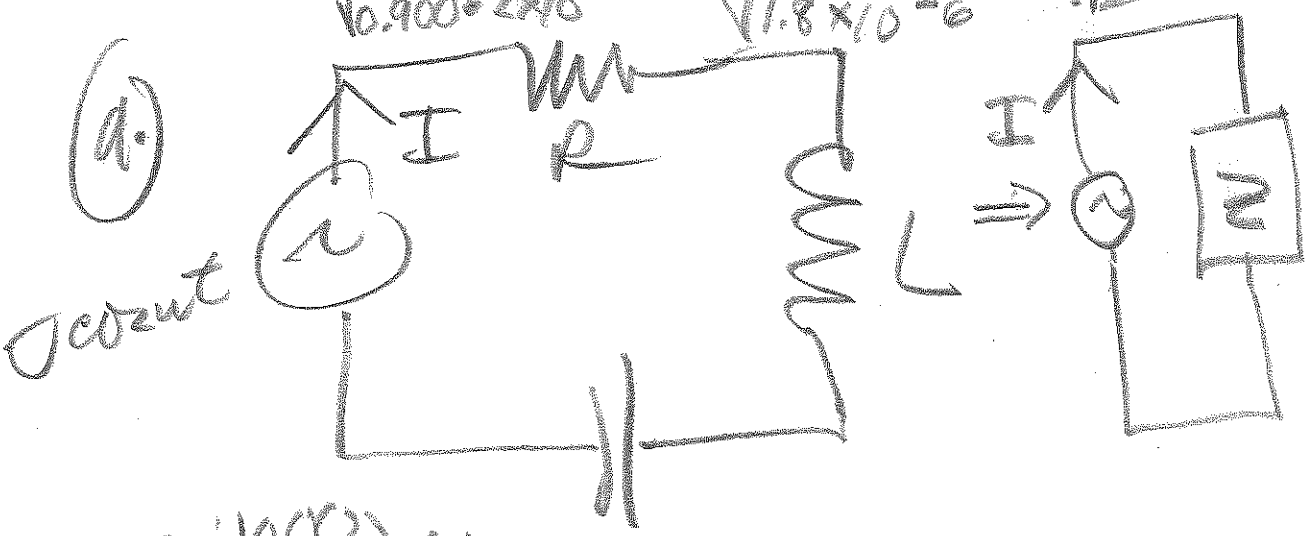
5-2-14 Ch 31 4 E Part 3

Practice problem.

ALWAYS START OFF: $\omega_{RES} = \frac{1}{\sqrt{LC}}$

PRACTICE $= \frac{1}{\sqrt{0.900 \cdot 2\times10^{-6}}} = \frac{1}{\sqrt{1.8\times10^{-6}}} = 745 \frac{RAD}{S}$

(a.)



DO FIRST → $\omega = \begin{pmatrix} 1000 \\ 750 \\ 500 \end{pmatrix} \frac{RAD}{S}$ C

$500 < \omega_{RES} \leq 750$ $\quad Z = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$

$R = 200\,\Omega$, $L = 0.900H$

$C = 2\times10^{-6}F$

$$Z = \sqrt{(200)^2 + \left(750 \cdot 0.9 - \frac{1}{750 \cdot 2\times10^{-6}}\right)^2}$$

(a)

ω (rad/s)	table Ω	$\omega L - \frac{1}{\omega C}$	work (Ω)
(KMEL) 1,000	447 Ω	900 Ω	$\sqrt{40000+160000}$
(KPFA) 750 near resonance	200.2 Ω near R	90 Ω	$\sqrt{40000+81}$
(KQED) 500	585 Ω	-550 Ω	$\sqrt{40000+302500}$

$R^2 = 40{,}000\ \Omega^2$

observations

* near resonance $Z \approx R$.
* at resonance $Z = R$.
* SMALL R means LARGE I_m

Near resonance

(4)

→ CHECK: $750 \cdot 0.9 - \frac{1}{750 \cdot 2\times10^{-6}}$

$= 675 - (0.666)\times10^{3}$

$= 675 - 666$

$\approx 9\,\Omega$

NEAR RESONANCE: → $\frac{9}{670.5} \times 10^{0} = 1.3\%$

$\omega L - \frac{1}{\omega C}$ for: (a) $\omega = 1000\ \frac{RAD}{S}$

$1000 \cdot 0.9 - \frac{1}{1000 \cdot 2\times10^{-6}} = 900 - 500$

$= 400\,\Omega >> 9\,\Omega$

(b.) $\omega = 500 \Rightarrow$ RADIS $\rightarrow 3.6$

$500 \cdot 0.9 - \frac{1}{500 \cdot 2\times10^{-6}}$

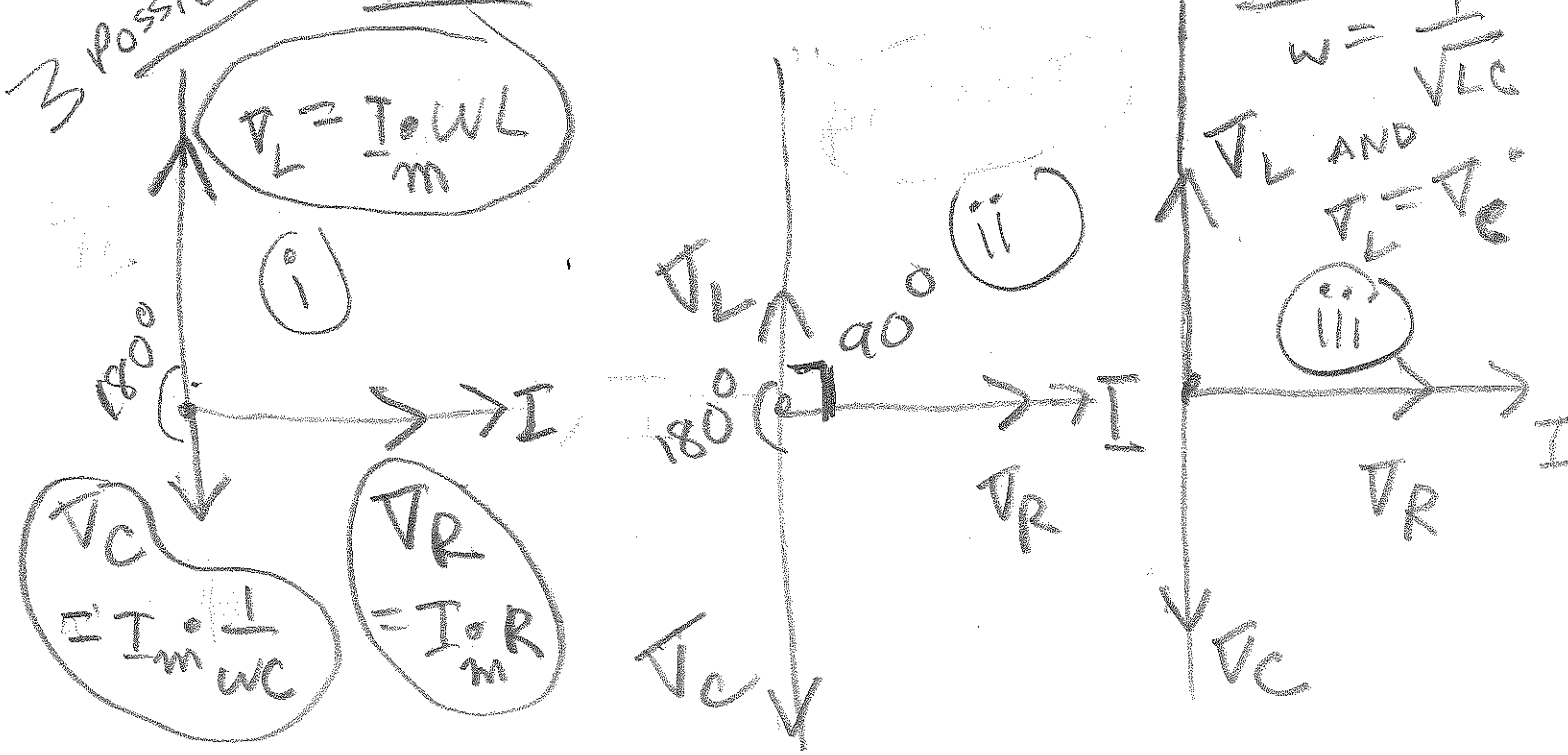
$= 450 - 10 \cdot 10^{6} = 450 - 1000 = -550\,\Omega$

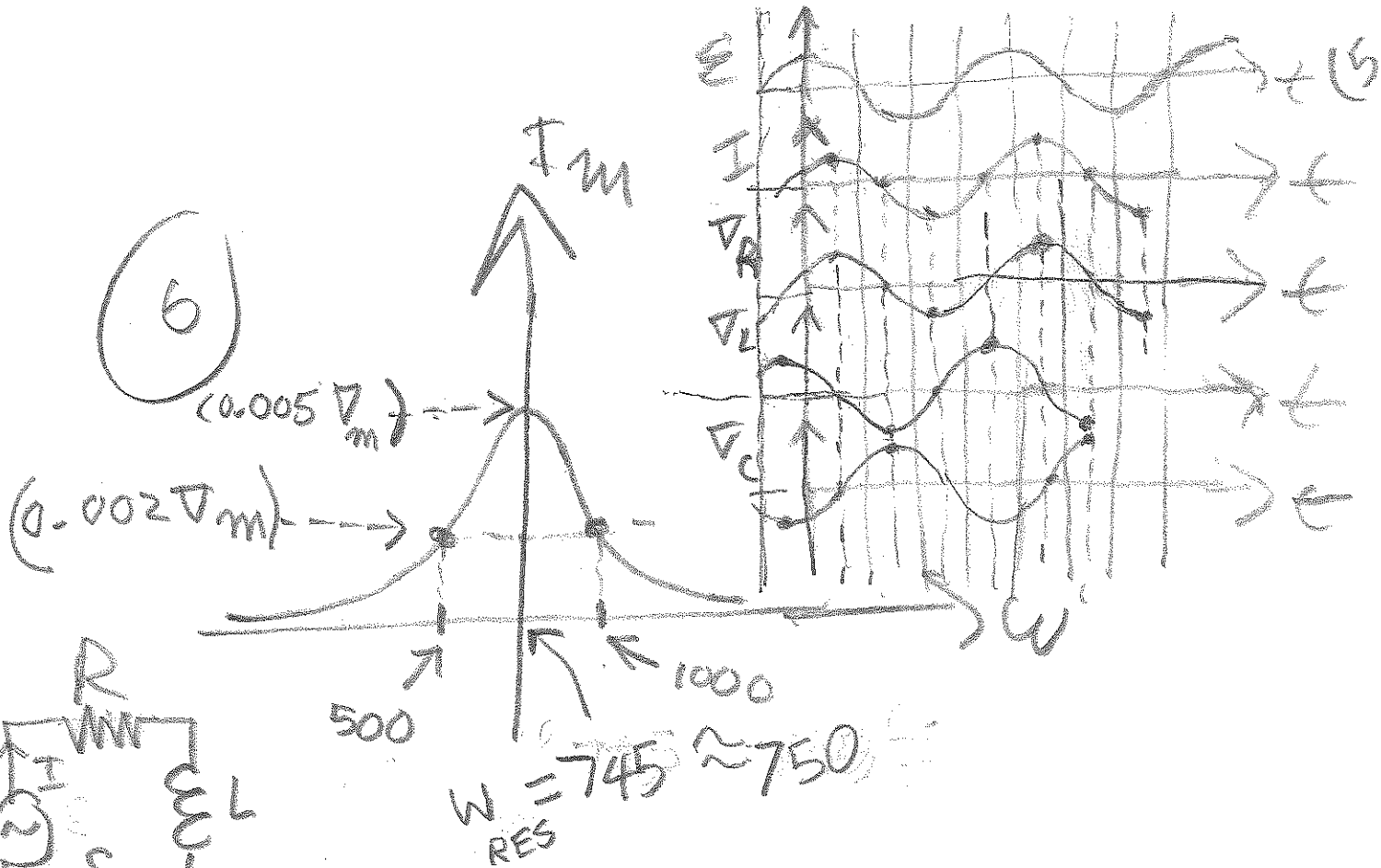
(b)

ω	$I_m = \frac{V_m}{Z}$	work: $I = \frac{V_m}{Z}$
1000	$(0.002) \cdot V_m$	$\frac{V_m}{447} \Leftrightarrow \frac{1}{447} = 0.002$
$\omega_{res} \approx 750$ near resonance	$(0.005) \cdot V_m \approx V_m / R$	$\frac{V_m}{200.2} \rightarrow \frac{1}{200.2} = 0.005$
500	$(0.002) \cdot V_m$	$\frac{V_m}{585} \rightarrow \frac{1}{585} = 0.002$

note: $I_{750} > I_{1000} \simeq I_{500}$

3 possibilities





(6)

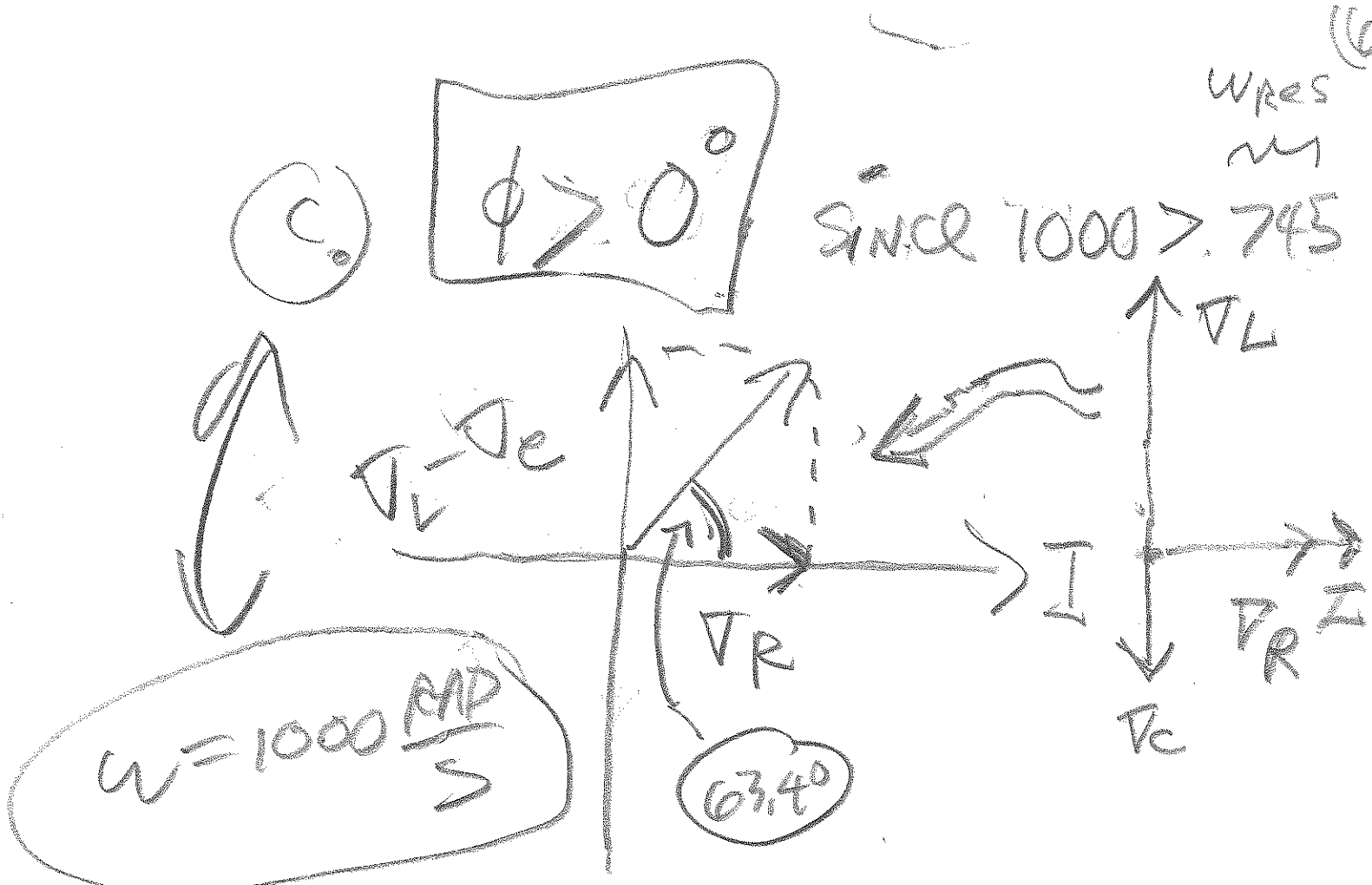
$$I_m = \frac{V_m}{Z}, \quad V_m = V$$

as in $\varepsilon = V \cdot \cos \omega t$

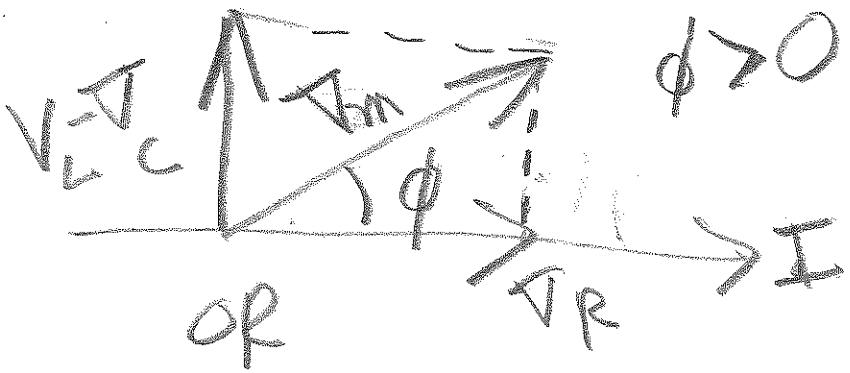
$$I = I_m \cdot \cos(\omega t - \phi)$$

ϕ = complicated function of ω, L, C and R.

see notes below

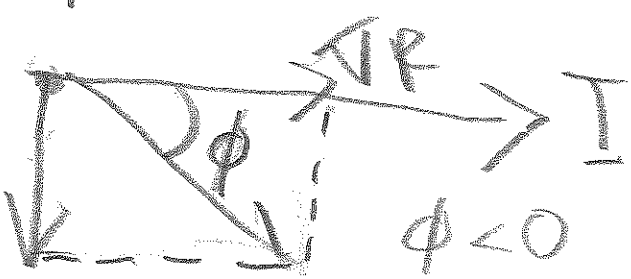


general diagrams:



or

$$\tan\phi = \frac{V_L - V_C}{V_R} = \frac{\omega L - 1/\omega C}{R}$$



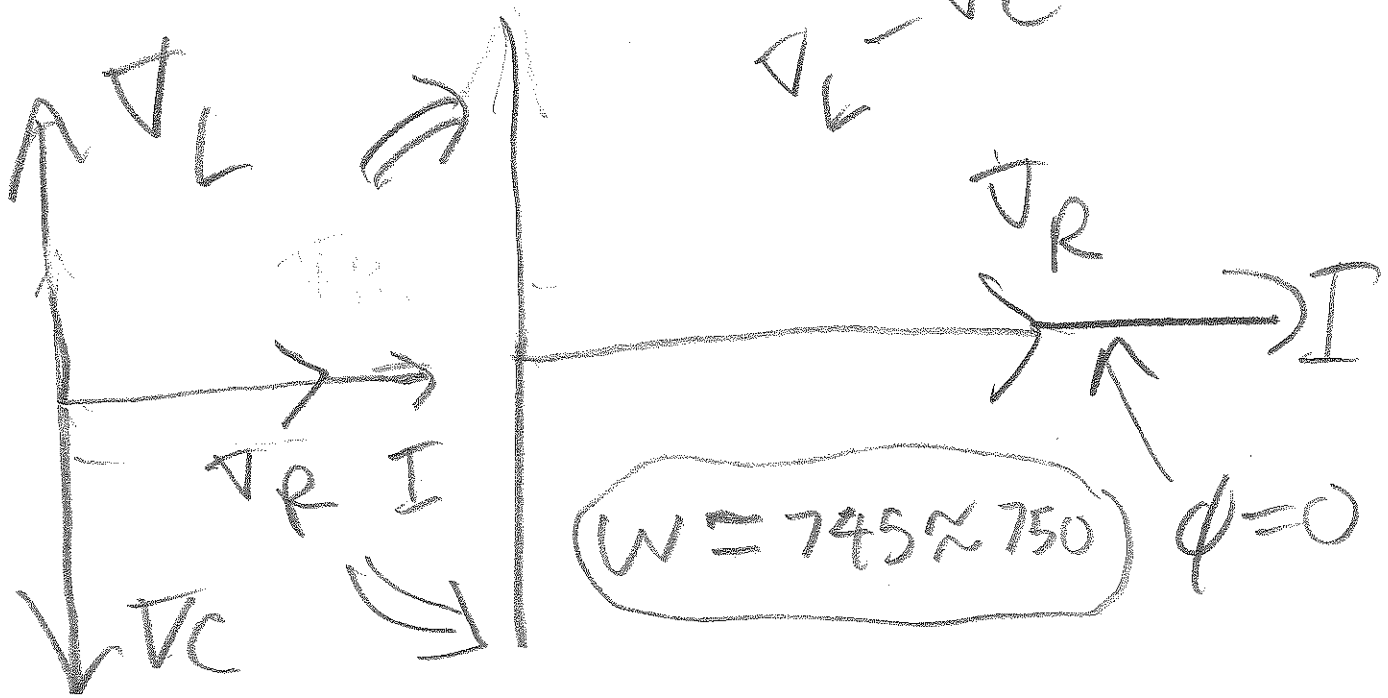
$\omega = 1000$ RAD/s

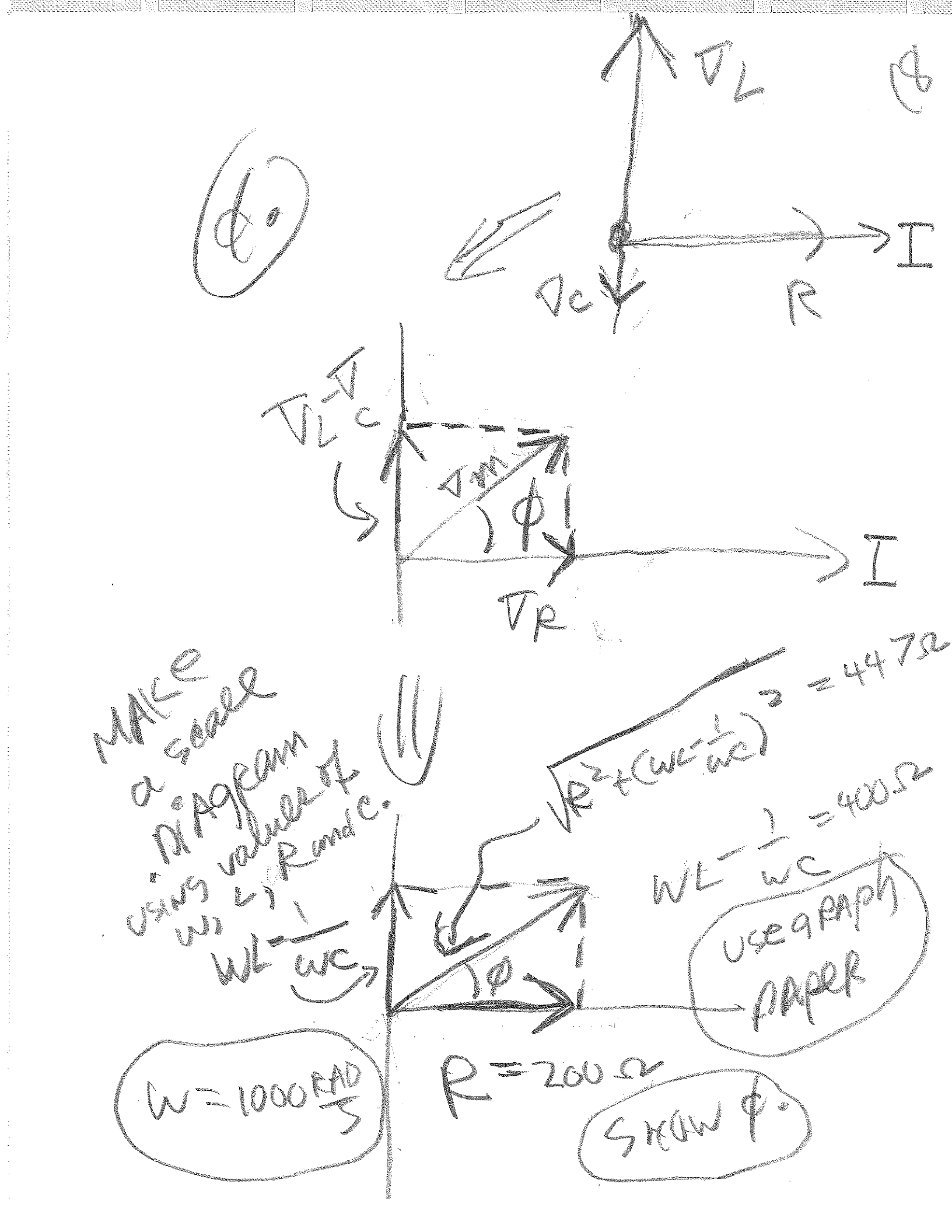
$$\tan\phi = \frac{400\Omega}{200\Omega} = \frac{\omega L - \frac{1}{\omega C}}{R}$$

$$\phi = \tan^{-1} 2 = 63.4^\circ$$

NOTE: resonance ($\omega = 745$) looks like this:

$V_L - V_C = 0$




(c)
V_L
(d)
I
V_C
R
$V_L - V_C$
V_{RL}
ϕ
I
V_R
MAKE a scale diagram using values of R and C.
$\sqrt{R^2 + (\omega L - \frac{1}{\omega C})^2} = 447\Omega$
$\omega L - \frac{1}{\omega C} = 400\Omega$
use graph paper
$\omega = 1000 \frac{RAD}{S}$
$R = 200\Omega$
Show ϕ.