EE 221 Circuits II

MARCH 11, 2019

Lecture 13

Review for the midterm

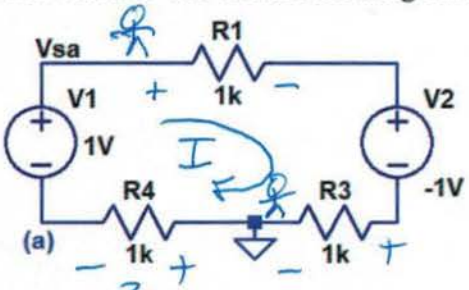
work quizzes & H.W.

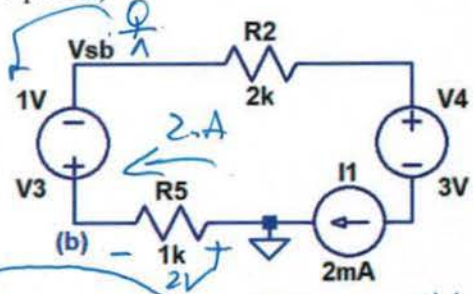
Practice Midterm Exam – EE 221 Circuits II
University of Nevada, Las Vegas

NAME: Review :)

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!

1. Find Vsa and Vsb in the following circuits. (10 points)





$\frac{2}{3}V$ 2V

$0 = 1K \cdot I + (-1V) + 1K \cdot I - 1 + 1K \cdot I$

$0 = I\,3K - 2$

$I = \frac{2}{3}mA$

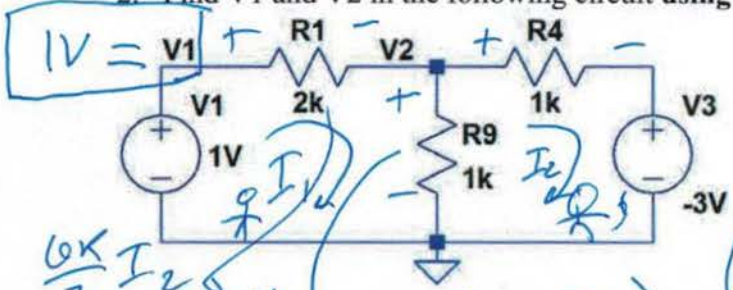
$V_{SA} = 1V + 1K \cdot I = 0,\ V_{SA} = 1 - \frac{2}{3}mA \cdot 1K$

$V_{SA} = \frac{1}{3}V$

$V_{SB} + 1V + 2V = 0$

$V_{SB} = -3V$

2. Find V1 and V2 in the following circuit **using mesh analysis**. (10 points)



$1V = V1$

$\frac{6K}{3}I_2$ 1.066 $1K \cdot (I_1 - I_2)$

$-3 + 2KI_2$

$-3\frac{1}{3} - \frac{5K}{3}I_2 = 0$

$I_2 = \frac{-3}{5K} = 600\mu A$

$V_1 - I_1 \cdot 2K - 1K(I_1 - I_2) = 0$

$-3V + I_2 \cdot 1K - 1K(I_1 - I_2) = 0$

$V_1 + 1K \cdot I_2 = 3K I_1$ 333μA

$\frac{1}{3} - \frac{1K}{3} \cdot I_2 \geq 0$ 133mV?

$V_2 = -666mV$

$V_2 = -1.066 + 1V$

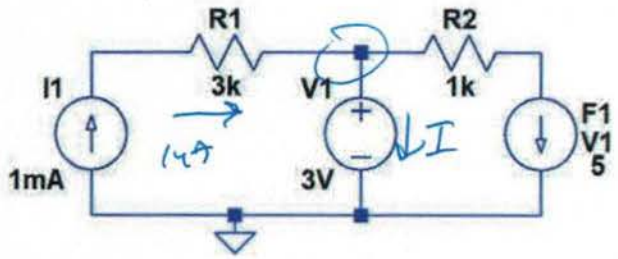
$I_1 = \frac{V_1}{3K} + \frac{1}{3}I_2$ 200μ 200μA

$I_1 = 533\mu A$

$-3 + 2KI_2 - 1KI_1 = 0$

$-3 + 2KI_2 - 1K\left(\frac{V_1}{3K} + \frac{1}{3}I_2\right) = 0$

3. Find the current through V1. (10 points)

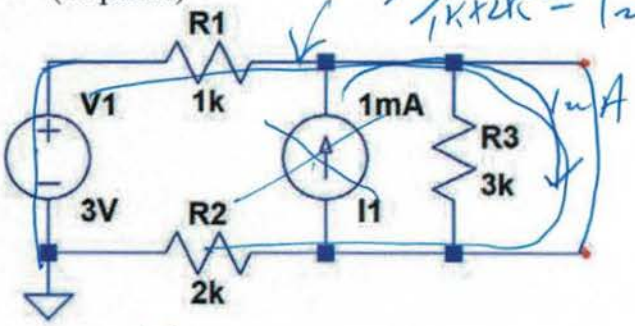


$1mA = I + 5I$

$1mA = 6I$

$I = \frac{1}{6} mA$

4. Find the Thevenin equivalent of the following circuit at the port indicated by the red dots. (10 points)

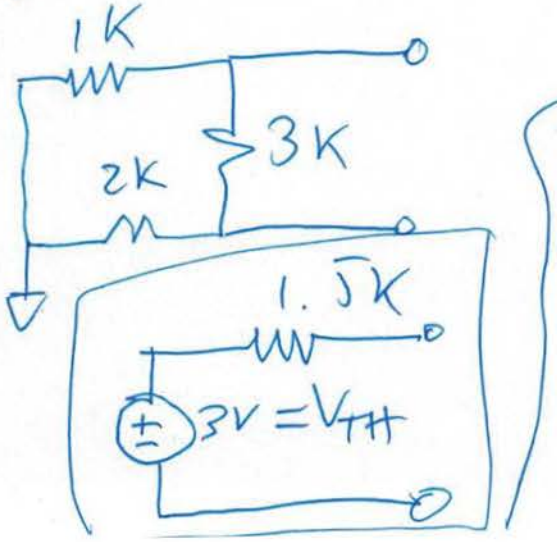


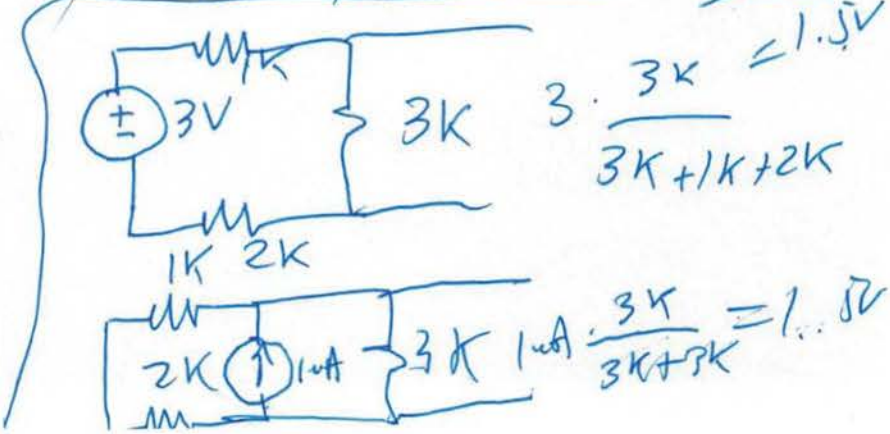
$3V / 1K+2K = 1mA$

$R_{TH} = 1.5K$

$I_{SC} = 2mA$

$V_{OS} = I_{SC} \cdot R_{TH} = 3V$

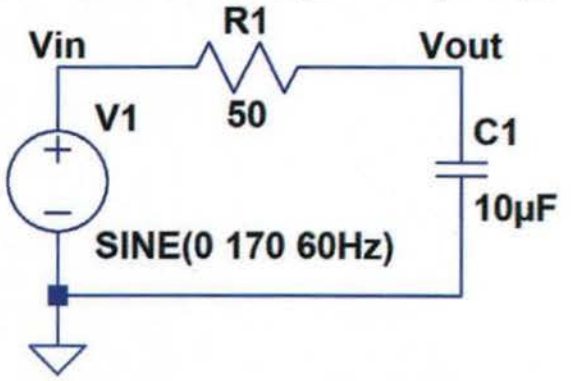




$3 \cdot \frac{3K}{3K+1K+2K} = 1.5V$

$\frac{3K}{3K+3K} = 1.5V$

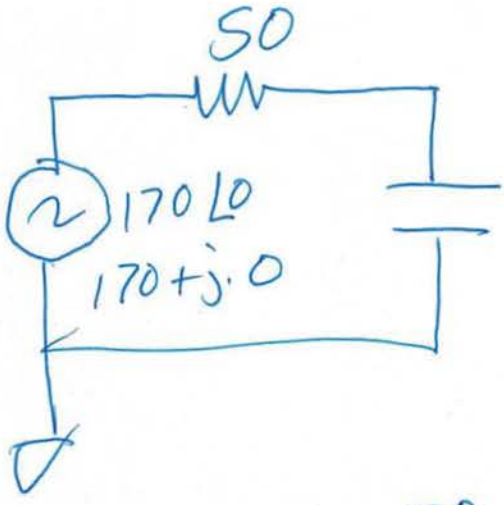
5. Find the AC current (write an equation) flowing in the following circuit. (10 points)



$$\Rightarrow \frac{1}{j \cdot 2\pi \cdot 60 \cdot 10^{-5}} = j \cdot (-265.4)$$

$$\Downarrow$$

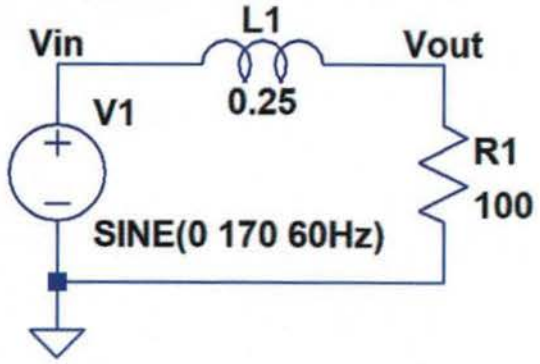
$$265.4 \angle -90^\circ$$



$$\vec{I} = \frac{170 \angle 0^\circ}{265.4 \angle -90^\circ} = 0.64 \angle 90^\circ$$

$$i(t) = 0.64 \sin(2\pi \cdot 60 \cdot t + 90)\ A$$

6. Find Vout in the following circuit and sketch on the same plot with Vin, showing the phase shift and magnitude. (15 points)

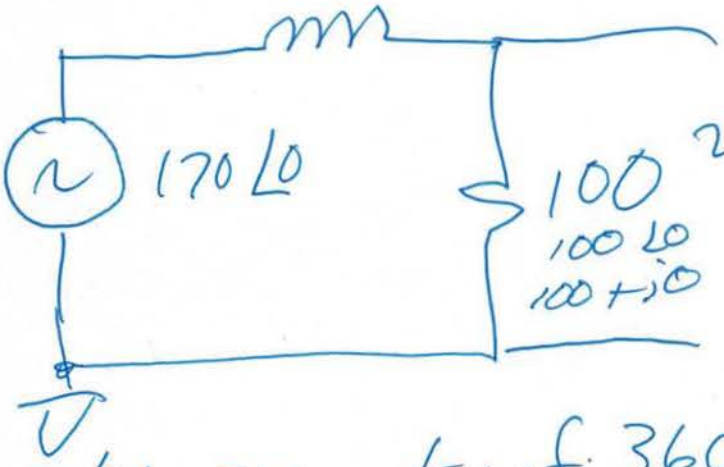


$Z_L = j\omega L$

$= j \cdot 2\pi \cdot f \cdot L$

$= j \cdot 2\pi \cdot 60 \cdot 0.25$

$= j \cdot 94.2$



$$V_{OUT} = \frac{170\angle 0 \cdot 100}{100 + j94.2} = \frac{17k\angle 0}{137.4\angle 43.3}$$

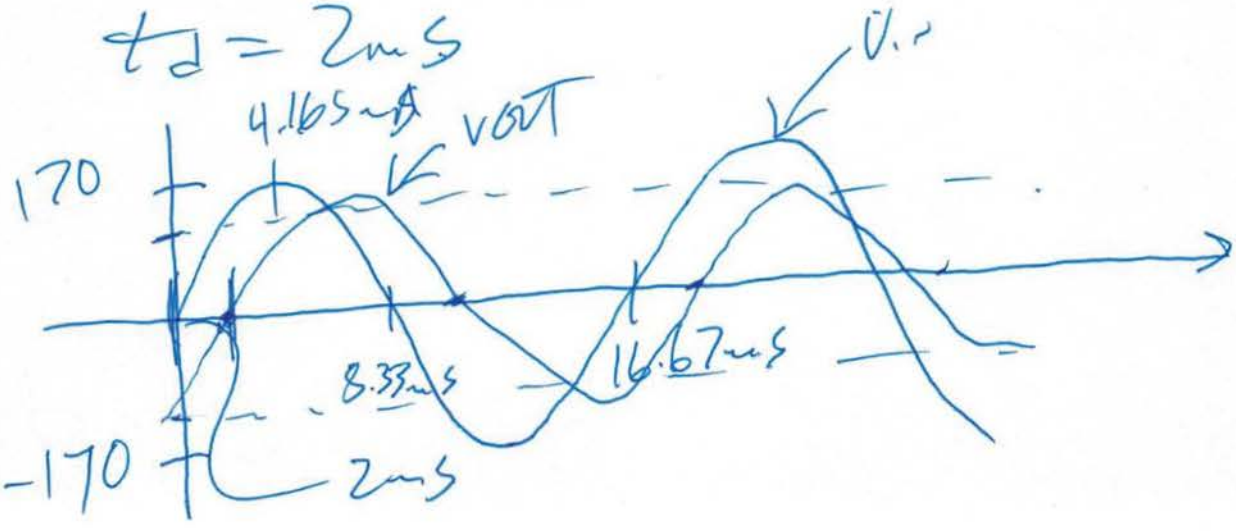
$$\theta = \frac{t_d}{T} \cdot 360 = t_d \cdot f \cdot 360$$

$V_{OUT} = 123.7\angle -43.3$

$43.3 = t_d \cdot 60 \cdot 360$

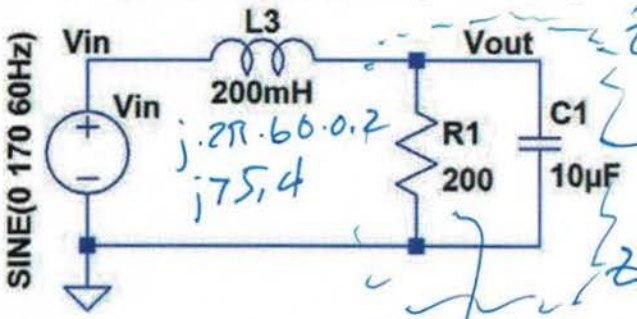
$v_{OUT}(t) = 123.7 \sin(2\pi 60t - 43.3°)$

$t_d = 2ms$



5)

7. Find Vout in the following circuit and sketch in the time-domain, along with Vin, showing the phase shift and magnitude. (20 points)



$Z = 160\angle -37^\circ$

$= 127 + j(-96.3)$

$\rightarrow 265.4\angle -90^\circ$

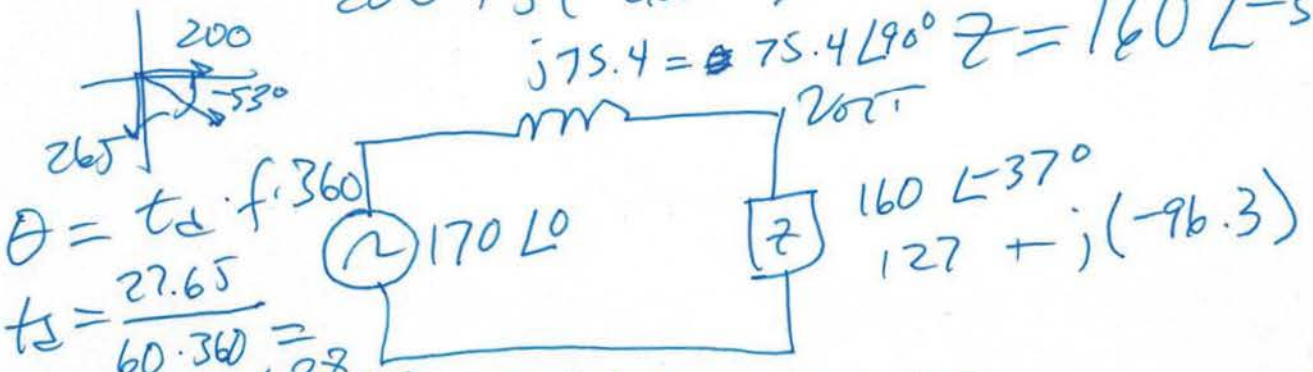
$0 + j(-265.4)$

$200\angle 0$

$$Z = \frac{200\angle 0^\circ \cdot 265.4\angle -90}{200 + j0 + 0 + j(-265.4)} = \frac{200 + j0}{200 + j(-265.4)} = \frac{53080\angle -90}{332\angle -53^\circ}$$

$j75.4 = 75.4\angle 90^\circ$

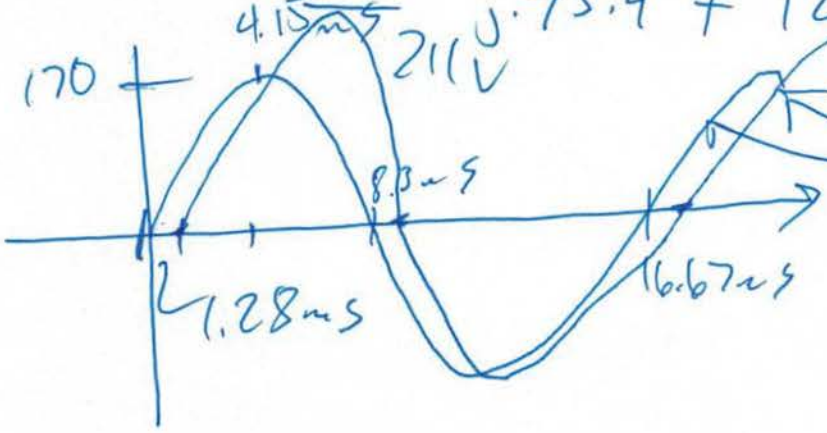
$Z = 160\angle -37^\circ$



$\theta = t_d \cdot f \cdot 360$

$t_d = \frac{27.65}{60 \cdot 360} = 1.28\text{ms}$

$$V_{OUT} = \frac{170\angle 0^\circ \cdot 160\angle -37}{j75.4 + 127 + j(-96.3)} = \frac{27.2K\angle -37}{127 + j(-20.9)}$$



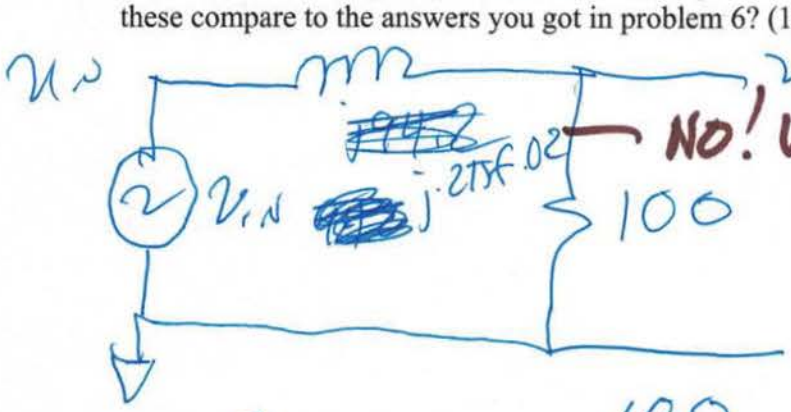
$$\frac{V_{OUT}}{V_{in}} = \frac{27.2K\angle -37}{128.7\angle -9.35^\circ}$$

$V_{OUT} = 211.3\angle -27.65$

$V_{OUT} = 211.3\sin(2\pi \cdot 60 \cdot t - 27.65^\circ)V$

a)

8. Determine, and sketch, the frequency response (both magnitude and phase) of the circuit in problem 6. From your plots what are the magnitude and phase shifts at 60 Hz? How do these compare to the answers you got in problem 6? (15 points)



$$\frac{V_{OUT}}{V_{IN}} = \frac{100}{100 + j\cdot 2\pi f \cdot 0.2} = \frac{1}{1 + j\frac{2\pi f \cdot 0.2}{100}}$$

$$\left|\frac{V_{OUT}}{V_{IN}}\right| = \frac{1}{\sqrt{1+\left(\frac{f}{f_p}\right)^2}}$$

$$\angle\frac{V_{OUT}}{V_{IN}} = -\tan^{-1}\frac{f}{f_p}$$

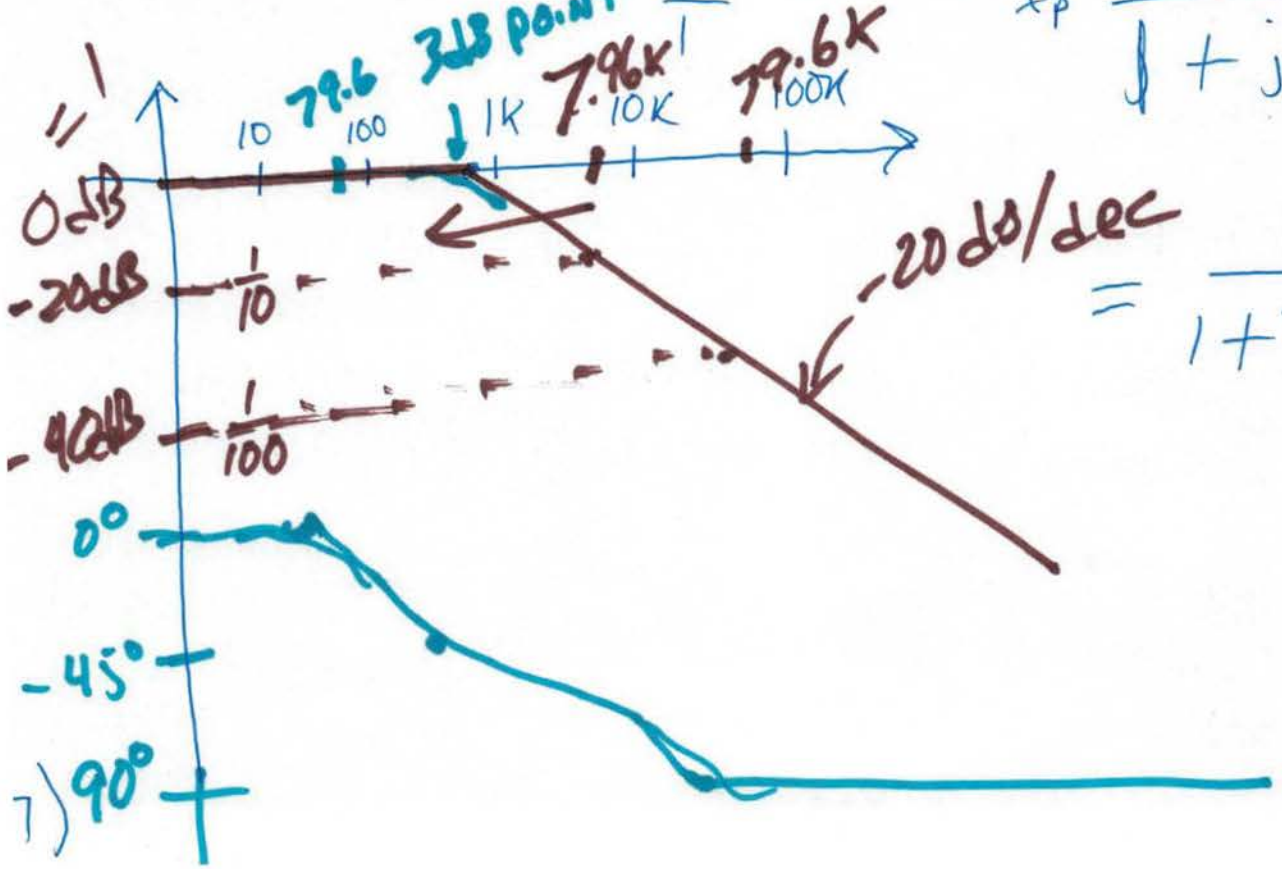
$f_p = 796\ Hz$

$$= -\tan^{-1}\frac{f}{796}$$

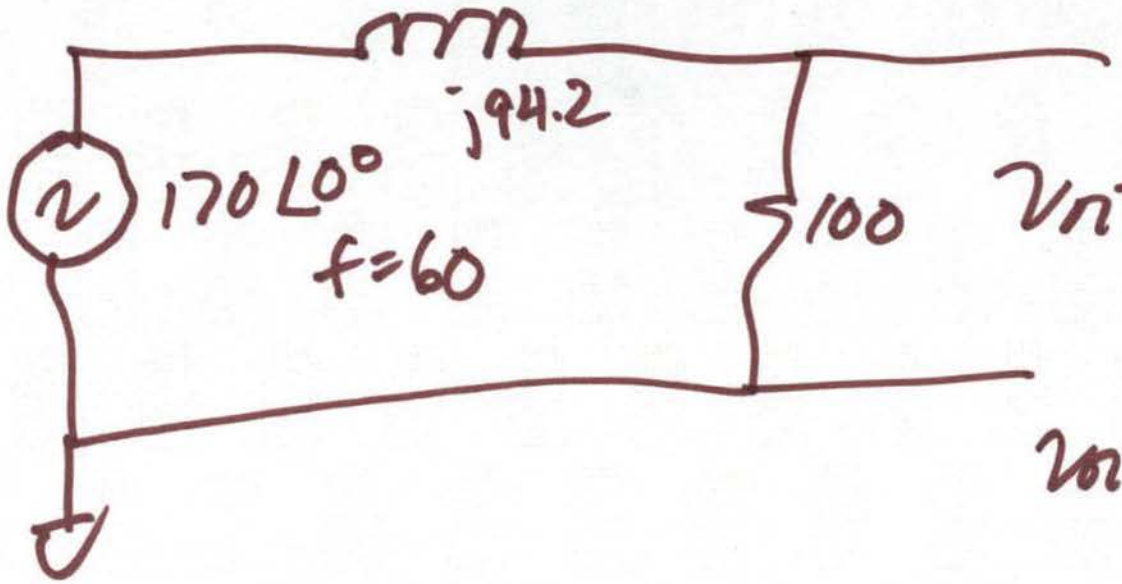
$$\frac{1}{1 + j\cdot\frac{j\cdot 2\pi f\cdot 0.2}{100}}$$

$$\frac{1}{1 + j\frac{f}{\frac{100}{2\pi\cdot 0.2}}}$$

$$= \frac{1}{1 + j\frac{f}{796}}$$



6)

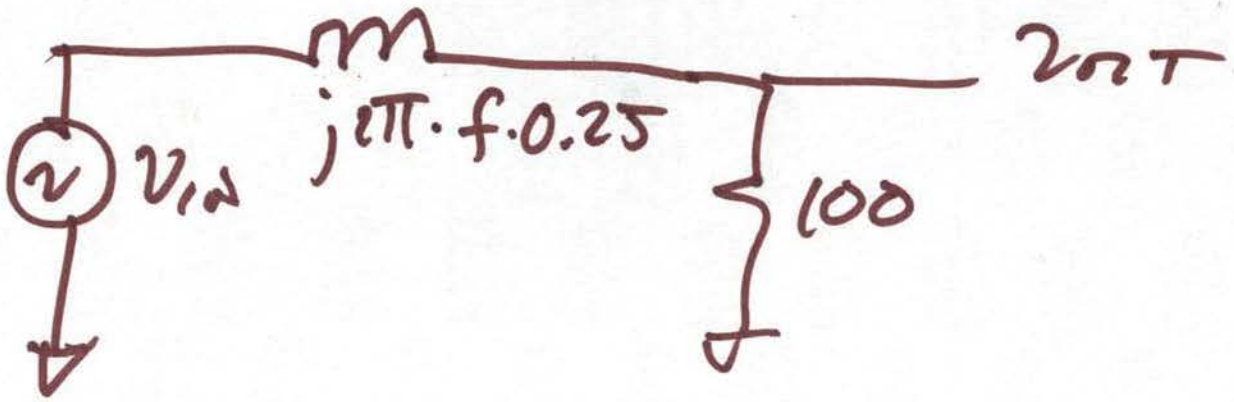


$$V_{nT} = \frac{170\angle 0^\circ \cdot 100\angle 0^\circ}{100 + j94.2}$$

$$137.3\angle 43.3^\circ$$

$$V_{nT} = 123.7\angle -43.3^\circ$$

Right!



$$V_{OUT} = V_{IN} \cdot \frac{100}{100 + j2\pi \cdot f \cdot 0.25}$$

$$\Rightarrow \frac{V_{OUT}}{V_{IN}} = \frac{1}{1 + j\frac{2\pi f \cdot 0.25}{100}}$$

$$\left|\frac{V_{OUT}}{V_{IN}}\right| = \frac{1}{\sqrt{1 + \left(\frac{f}{63}\right)^2}}, \quad \angle = -\tan^{-1}\frac{f}{63} = \frac{1}{1 + j \cdot \frac{f}{\frac{100}{2\pi \cdot 25}}}$$

$$= \frac{1}{1 + j\frac{f}{63\text{Hz}}}$$