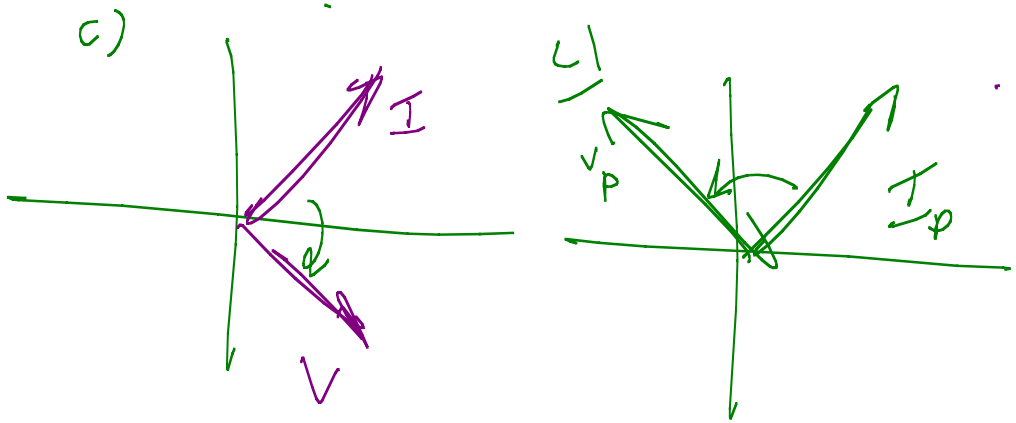
Phys 2120-4 10/31/12

Note Title 10/31/2012

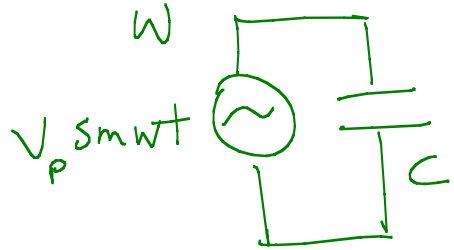
AC Circuits

$\omega = 2\pi f$



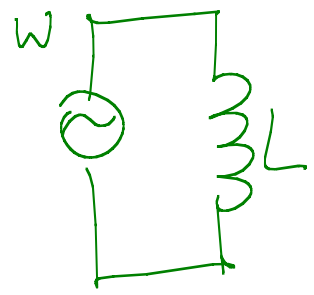
phasors

p. 495



$V_p = I_p X_C$

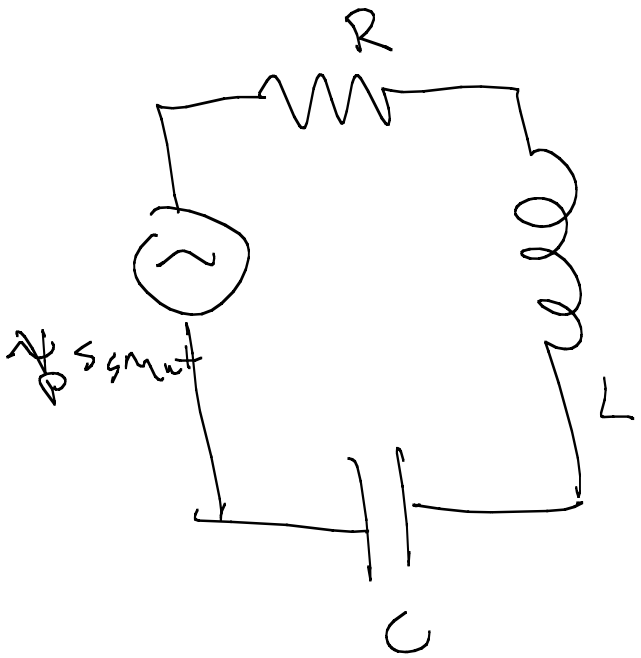
$X_C = \frac{1}{\omega C}$



$V_p = I_c X_L$

$X_L = \omega L$

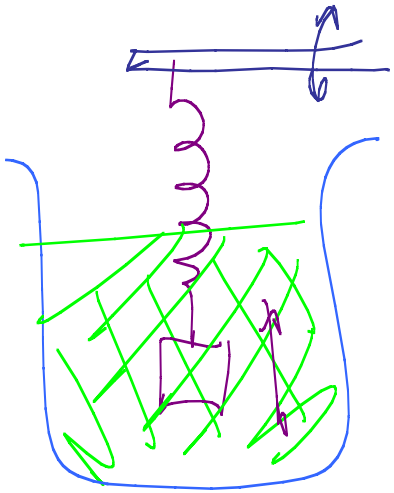
Ohms



$\omega_0 = \frac{1}{\sqrt{LC}}$

Mech. analogy

Currents, Voltages, Phases



Current oscillates

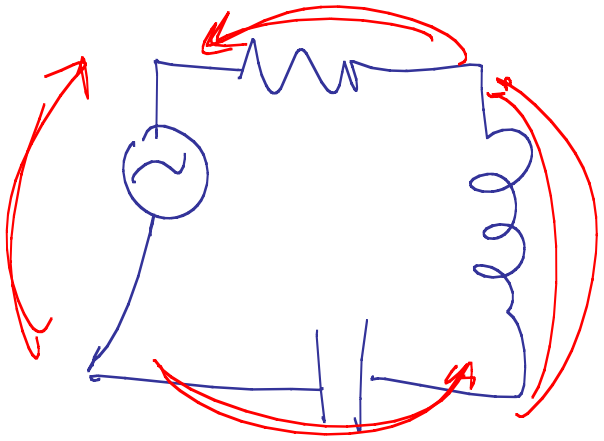
Same for all elements

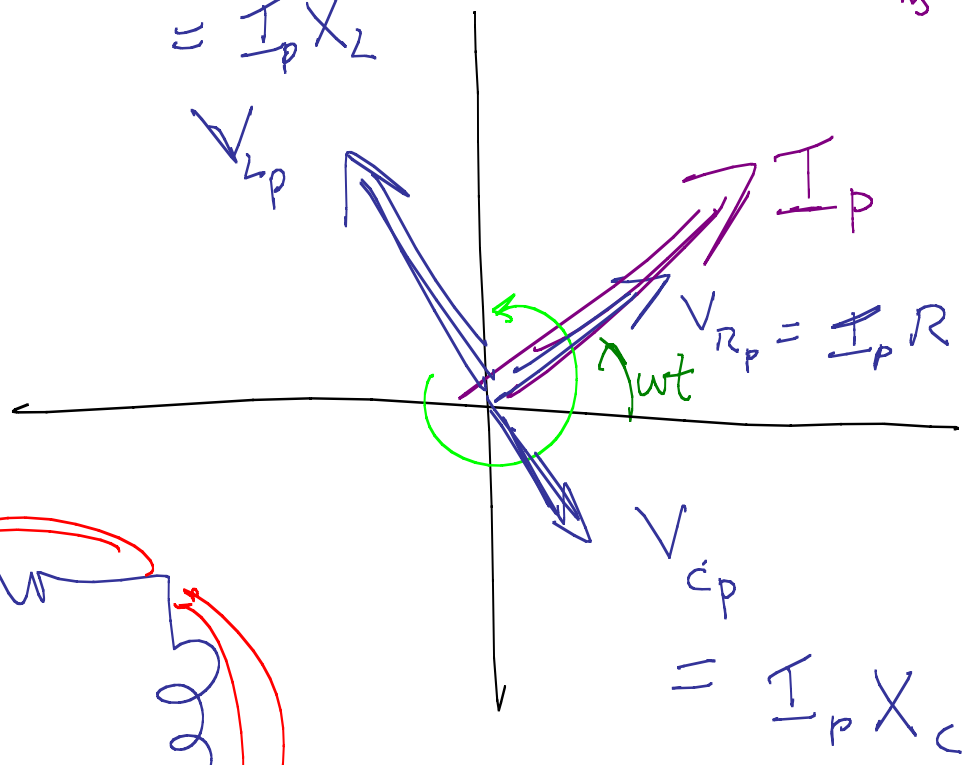
$I(t) = I_p \sin(\omega t)$

In the inductor, V leads the current

In the capacitor, I leads V

V lags I





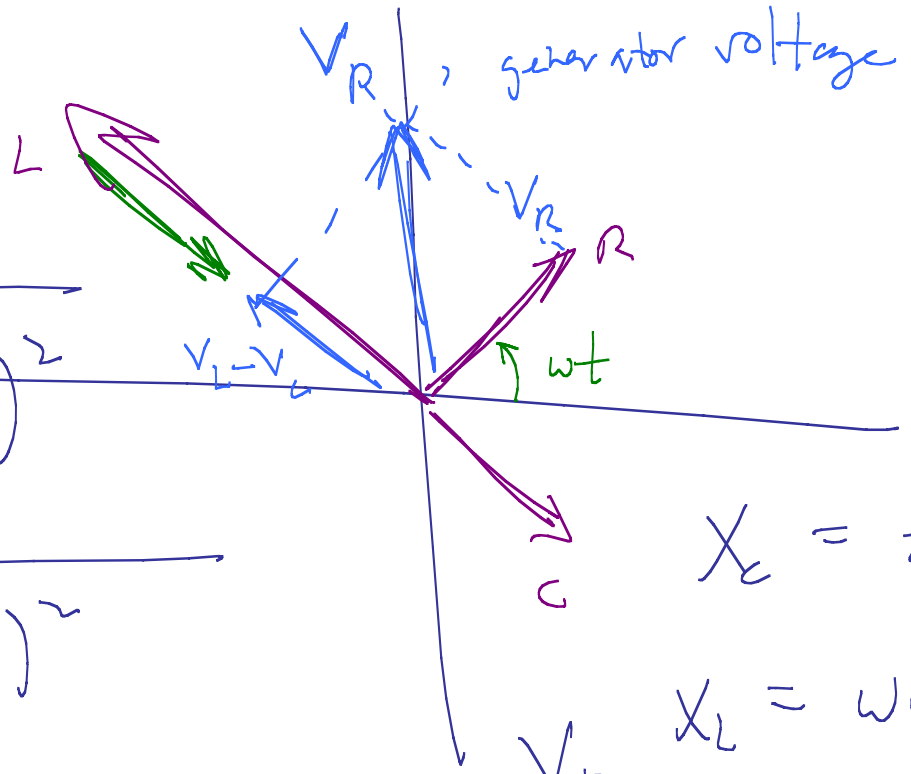
$$V_p = \sqrt{V_{R_p}^2 + (V_{L_p} - V_{C_p})^2}$$

peak across gen

$$= \sqrt{(I_p R)^2 - (I_p X_L - I_p X_C)^2}$$

$$= I_p \sqrt{R^2 + (X_L - X_C)^2}$$

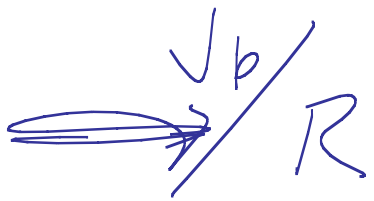
$$I_p = \frac{V_p}{\sqrt{R^2 + (X_L - X_C)^2}} = \frac{V_p}{Z}$$ impedance



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

$$X_L = \omega L$$

Special cases $X_L = X_C$



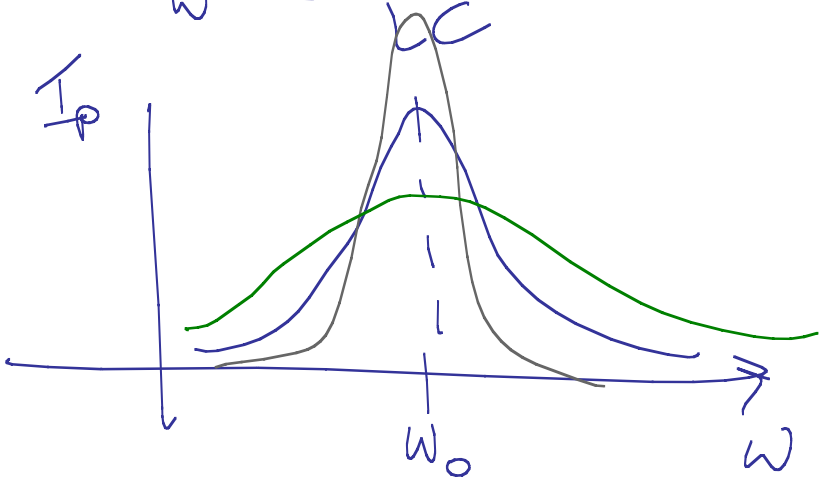
$\omega L = \frac{1}{\omega C}$

$\omega^2 = \frac{1}{LC}$

$\omega = \frac{1}{\sqrt{LC}} = \omega_0$

Then I_p is biggest.

Resonance



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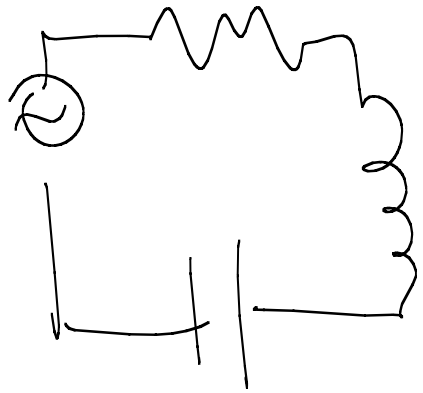
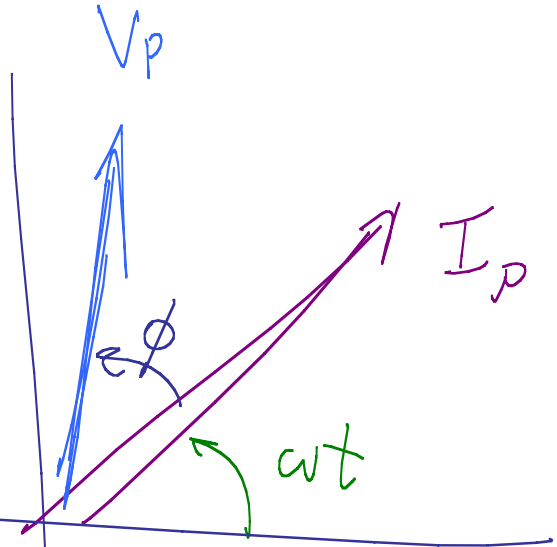
Q-value



ϕ = phase angle

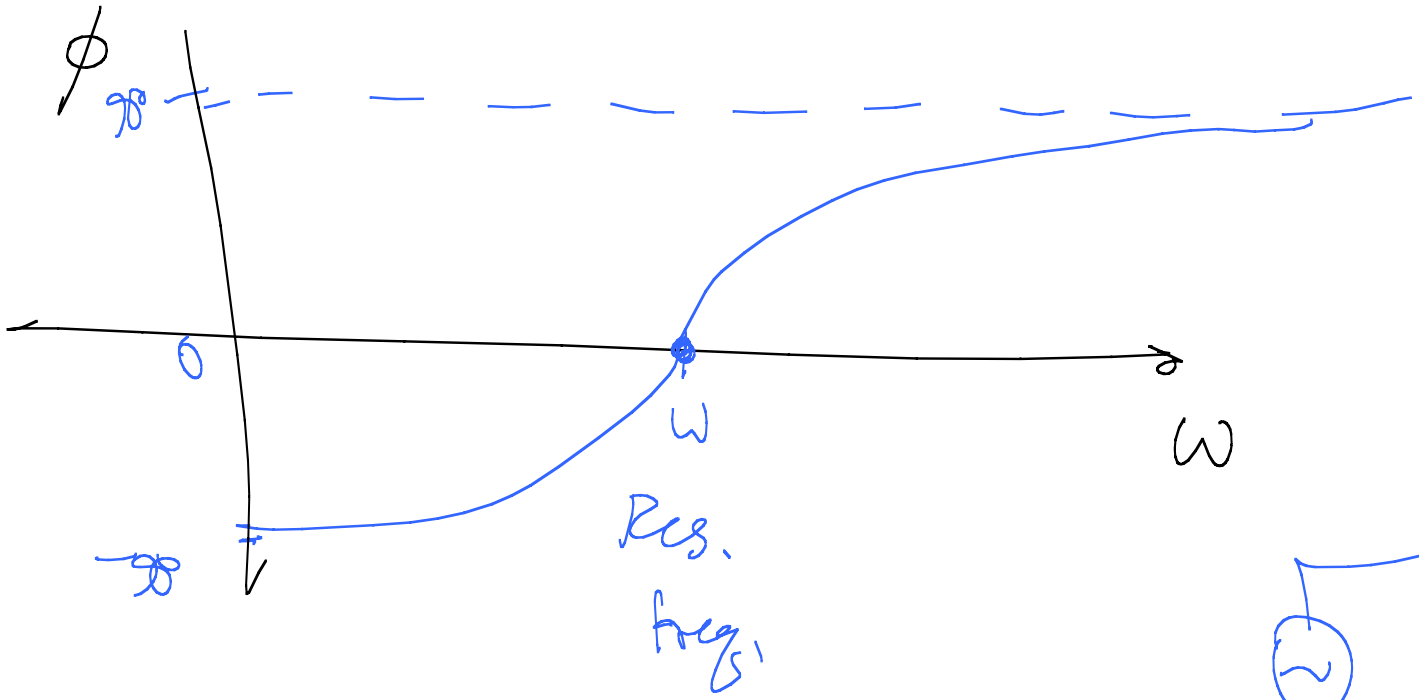


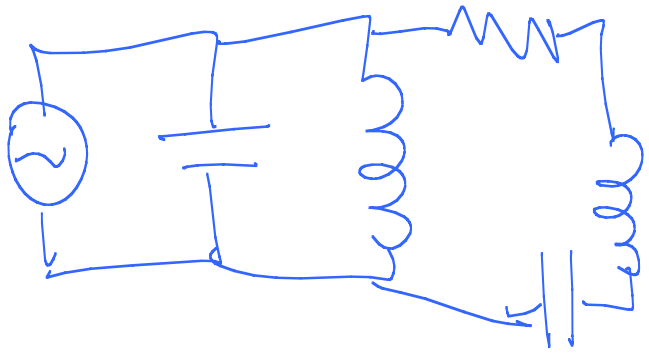
$$\tan\phi = \frac{X_L - X_C}{R} = \frac{\omega L - \frac{1}{\omega C}}{R}$$

$$= \phi_V - \phi_I$$

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

= impedance


ϕ
90
0
-90
ω
Res. freq.



Power

Energy loss (in R)

$P = I^2 R$ instantaneously

$P = V_R I$

$V_{R_p} = V_p \cos\phi$

$= V_p \cos\phi (\omega t + \phi) I_p \sin^2 \omega t$