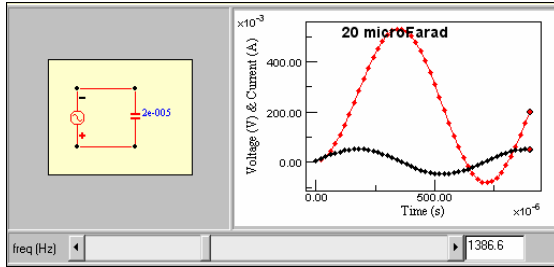


## Worksheet for Exploration 31.2: Reactance



Assume an ideal power supply. The reactance,  $X$ , of a circuit element is the ratio between peak voltage and current so that  $V = I X$ . For a resistor,  $X_R = R$ . This exploration shows that for an active load like a capacitor or inductor, the reactance depends on the frequency as well (**voltage is given in volts, current is given in amperes or milliamps (note graph labels), capacitance is given in farads, inductance is given in henries, and time is given in seconds**). [Restart.](#)

- a. For a [capacitive load](#), vary the frequency and observe what happens to the current. How is this result related to the formula for capacitive reactance? The graph shows the voltage across (**red**) and current from the power supply (**black**) as a function of time. Note that you may need to wait for transient effects to decay if you change the frequency.

High frequency = \_\_\_\_\_ Current = \_\_\_\_\_

Low frequency = \_\_\_\_\_ Current = \_\_\_\_\_

- i. Formula for capacitive reactance (look in your book if needed)?

- ii. Connection between observations of current and capacitive reactance:

- b. [Double the capacitance](#) and try it again. What happens? Explain your observations in terms of the capacitive reactance.

Frequency = \_\_\_\_\_

$C =$  \_\_\_\_\_ Current = \_\_\_\_\_

$2C =$  \_\_\_\_\_ Current = \_\_\_\_\_

- i. Relation to capacitive reactance?

- c. Repeat (a) and (b) with an [inductive load](#). What happens if you [double the inductance](#)? Explain your observations in terms of the inductive reactance.

High frequency = \_\_\_\_\_ Current = \_\_\_\_\_

Low frequency = \_\_\_\_\_ Current = \_\_\_\_\_

Frequency = \_\_\_\_\_

L = \_\_\_\_\_ Current = \_\_\_\_\_

2L = \_\_\_\_\_ Current = \_\_\_\_\_

- i. Formula for inductive reactance (look in your book if needed)?

- ii. Connection between observations of current and inductive reactance:

If we take this to the limit of  $f \rightarrow 0$  (DC circuits), then a capacitor is essentially an open circuit. At high frequencies, the capacitor is essentially a short circuit (acts like a wire with little or no resistance).

- d. Explain these limits in terms of what a capacitor does (stores charge) and how it works.

- e. At low frequencies, is an inductor essentially an open circuit or a short circuit? What about at high frequencies?

- f. Explain in terms of what an inductor does (in terms of induced current).