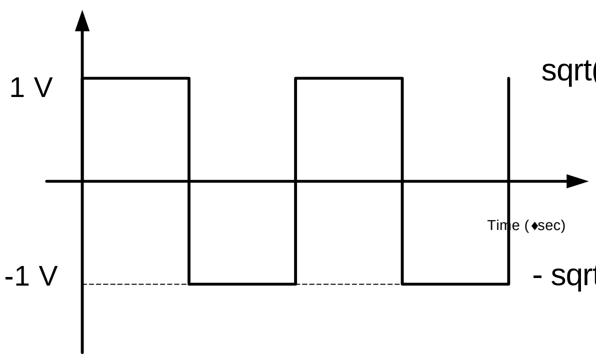
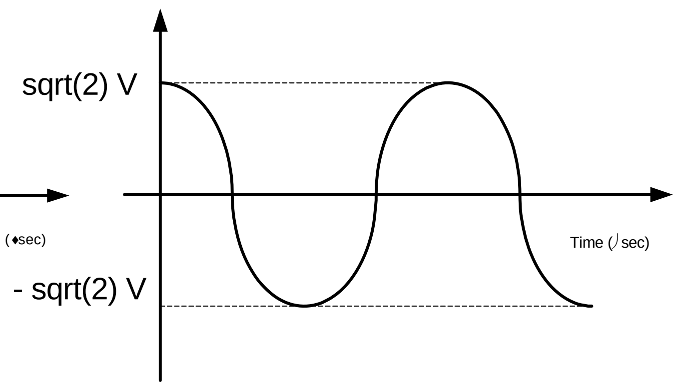
(4 points) On the axes given below, draw two different waveforms that each have an rms value of 1.0 Volts. Label the waveforms sufficiently that it is possible to calculate that rms value of 1.0 Volts from the labels that you provide.





2. (10 points) For the small power system shown below, the voltages and currents are as labeled. The three loads are identical.

a. (3 points) Find the voltage across the loads.

$$j := \sqrt{-1} \qquad VAr := V \cdot A$$

$$V_s := 240 \cdot V \qquad I_s := 4.2 \cdot e^{-j \cdot 25 \cdot deg} \cdot A \qquad X_s := 5.0 \cdot \Omega$$

Use a loop equation.

$$V_L := V_s - j \cdot X_s \cdot I_s = (231.125 - 19.032i)\,V \qquad \left|V_L\right| = 231.907\,V \qquad \arg\left(V_L\right) = -4.708 \cdot deg$$

b. (5 points) Find the real and reactive power consumed in one of the loads.

$$S_L := \frac{1}{3} \cdot \left(V_L \cdot \overline{I_s}\right) = (304.519 + 112.6i)\,W \qquad P_L := Re\left(S_L\right) = 304.519\,W$$

$$Q_L := Im\left(S_L\right) = 112.6 \cdot VAr$$

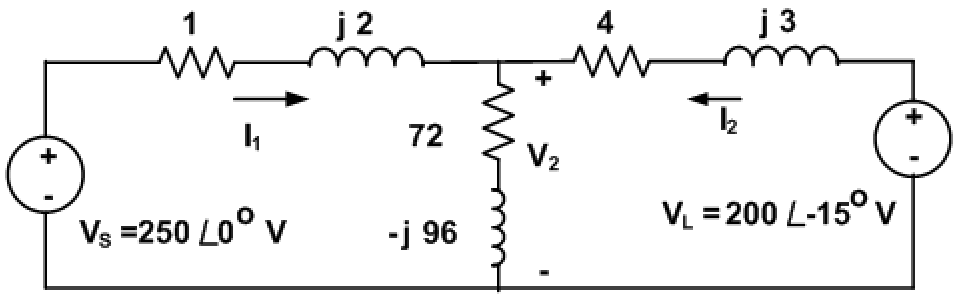
c. (2 points) If the frequency is 50 Hertz, what is the inductance of the line that connects the source to the loads?

The basic relation is $X_s = \omega \cdot L_s$

$$\omega := 2 \cdot \pi \cdot 50 \cdot \frac{rad}{sec} = 314.159\,\frac{1}{s} \qquad X_s = 5\,\Omega$$

$$L_s := \frac{X_s}{\omega} = 15.915 \cdot mH$$

3. (6 points) For the circuit shown below, write a set of linearly independent equations that can be solved for the voltage V_2 and the current I_2. You need not solve the equations; just write them.



Units for impedances are Ohms

Here is one set of equations based on a node equation:

$$\frac{V_2 - 250}{1 + j\cdot 2} + \frac{V_2}{72 - j\cdot 96} + \frac{V_2 - 200\cdot e^{-j\cdot 15\cdot deg}}{4 + j\cdot 3} = 0$$

$$\frac{200\cdot e^{-j\cdot 15\cdot deg} - V_2}{4 + j\cdot 3} = I_2$$

Here is another set of equations based on loop equations:

$$-250 + (1 + j\cdot 2)\cdot I_1 + (72 - j\cdot 96)\cdot (I_1 + I_2) = 0$$

$$-200\cdot e^{-j\cdot 15\cdot deg} + (4 + j\cdot 3)\cdot I_2 + (72 - j\cdot 96)\cdot (I_1 + I_2 = 0)$$

$$V_2 = (72 - j\cdot 96)\cdot (I_1 + I_2)$$