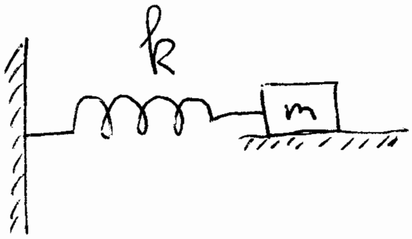
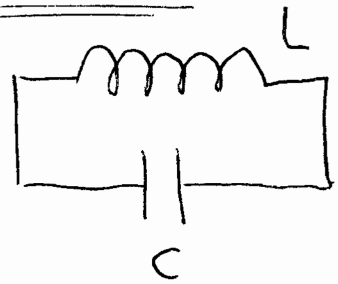
3(16): Some Simple Equivalent Circuits.

1)



Hooke's Law

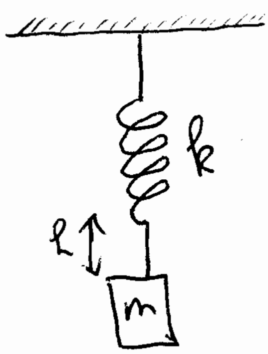


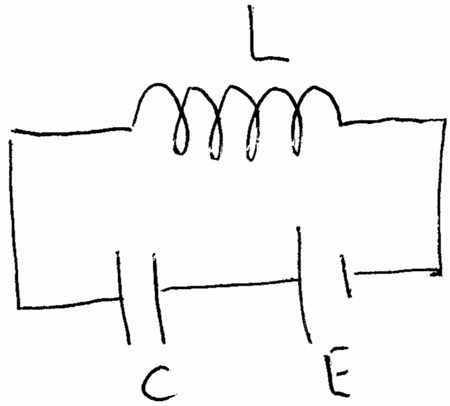
$$m\ddot{x} + kx = 0 \qquad\qquad L\ddot{q} + \frac{1}{C}q = 0$$

The above is the equivalent circuit for Hooke's Law.

$$\boxed{m \to L, \quad x \to q, \quad \frac{1}{k} \to C, \quad \dot{x} \to I}$$

2) Undamped Driven Oscillator





$$m\ddot{x} + kx = F \qquad\qquad L\ddot{q} + \frac{q}{C} = E$$

$$(F = kl) \qquad\qquad (E = q_1/C)$$

It is seen that the equivalent circuit is an emf, a capacitor and inductor. The emf E plays the role of driving force, and the

2)

Hooke constant is :

$$k \equiv \frac{1}{LC} \quad - (1)$$

It is seen that if :

$$E = E_0 \cos(\omega t) \quad - (2)$$

then :

$$\boxed{\ddot{q} + \left(\frac{1}{LC}\right) q = E_0 \cos(\omega t)} \quad - (3)$$

this equation is to be compared with :

$$\boxed{\ddot{x} + \omega_0^2 x = A \cos \omega t} \quad - (4)$$

The particular integral of eq. (4) is :

$$x_p(t) = \frac{A \cos \omega t}{(\omega_0^2 - \omega^2)} \quad - (5)$$

Resonance occurs at

$$\omega_0 = \omega \quad - (6)$$

with an infinite Q factor.

The particular integral of eq. (3)

is as follows

3)

$$q_p(t) = \frac{E_0 \cos(\omega t)}{\left(\frac{1}{LC} - \omega^2\right)} \quad -(7)$$

Resonance occurs at:

$$\omega = \left(\frac{1}{LC}\right)^{1/2} \quad -(8)$$

with infinite Q factor. Therefore to tune to resonance, eq. (8) is used. This assumes an alternating power source ($E_0 \cos(\omega t)$) and no resistance in the circuit. Tuning to resonance in this case means tuning the frequency of the power source to $(1/(LC))^{1/2}$.

Following these guidelines it is possible to design a circuit for the solution of the ECE Coulomb law and to show that the spin connection induces an extra capacitance C and inductance L.