LC and driven LC circuits

1. Consider an LC circuit with $L = 10\,mH$, $C = 0.7\,mF$ and capacitor initially charged to $10\,V$.
   (a) from conservation of energy, find the maximuum current
   (b) find the resonant frequency ω_0 in rad/s
   (c) derive explicit formulas for the charge $q(t)$ and the electric energy $U_C(t)$ in the capacitor
   (d) derive explicit formulas for the current $I(t)$ and the magnetic energy $U_M(t)$ in the inductor
   (e) verify $U_M(t) + U_E(t) = const$ (and determine the $const$)
2. An LC circuit is driven by an external AC source with $\mathcal{E} = \mathcal{E}_m \sin(\omega_d t)$. Use $L = 10\,mH$, $C = 0.7\,mF$, $\mathcal{E}_m = 150\,V$, $f_d = 60\,Hz$.
   (a) find ω_d
   (b) write down the loop equation in terms of the charge on the capacitor $q(t) = Q\sin(\omega_d t)$.
   (c) find the charge amplitude Q
   (d) find the current amplitude I
   (e) suppose, L can be varied; which value would bring the circuit into resonance?
   (f) Plot $I(L)$