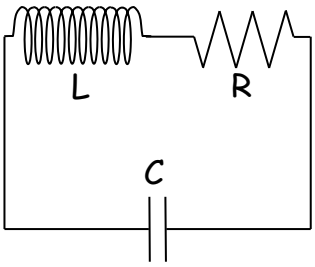
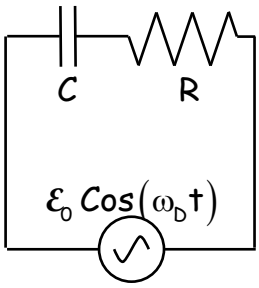
HOMEWORK SET 13: THE MECHANICAL-ELECTRICAL CONNECTION
Due Friday, October 21, 2022

PROBLEMS FROM MT3 (Not in TM5 … text from MT3 on T :\O'Donoghue\Mechanics\ClassNotes**) .**



1) *3-22* Show that for an RLC circuit in which the resistance is small, the logarithmic decrement of the oscillations is approximately $\pi R\sqrt{C/L}$.
The logarithmic decerement is defined on p. 111 of TM5.

2) *3-23* Compute the oscillation frequencies, periods and amplitude after 2 periods (as a fraction of A_0) for the circuit shown for L = 0.01 H, C = 10 μF, and R = 10 Ω.



3) *3-24* An electrical circuit consists of a resistor R and a capacitor C connected in series to a source of alternating emf. Find expressions for the charge and current as a function of time and show that the current decreases to zero as the frequency of the alternating emf approaches zero.
Solve a differential equation similar to that in Example 3.5 (above Figure 3-18 on p. 125). Guess a solution that is a sum of a cosine and a sine, then force it to work … look back at how we solved the driven harmonic oscillator … but use Q(t) = Acos(ω_Dt) + Bsin(ω_Dt). I get,

$$Q(t) = \frac{C\mathcal{E}_0}{\omega_D^2 R^2 C^2 + 1}\left[\cos(\omega_D t) + \omega_D RC \sin(\omega_D t)\right]$$

$$I(t) = \frac{\omega_D C\mathcal{E}_0}{\omega_D^2 R^2 C^2 + 1}\left[\omega_D RC \cos(\omega_D t) - \sin(\omega_D t)\right]$$

"Got any 25-amp fuses?"