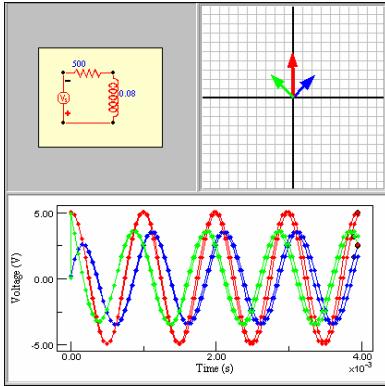


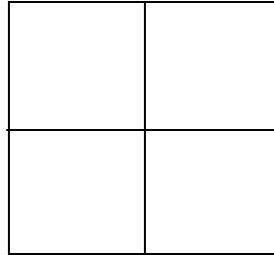
Worksheet for Exploration 31.5: RL Circuits and Phasors



Assume an ideal power supply. The graph shows the voltage as a function of time across the source (**red**), the resistor (**blue**), and the inductor (**green**) (voltage is given in volts and time is given in seconds). [Restart](#).

To analyze the currents and voltages in this circuit, notice that you cannot simply use $V = I X$ along with the peak current values. You must account for the phase differences between the voltages and the currents. One way to account for the phase differences is to describe the voltage, current and reactance with phasors. Next to the circuit is an animation that shows the phasor representation of the circuit elements (this allows us to show the phase difference) where the inductor voltage (**green**) is $\pi/2$ ahead of the resistor voltage (**blue**). The magnitude of each vector is the peak voltage across the element.

- a. Since there is no phase shift between the resistor current and the voltage across the resistor, what would a phasor for the current look like in the phasor diagram?



- b. Why is the phasor for the inductor $\pi/2$ ahead of the resistor voltage (i.e., the current through the circuit)? (Hint: Does the inductor current lead or lag the voltage (see [Illustration 31.4](#))?)

- c. How does the length of the inductor's phasor change as you change the frequency?

- d. Why does the length change as a function of frequency?

Notice that the phasors rotate at an angular speed of $\omega = 2 \pi f$. The projection of any given voltage phasor on the y axis is the voltage across the circuit element at that time.

- e. Pause the animation and explain how you can tell that the phasor diagram matches the voltages across the different circuit elements shown in the graph. In other words, verify that the y component of the vector in the phasor animation matches the value of the voltage shown on the graph.

Frequency = _____

Time	y-component of vectors			Voltage		
	Source	inductor	resistor	source	inductor	resistor

From the vectors on the phasor diagram, we can develop a connection between the peak (or rms) voltage and the peak (or rms) current, where $V_0 = I_0 Z$ and the phase difference between the voltage and current is given by ϕ . On the phasor diagram, V_0 (**the source voltage-red**) is the vector sum of the two voltage vectors (**resistor-blue**, and **inductor-green**) and ϕ is the angle between V_0 and the current (in the same direction as the resistor voltage phasor on the diagram). [Exploration 31.6](#) develops the use of phasors for RLC circuits.