Name: _____ (please print)

Signature: _____

ECE 2202 – Quiz 5
July 31, 2020

Online

1. This quiz is open book, open notes.
2. Show all work necessary to complete the problem. A solution without the appropriate work shown will receive no credit. A solution which is not given in a reasonable order will lose credit.
3. Show all units in solutions, intermediate results, and figures. Units in the quiz will be included between square brackets.
4. If the grader has difficulty following your work because it is messy or disorganized, you will lose credit.
5. Do not use red ink. Do not use red pencil.
6. You will have 25 minutes to work on this quiz, and 15 minutes to download/print, scan and submit.

_____/25

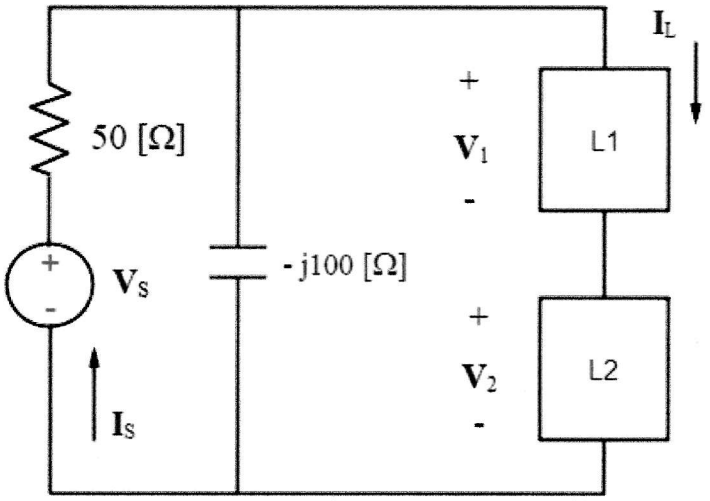
Choose one of the problems below to work for the quiz. I will grade only one problem. Please indicate here the number of the problem I should grade: _____

Room for extra work

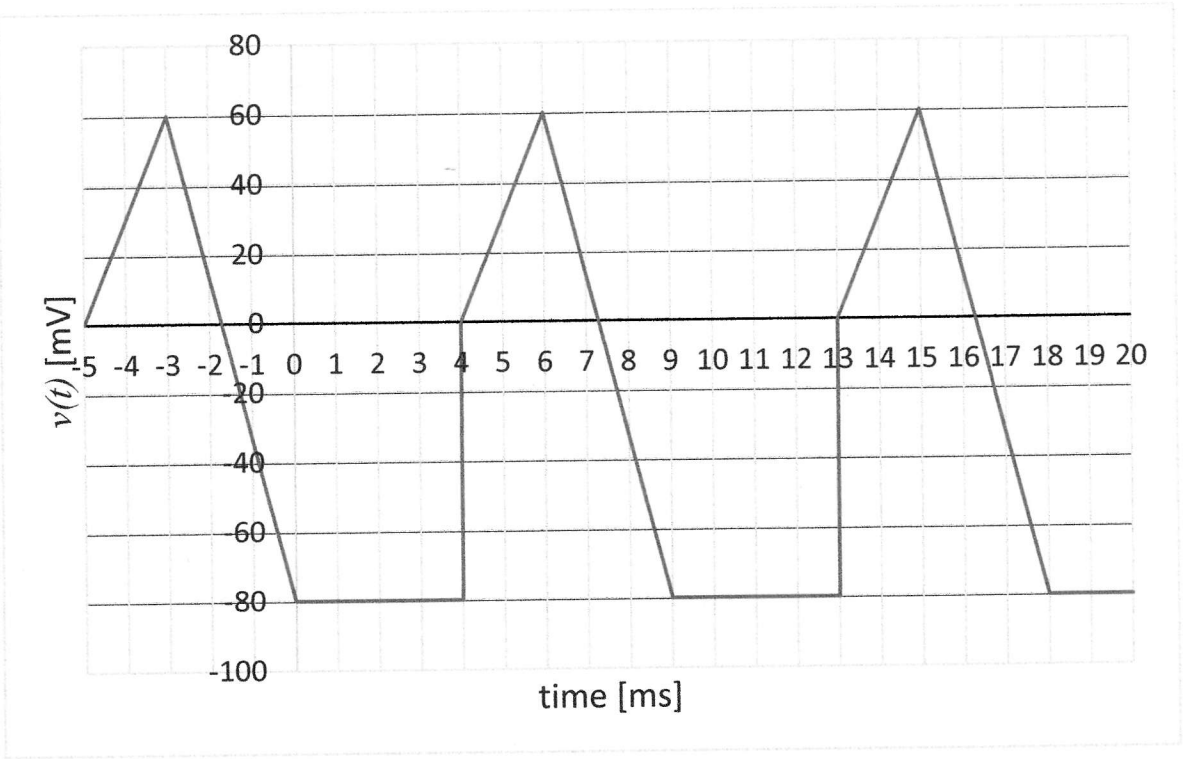
1. In this quiz, phasors are indicated in bold capital letters, for example $\mathbf{I}_L$.

The circuit below is in steady state. Load L_1 absorbs 288 [VA] at a power factor of 0.9397 lead. Load L_2 absorbs 576 [VA] at a power factor of 0.8 lag. The load voltage across L_2 is known to be $\mathbf{V}_2 = 240\ [V]_{rms}$.

a. Find the real and reactive power absorbed by Load L1.
b. Find the load current $\mathbf{I}_L$.
c. Find the source current $\mathbf{I}_S$.



2. Find the RMS value of the voltage waveform given below.



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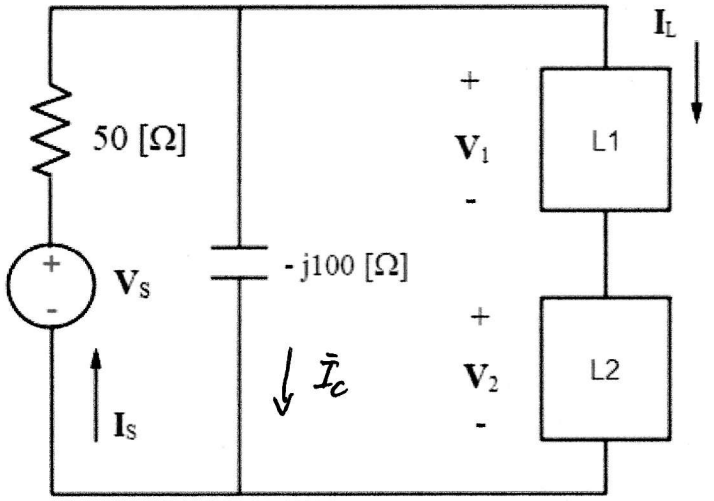

L_1: $\cos^{-1}(0.9397) = 20^\circ$ "lead" $\Rightarrow \theta_v - \theta_i = -20^\circ$

$S_1 = 288\cos(-20^\circ) + j\overset{288}{1}\sin(-20^\circ)$

a) $\therefore$ real power $P = 288\cos(-20^\circ) = 270.6$ [W]

reactive power $Q = 288\sin(-20^\circ) = -98.50$ [VAR]

b) $S_2 = 576\angle 36.87^\circ$ [VA] $\quad \cos^{-1}(0.8) = 36.87^\circ$

$= \bar{V}_2 \bar{I}_L^*$ $\Rightarrow$ $\bar{I}_L^* = \dfrac{576\angle 36.87^\circ}{240} = 2.4\angle 36.87^\circ\ [\mathrm{A}]_{\mathrm{rms}}$

$\therefore \bar{I}_L = 2.4\angle -36.87^\circ\ [\mathrm{A}]_{\mathrm{rms}}$

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Room for extra work

c) $S_1 = 288 \angle -20^\circ \text{ [VA]} = \bar{V}_1 \bar{I}_L^*$

$$\Rightarrow \bar{V}_1 = \frac{288 \angle -20^\circ}{2.4 \angle 36.87^\circ} = 120 \angle -56.87^\circ \text{ [V]}_{rms}$$

$$\bar{I}_C = \frac{\bar{V}_1 + \bar{V}_2}{-j100} = \frac{321.7 \angle -18.20^\circ}{-j100} = 3.22 \angle 71.80^\circ \text{ [A]}_{rms}$$

$$\therefore \bar{I}_S = \bar{I}_C + \bar{I}_L = 3.34 \angle 28.96^\circ \text{ [A]}_{rms}$$

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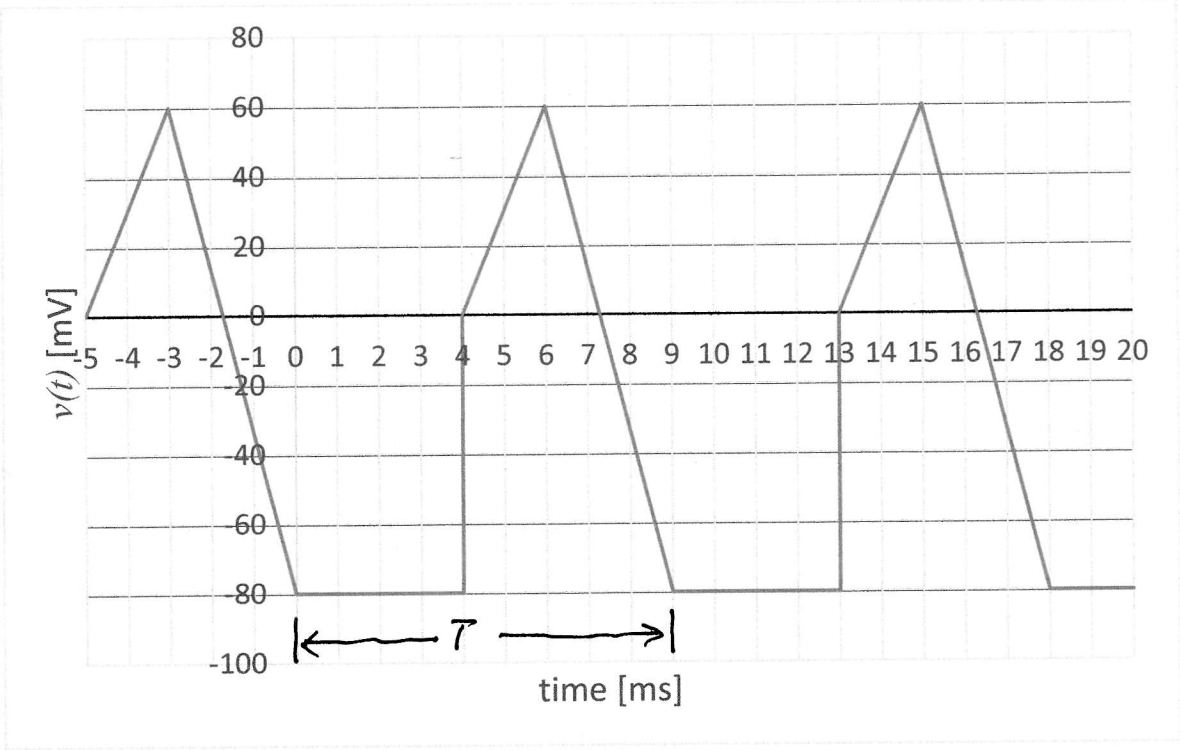
2. Find the RMS value of the voltage waveform given below.



$T = 9$ [ms] $\quad V_{rms} = \sqrt{\frac{1}{T}\int_0^T v^2(t)\,dt}$

we will work in [mV] and [ms] ...

$v(t) = -80$ [mV] $\quad 0 \le t \le 4$ [ms]

$= 30t - 120$ [mV] $\quad 4 \le t \le 6$ [ms]

$= \frac{-140}{3}t + 340$ [mV] $\quad 6 \le t \le 9$ [ms]

$$V_{rms} = \sqrt{\frac{1}{9}\left[\int_0^4 (-80)^2\,dt + \int_4^6 (30t-120)^2\,dt + \int_6^9 \left(\frac{-140}{3}t + 340\right)^2 dt\right]} \cdots$$

$\int_0^4 (-80)^2\,dt = 25600$ [mV^2·ms] $\quad \int_4^6 (30t-120)^2\,dt = 2400$ [mV^{2}ms] $\quad \int_6^9 \left(\frac{-140}{3}t + 340\right)^2 dt = 5200$ [mV^{2}ms]

units?

p 2

Room for extra work

$$V_{rms} = \sqrt{\frac{1}{9[ms]}\left[33200\,[mV^2 \cdot ms]\right]}$$

$$V_{rms} = 60.74\,[mV]_{rms}$$