Impedance Diagrams

- Impedance Diagrams
  - For the basic elements
  - For a series circuit
  - **ICP 1 – Impedance Diagrams**
- Lab #3 – Prelab Discussion and Demo
  - Simulation demo
  - Finding $v_L(t)$

Impedance Diagram – for R, L, C

- Now that an angle is associated with resistance, inductive reactance, and capacitive reactance, each can be placed on a complex plane diagram.

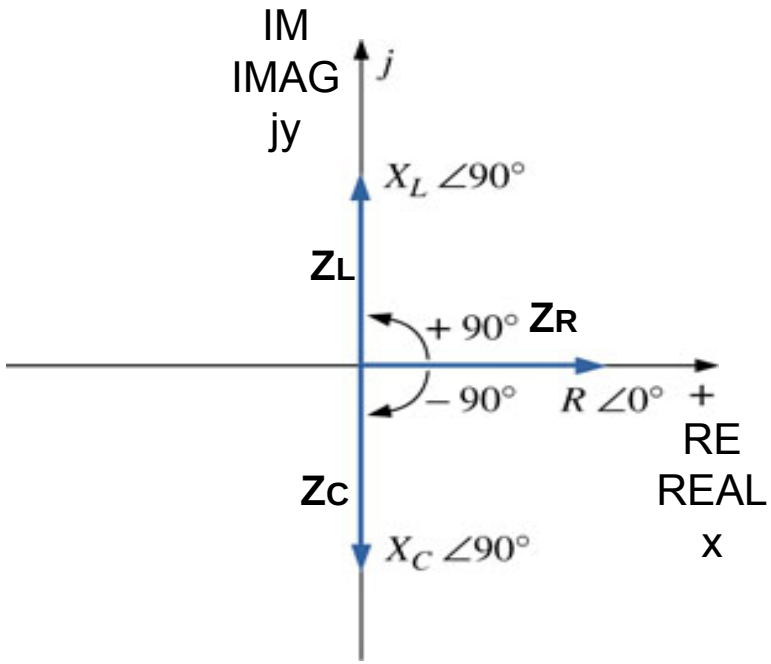


FIG. 15.20 *Impedance diagram.*

Impedance Diagram – For a Series R-L Circuit

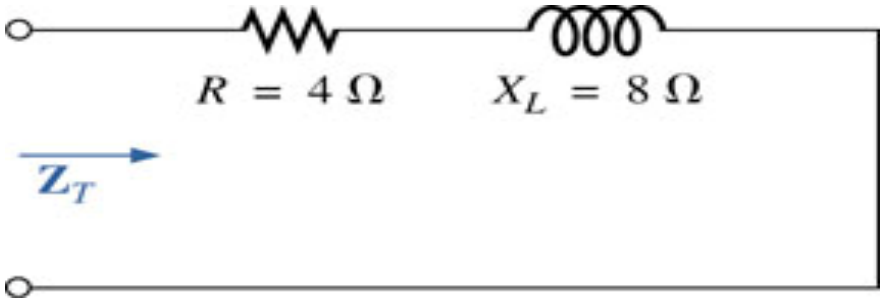


FIG. 15.24 *Example 15.9.*

Note: You are given X_L

What's the magnitude and angle of **Z_T**?

Z_T = 4 + j8 =
8.94 < 63.4°

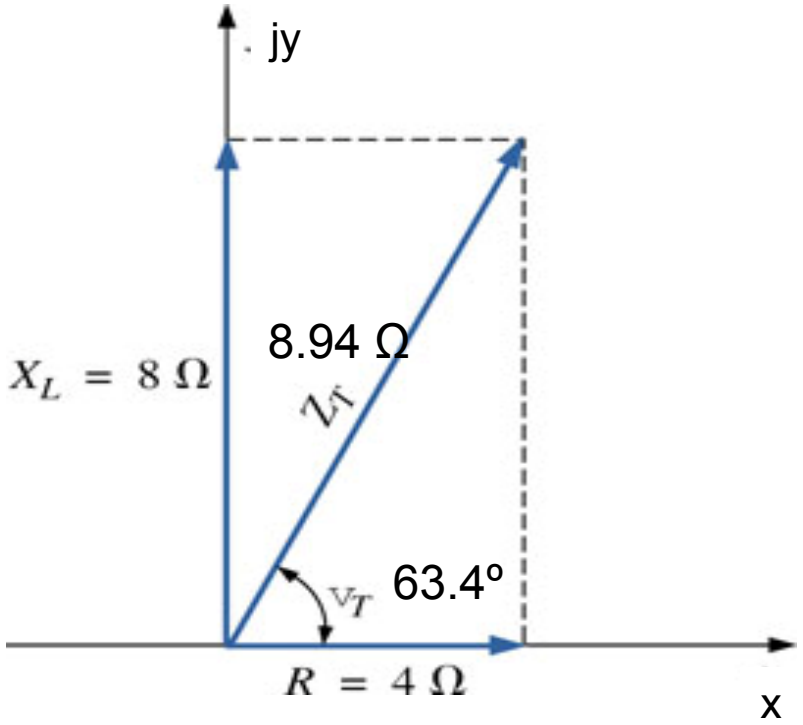


FIG. 15.25 *Impedance diagram for Example 15.9.*

Impedance Diagram – For a Series R,L,C Circuit

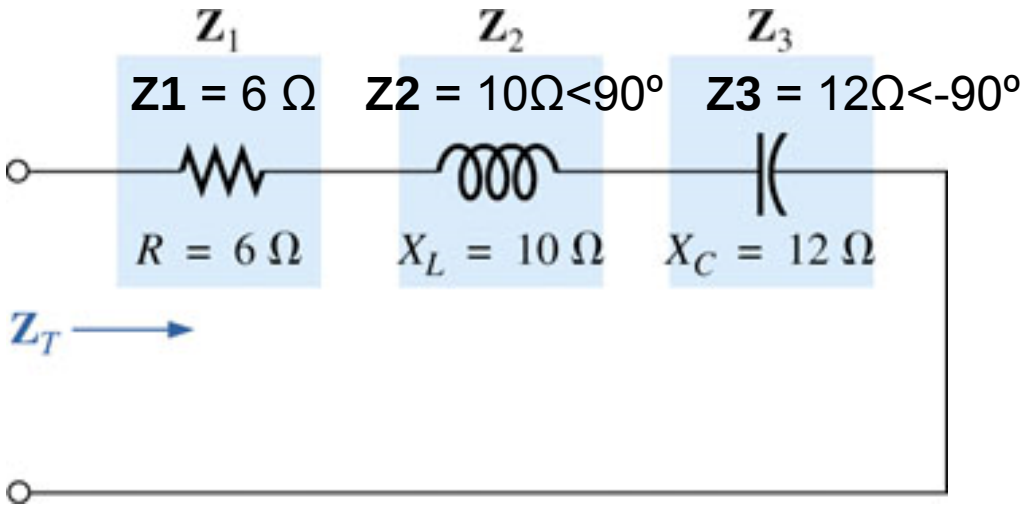


FIG. 15.26 *Example 15.10*

What's the magnitude and angle of Z_T?

$$Z_T = 6 + j10 - j12 = 6 - j2$$
$$6.32\angle -18.4^\circ$$

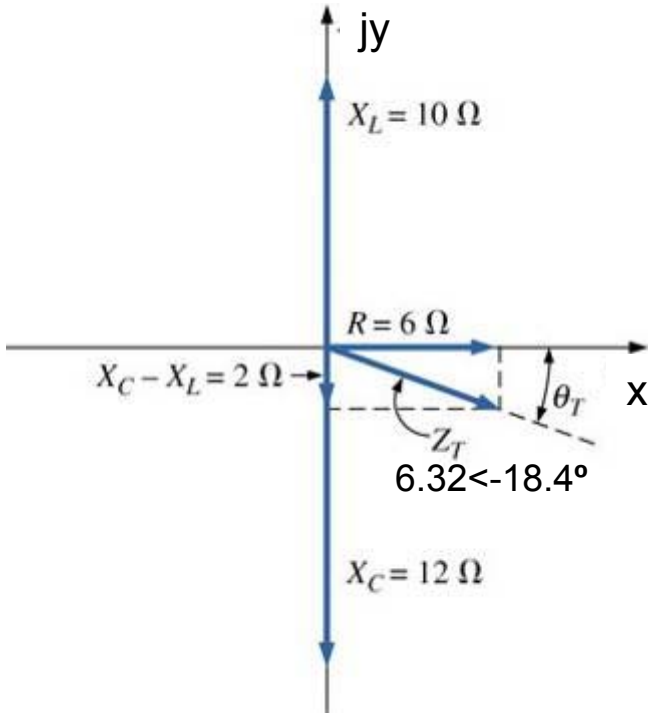
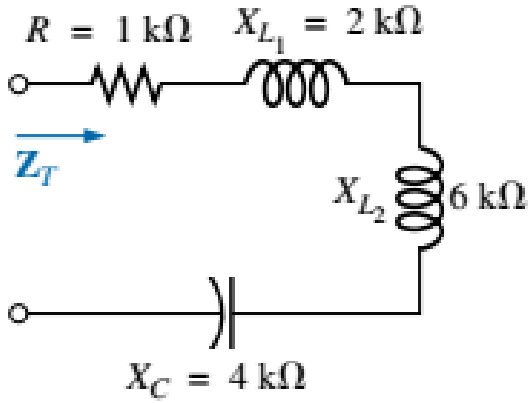


FIG. 15.27 *Impedance diagram for Example 15.10.*

ICP Set 1 – Impedance Diagram

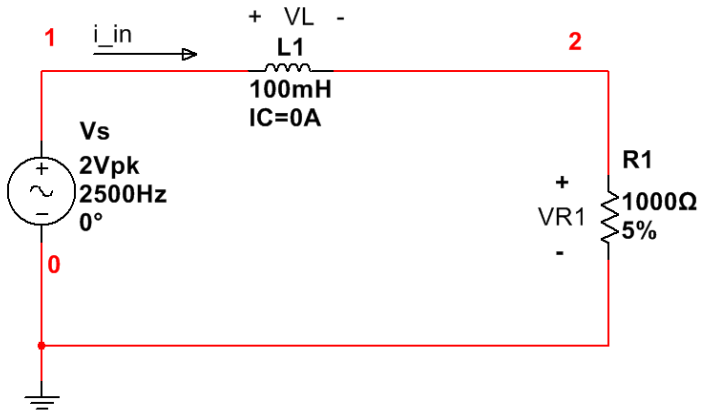
1 - Find Z_T (in rectangular form) for:



2 - Express your answer in polar form (angle in degrees):

3 - Draw the impedance diagram for the circuit shown:

Recall (from Wednesday) - Lab #3 Prelab (Partial)



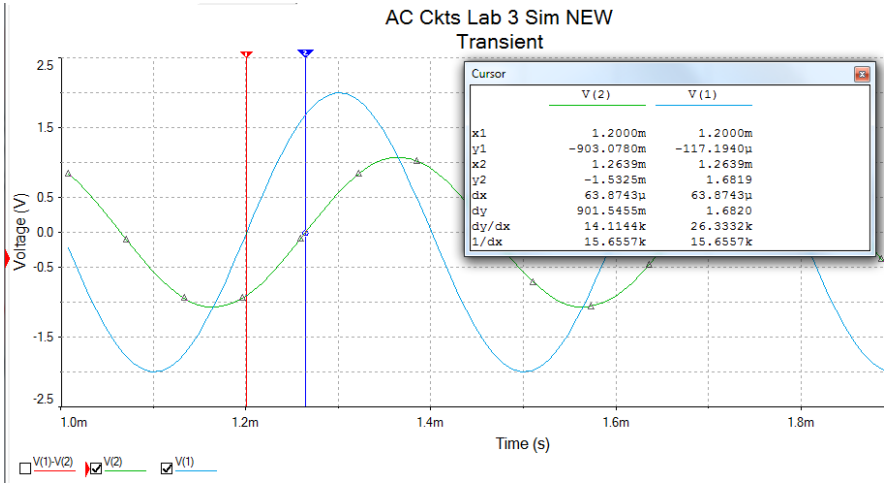
$\mathbf{Z_{L1}} = wL_1 < 90^O = 1{,}571 \text{ Ohms} < 90^O$

$\mathbf{Z_{R1}} = R_1 < 0^O = 1000 \text{ Ohms} < 0^O$

$\mathbf{Z_T} = \mathbf{Z_{L1}} + \mathbf{Z_{R1}} = 1862 \text{ Ohms} < 57.5^O$

$\mathbf{I\_in} = \mathbf{Vs}/\mathbf{Z_T} = (2\text{Vpk} < 0) / (1862 \text{ Ohms} < 57.5^O)$

1. **Find the impedance of each component**
2. Use Ohm's Law for phasors to determine **i_in(t)**, VL(t) and VR1(t)
3. **Verify your results by simulating the circuit in Multisim**

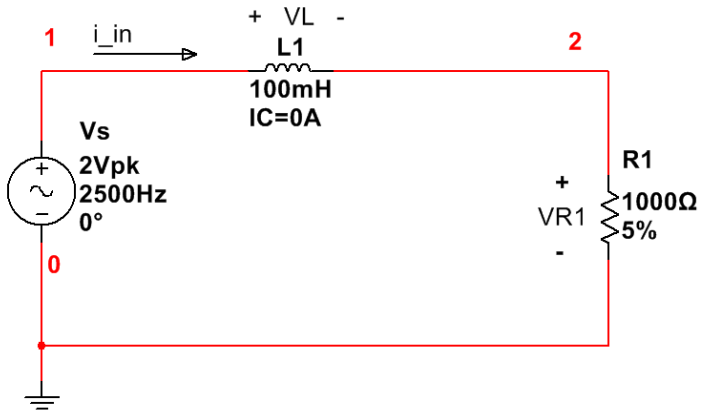


$\mathbf{I\_in} = V_{R1}/1000 = 1.07\text{Vpk}/1000$ Ohms, lags **Vs** by 63.9uSec

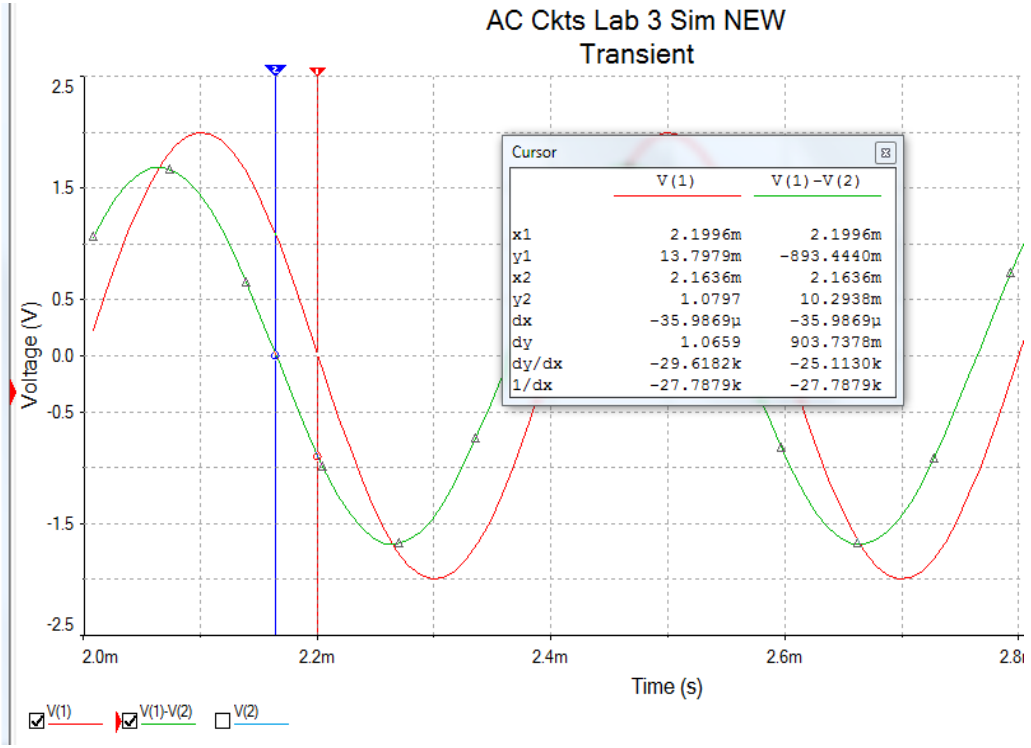
$\mathbf{I\_in} = 1.07\text{mApk} < -57.5^O$

$i\_in(t) = 1.07\text{E-}3 \sin(15{,}708t - 57.5^O)$ A

Lab #3 Prelab (Partial – Simulating on Multisim)



1. Find the impedance of each component
2. Use Ohm's Law for phasors to determine i_in(t), **V_L(t)** and VR1(t)
3. Verify your results by simulating the circuit in Multisim



Also from the simulation: V1 = 2Vpk, V1-V2 =

Hence V_L = 1.68Vpk

What is **V_L** (magnitude and angle)?

VL leads Vs by 35.99 uSec or 32.4 Deg

Therefore, **V_L** = 1.68Vpk < 32.4 Deg

V_L = 1.68Vpk < 32.4 Deg -> 1.68 sin(15,708t + 32.4 Deg) V