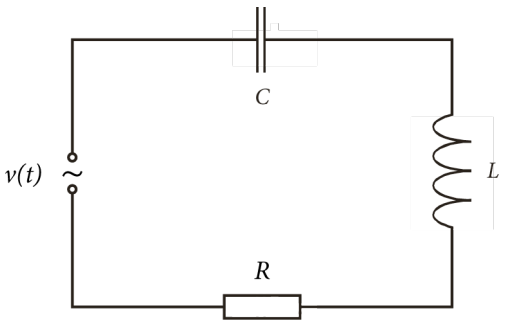
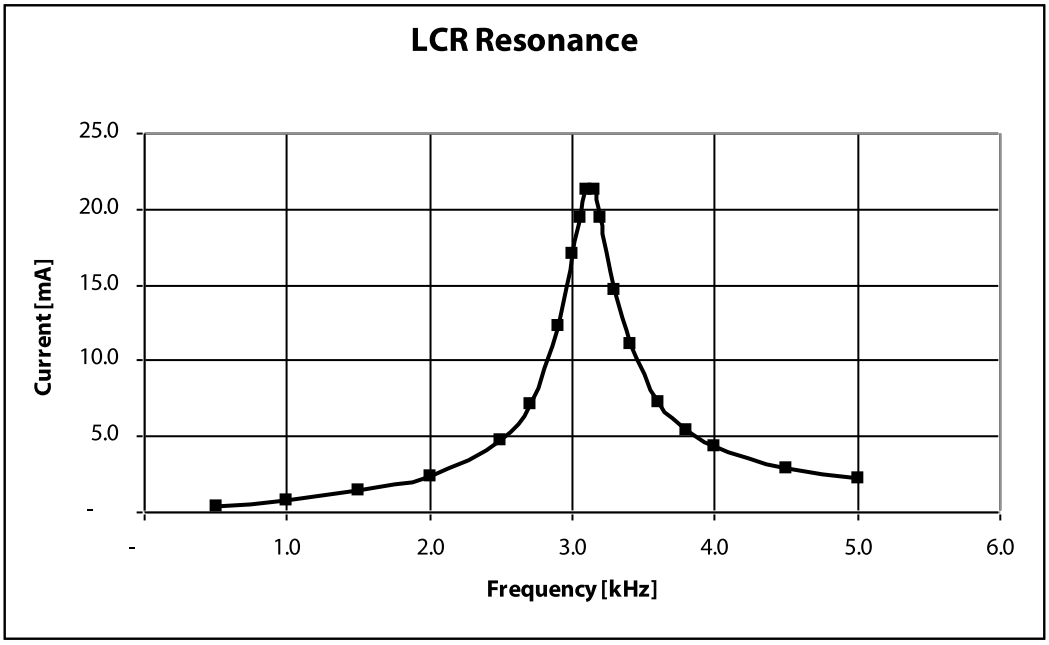
LCR Circuit

As we already know, an LCR circuit can be considered as an example of a damped oscillator. If we connect the circuit to an ac voltage supply, we therefore get a driven oscillation. We are going to investigate the resonant behaviour of this circuit.



The following diagram displays the current (rms value) vs. frequency for an LCR circuit with capacitance 69 nF (Byland, 7 January 2009). The rms value of the "driving" voltage supply was 1.6 V.



1. How does the LCR circuit's natural frequency depend on the parameters *L*, *C* and *R*? Use this relation and the diagram to determine the inductance.
2. Using the well known expression for the impedance of an ac series circuit, derive a formal expression for the current amplitude. Determine the circuit's total resistance from the measured current at resonance.
3. Calculate the full width at half maximum (FWHM) for the resonance graph.
4. The resistor is replaced by another one with a greater resistance. Sketch the corresponding graph in a different colour into the same diagram. How does this affect the FWHM?
5. Using the expression for the phase shift between voltage and current in an ac series circuit, find the phase shift for low frequencies, high frequencies and at the resonance frequency. Why is this different from the result we found for the mechanical oscillator?