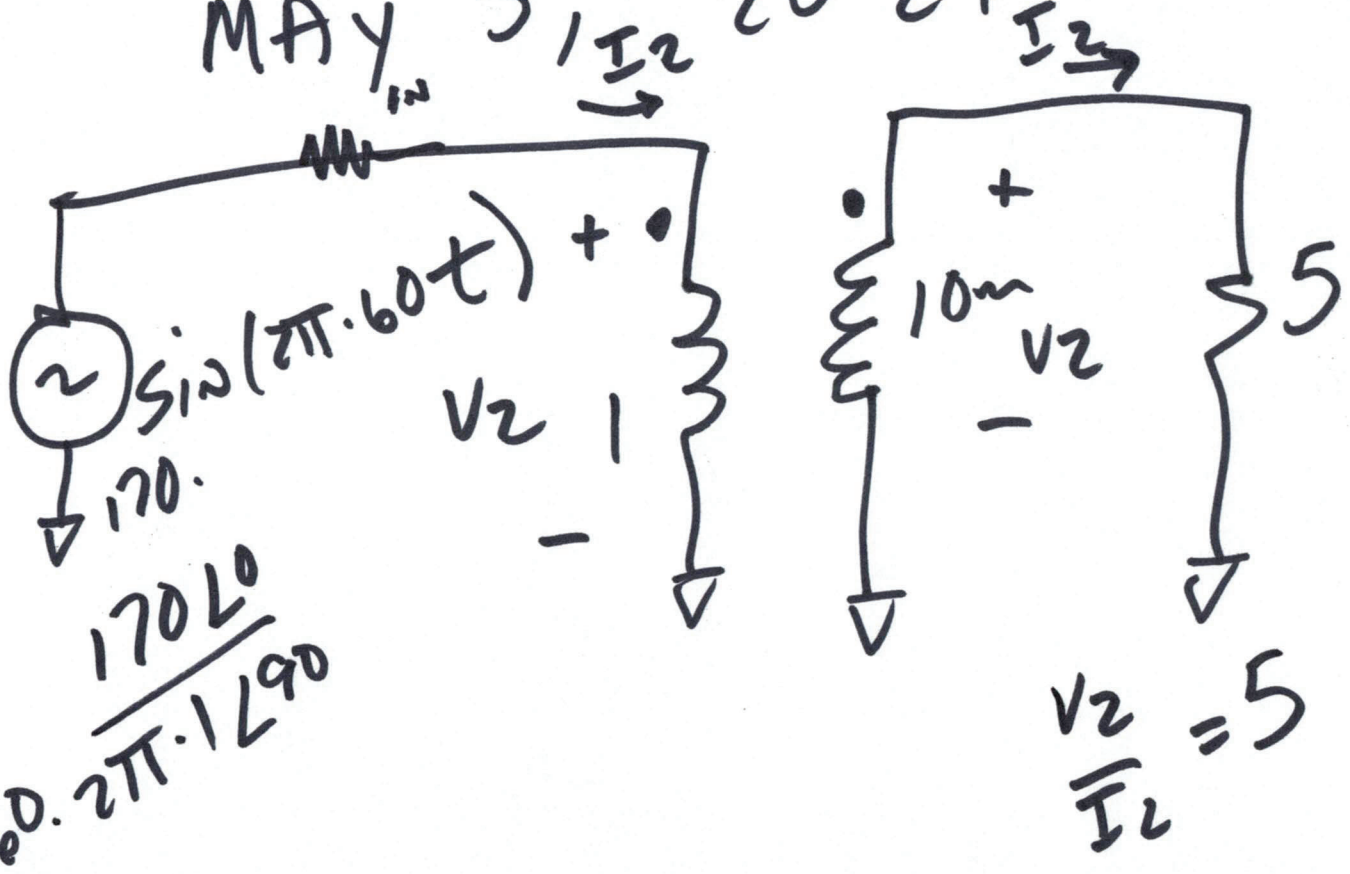
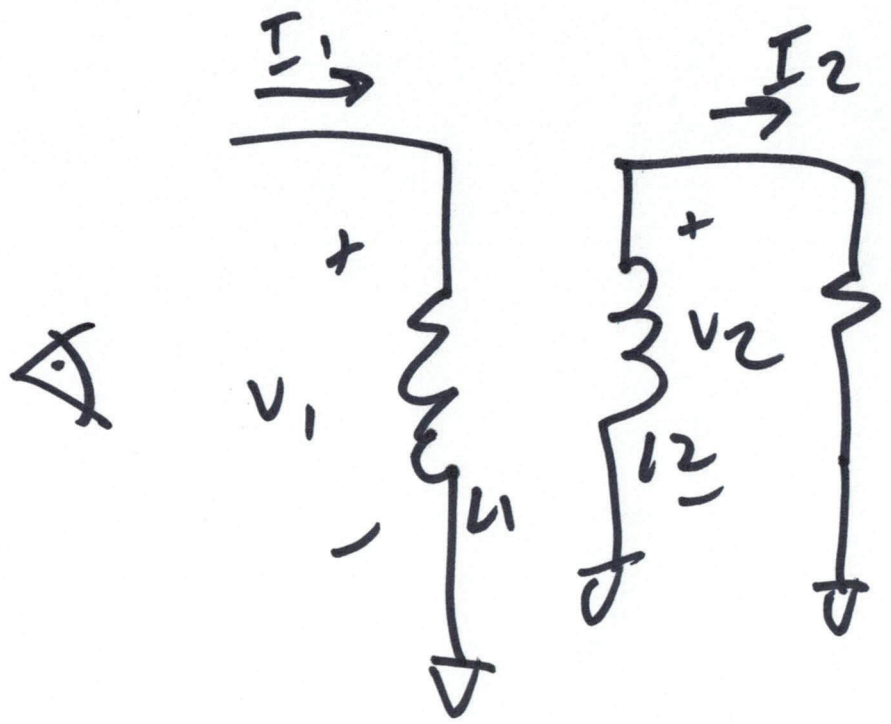
EE 221 Circuits II

Lecture 27

$$\frac{I_2}{I_1} = \frac{V_1}{V_2} = \frac{N_1}{N_2} = \sqrt{\frac{L_1}{L_2}}$$

MAY 5, 2021





$$R_{IN} = \left(\frac{N_1}{N_2}\right)^2 R_L$$

$$\frac{I_2}{I_1} = \frac{V_1}{V_2} = \frac{N_1}{N_2}$$

$$R_{IN} = \frac{V_1}{I_1} = \frac{\frac{N_1}{N_2}}{\frac{N_2}{N_1}} R_L = \frac{\frac{V_1}{V_2}}{\frac{I_1}{I_2}} \qquad \frac{V_2}{I_2}$$

$R_L = \frac{V_2}{I_2}$

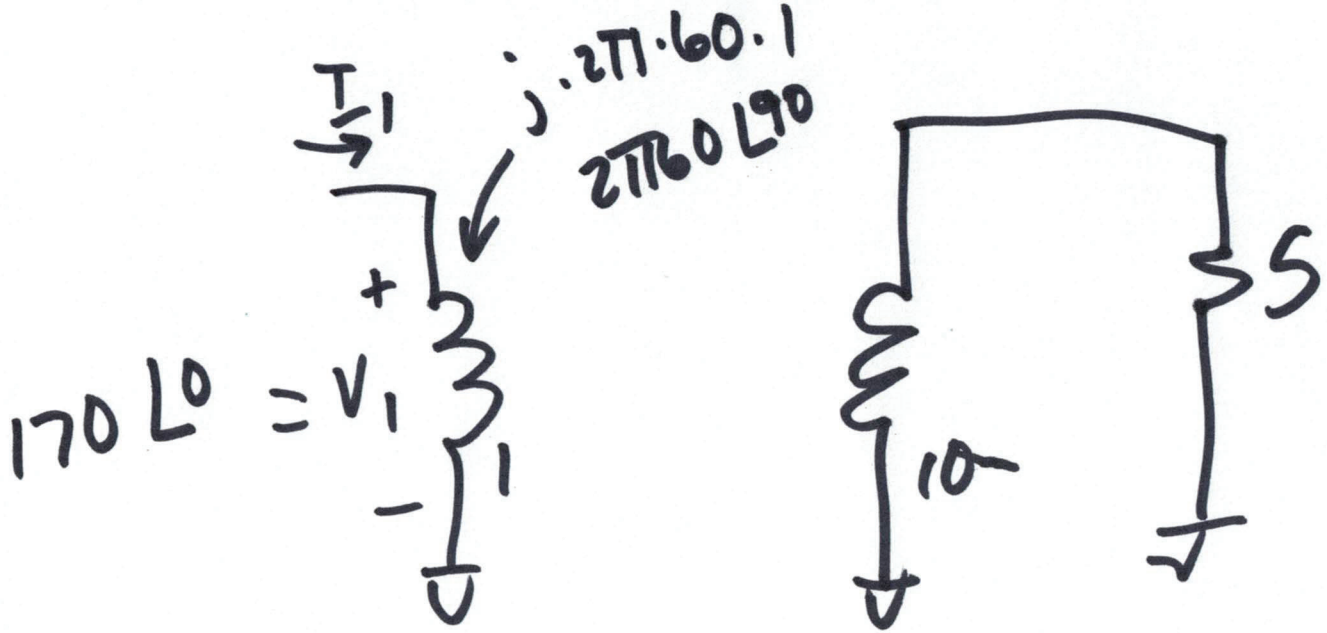
$$\frac{I_2}{I_1} = \frac{V_1}{V_2} = \frac{N_1}{N_2} \qquad R_2 = \frac{V_2}{I_2}$$

$$V_2 = V_1 \cdot \frac{N_2}{N_1}$$

$$I_2 = I_1 \cdot \frac{N_1}{N_2}$$

$$R_L = \frac{V_1 \cdot \frac{N_2}{N_1}}{I_1 \cdot \frac{N_1}{N_2}} = R_{IN}\left(\frac{N_2}{N_1}\right)^2$$

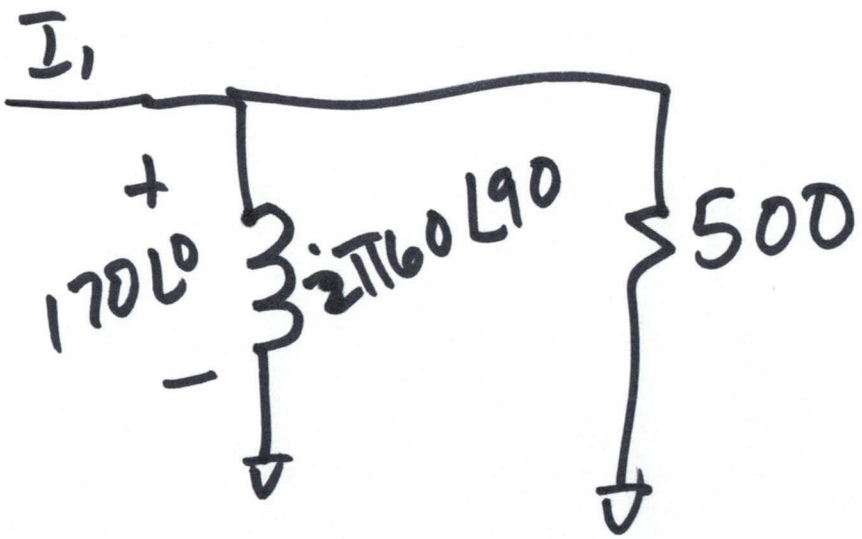
$$R_{IN} = R_L \cdot \left(\frac{N_1}{N_2}\right)^2$$



$$\frac{N_1}{N_2} = \sqrt{\frac{1}{.01}}$$

$$\frac{N_1}{N_2} = 10$$

$$R_{in} = 5 \cdot 10^2 = 500$$



$$I_1 = \frac{170\angle 0}{\dfrac{2\pi 60\angle 90 \cdot 500}{500 + j2\pi 60}}$$

$$626\angle 37^\circ$$

$$I_1 = \frac{170\angle 0}{\dfrac{188K\angle 90}{626\angle 37}} = \frac{626\angle 37 \cdot 170\angle 0}{188K\angle 90}$$

$$= 0.565\angle -53$$

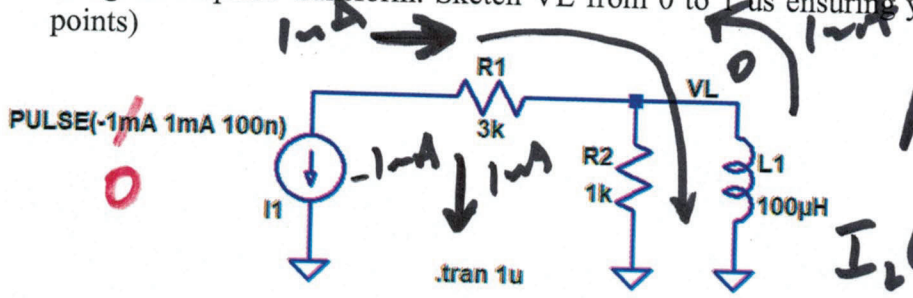
$$i_1(t) = 565\,mA\ \sin(2\pi \cdot 60 \cdot t - 53^\circ)$$

Practice Final Exam – EE 221 Circuits II
University of Nevada, Las Vegas

NAME: _____

Closed book and notes. No extra paper, do your work on this exam, use the back if needed. **Show your work for credit and be neat! Place a box around each of your answers.** No Laplace transform table is allowed or (again) any other extra material (scratch paper).

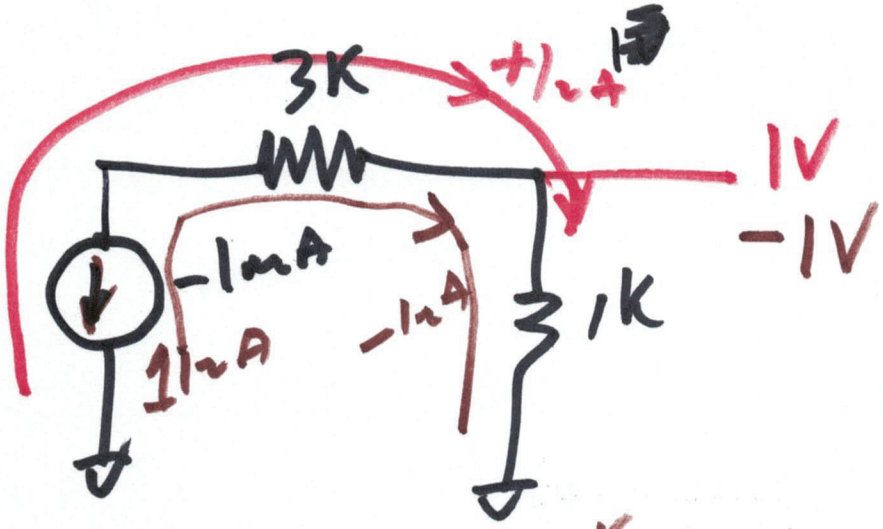
1. Find VL (an equation that includes the input current pulse's delay) in the following circuit using the Laplace transform. Sketch VL from 0 to 1 us ensuring you label the axis. (15 points)

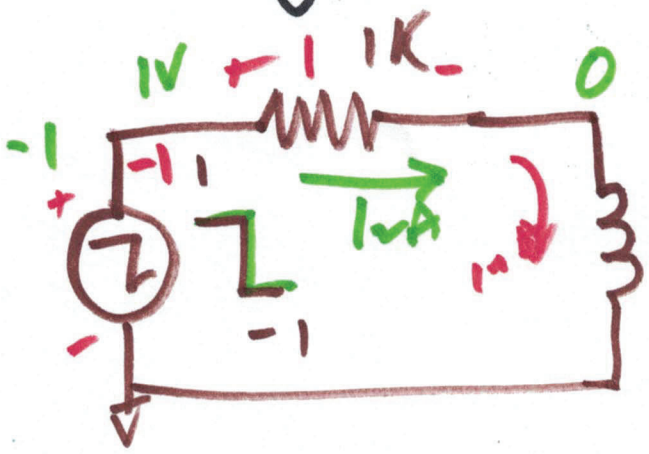


$R_{TH} = 1K$

$I_L(0) = 1mA$

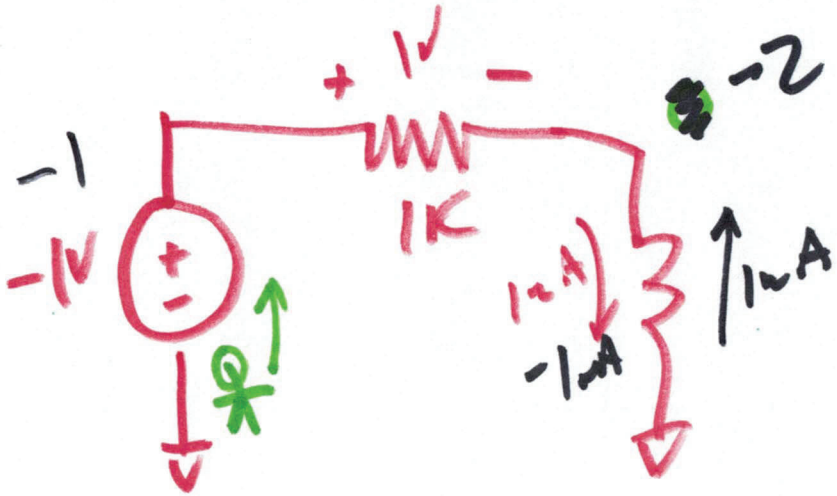
$V_L(0) = 0$



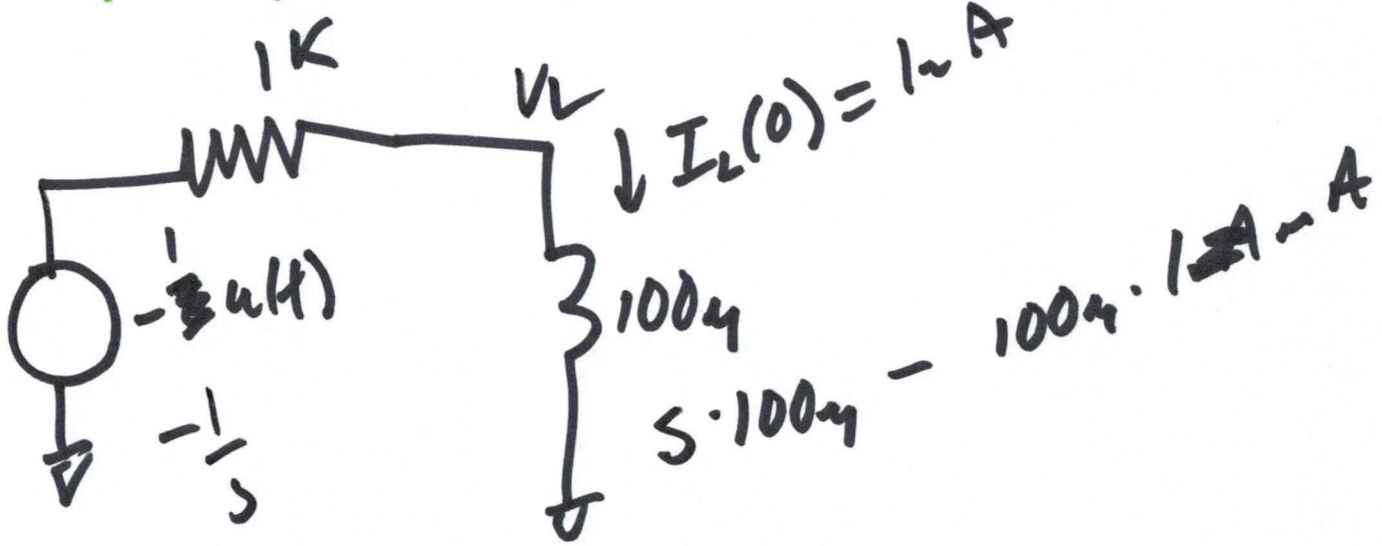


$I_L(0) = 1mA$

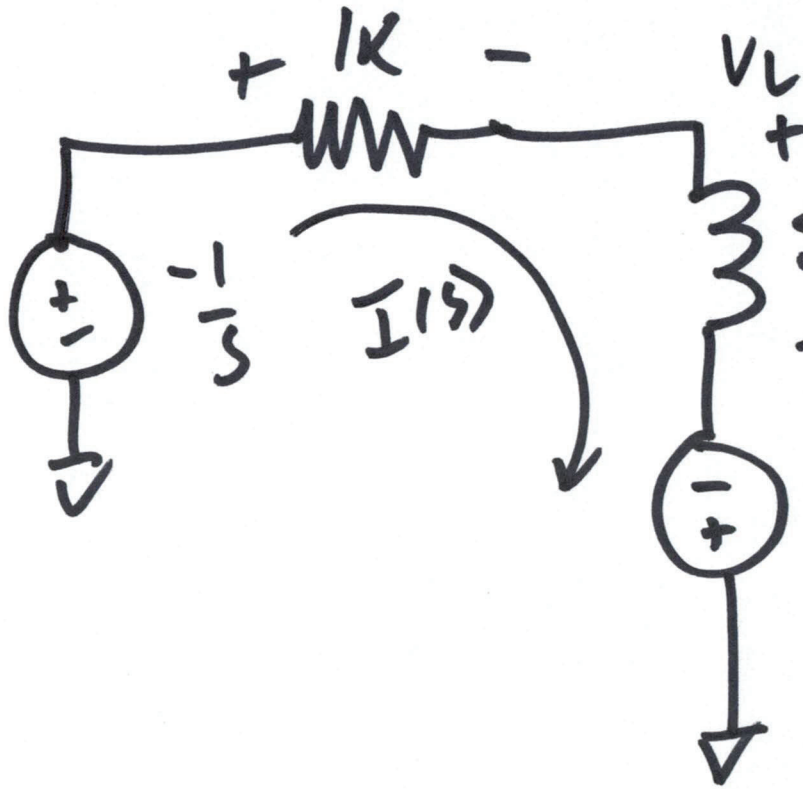
6)


+ 1V −
1K
-1
-1V
1mA
-1mA
1mA

$+(-1)-1=-2$


1K
V_L
$I_L(0)=1mA$
$-\frac{1}{s}u(t)$
$-\frac{1}{s}$
100μ
$s\cdot 100\mu - 100\mu\cdot 1mA - A$

$$V_L = -\frac{1}{S} \cdot \frac{S \cdot 100\mu}{10^3 + S \cdot 100\mu} - 100\mu \cdot 10^{-3}$$



$$0 = -\frac{1}{S} * - I(s) \cdot 1k - I(s) \cdot S \cdot 100\mu + 100\mu \cdot 10^{-3}$$

b)

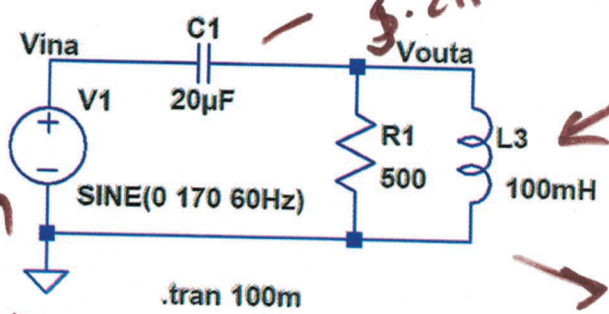
$$V_L = I(s) \cdot s \cdot 100\mu - 100\mu \cdot 10^{-3}$$

$$+\frac{1}{s} \frac{-}{=} 100\mu \cdot 10^{-3} = -I(s)\left(1K + s\,100\mu\right)$$

$$I(s) = \frac{\frac{1}{s} - 100\mu \cdot 10^{-3}}{1K + s \cdot 100\mu}$$

$$V_L(s) = \frac{\frac{1}{s} - 100\mu \cdot 10^{-3}}{1K + s \cdot 100\mu}$$

2. Assuming the circuit seen below is operating in steady-state, use AC analysis to determine Vouta. Sketch Vouta and Vina on the same plot ensuring to label times (phase shift) and voltages. (15 points)



$170\angle 0$

$\frac{1}{j \cdot 2\pi \cdot 60 \cdot 20 \cdot 10^{-6}}$ ← $j \cdot 2\pi \cdot 60 \cdot 0.1$

$\rightarrow \frac{500 \cdot j2\pi 6}{500 + j2\pi 6}$

$V_{OUTA} = \frac{170\angle 0 \cdot 37.68\angle 85.7}{37.68\angle 85.7}$

$\frac{3000 \cdot 2\pi \cdot j}{500\angle 4.3}$

$\frac{37.68\angle 85.7}{}$

$+ \frac{1}{j \cdot 2\pi \cdot 60 \cdot 20 \cdot 10^{-6}}$

$2.82 + 37.57j$

$-j132$

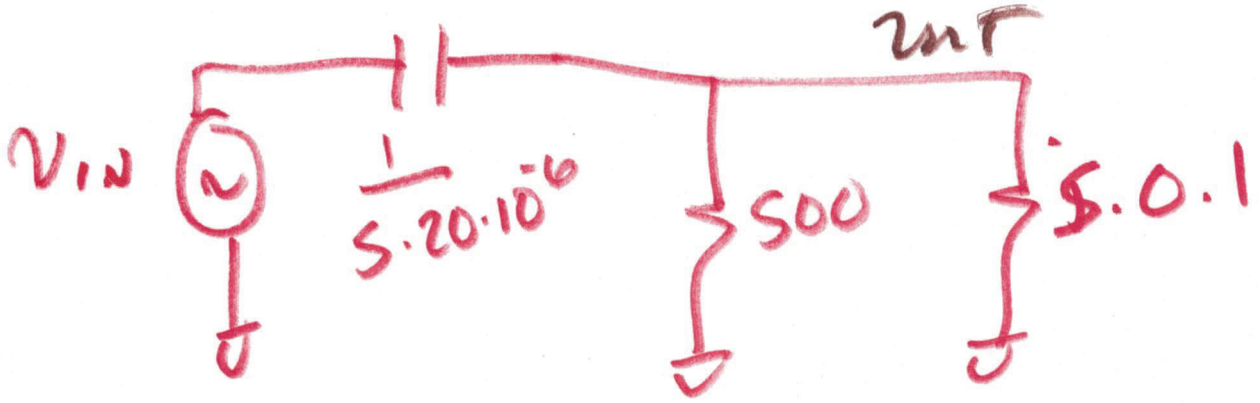
$2.92 - 94.47j$

$V_{OUTA} = \frac{170\angle 0 \cdot 37.68\angle 85.7}{94.47\angle -88}$

10)

$= 67.0 \sin(2\pi 60t + 173.7)$ $678\angle 173.7$

3. Determine the transfer function (Vouta/Vina) of the circuit in problem 2 and then determine the (magnitude and phase) frequency responses. Sketch the frequency responses and discuss, using numbers, how your results in problem 2 are correct. (20 points)



$$\frac{s \cdot 500}{s + 5000} = \frac{500 \cdot s \cdot 0.1}{500 + s \cdot 0.1}$$

$$V_{OUT} = V_{IN} \cdot \frac{\frac{s \cdot 500}{s + 5000}}{\frac{1}{s \cdot 20 \cdot 10^{-6}} + \frac{s \cdot 500}{s + 5000}}$$

$$\frac{V_{OUT}}{V_{IN}} = \frac{s \cdot 500}{s \cdot 500 + \frac{5000 + s}{s \cdot 20 \cdot 10^{-6}}}$$

11)

$$\frac{v_{out}}{v_{in}} = \frac{s}{s + \dfrac{10 + s/500}{s \cdot 20 \cdot 10^{-6}}}$$

$$\frac{v_{out}}{v_{in}} = \frac{s^2 \cdot \cancel{20 \cdot 10^{-6}}}{s^2 \cdot \cancel{20 \cdot 10^{-6}} + \dfrac{s}{20 \cdot 10^{-6} \cdot 500} + \dfrac{10}{20 \cdot 10^{-6}}}$$

$$= \frac{s^2}{s^2 + 100 \cdot s + 500K}$$

$$(s - p_1)(s - p_2) \qquad p_1, p_2$$

$$p_1, p_2 = \frac{-100 \pm \sqrt{10^4 - 4 \cdot 500K}}{2}$$

$$= -50 \pm j1.41K$$

$$\frac{v_{out}}{v_{in}} = \frac{s^2}{(s + 50 - j141K)(s + 50 + j141K)}$$