ELC_2323 Test 6, 2021_0423. Make comments. Show your work. Name:_____

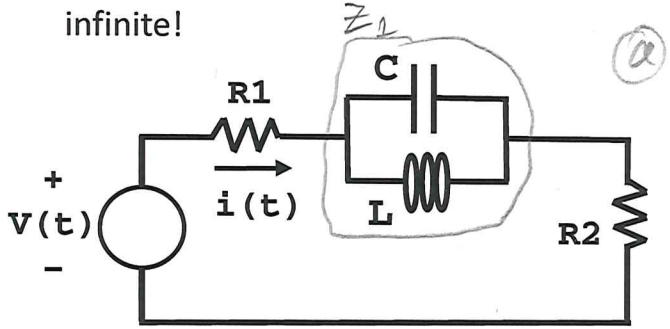
Problem 1. The circuit shown below is energized by an AC voltage source Vcos(ωt).

a. Use KVL to develop an equation for phasor current **I**. If you wish, you can define a new variable Z1 to represent L||C. (i.e., L in parallel with C).

b. Convert phasor current **I** to time domain.

c. Using the circuit as shown, if C is removed, what will be the new time-domain expression for i(t)?

d. Determine a combination of L and C that will force i(t) to be zero. Note - neither L or C can be zero or infinite!



(a) $-\tilde{V} + I(R1 + Z1 + R2) = 0$

$\tilde{I} = \dfrac{\tilde{V}}{R1 + Z1 + R2}$, $Z1 = \dfrac{j\omega L\left(\frac{1}{j\omega C}\right)}{j\omega L + \frac{1}{j\omega C}} = \dfrac{L/C}{j\left[\omega L - \frac{1}{\omega C}\right]}$

(b) Do this by converting $[R1+R2] + Z1$ to a rectangular form complex number, the to a polar form complex number. Divide polar form $\tilde{V}$ by ↙ to get $\tilde{I}$

(c) Z1 becomes just jωL.
Repeat the (a), (b) processes.

(d) $Z1 = \dfrac{L/C}{j\left[\omega L - \frac{1}{\omega C}\right]}$, when $\omega L = \frac{1}{\omega C}$, $Z1 \to \infty$ to form an open ckt.

$\omega L = \frac{1}{\omega C}$, $\omega^2 LC = 1$, $LC = \frac{1}{\omega^2}$

Any combination

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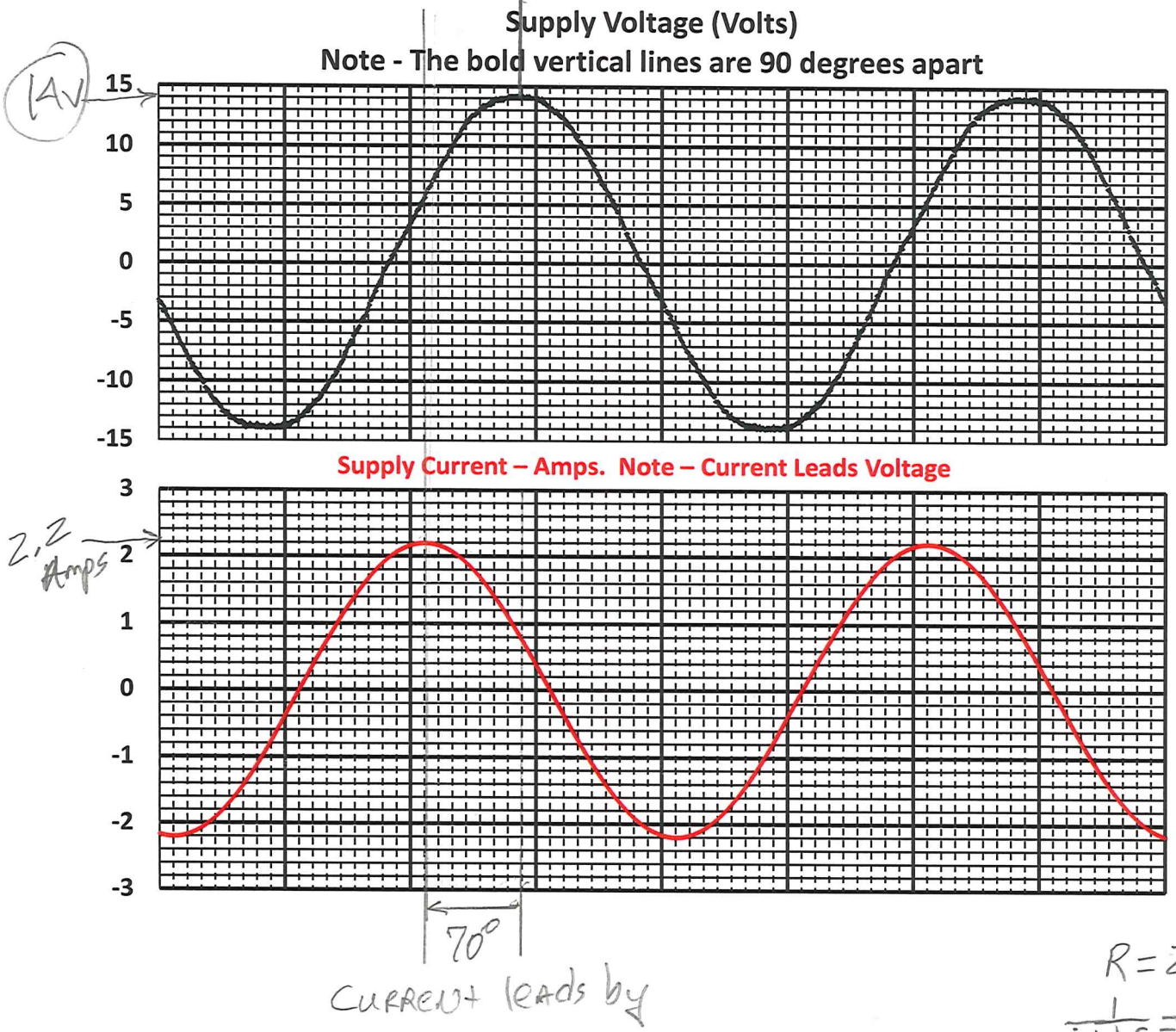
$\omega = 2\pi f = 2\pi(60) = 120\pi$ r/s

Ref at peak of voltage waveform



Problem 2.

A 60 Hz AC voltage supply (top graph) powers a series combination of capacitor + resistor. No inductor.

a. Pick a vertical line for your zero angle reference, and express the two waveforms in time-domain cosine form.
b. Convert the time domain waveforms to phasors.
c. Compute the combined complex impedance of the capacitor and resistor.
d. Compute the capacitor microF and resistor ohms.

$v(t) = 14\cos(120\pi t)$ volts

$i(t) = 2.2\cos(120\pi t + 70^\circ)$ Amps

$\tilde{V} = 14\angle 0$

$\tilde{I} = 2.2\angle 70^\circ$

$Z = 6.36\angle -70^\circ = 2.175 - j5.98\ \Omega$

$R = 2.175\ \Omega$

$\frac{1}{j\omega C} = -j5.98$, $(j\omega C)(-j5.98) = 1$

$C = \frac{1}{5.98\omega} = 443$ MilliF