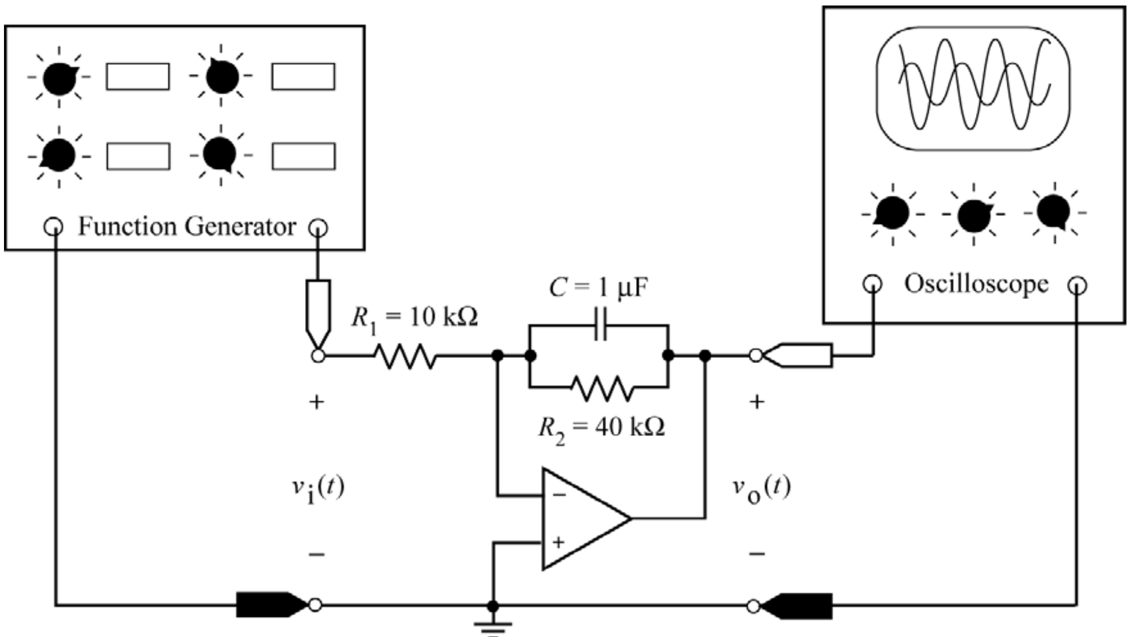
Frequency Response

Consider this experiment:



Here a function generator provides the input to a linear circuit and the oscilloscope displays the output, or response, of the linear circuit. The function generator allows us to choose from several types of input function.

Suppose we select a sinusoidal input. The function generator permits us to adjust the amplitude, phase angle and frequency of the input. Trying various settings, we collect the following data:

$v_i(t)$, V	$v_o(t)$, V
$2.5\cos(200t+45°)$	$1.24\cos(200t+142°)$
$2.5\cos(100t+45°)$	$2.43\cos(100t+149°)$
$2.5\cos(50t+45°)$	$4.47\cos(50t+162°)$
$5.0\cos(100t+45°)$	$4.85\cos(100t+149°)$
$25\cos(200t+45°)$	$12.40\cos(200t+142°)$
$2.5\cos(50t+30°)$	$4.47\cos(50t+147°)$
$2.5\cos(50t+135°)$	$4.47\cos(50t-108°)$
$5.0\cos(150t+60°)$	$3.29\cos(150t+160°)$

First, we notice that no matter what adjustments we make, the (steady state) response is always a sine wave at the same frequency as the input. The amplitude and phase angle of the output differ from the input, but the frequency is always the same as the frequency of the input.

After a little more experimentation we find that **at any fixed frequency**

- The ratio of the amplitude of the output sinusoid to the amplitude of the input sinusoid is a constant.

- The difference between the phase angle of the output sinusoid and the phase angle of the output sinusoid is also constant.

The situation is not as simple when we vary the frequency of the input. Now the amplitude and phase angle of the output change in a more complicated way.

We need analytical tools that will enable us to predict how the amplitude and phase angle of the output sinusoid will change as we vary the frequency of the input sinusoid.