Physics 201 Day 16

No lab Friday.

Note: March 30 is a holiday
we will review for exam 2 in lecture.

Exam 2 will occur at end of week 10
April 6th.

Some Items for Exam 2:

★ - Ampere's Law

★ - Faraday's Law

Lenz's law for 1 point only

right hand rules

Sketch $\vec{B}$

3 Magnetic materials

LR circuits ...

RC Circuits - -

LC Circuit

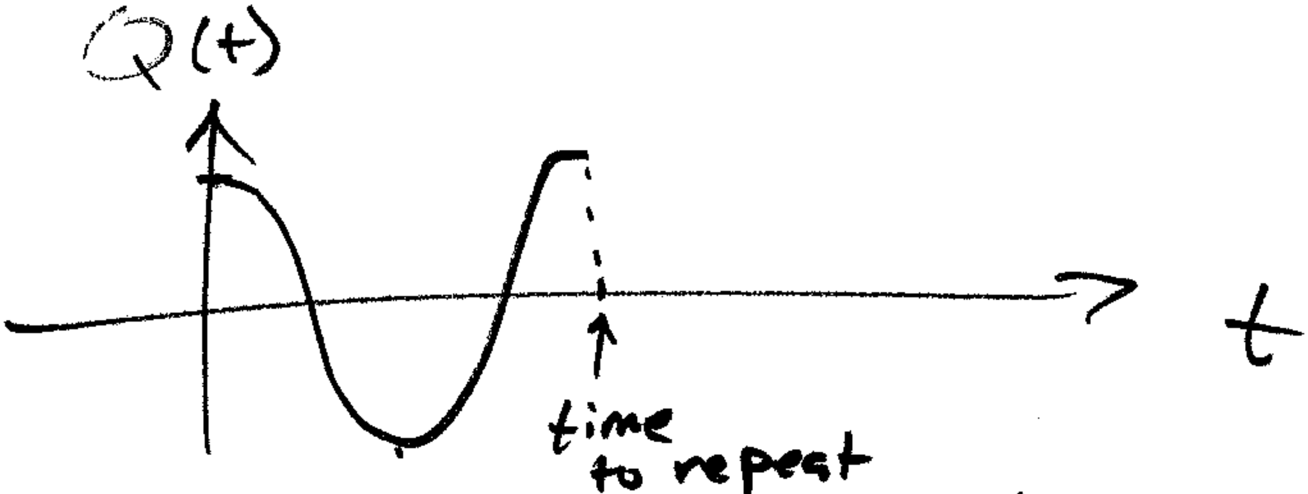
AC Circuits

maybe electromagnetic waves (light)

I will show you

$2\pi f = \omega$ the angular frequency

the frequency



$t = T$ = the period

$f = \frac{1}{T}$ $\qquad 2\pi f = \omega$

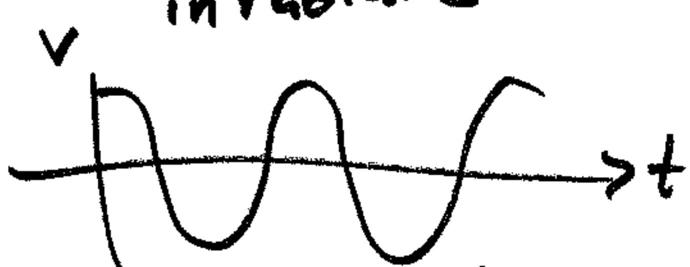
$T = \frac{2\pi}{\omega}$

AC Circuits

the voltage is a function of time

$$V = V_{max} \cos(\underbrace{\omega t}_{\text{in radians}})$$

$\overline{V} = 0$



V_{rms} should be measured.

$Q = CV$

$I = -\frac{dQ}{dt}$

$V = -L\frac{dI}{dt}$

LC Circuit (No power supply needed).

$\sum V_{loop} = 0 \qquad V_c + V_L = 0$

$$\frac{Q(t)}{C} - L\frac{dI(t)}{dt} = 0$$

$$\frac{Q(t)}{C} = -L\frac{d^2Q}{dt^2}$$

$$Q(t) = Q_{max} \cdot \frac{\cos}{t}(\omega t)$$

if $Q(t=0) = Q_{max}$
so all Q on C at
the beginning.

$$\frac{d^2Q}{dt^2} = -Q_{max}\cos(\omega t)\omega^2$$

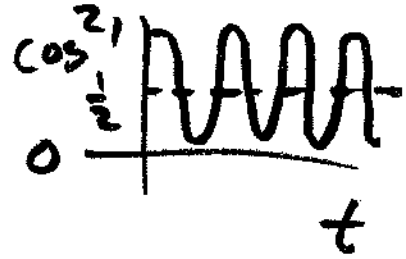
$$\frac{\cancel{Q_{max}}\cancel{\cos(\omega t)}}{C} = -L(-\cancel{Q_{max}})\cancel{\cos(\omega t)}\,\omega^2$$

$$\frac{1}{LC} = \omega^2 \qquad \boxed{\omega = \frac{1}{\sqrt{LC}}}$$

$$\sqrt{\overline{V^2(t)}} = V_{rms}$$

$$\sqrt{\overline{V_{max}^2 \cos^2(\omega t)}} = V_{rms}$$

$$V_{max}\sqrt{\underbrace{\overline{\cos^2(\omega t)}}_{1/2}} = V_{rms}$$



$$\frac{V_{max}}{\sqrt{2}} = V_{rms} \leftarrow$$ this is our 120V ac in the USA.

same with current.

$$I(t) = I_{max}\cos(\omega t)$$

measure $I_{rms} = \dfrac{I_{max}}{\sqrt{2}}$

The resistor

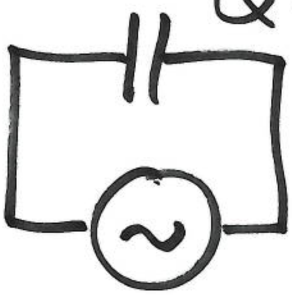
$$V = RI$$

$$V_{max}\cos(\omega t) = R\, I_{max}\cos(\omega t)$$

$$\frac{V_{max}}{R} = I_{max} \quad \text{and} \quad \frac{V_{rms}}{R} = I_{rms}$$

the Capacitor:

$$Q(t) = C\,V_c(t)$$



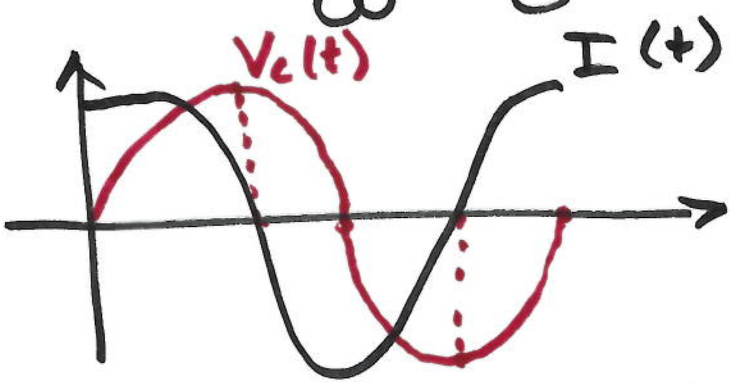
↑ AC power supply,
or function generator
has V_{max} and ω.

$$I(t) = \frac{dQ(t)}{dt} \qquad \text{if} \quad I(t) = I_{max}\cos(\omega t)$$

then $$Q(t) = \int_0^t I(t)\,dt = \int I_{max}\cos(\omega t)\,dt$$

$$Q(t) = I_{max}\frac{\sin(\omega t)}{\omega}$$

$$V_c(t) = \frac{I_{max}}{\omega}\cdot\frac{1}{C}\sin(\omega t)$$



I leads the V in a Capacitive circuit by $\frac{\pi}{4}$ radians

$V_{max} = X_c I_{max}$

the reactance of Capacitor

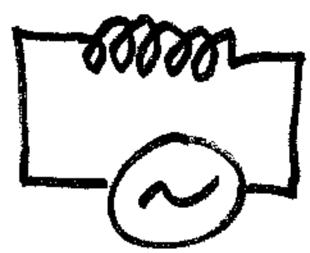
(Note: has unit of Ω acts like a frequency dependent resistor).

$V_{max} = I_{max} \frac{1}{\omega C}$

$\boxed{\frac{1}{\omega C} = X_c}$

high ω has low X.

In an Inductor only



$X_L = \omega \cdot L$

at large ω, high resistance

I lag behind V in inductive circuit also by $\frac{\pi}{4}$ radians.

$V_L = -L \frac{dI(t)}{dt}$

assume $I(t) = I_{max} \cos(\omega t)$