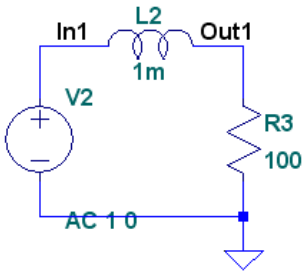
What is this for?

Today we first looked at "frequency response," or the behavior of circuits to different frequencies of input, as opposed to different functions of time. It's especially easy to predict frequency response using passive components (resistors, capacitors and inductors). You can treat everything like a voltage divider using each component's impedance (Z) instead of just resistance (R). It's a pretty useful thing to do, and it helps for a lot of different kinds of circuits: audio, radio, sensing, and power supplies.

Here are two questions asking about the response of linear circuits. The first one is the practice you asked for in doing the algebra. The second is my attempt to make you think about a circuit in terms of a few important characteristics without having to do any algebra. Enjoy.

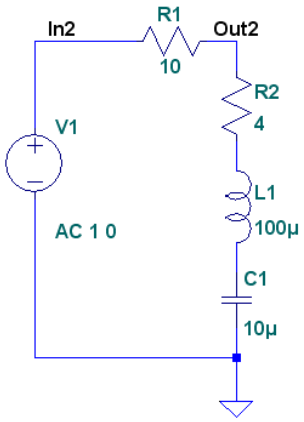
Step by step: Inductor and resistor



The impedance of the resistor is $Z_R = R$ (constant for all frequencies) and the impedance of the inductor is $Z_L = i\omega L$.

1. What's the voltage ratio V_{out}/V_{in}? Compute this like any voltage divider, but keep in mind the answer is a function of frequency. It's called the frequency response.
2. Find an expression for the frequency where the real and imaginary parts of the frequency response are equal. This the corner frequency, F_c, of the filter.
3. What kind of filter is this? Lowpass, highpass, bandpass, notch, or something else?
4. Compute the corner frequency of the filter, in Hz, using the component values on the schematic.

Still step by step: Notch filter



This circuit is a little more complicated. Let's try to figure out what it does without making a mess of complex numbers.

1. If the L-C combination has a really big impedance, what's the ratio V_{out}/V_{in}?
2. At what frequency does the L-C combination have zero impedance? (Hint: $\frac{1}{i} = -i$, so $\frac{1}{i\omega C} = -\frac{i}{\omega C}$.)
3. If the L-C combination has zero impedance, what's the ratio V_{out}/V_{in}?
4. What kind of filter is this? Lowpass, highpass, bandpass, notch, or something else?
5. Compute the numerical value of your first three answers (output ratios and frequency).
6. Try to draw the frequency response graph of this circuit.

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