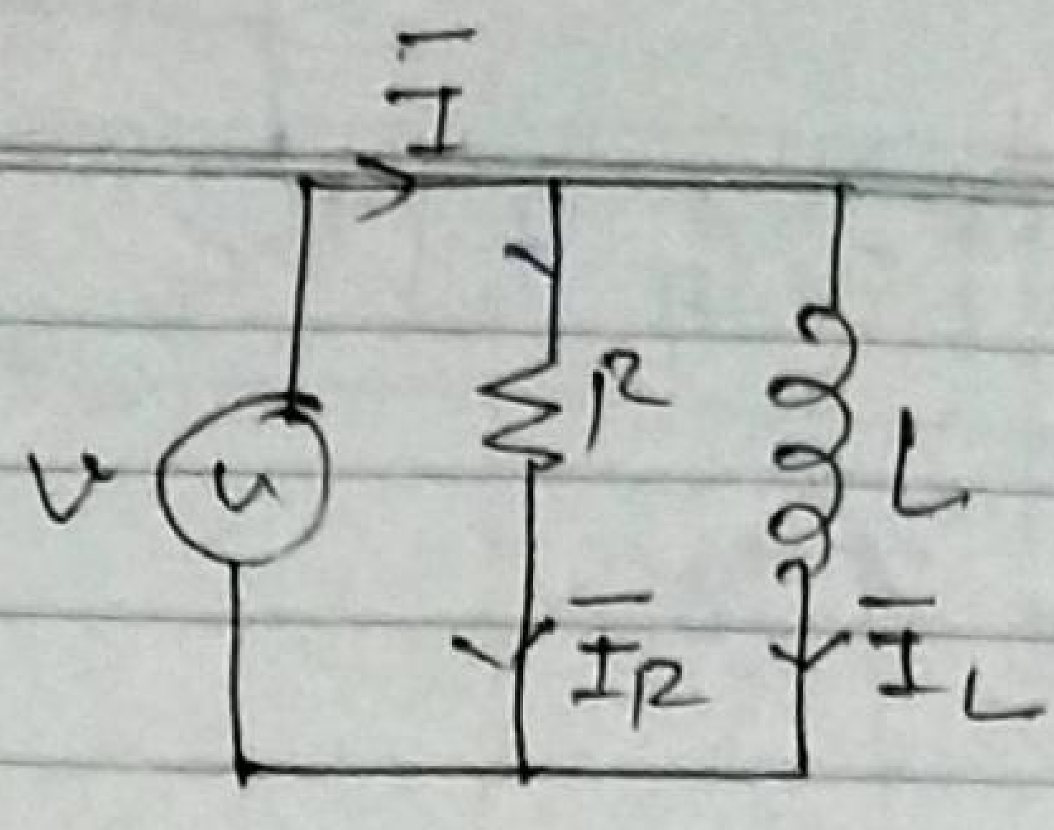
$V = \sqrt{V_R^2 + (V_L - V_C)^2}$ $\quad Z = \sqrt{R^2 + (X_L - X_C)^2}$ $\quad S = \sqrt{P^2 + (Q_L - Q_C)^2}$

$\tan\theta = \frac{V_L - V_C}{V_R}$ $\quad \tan\theta = \frac{X_L - X_C}{R}$ $\quad \tan\theta = \frac{Q_L - Q_C}{P}$

$\cos\theta = \frac{V_R}{V}$ (lagging) $\quad \cos\theta = \frac{R}{Z}$ (lagging) $\quad \cos\theta = \frac{P}{S}$ (lagging)

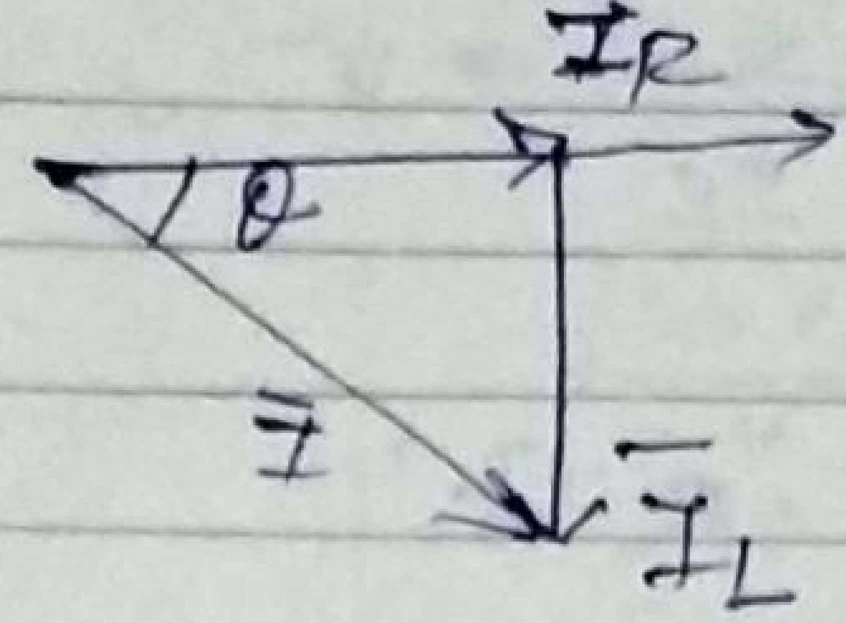
(7) Parallel RL Ckt:-

$\bar{I} = \bar{I}_R + \bar{I}_L$



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

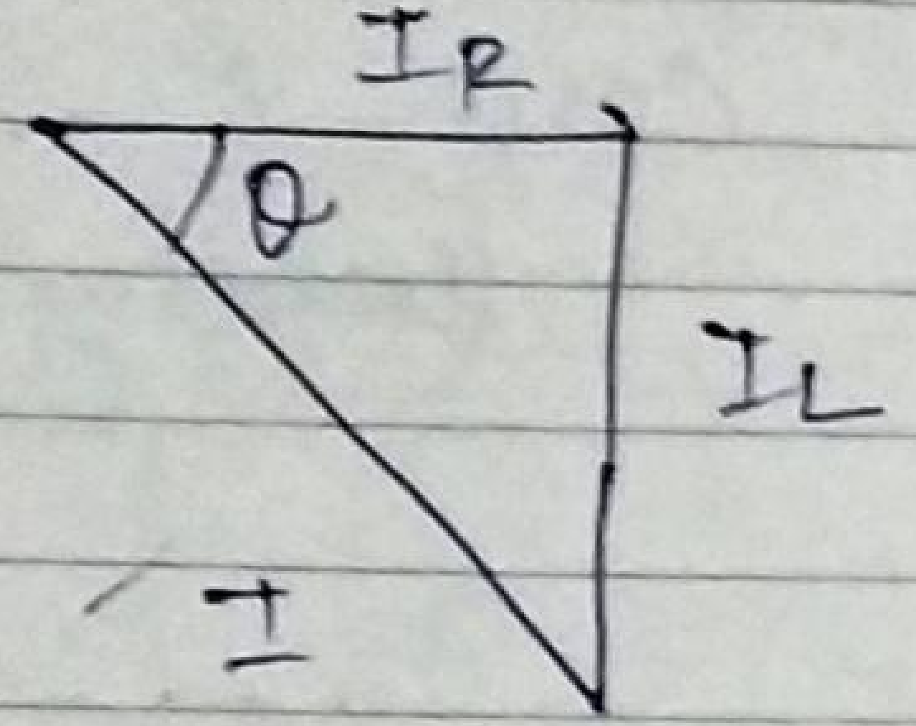
$\frac{1}{Z} = \frac{1}{R} - j\frac{1}{X_L}$

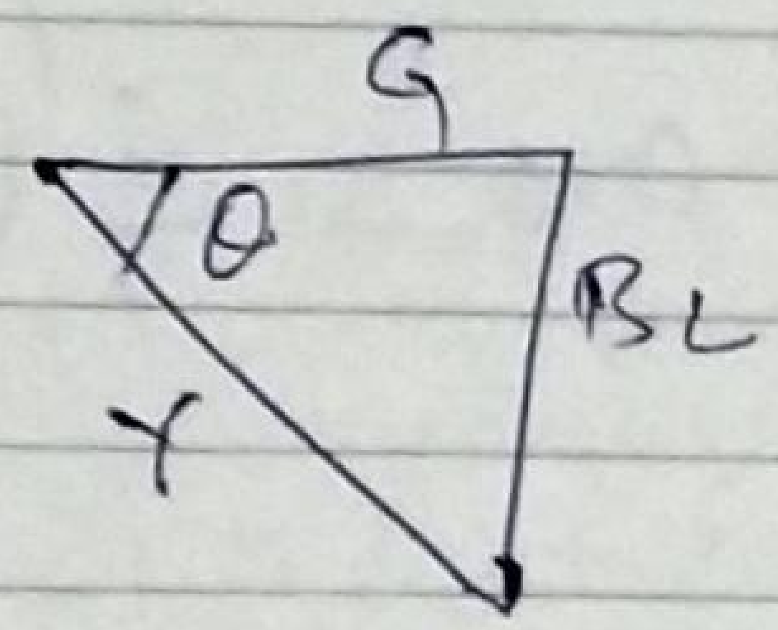


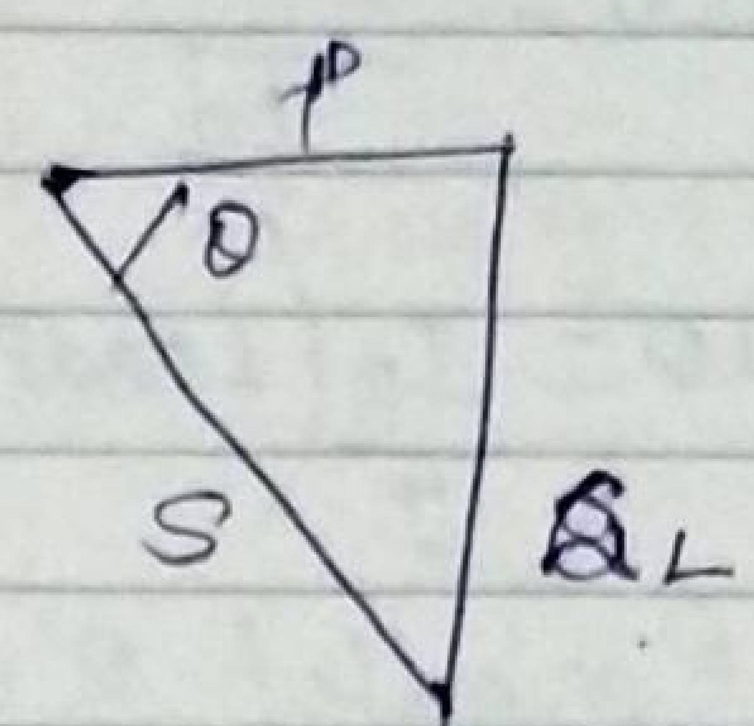
$\boxed{Y = G - jB_L}$

$\hookrightarrow$ conductance

$\hookrightarrow$ Inductive susceptance







$I = \sqrt{I_R^2 + I_L^2}$

$\tan\theta = -\frac{I_L}{I_R}$

$\cos\theta = \frac{I_R}{I}$ (lagging)

$Y = \sqrt{G^2 + B_L^2}$

$\tan\theta = \frac{-B_L}{G}$

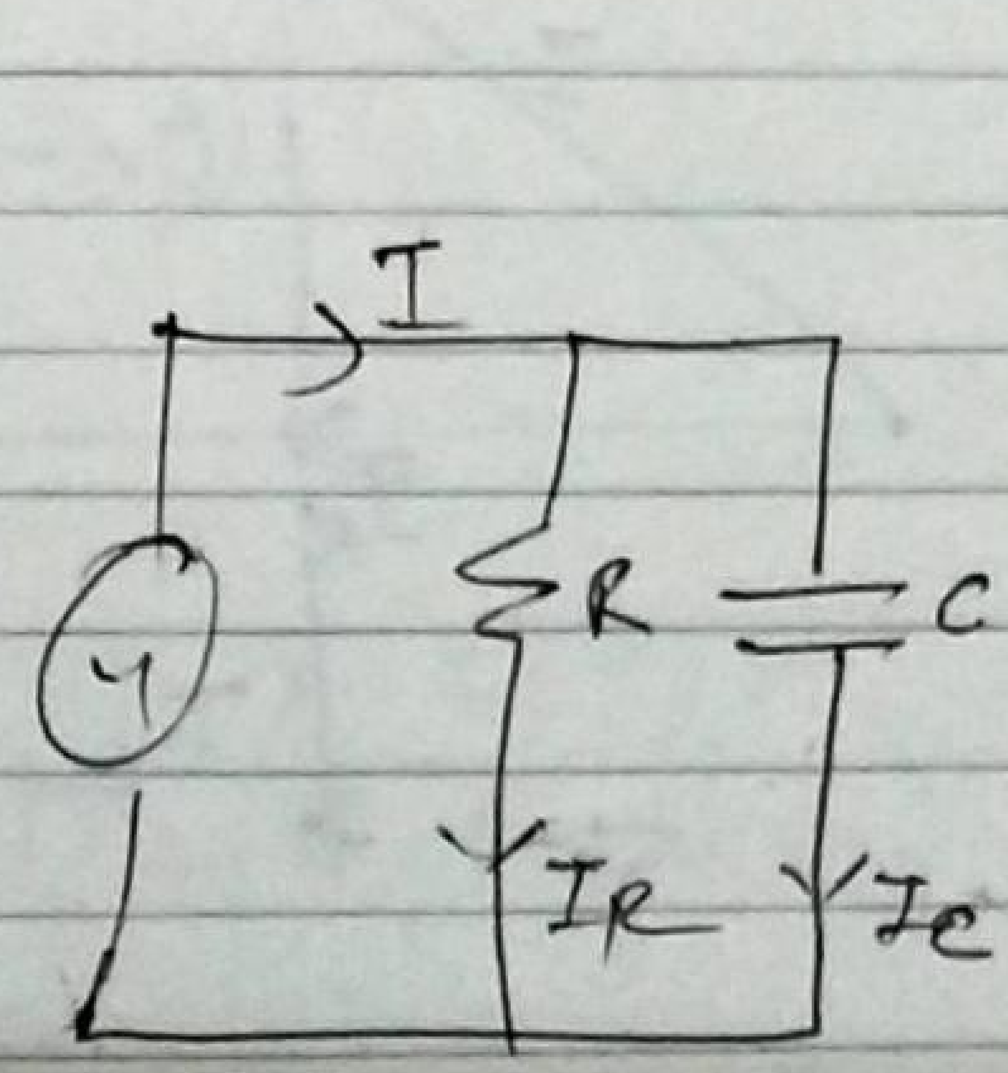
$\cos\theta = \frac{G}{Y}$ (lagging)

$S = \sqrt{P^2 + Q_L^2}$

$\tan\theta = -\frac{Q_L}{P}$

$\cos\theta = \frac{P}{S}$

Parallel RC Ckt :-



$\bar{I} = \bar{I}_R + \bar{I}_C$ (phasor sum)

$\frac{\bar{V}}{Z} = \frac{\bar{V}}{R} + \frac{\bar{V}}{-jX_C}$

$\frac{1}{Z} = \frac{1}{R} + j\frac{1}{X_C}$

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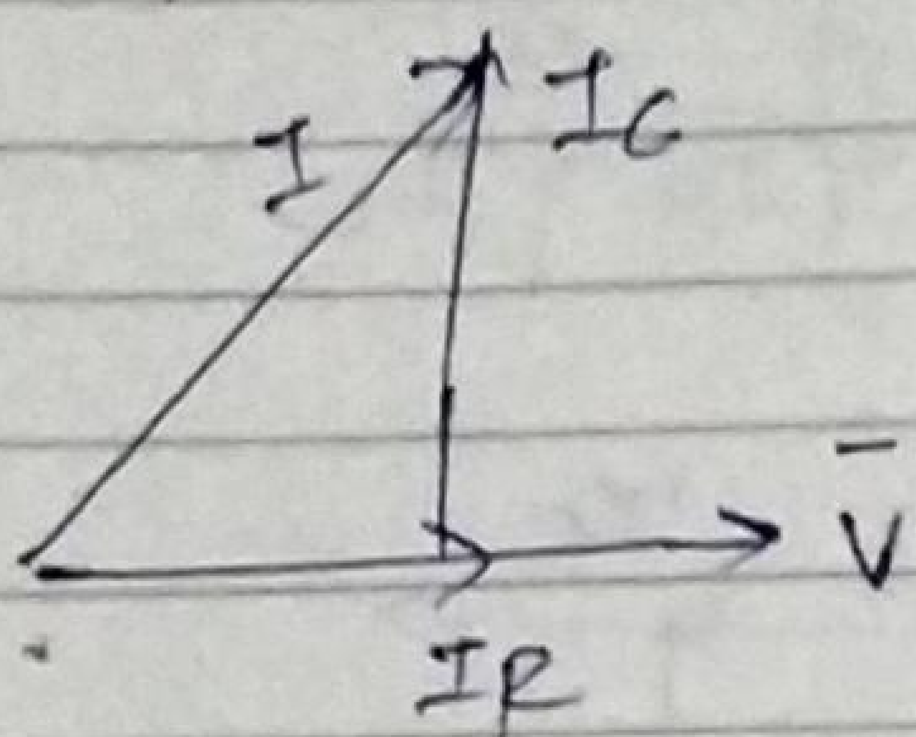
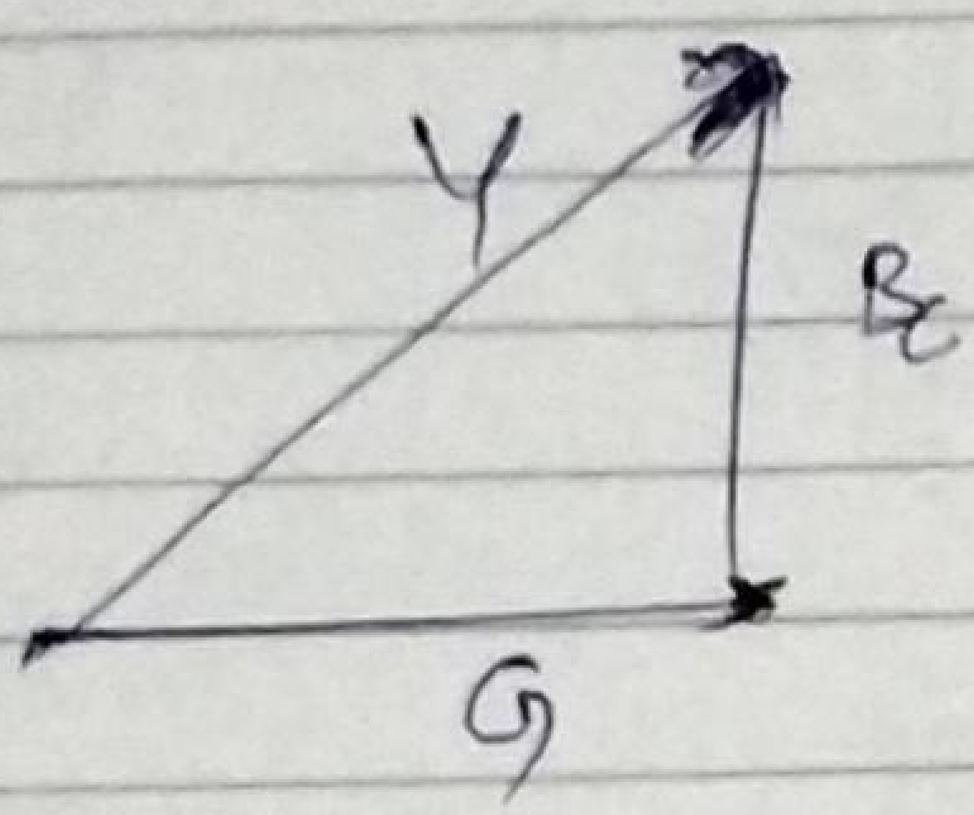
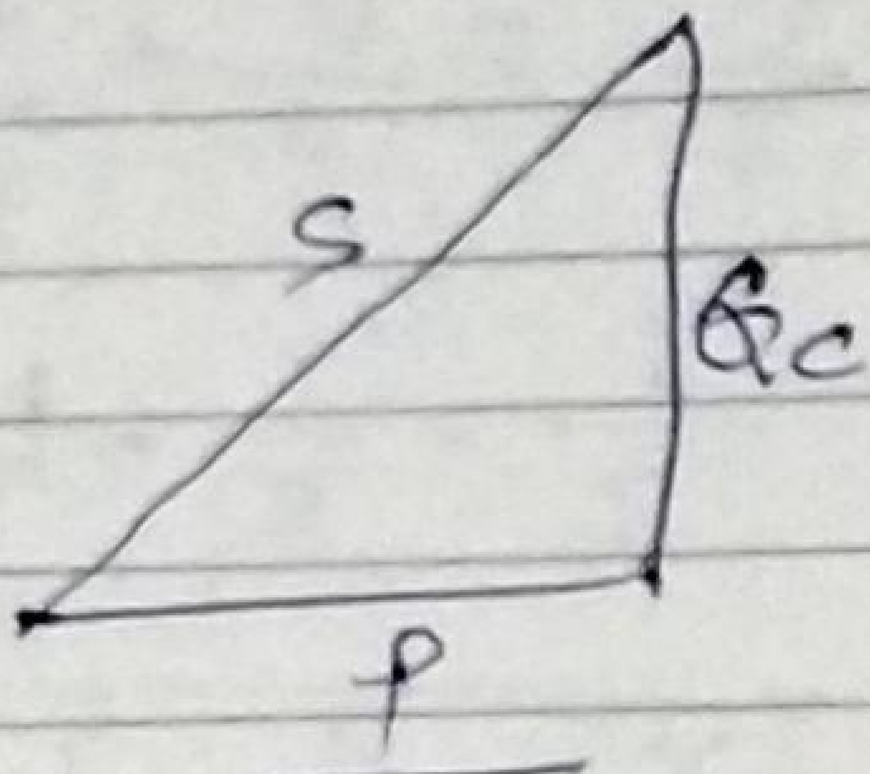
Capacitive susceptance

$$\boxed{Y = G + jB_C}$$







$I = \sqrt{I_R^2 + I_C^2}$

$\tan\theta = \frac{I_C}{I_R}$

$\cos\theta = \frac{I_R}{I}$ (leading)

$Y = \sqrt{G^2 + B_C^2}$

$\tan\theta = \frac{B_C}{G}$

$\cos\theta = \frac{G}{Y}$ (leading)

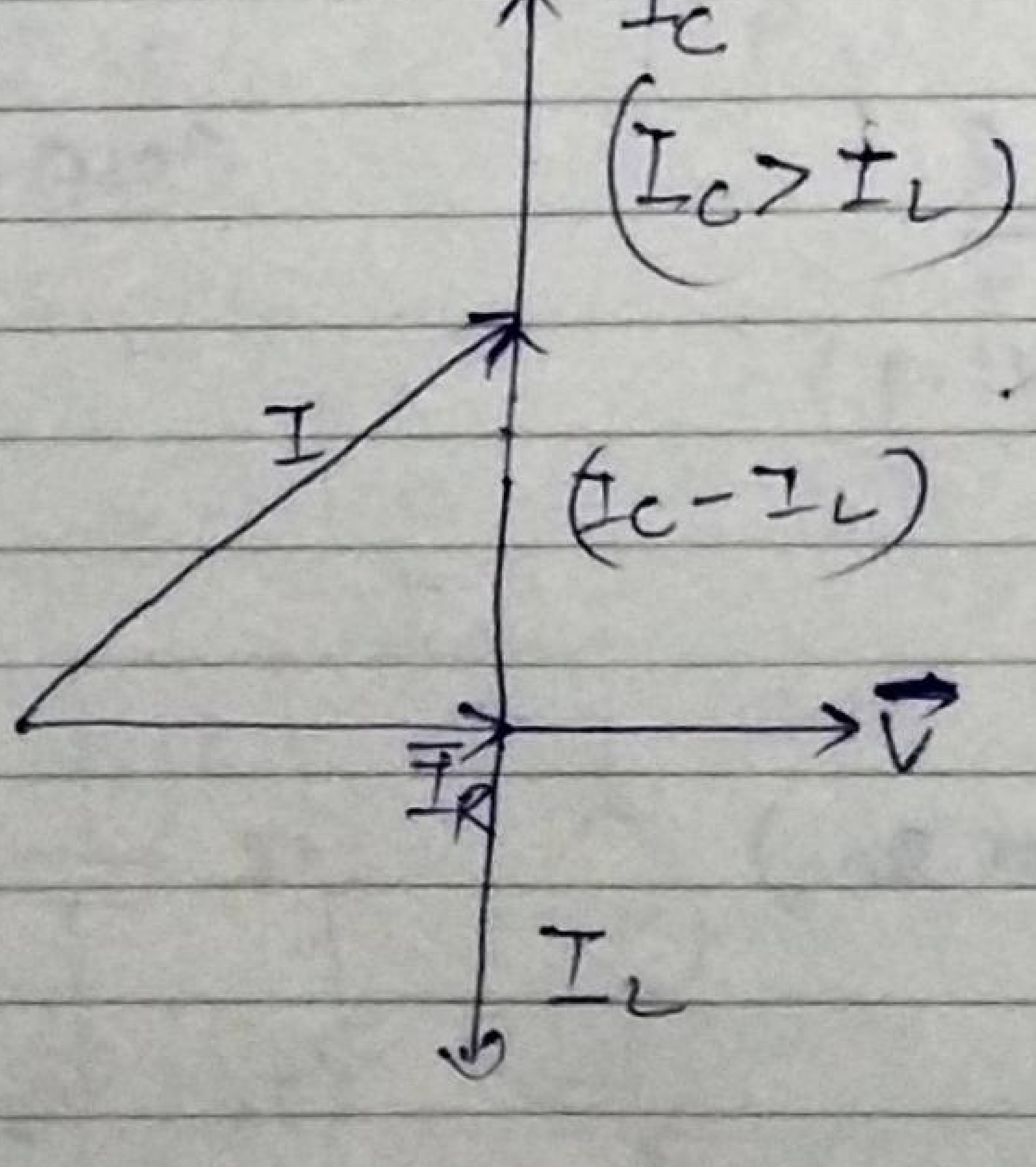
$S = \sqrt{P^2 + Q_C^2}$

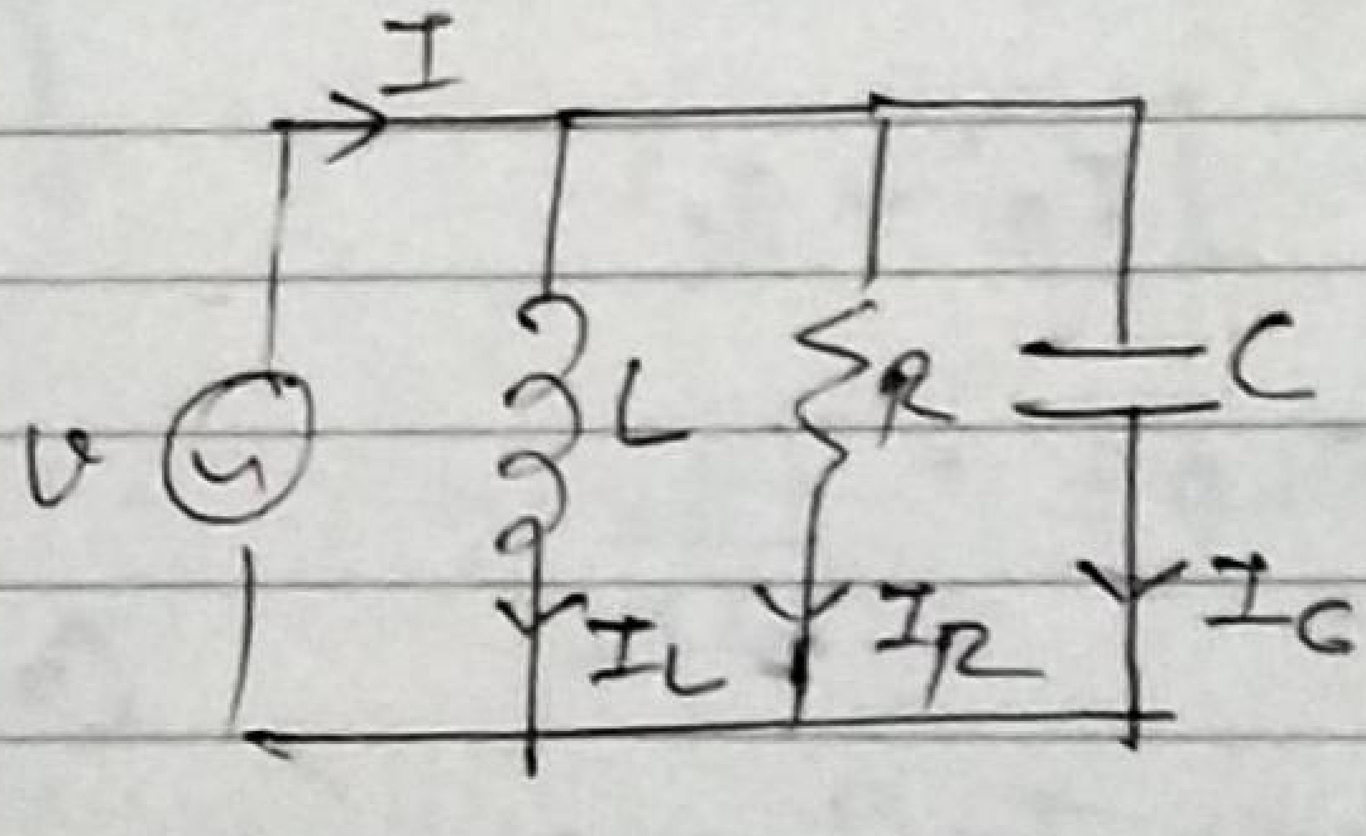
$\tan\theta = \frac{Q_C}{P}$

$\cos\theta = \frac{P}{S}$ (leading)

Parallel RLC ckt :-

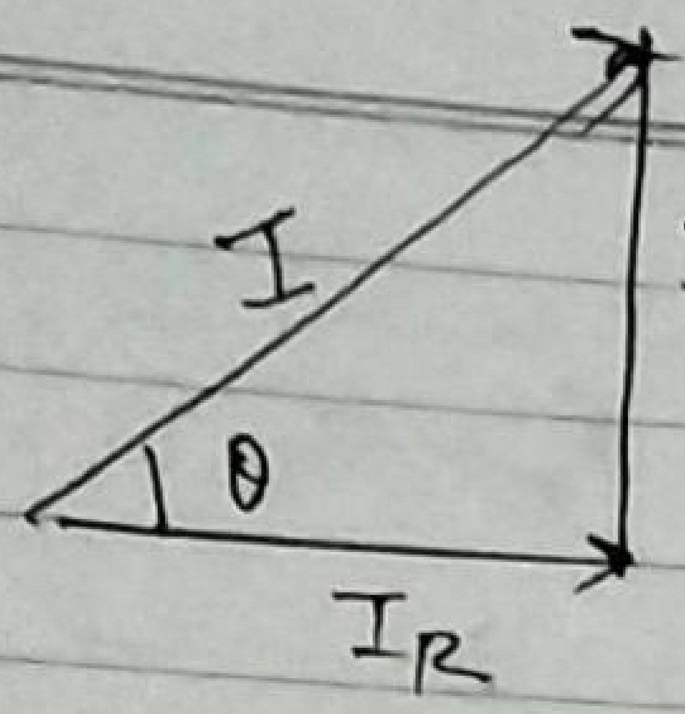
$\bar{I} = \bar{I}_R + \bar{I}_L + \bar{I}_C$

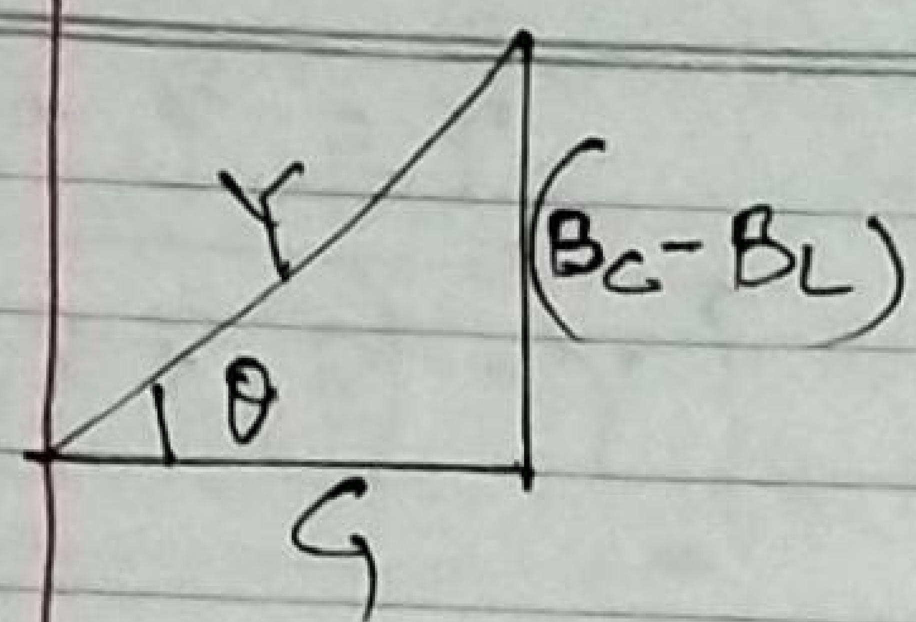


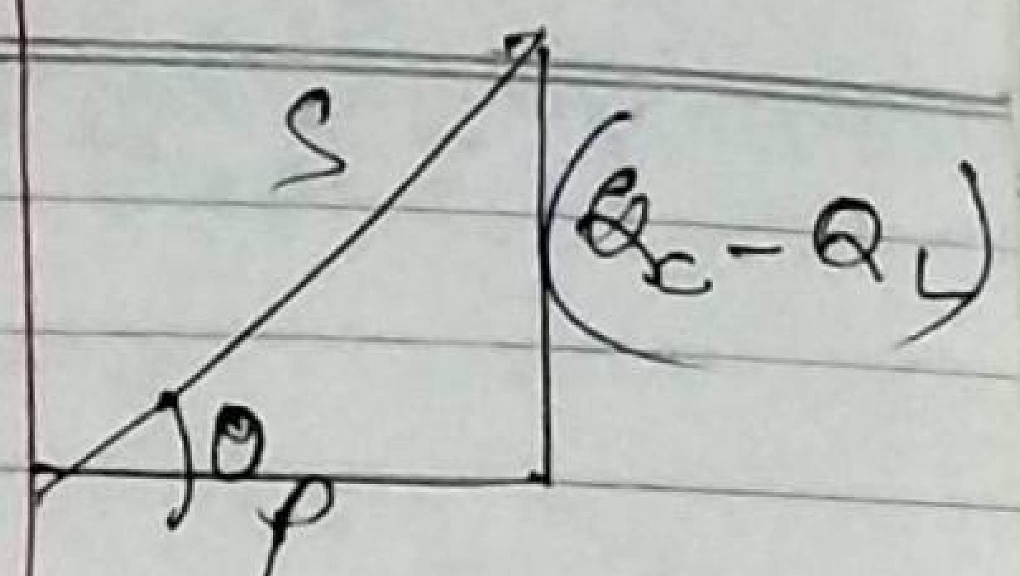


$$\frac{V}{Z} = \frac{V}{R} + \frac{V}{jX_L} + \frac{V}{-jX_C}$$

$$\boxed{Y = G + j(B_C - B_L)}$$







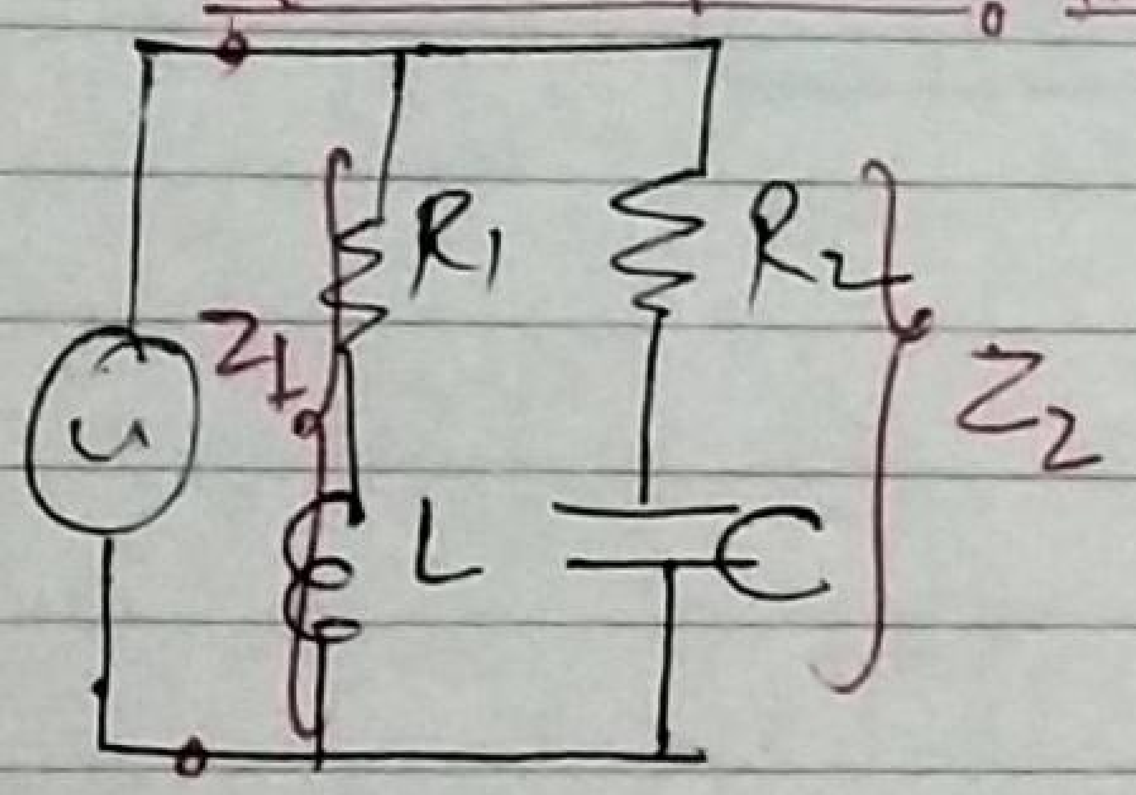
$I = \sqrt{I_R^2 + (I_C - I_L)^2}$ $\quad$ $Y = \sqrt{G^2 + (B_C - B_L)^2}$ $\quad$ $S = \sqrt{P^2 + (Q_C - Q_L)^2}$

$\tan\theta = \dfrac{I_C - I_L}{I_R}$ $\quad$ $\tan\theta = \dfrac{B_C - B_L}{G}$ $\quad$ $\tan\theta = \dfrac{Q_C - Q_L}{P}$

$\cos\theta = \dfrac{I_R}{I}$ $\quad$ $\cos\theta = \dfrac{G}{Y}$ $\quad$ $\cos\theta = \dfrac{P}{S}$

(leading) $\quad$ (leading) $\quad$ (leading)

equivalent admittance :-



$$Z_1 = R_1 + jX_L$$

$$Y_1 = \frac{1}{R_1 + jX_L} \times \frac{(R_1 - jX_L)}{(R_1 - jX_L)}$$

$$Y_1 = \frac{R_1 - jX_L}{R_1^2 + X_L^2}$$

$$Y = Y_1 + Y_2$$

$$Y_1 = \frac{R_1}{(R_1^2 + X_L^2)} - j\frac{X_L}{(R_1^2 + X_L^2)}$$

$$Y_1 = G_1 - jB_L$$

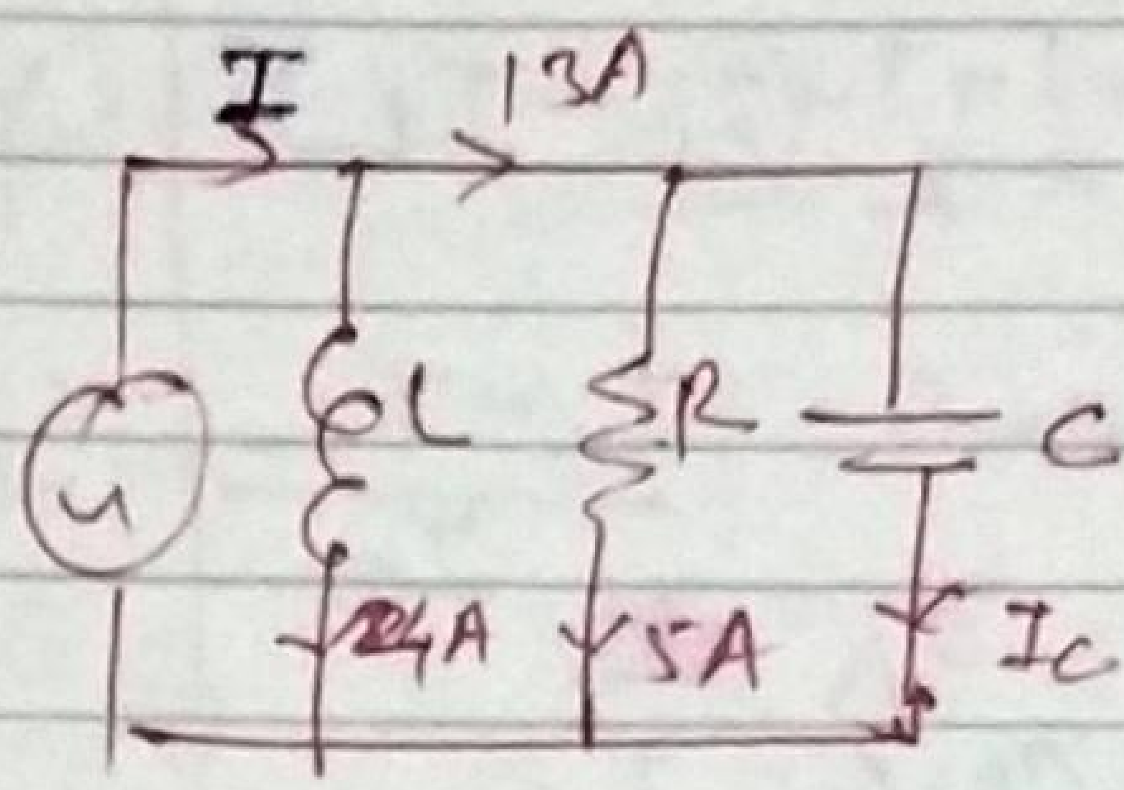
$$Z_2 = R_2 - jX_C \qquad Y_2 = \frac{1}{R_2 - jX_C} \times \frac{R_2 + jX_C}{R_2 + jX_C}$$

$$Y_2 = \frac{R_2 + jX_C}{R_2^2 + X_C^2} \qquad Y_2 = \frac{R_2}{(R_2^2 + X_C^2)} + j\frac{X_C}{(R_2^2 + X_C^2)}$$

$Y_2 = G_2 + jB_C$ $\quad Y = Y_1 + Y_2$

$$\boxed{Y = (G_1 + G_2) + j(B_C - B_L)}$$

Ques:



$13 = \sqrt{5^2 + I_c^2}$

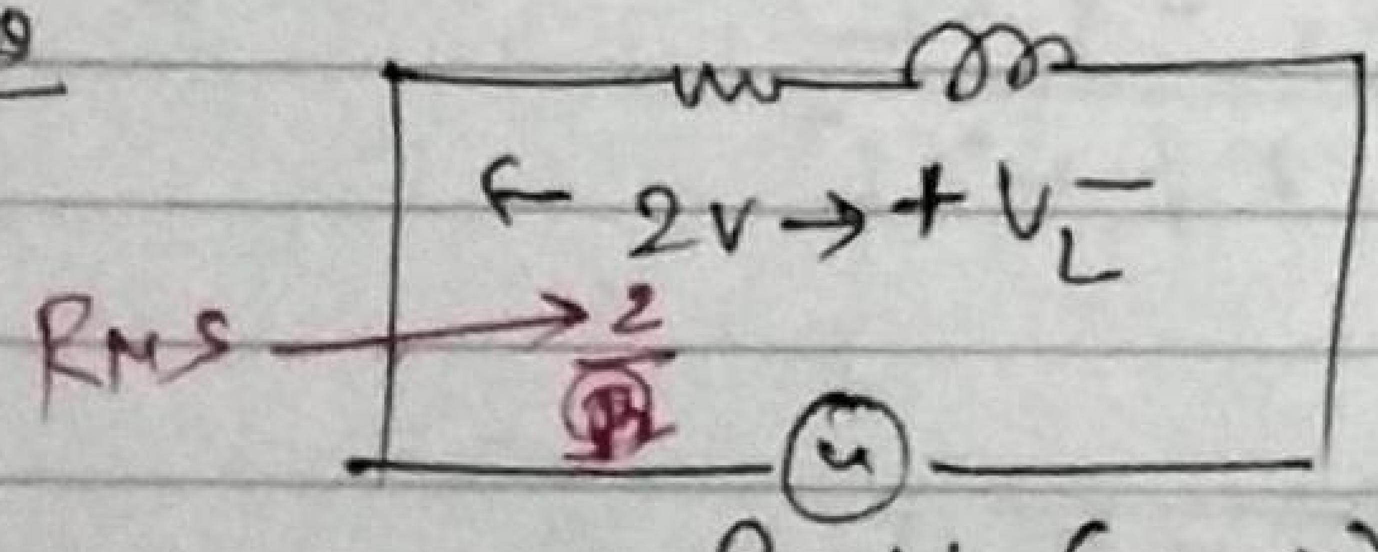
$169 - 25 = I_c^2$

$$\boxed{I_c = 12}$$

$I = \sqrt{25 + (12-24)^2}$ $\quad \boxed{\cancel{I = 21.37}}$

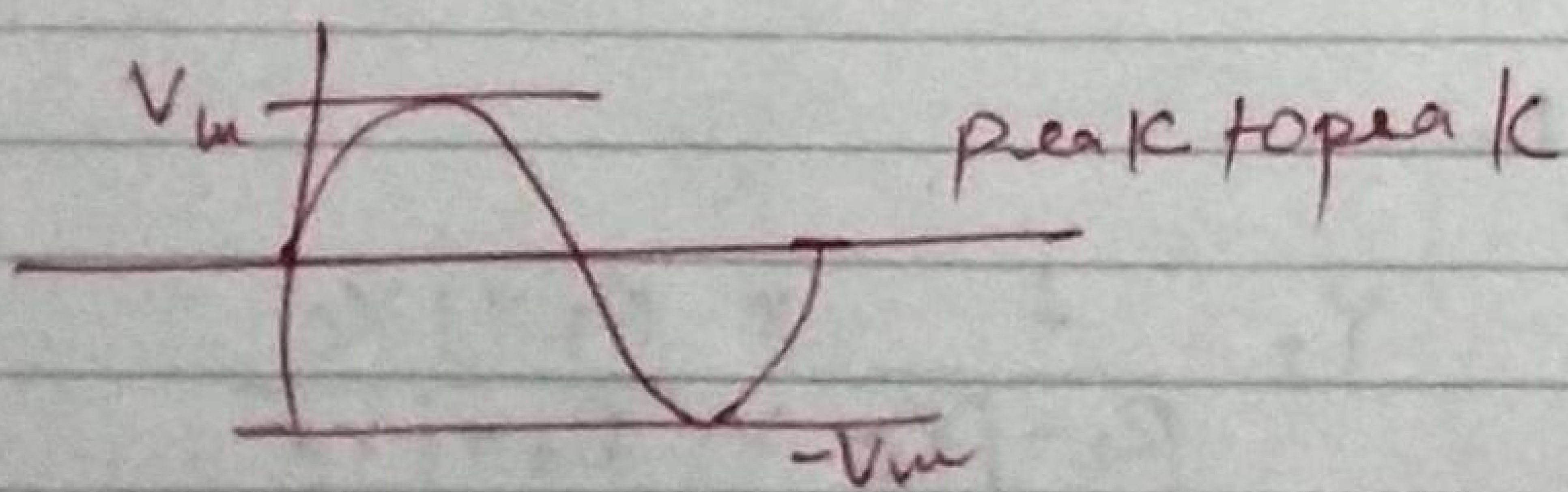
$$\boxed{I = 13A}$$

Ques



$\cancel{20^2 = 2^2 + V_L^2}$

$\cancel{\boxed{19.9\,V}}$



$2V_m = 20V$

$$\boxed{V_m = 10V}$$

$V_{rms} = \frac{10}{\sqrt{2}}$

$V = \sqrt{(V_R^2 + V_L^2)}$ $\quad \left(\frac{10}{\sqrt{2}}\right)^2 = 4 + V_L^2$

$$\boxed{V_L = \sqrt{46}\ \text{volts}}$$

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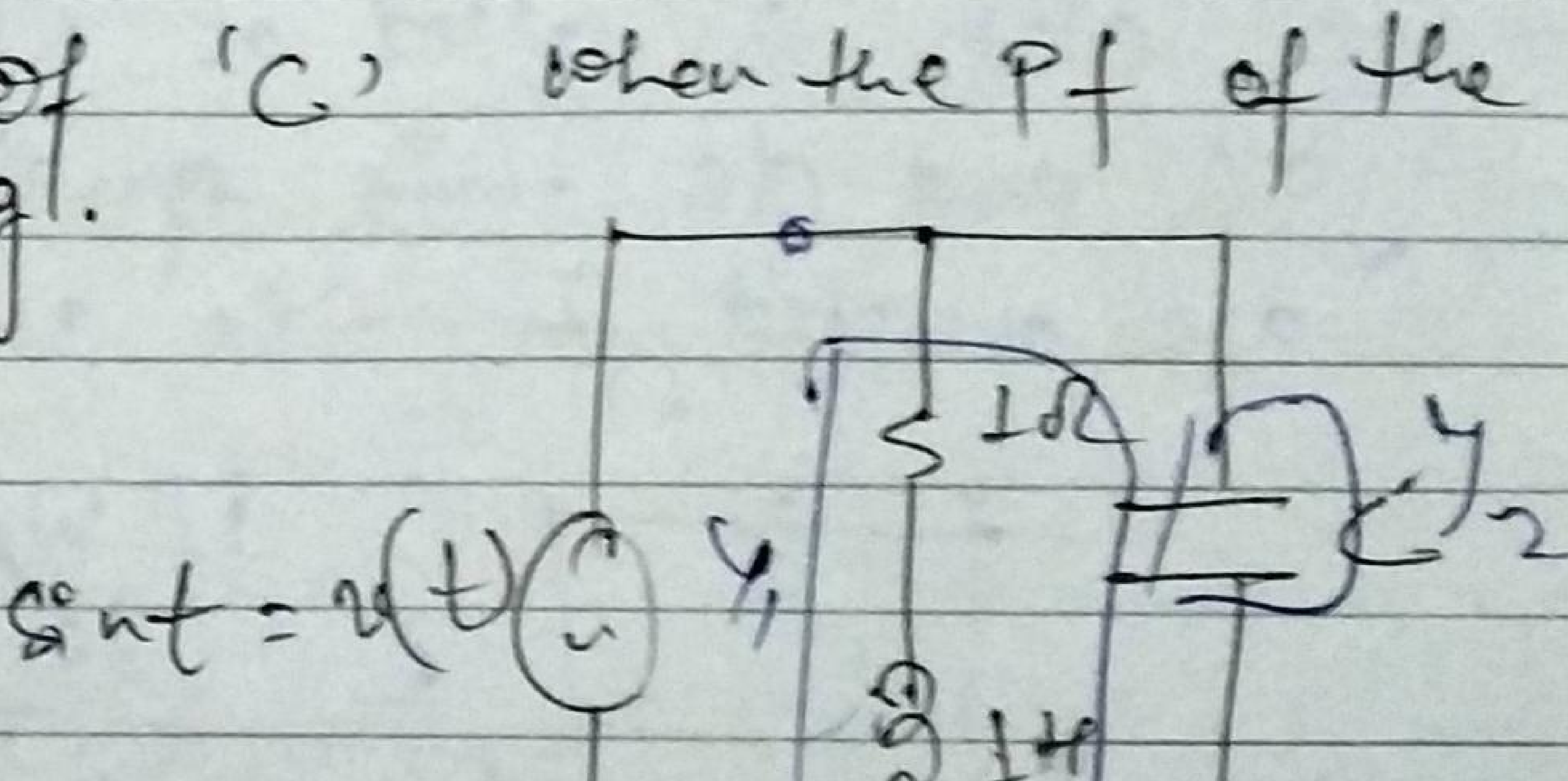
R_L 5

Ques :- Find the value of 'C' when the pf of the ckt is 0.8 lagging.



$Y_1 = G_1 - j B_L$

$G_1 = \frac{R_1}{R_1^2 + X_L^2}$

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$X_L = \omega L = (1)(1) = 1\ \Omega$ $\quad G_1 = \frac{1}{1+1} = \frac{1}{2}$

$B_1 = \frac{X_L}{R_1^2 + X_L^2} = \frac{1}{2}$ $\quad Y_1 = \frac{1}{2} - j\frac{1}{2}$

$B_C = \frac{1}{X_C} = \frac{1}{1/\omega C}$ $\quad Y_2 = jB_C = jC$

$Y = Y_1 + Y_2 \Rightarrow \frac{1}{2} - j\frac{1}{2} + jC$

$Y = \frac{1}{2} + j\left(C - \frac{1}{2}\right)$ $\quad \cos\phi = \frac{G}{|Y|}$

$0.8 = \frac{1/2}{\sqrt{\frac{1}{4} + \left(C - \frac{1}{2}\right)^2}}$ $\quad C = \frac{7}{8}, \frac{1}{8}$

$C = \frac{1}{8}$ F $\because$ Pf lagging