Objectives
1.) Observe, measure and plot the resonance of a series RLC circuit.
2.) Observe the effect of R on the “Q”. Observe the resonance of a parallel RLC circuit.

Equipment and materials from stockroom:
- 2 10X Oscilloscope probes (If they have switches, make sure they’re set to 10X)
- EE 1050 kit, optional, if available.
- Wire kit

Parts:
These items may be bought from stockroom or may be in the EE 1050 kit.
- 100 (brn,blk,brn), 390 (org,wht,brn) and 2 kΩ (red,blk,red) resistors
- 0.001 µF capacitor (typ. marked 102)
- Inductor, 2 to 4 mH (probably 2.8 mH)

Experiment
Inductor Imperfections
Some EE1050 kit inductors are obviously coils of wire and some are in blue plastic cylinders marked “LH233”. The LH233 ones are better quality. Measure the resistance of your inductor with an ohmmeter. Ideally this should be 0 Ω, although you will measure some (hopefully small) value.

Series RLC Circuit
Construct the circuit shown at right. $V_S$ is the MAIN OUT (LO) of the Krohn-Hite function generator in the bench. Connect the MAIN OUT (HI) to the EXT INPUT of the scope and set the scope triggering to EXT. Set the scope to show BOTH input channels.

Find resonance: Compute the resonant frequency ($f_0$ in Hz or kHz) of your capacitor and inductor combination (calculated value). Set the function generator to this frequency. Now vary the frequency up and down while looking at $v_c$ on the scope. The frequency where $v_c$ is at its maximum is the actual resonant frequency ($f_0$) of your circuit. Measure this frequency with the scope or a frequency counter, don’t just take it off the function-generator dial. Compare it to your calculated value.
**Plot freq. response:** Take enough measurements of the CH1 and CH2 voltages to plot them both as a function of frequency from $f_0/8$ to $8f_0$. Generally, when a value is plotted as a function of frequency, the frequency is plotted on a log scale, it makes your curves look much more symmetric. You may have done this before by plotting 100Hz, 300Hz, 1kHz, 3kHz,... measurements on an evenly divided scale. Another simple way to do this is to take and plot your measurements by factors of two. Divide your horizontal axis into six divisions (seven marks). Label the center mark with the nearest whole number to $f_0$. Double the frequency for each mark to the right and halve the frequency for each mark to the left. This way the left-most mark will be about $f_0/8$ and the right-most will be about $8f_0$. Wah-lah.., A simple log scale.

Move CH2 of the scope to measure $v_s$ (other side of the resistor). Tune your circuit to $f_0$. Find the ratio of $v_c/v_s$. How can this be greater than 1? Explain.

**Phases:** Tune the function generator up and down around the resonant frequency while you observe the phase relationship between the two traces. Explain or sketch what you see. Explain why this makes sense. Think in terms of the inductor and capacitor impedances. Which one dominates above the resonant frequency and which one dominates below the resonant frequency? The dominant one will determine the phase of the current in the circuit.

**Different resistor:** Exchange the 100 Ω resistor with the 390 Ω. Connect CH2 of the scope back to where it was. Take measurements to make the same type of plots as you made before. You may want to plot these on the same horizontal axis, but be sure that all your plotted lines are clearly labeled.

**Q:** Resonant circuits are also characterized by a factor known as the “quality” or “Q” of the circuit. The higher the Q value the sharper the resonant peaks and valleys. Judging by your plots, which of your two circuits has the higher Q? Usually the Q is inversely related to the resistance it the circuit. Comment in your notebook.

**Parallel RLC Circuit**

Construct the circuit shown at right, using the same components. Experimentally find the resonant frequency ($f_0$) of this circuit. Is it the same as that of the series circuit? How is resonance different in this circuit?

**Conclude**

As always, check off and write a conclusion.

Reset the scope triggering from EXT to INT, otherwise the next poor fool who uses this scope will have to think--and we wouldn’t want that.