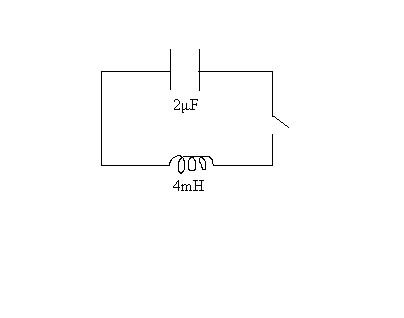
**Example**

Consider the LC circuit below. If the initial charge stored on the capacitor is 2μC, what will be the maximum current through the circuit? What will be the frequency of oscillation. What will be the max energy stored across the inductor?



Well, the maximum current is I = Qω. Since we have,



And so,

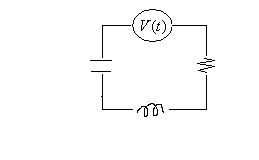


the energy stored across the inductor is:



**Example**

Suppose V(t) = 120sin(120πt), R = 50Ω, L = 30mH, C = 40μF. What is the rms current in the circuit? What is the maximum current in the circuit? What is the rms potential difference across the inductor? What is the rms potential difference across both the capacitor and inductor combined? What is the average power dissipated across the resistor? What is the average power supplied by the battery?



First let’s determine the resistance of the inductor, and capacitor.



and,



Therefore, the equivalent resistance of the circuit:



Finally, Vrms = V/√2 = 120/√2 = 85. And so the rms current will be:



the maximum current is:



the rms potential difference across the inductor is:



and,



The power dissipated across the resistor is:



The average power supplied by the battery is:



Now the cosφ part is:



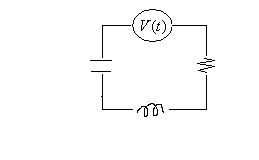
Therefore,



This should be the same as the i2R result of course, since the power in must equal the power out.

**Example**

Suppose V(t) = 120sin(120πt), R = 50Ω, L = 30mH, C = 40μF. What is the rms current in the circuit? What is the resonant frequency of the circuit? What is the resonant current?





which is a frequency of:



The current at the resonant frequency is:

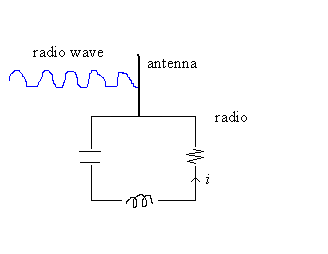


where in the third line we use the fact that χL = χC (by definition) at resonance.

**Application to radios**

Suppose you want to tune into a certain radio station – like 89.1FM. This station is broadcast using radio waves at a frequency of roughly 89.1MHz. So an FM ~ MHz.

The radio waves are, as we’ll learn later, oscillating electromagnetic fields. In effect, then, they are like oscillating (AC) voltages sources (since any voltage source works by setting up an electric field in the circuit). This voltage source is picked up by your car antenna which is part of an RLC circuit in your radio.



Radios are tuned to incoming radio waves by turning a dial which changes the capacitance of the circuit in the radio until the resonant frequency of the circuit matches the incoming frequency of the radio wave (the radio wave is the voltage source). This results in a maximum current value in the circuit.

**Example**

Suppose you want to listen to 89.1FM, and the inductor in your radio has a value of 5mH. What value should you tune the capacitor to in order to pick up the station?

Well, we want to tune the capacitor so that the resonant frequency of the circuit matches the frequency of the source. The angular frequency of the source is:



and the resonant frequency of the circuit is:

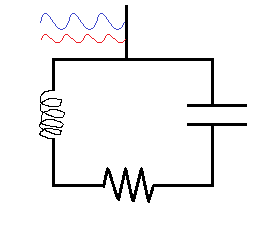


and setting these equal gives,



**Problem 1.**

Consider the following RLC circuit, which we’ll use as a model for a radio. Radio waves with different frequencies, f, hit the antenna and exert oscillating electric forces on the electrons in the antenna. Thus they act, via the antenna, as individual batteries, each oscillating at their particular frequency f. Suppose that R = 1200Ω, then what should L and C be so that we get the largest current in the circuit at frequency f = 89.9 MHz, but at the frequency f = 90.3 MHz, the current is only 1/10 as large (this will insure that we get a good reception)?



For largest current to occur at 89.9 MHz, this must be equal to resonant frequency. So:



If current at 90.3 Mhz is tenth the resonant value, then using formula I = V/[R2 + (χL – χC)2]1/2, and recognizing χL = χC at resonance, we have:



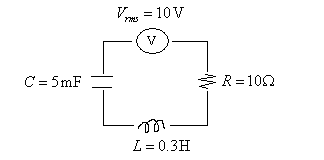
Now filling in L from above…



and going back for L…



15. Consider the circuit below. Let the voltage source oscillate with a frequency of 10Hz. What is the average power dissipated through the resistor?



to find the average power we need the rms current, which requires we know the equivalent resistance of the circuit, which requires we know the resistances of the elements. So we have,



The total resistance is:



And so irms is given by:



and so the power dissipated across the resistor is:

