Phyx 135-2, Sec 02 (1 pm), Quiz 6 **Name: _____**

1) A capacitor of 78 μF and an inductor of unknown size form an LC circuit that oscillates at 4.15 kHz, with a peak current of 10.3 mA.
1a) (3 points) What is the inductance in the circuit?
1b) (3 points) What is the total energy in the circuit?
1c) (4 points) What is the maximum charge on the capacitor?

Solutions:
1a) We have $\omega^2 = 1 / LC$, so $L = 1/\omega^2 C = 1/(2\pi \times 4150 \text{ Hz})^2(78 \times 10^{-6}) = 1.89 \times 10^{-5}$ H = 18.9 μH.

1b) The total energy in the circuit is equal to the maximum energy in either the capacitor or the inductor. Since we already know the current, we can use $U = \frac{1}{2} LI^2 = \frac{1}{2}(18.9 \text{ μH})(10.3 \text{ mA})^2 = 1.00 \times 10^{-9}$ J.

1c) From conservation of energy, the maximum energy in the capacitor will equal the maximum energy in the inductor, or $U = \frac{1}{2} q^2/C$, so $q = (2UC)^{1/2} = (2 \times 1.00 \times 10^{-9} \times 78 \times 10^{-6})^{1/2} = 3.95 \times 10^{-7}$ C.

2) A series RLC circuit is driven by a generator at a frequency of 400 Hz and a peak emf of 120 V. The inductance is 40 mH, the capacitance is 3.0 μF, and the resistance is 150 Ω.

2a) (5 points) What is the peak current in the circuit?
2b) (5 points) What is the phase constant in degrees?

Solutions: The angular frequency ω of the circuit is: $\omega = 2\pi f = 2\pi(400 \text{ Hz}) = 2.51 \times 10^3$ rad/sec. Therefore $X_L = \omega L = (2510)(40 \times 10^{-3}) = 100$ Ω, and $X_C = 1/\omega C = 1/(2510)(3 \times 10^{-6}) = 133$ Ω.

2a) $I = \text{emf} / [R^2 + (X_L - X_C)^2]^{1/2} = 120 / [150^2 + (100 - 133)^2]^{1/2} = 0.78$ amp.

2b) $\tan\phi = (X_L - X_C) / R = (100 - 133) / 150 = -0.22$, or $\phi = -12.4°$