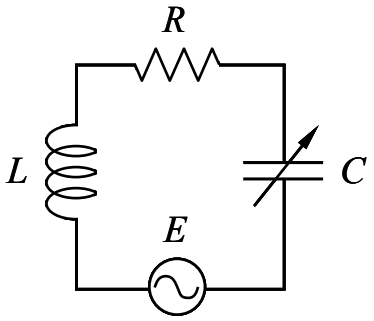
Name: _____ Sec. _____ **P112: Quiz 8B, Week 11**

In the RLC circuit shown at right, the resistance R and inductive reactance X_L are set to the given values. The capacitor is of variable magnitude (indicated by the diagonal arrow). The AC generator puts out a peak EMF of $\mathcal{E}_{max}$ = 120 V.



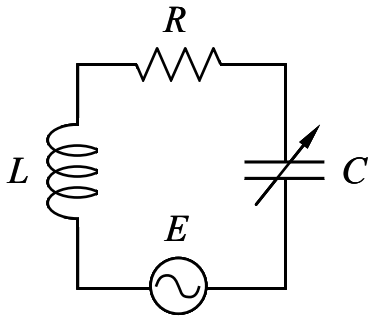
$R = 200\ \Omega$
$X_L = 450\ \Omega$
$E_{max} = 120$ V

1) If the capacitance is set to C = 200 μF, the circuit is <u>in resonance</u>. Given this information, calculate the inductance L of the circuit and the frequency ω of the generator. **[5]**

2) Leaving the frequency ω and peak voltage $\mathcal{E}_{max}$ of the AC generator unchanged, the variable capacitor is now changed to C = 350 μF. This puts the circuit off resonance. What is the phase angle ϕ of the generator EMF with respect to the current? **[4]**

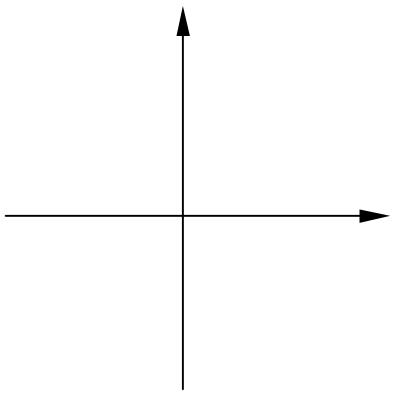
3) Does the generator EMF <u>lead</u> or <u>lag</u> the current when C = 350 μF? **[3]**

4) What is the impedance Z of the final circuit (with $C = 350\ \mu F$)? **[4]**



$R = 200\ \Omega$
$X_L = 450\ \Omega$
$E_{max} = 120\ V$

5) Draw the voltage phasor diagram ($\mathcal{E}$, V_C, V_L, V_R) for this final circuit, with the angles and lengths of the phasors indicated numerically. **[4]**



W11 Quiz 2

Q8B

$X_L = \omega L$. At Resonance, $X_L = 450\Omega = X_C = 1/\omega_{res} C$.

1) So, $\omega_{res} = 1/(450\Omega \times 200\,\mu\text{F}) = 11.1\text{rad/sec}$. (5)

$X_L = \omega L \Rightarrow L = 40.5\ H$

Equation for X_C	(1)
Equation for X_L	(1)
Condition for resonance	(1)
Solution for ω_{res}	(1)
Solution for L	(1)
Numerical errors	(-1, but only once per quiz)

2) $X_C \Rightarrow \frac{200}{350} 450\Omega = 257\Omega \Rightarrow X_L - X_C = 193\Omega$
$\phi = \tan^{-1}\left(\frac{X_L - X_C}{R}\right) = 44.0° = 0.77$ rad (4)

Equation for ϕ	(2)
New X_C	(1)
Answer	(1)
Numerical errors	(-1, but only once pre quiz)

3) V leads I, because $X_C < X_L$. Alternatively, because $\phi > 0$. (3)
This can be said in words, or graphically.

V leads I	(2)
Explanation	(1)

No credit w/o explanation..

4) $|Z| = \sqrt{R^2 - (X_L - X_C)^2} = 278\Omega$ (4)

Equation for $\|Z\|$	(2)
Answer	(2)
Numerical errors	(-1, but only once pre quiz)

Do not take off points for errors propagated from previous parts.

5) Magnitude of each V_i-phasor is $(\mathcal{E}/Z)^* X_i$.

$I_C = \frac{120}{278} \times 257$

$= 110.9\ V$ along $-y$.

$\mathcal{E}$: 120 V, to the right (along $+x$)	(1)
[illegible]	(1)
V_L: (120/278)*450 = 194 V, up (along $+y$)	(1)
V_R: (120/278)*200 = 86.3 V, to the right (along $+x$)	(1)
Equation for phasor magnitude	(2)
Each correct phasor	(½)
Numerical errors	(-1, but only once pre quiz)

Do not take off points for errors propagated from previous parts.