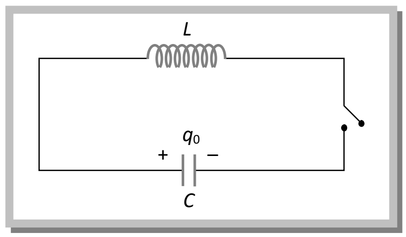
LC Oscillation.

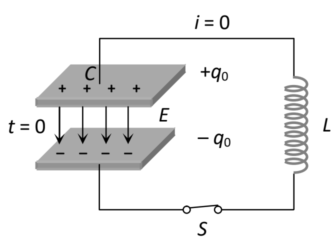
When a charged capacitor C having an initial charge q0 is discharged through an inductance L, the charge and current in the circuit start oscillating simple harmonically. If the resistance of the circuit is zero, no energy is dissipated as heat. We also assume an idealized situation in which energy is not radiated away from the circuit. The total energy associated with the circuit is constant.



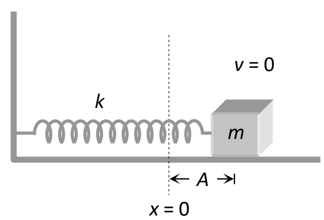
Frequency of oscillation is given by

$$\omega = \frac{1}{\sqrt{LC}} \frac{rad}{sec} \text{ or } \nu = \frac{1}{2\pi\sqrt{LC}} Hz$$

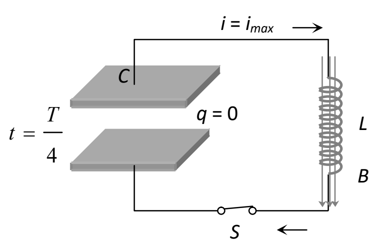
The oscillation of the LC circuit are an electromagnetic analog to the mechanical oscillation of a block-spring system.



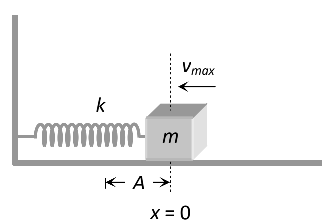
At *t* = 0, capacitor is ready to discharge



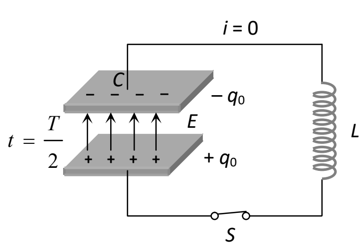
At *t* = 0, block is ready to move



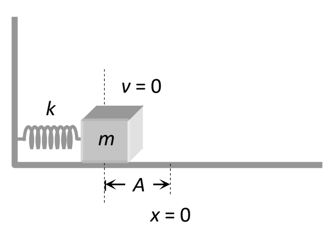
At $t = \frac{T}{4}$, capacitor is fully discharged *i.e.* charge *q* = 0 and current through the circuit is maximum



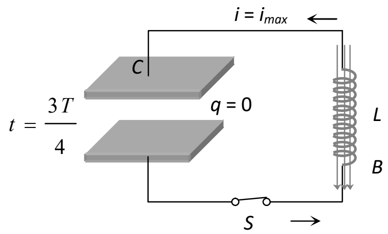
At $t = \frac{T}{4}$, block comes in it's mean position *i.e.x* = 0and velocity of block becomes maximum



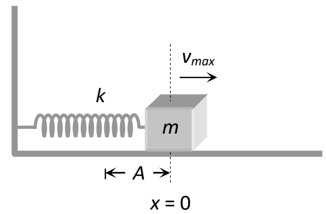
At $t = \frac{T}{2}$, capacitor is again recharged with reverse polarity and *i* = 0



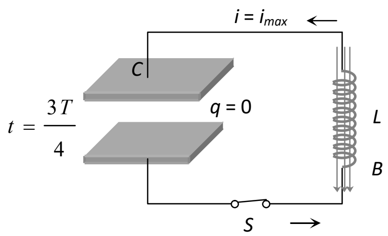
At $t = \frac{T}{2}$, block reaches it's extreme position other side and *v* = 0



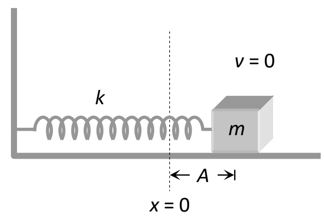
At $t = \frac{3T}{4}$, capacitor again discharges completely $i = i_{max}$



At $t = \frac{3T}{4}$, block again reaches it's mean position and it's velocity becomes maximum



At $t = \frac{3T}{4}$, capacitor again discharges completely $i = i_{max}$



At $t = \frac{3T}{4}$, block again reaches it's mean position and it's velocity becomes maximum

Concepts

Comparison of oscillation of a mass spring system and an LC circuit

Mass spring system	v/s	LC circuit
Displacement (x)		Charge (q)
Velocity (v)		Current (i)
Acceleration (a)		Rate of change of current $\left(\frac{di}{dt}\right)$
Mass (m) [Inertia]		Inductance (L) [Inertia of electricity]
Momentum (p = mv)		Magnetic flux (ϕ = Li)
Retarding force $\left(-m\frac{dv}{dt}\right)$		Self induced emf $\left(-L\frac{di}{dt}\right)$
Equation of free oscillations :		Equation of free oscillations :
$\frac{d^2x}{dt^2} = -\omega^2 x$; where $\omega = \sqrt{\frac{K}{m}}$		$\frac{d^2q}{dt^2} = -\left(\frac{1}{LC}\right).q$; where $\omega^2 = \frac{1}{LC} \Rightarrow \omega = \frac{1}{\sqrt{LC}}$
Force constant K,		Capacitance C
Kinetic energy $= \frac{1}{2}mv^2$		Magnetic energy = $\frac{1}{2}Li^2$

Elastic potential energy = $\frac{1}{2}Kx^2$	Electrical potential energy $= \frac{1}{2}\frac{q^2}{C}$