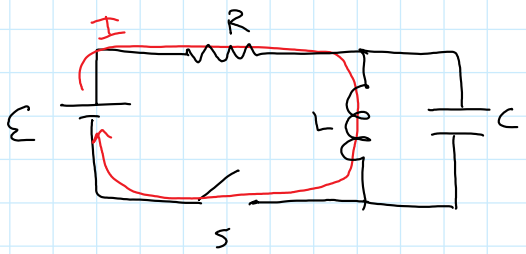
Phy 4B 6/15

Thursday, June 15, 2017 6:42 PM

Goals for the Lecture:

1) Be able to calculate inductance and EMF generated across an inductor
2) Understand that RL circuits are very similar to RC circuits
3) Be able to solve problems involving time constants for RL circuits
4) Be able to calculate energy stored in the magnetic field of an inductor

Book Prob 32-47



switch is closed for a long time

after switch is opened -

V_{max} on Cap is 150 V

what is L ?

given: $\mathcal{E} = 50\ V$

$R = 250\ \Omega$

$C = 0.5\ \mu F$

at $t=0$:

$\Delta V_L = 0 \rightarrow I_i = \frac{\mathcal{E}}{R} = \frac{50}{250} = 0.2\ A$

$\Delta V_c = 0 \rightarrow Q_i = 0$

$U_{total} = U_L + U_c = \text{constant}$

$\frac{1}{2} L I^2 + \frac{1}{2} C V_c^2 = \text{constant}$

$U_{total} = \frac{1}{2} C (\Delta V_c)_{max}^2 = \frac{1}{2} (0.5 \times 10^{-6}\ F)(150\ V)^2$

$= 5.625\ mJ$

$\frac{1}{2} L I_{max}^2 = 5.625\ mJ$

$L = \frac{2(5.625 \times 10^{-3})}{\quad} = 9\ H$

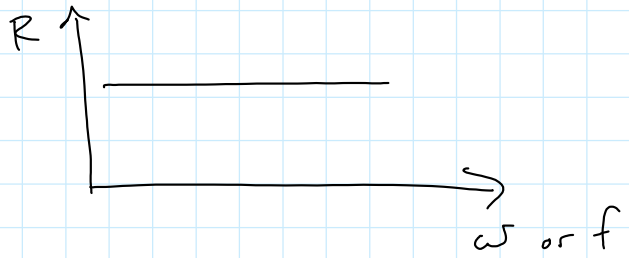
$$L = \frac{2(5.625 \times 10^{-3})}{(0.2)^2} = 0.281 \text{ H}$$

AC Circuits

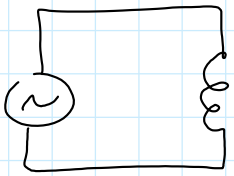
1) Resistors in AC circuits

$V = I R$

$V = V_{max} \sin \omega t$

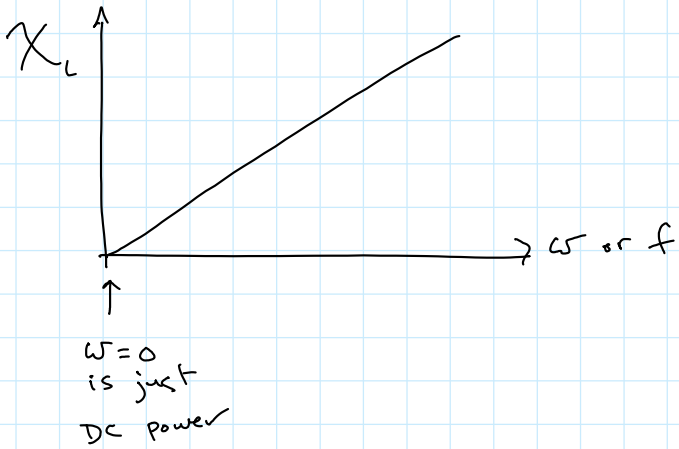


2) Inductors

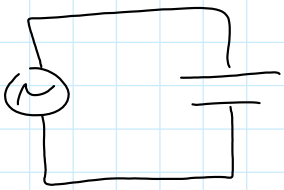


Reactance: X_L (Like Resistance)

$V = I X_L$

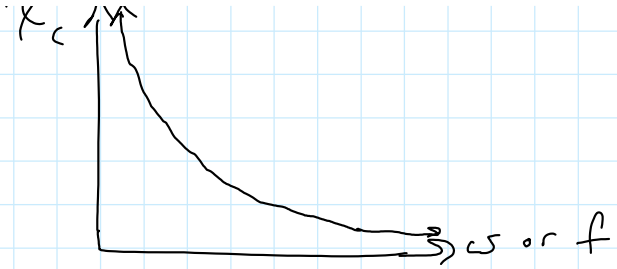


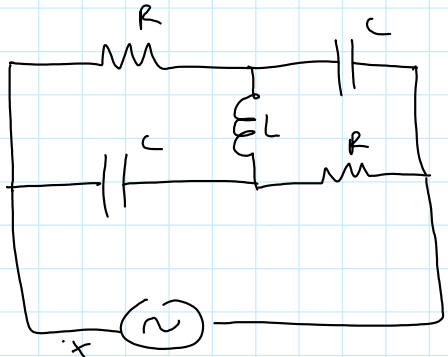
3) Capacitor



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

X_C ↑↑





in high freq limit
$f \to \infty$

in low freq limit
$f \to 0$

C → zero resistance
(a wire, a short)

L → infinite resistance
(open circuit)

C → infinite Resistance
(open)

L → zero resistance
(a wire, short)