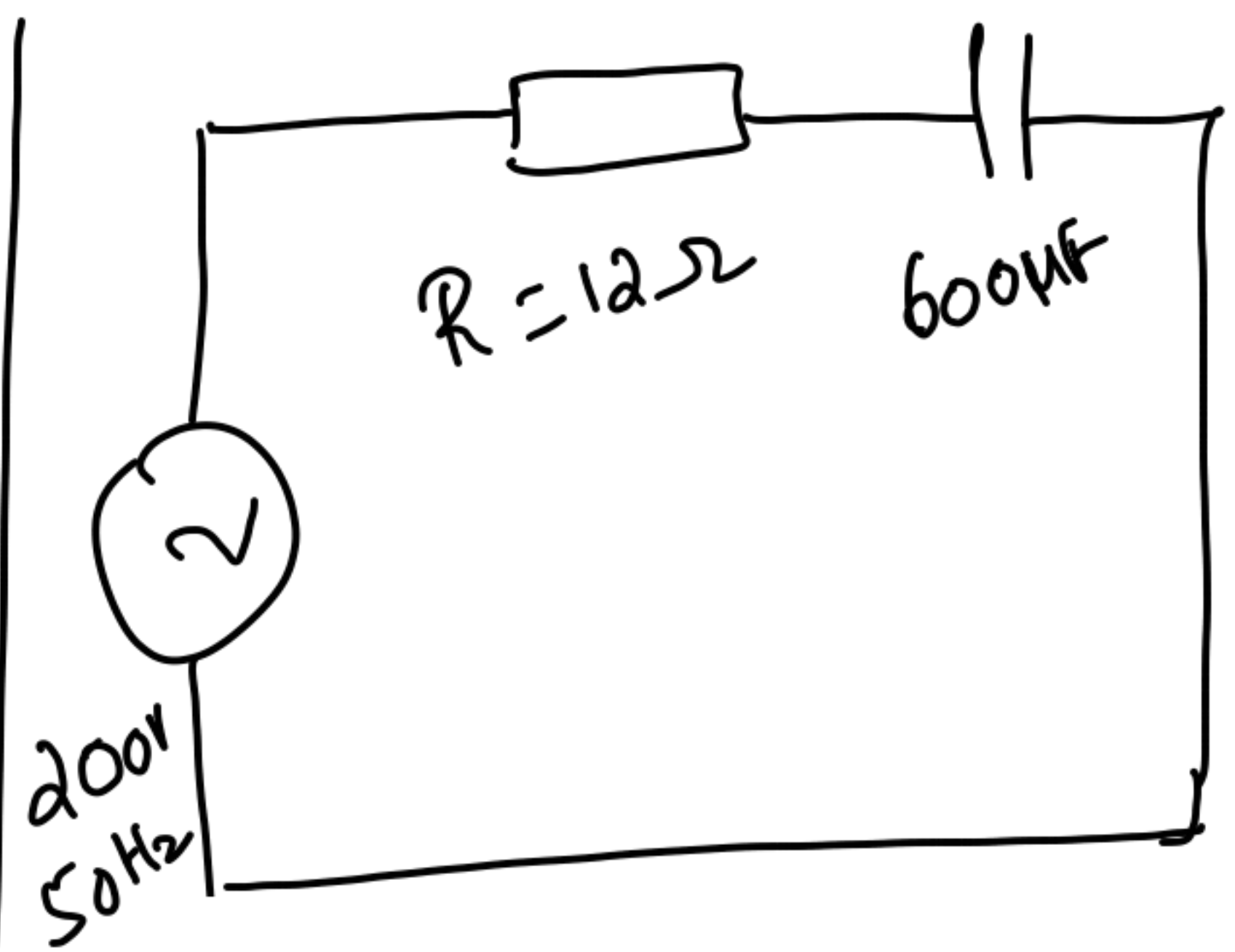


6) A Series Combination of 12Ω Resistor and $600\mu\text{F}$ Capacitors is Connected to a 200V , 50Hz Supply. Estimate the Current, active power, Reactive Power, apparent power, Voltage across R and C , and the phasor diagram [calculate using complex Numbers]



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

$$Z = R - jX_C$$

$$X_C = \frac{1}{2\pi fC}$$

$$X_c = \frac{1}{2\pi \times 50 \times 600 \times 10^{-6}}$$

$$X_c = 5.31 \Omega$$

$$Z = 12 - j5.31 \Omega$$

$$|Z| = \sqrt{12^2 + (-5.31)^2}$$

$$|Z| = 13.12 \Omega$$

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

$$\phi = \tan^{-1}\left(\frac{-5.31}{12}\right)$$

$$\phi = -23.87^\circ$$

$$Z = 13.12 \angle -23.87^\circ$$

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

$$V = 200 \angle 0^\circ$$

$$I = \frac{200 \angle 0^\circ}{13.12 \angle -23.87^\circ}$$

$$I = 15.24 \angle (0 - (-23.87^\circ))$$

$$I = 15.24 \angle 23.87^\circ$$

Voltage across Resistor.

$$V_R = I \cdot R$$

$$= 15.24 \angle 23.87^\circ \times 12$$

$$= 12 \times 15.24 \angle 23.87^\circ$$

$$V_R = 182.88 \angle 23.87^\circ$$

$$\begin{aligned}
 V_C &= \bar{I} (-jX_C) \\
 &= 15.24 \angle 23.87^\circ \times (-j5.31) \\
 &= 15.24 \angle 23.87^\circ \times 5.31 \angle -90^\circ \\
 &= 15.24 \times 5.31 \angle 23.87 + (-90^\circ)
 \end{aligned}$$

$$V_C = 80.92 \angle -66.13^\circ$$

$$\begin{aligned}
 j &= 90^\circ \\
 -j &= -90^\circ
 \end{aligned}$$

$$S = V \cdot \bar{I}^*$$

$$S = 200 \times 15.24 \angle 23.87^\circ$$

$$S = 3048 \angle 23.87^\circ$$

$$\gamma \angle \phi$$

$$S = P + jQ$$

$$P = \gamma \cos \phi$$

$$Q = \gamma \sin \phi$$

$$P = 3048 \cos(-23.87) = 2787.29 \text{ W}$$

$$Q = 3048 \sin(-23.87) = -1233.41 \text{ VAR} \\ = 1233.41 \text{ VAR (Capacit)}$$

$$V = 200 \angle 0^\circ$$

$$I = 15.24 \angle 23.87$$

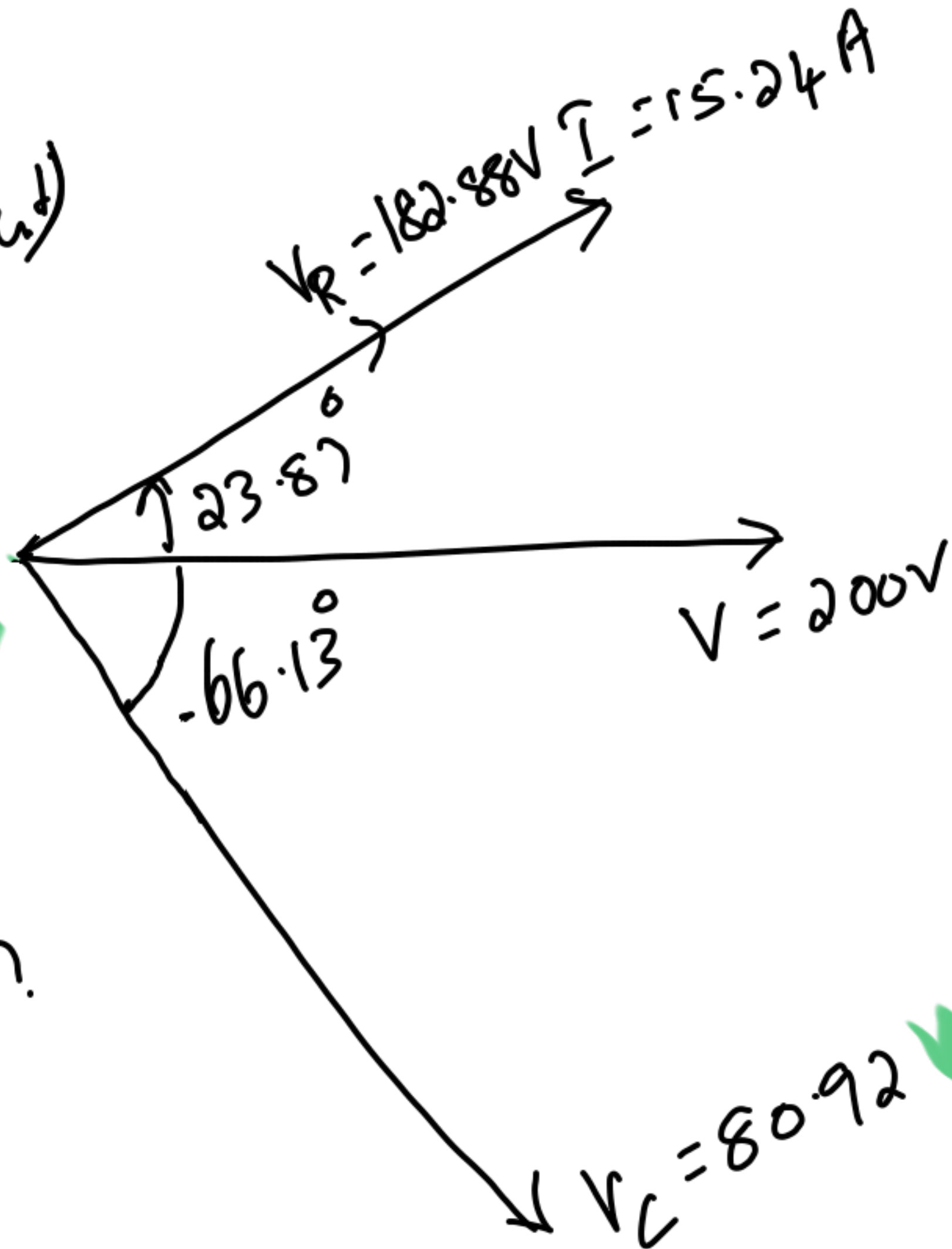
$$\phi = -23.87$$

$$V_R = 182.88, \phi_{V_R} = 23.87^\circ$$

$$V_C = 80.92, \phi_{V_C} = -66.13^\circ$$

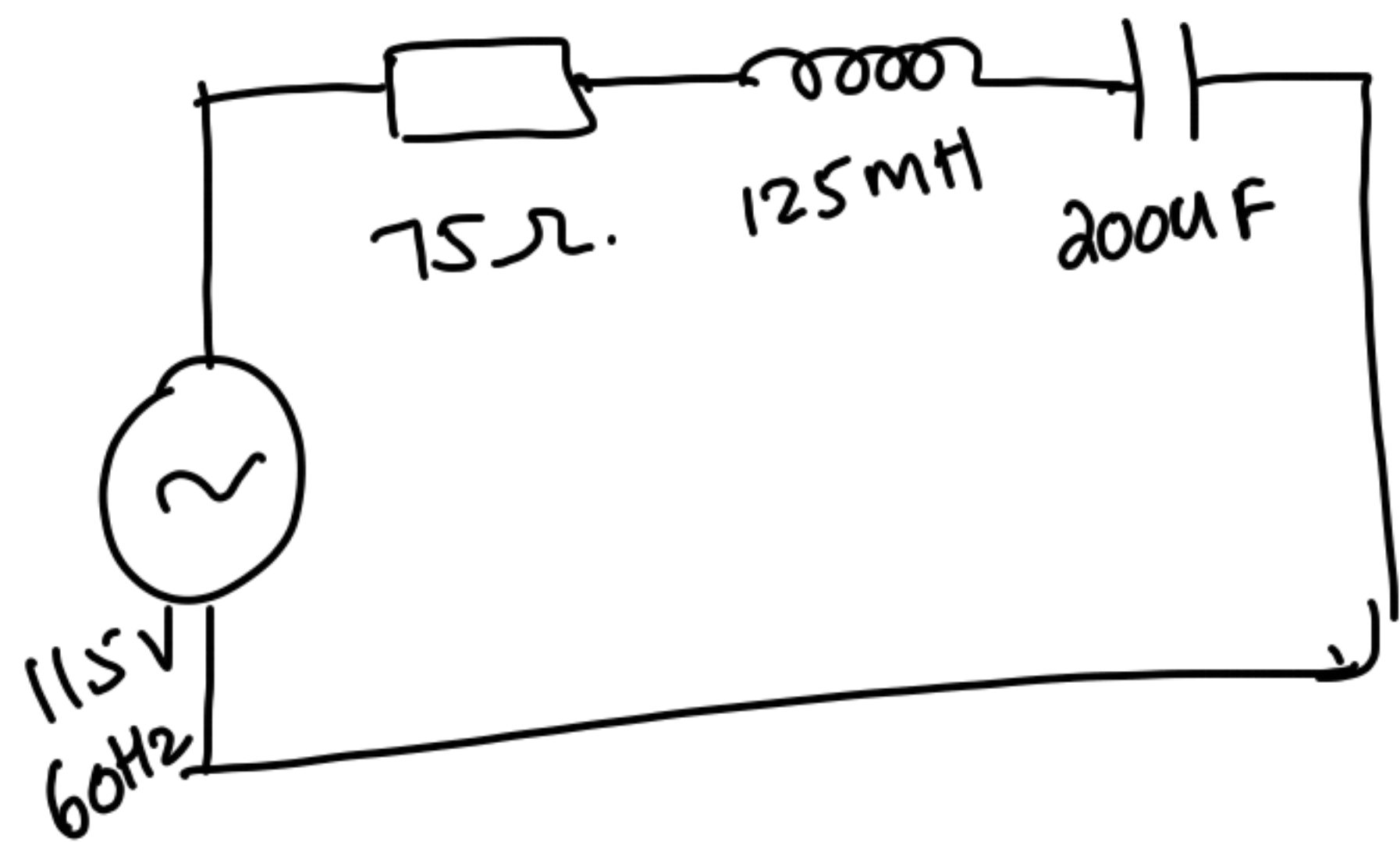
$$I = \angle 23.87$$

$$I^* = -23.87$$



7) A RLC Series Circuit consisting of $R = 75\Omega$, $L = 125\text{mH}$, and $C = 200\mu\text{F}$ is excited by a Sinusoidal Source of voltage 115V , 60Hz . Using Complex functions determine the following

- Current across the circuit.
- Voltage across each element.
- Apparent power
- Active power
- Reactive power
- Phasor diagram



$$\begin{aligned}X_L &= 2\pi fL \\&= 2\pi \times 60 \times 125 \times 10^{-3} \\&= 47.12\Omega.\end{aligned}$$

$$X_C = \frac{1}{2\pi fC} = \frac{1}{2\pi \times 60 \times 200 \times 10^{-6}}$$

$$X_C = 13.26\Omega.$$

$$Z = R + j(X_L - X_C)$$

$$= 75 + j(47.12 - 13.26)$$

$$Z = 75 + j33.86 \, \Omega$$

$$|Z| = \sqrt{75^2 + 33.86^2}$$

$$|Z| = 82.29 \, \Omega$$

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

$$\phi = \tan^{-1}\left(\frac{47.12 - 13.26}{75}\right) = 24.22^\circ$$

$$I = \frac{V}{Z} = \frac{115 \angle 0^\circ}{82.29 \angle 24.22^\circ}$$

$$I = 1.4 \angle -24.22^\circ \text{ A}$$

$$V_R = I \cdot R = 1.4 \angle -24.22^\circ \times 75$$

$$= 105 \angle -24.22^\circ \text{ V}$$

$$V_L = I \cdot (jX_L)$$

$$= 1.4 \angle -24.22^\circ \times j47.12$$

$$V_L = 1.4 \angle -24.22^\circ \times 47.12 \angle 90^\circ$$

$$V_L = 65.97 \angle 65.77^\circ \text{ V}$$

$$V_C = I \cdot (-jX_C)$$

$$= 1.4 \angle -24.22^\circ \times 13.26 \angle -90^\circ$$

$$V_C = 18.56 \angle -114.22^\circ$$

$$S = VI^* = 115 \times 1.4 \angle +24.22^\circ$$

$$S = 161 \angle +24.22^\circ$$

$$S = P + jQ$$

$$P = \gamma \cos \phi = 116 \cos (+24.22^\circ)$$

$$Q = \gamma \sin \phi = 116 \sin (+24.22^\circ)$$

$$P = 146.7 \text{ W}$$

$$Q = 66.25 \text{ VAR} \quad \text{Inductive}$$

$$X_L = 47.12 \quad X_C = 13. \dots$$

$$X_L > X_C$$

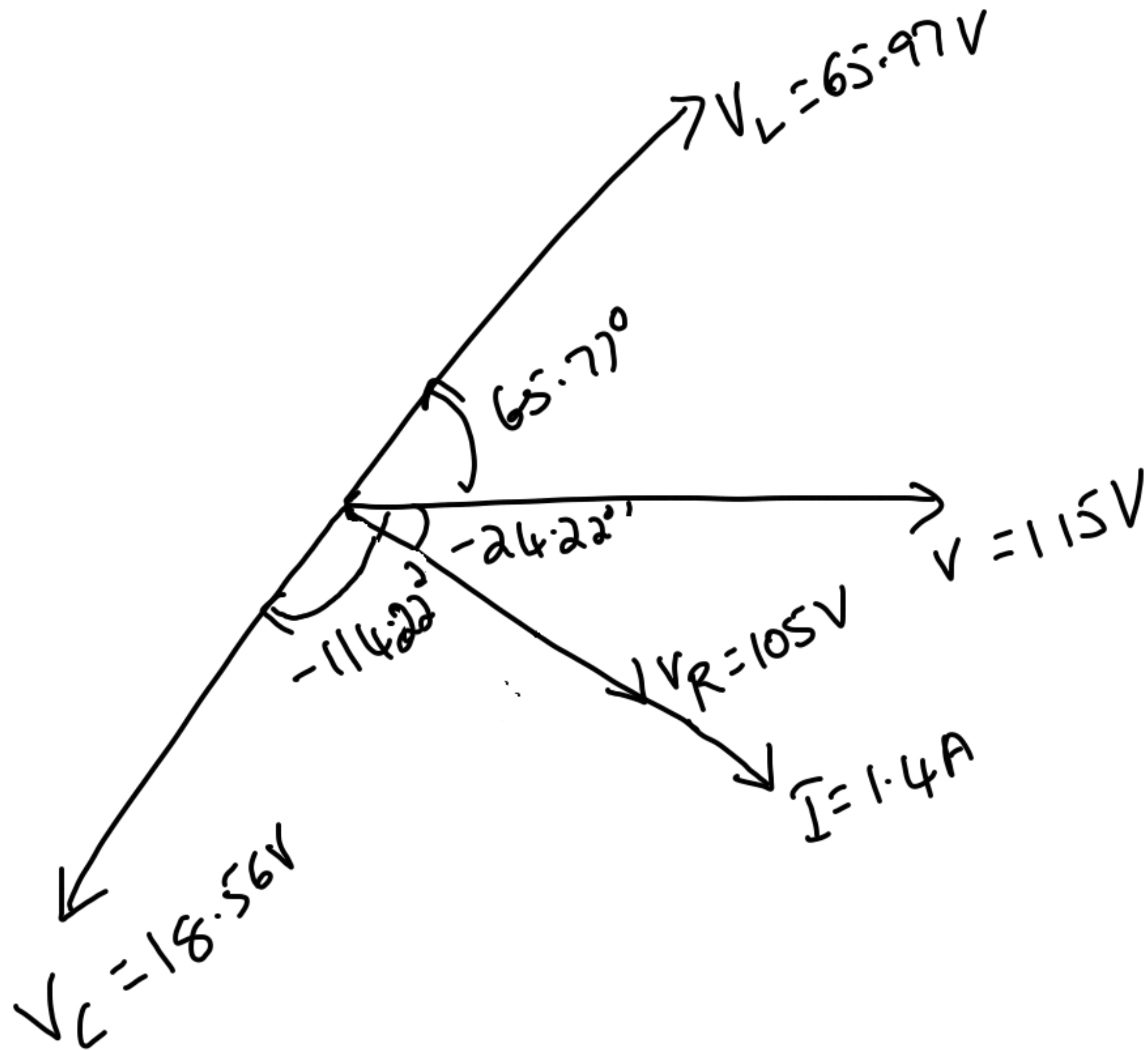
$$V = 115 \text{ V} \angle 0^\circ$$

$$\hat{I} = 1.4 \angle -24.22^\circ \text{ A}$$

$$V_R = 105 \angle -24.22^\circ \text{ V}$$

$$V_L = 18.56 \angle -114.23^\circ \text{ V}$$

$$V_L = 65.97 \angle +65.77^\circ \text{ V}$$



	L	C
$\vec{I}$	lags voltage	leads voltage
	$\phi = \text{lag}$	$\phi = \text{lead}$
Comp	polarm. $\oplus$ $Z = R + jX_L$	$\ominus$ $Z = R - jX_C$

