
LC Oscillator

A capacitor of capacitance C and an inductor of inductance L form a circuit that oscillates so that the capacitor charge Q is described by the function $Q = Q_0 \cos(\omega t)$.

1. What is the frequency f of oscillation in terms of the parameter ω ?
2. The parameter ω describes how rapidly the capacitor charge cycles.
 - a. What quantities control the value of ω ?
 - b. What sort of quantity is ω ? Is it a vector or scalar? Is it an integer, real, or complex? What are its units?
 - c. What is the formula for ω in terms of the characteristics of the circuit?
3. The voltage V across a capacitor depends on its charge Q by $V = Q/C$. What is the formula for the capacitor voltage as a function of time in an LC circuit?
4. The current into and out of a capacitor is the rate of charge accumulation on its plates, dQ/dt . What is the formula for the current as a function of time in an LC circuit?
5. The voltage across an inductor determines, or is determined by (it's hard to assign cause and effect in an inductor), the rate of change of current, $V = L dI/dt$. What is the formula for inductor voltage as a function of time in an LC circuit?
6. The energy stored in the electric field of a capacitor is $U_C = \frac{1}{2} QV$. What is the formula for the energy stored in the capacitor as a function of time?
7. The energy stored in the magnetic field of an inductor is $U_L = \frac{1}{2} LI^2$. What is the formula for energy stored in the inductor as a function of time?
8. What is the formula for the total energy in an LC circuit as a function of time?

9. In a simple harmonic oscillator, in which a mass m is acted on by the force $F = -kx$ of a Hooke's law spring with stiffness k , what are the expressions for:

a. ω^2 ?

b. x ?

c. $v = dx/dt$?

d. $a = dv/dt$?

e. $U = \frac{1}{2} kx^2$?

f. $K = \frac{1}{2} mv^2$?

g. $E = K + U$?