

4-7-14 CH 22 test 3

Practice problem.

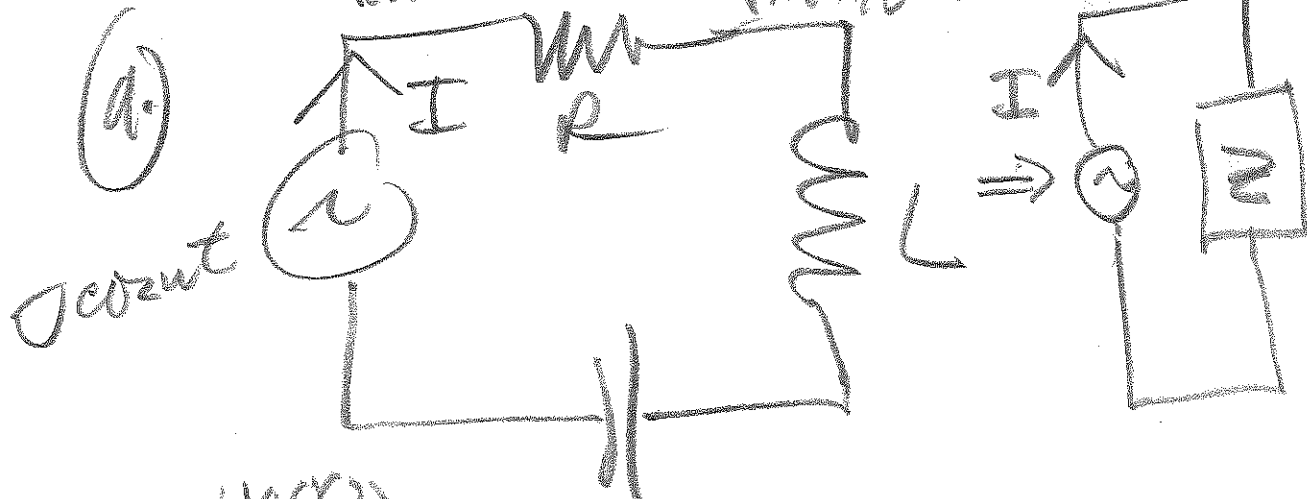
(13.)

ALWAYS
START off:

$$\omega_{Res} = \frac{1}{\sqrt{LC}}$$

$$= \frac{1}{\sqrt{0.900 \times 2 \times 10^{-6}}} = \frac{1}{\sqrt{1.8 \times 10^{-6}}} = 745 \frac{\text{RAD}}{\text{s}}$$

(a.)



DO FIRST $\omega = 1000 \rightarrow 750 \frac{\text{RAD}}{\text{s}}$

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

$$R = 200 \Omega, L = 0.900 \text{ H}$$

$$C = 2 \times 10^{-6} \text{ F}$$

$$Z = \sqrt{(200)^2 + \left(750 \cdot 0.9 - \frac{1}{750 \cdot 2 \times 10^{-6}}\right)^2}$$

(a) ω (RAD/s)	table z	$\omega L - \frac{1}{\omega C}$	WORK (Ω) ²
(K-mel) 1000	447 Ω	900 Ω	$\sqrt{40000 + 160000}$
(K-PFA) 750 near resonance	200.2 Ω near R	9 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

(3)

$$\rightarrow \text{CHECK} : 750 \cdot 0.9 - \frac{1}{750 \cdot 2 \times 10^{-6}}$$

$$= 675 - (0.666) \times 10^3$$

$$= 675 - 666$$

$$\approx 9 \Omega$$

NEAR
RESONANCE:

$$\frac{9}{670.5} \times 10^0 = 1.3\%$$

$$WL - \frac{L}{WC} \quad \text{for: (a) } \omega = 1000 \frac{\text{RAD}}{\text{s}}$$

$$1000 \cdot 0.9 - \frac{1}{1000 \cdot 2 \times 10^{-6}} = 900 - 500 = 400 \Omega \gg 9 \Omega$$

$$(b) \omega = 500 \Rightarrow 500 \cdot 0.9 - \frac{1}{500 \cdot 2 \times 10^{-6}}$$

$$\Rightarrow 450 - 10^3 = 450 - 1000 = -550 \Omega$$

(b)

V_m

$$I_m = \frac{V_m}{Z}$$

WORK: $I_m = \frac{V_m}{Z}$

1000

$$(0.002) \cdot V_m$$

$$\frac{V_m}{447} \Leftrightarrow \frac{1}{447} = 0.002$$

$W_{res} \approx 750$
near resonance

$$(0.005) \cdot V_m \approx V_m / R$$

$$\frac{V_m}{200.2} \rightarrow \frac{1}{200.2} = 0.005$$

500

$$(0.002) \cdot V_m$$

$$\frac{V_m}{585} \rightarrow \frac{1}{585} = 0.002$$

3 possibilities

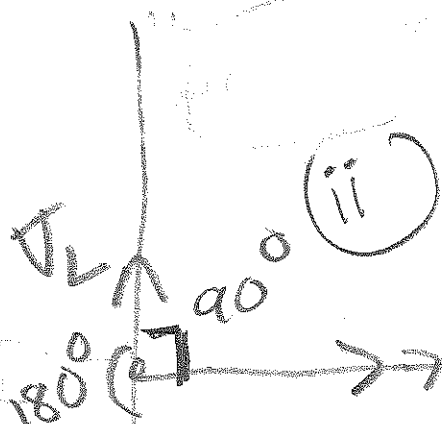
note: $I_{750} > I_{1000} \approx I_{500}$

(i) $V_L = I_m \omega L$

(i)

$V_C = I_m \cdot \frac{1}{\omega C}$

$V_R = I_m \cdot R$



(ii)

Resonance:

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

V_L AND $V_C = V_e$

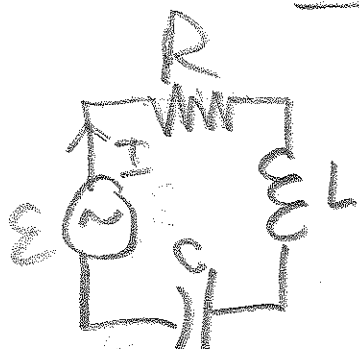
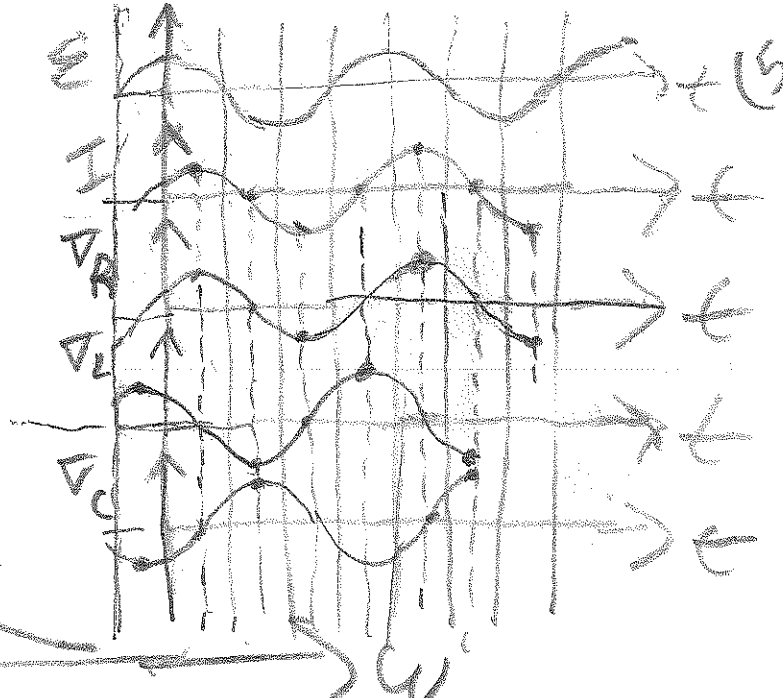
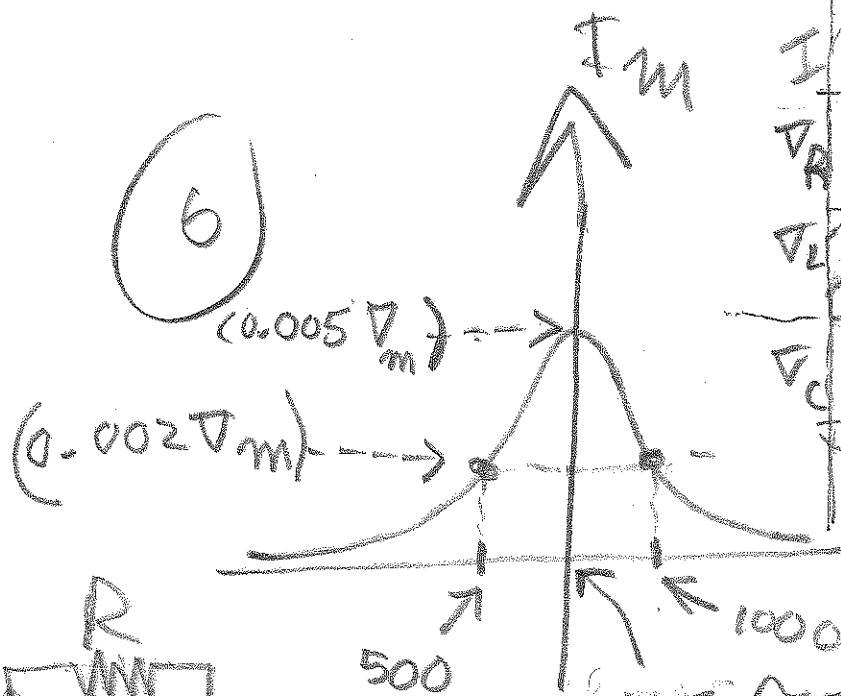
(iii)



V_R

I

(6)



$\omega_{RES} = 745 \approx 750$

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

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

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

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

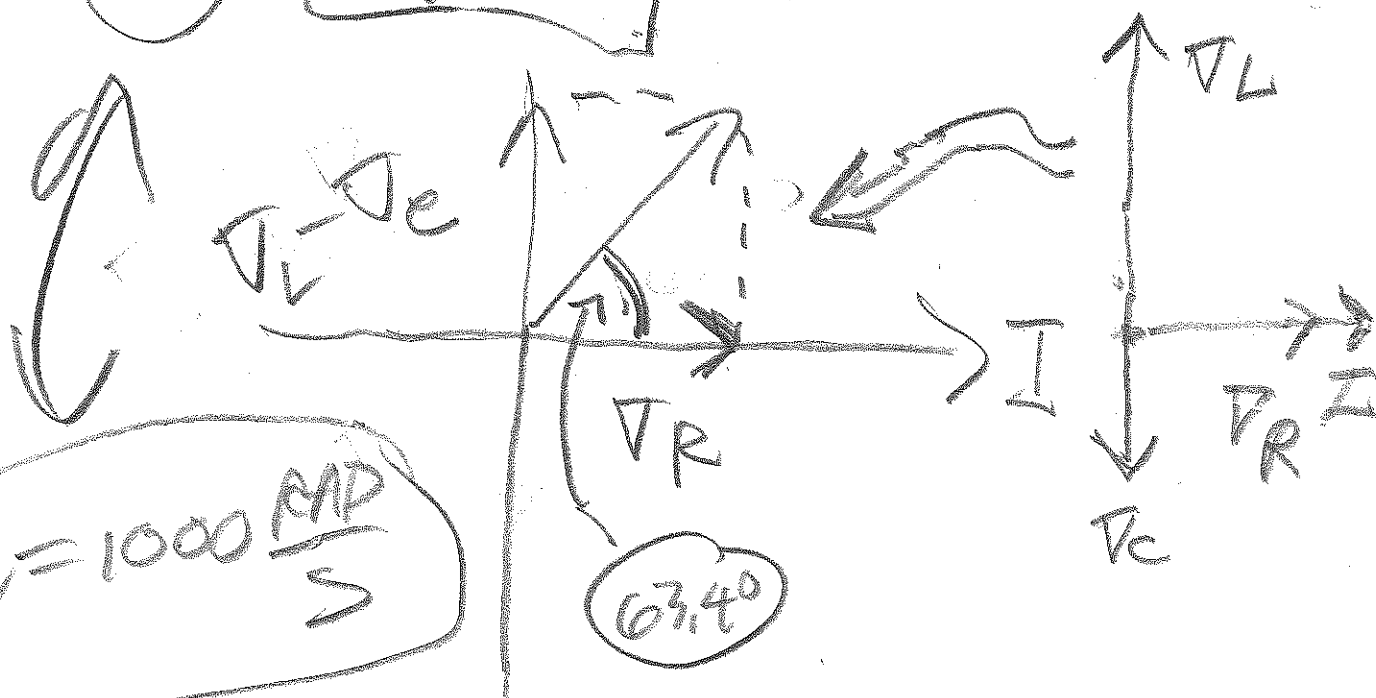
see notes below

(c)

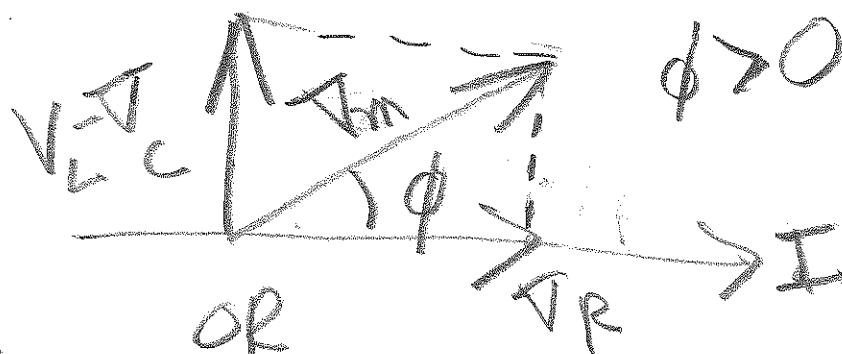
$$\phi > 0^\circ$$

SINCE $1000 > 745$

$\omega R > \omega L$



general diagrams :



$\tan \phi$

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

$$= \frac{\omega L - 1/\omega C}{R}$$

$$= \frac{\omega L - 1/\omega C}{R}$$



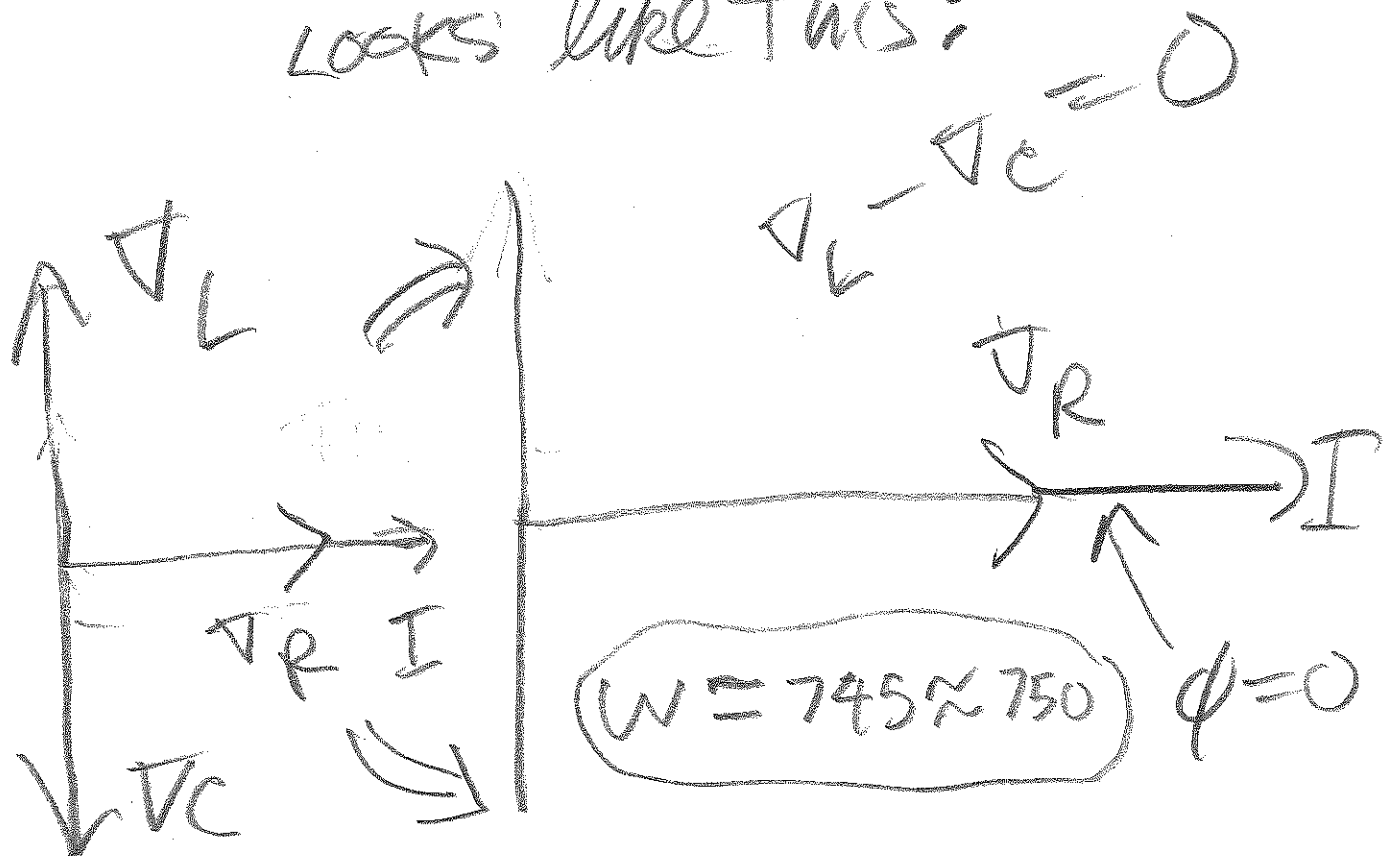
$$\omega = 1000 \text{ RAD/s}$$

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

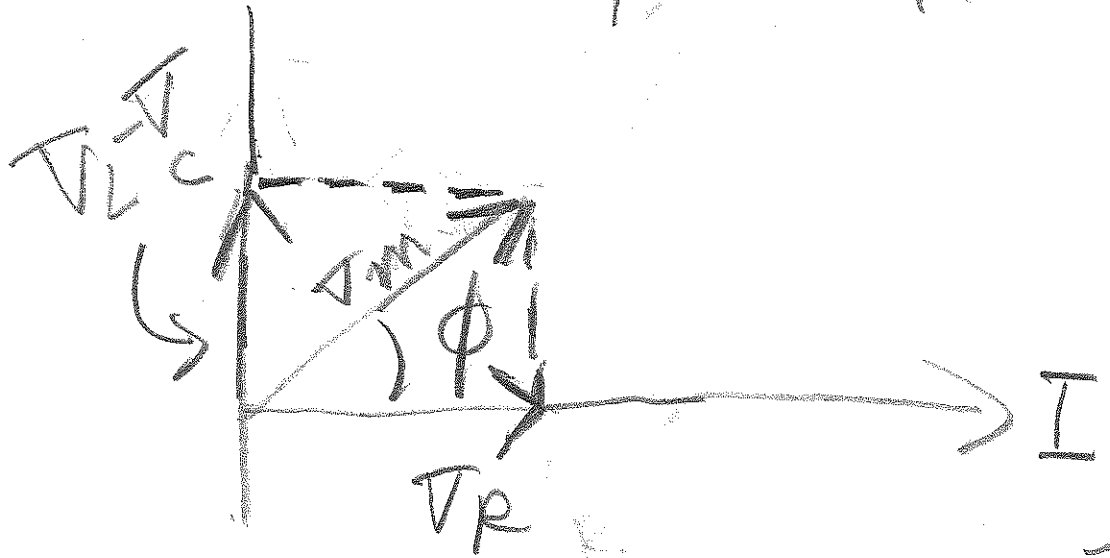
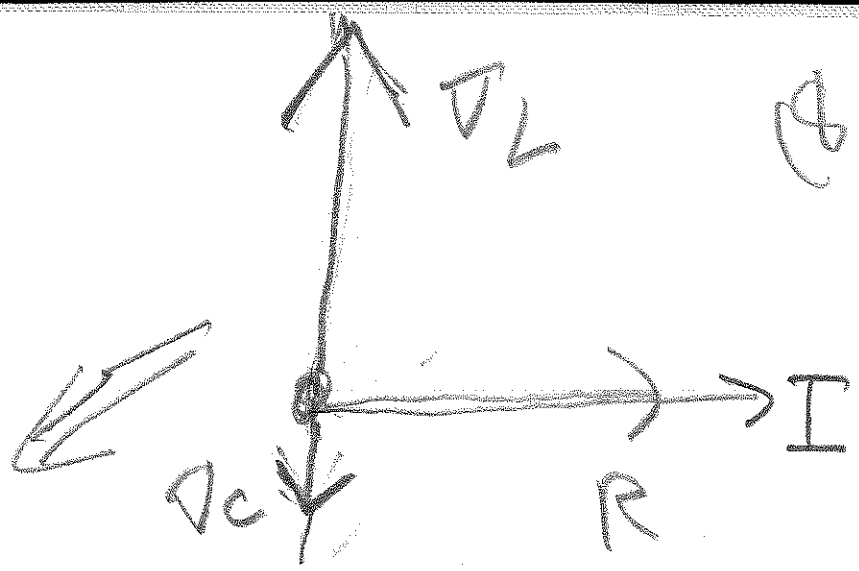
$$\phi = \tan^{-1} 2 = 63.4^\circ$$

NOTE: Resonance ($\omega = 745$)

Looks like this:



(d)



MAKE
a scale
diagram
using values of
 ωL and $\frac{1}{\omega C}$

(11)

$$\sqrt{R^2 + (\omega L - \frac{1}{\omega C})^2} = 447 \Omega$$

$$\omega L - \frac{1}{\omega C} = 400 \Omega$$

USE GRAPH
PAPER

$$\omega = 1000 \frac{\text{RAD}}{\text{s}}$$

$$R = 200 \Omega$$

SKETCH ϕ