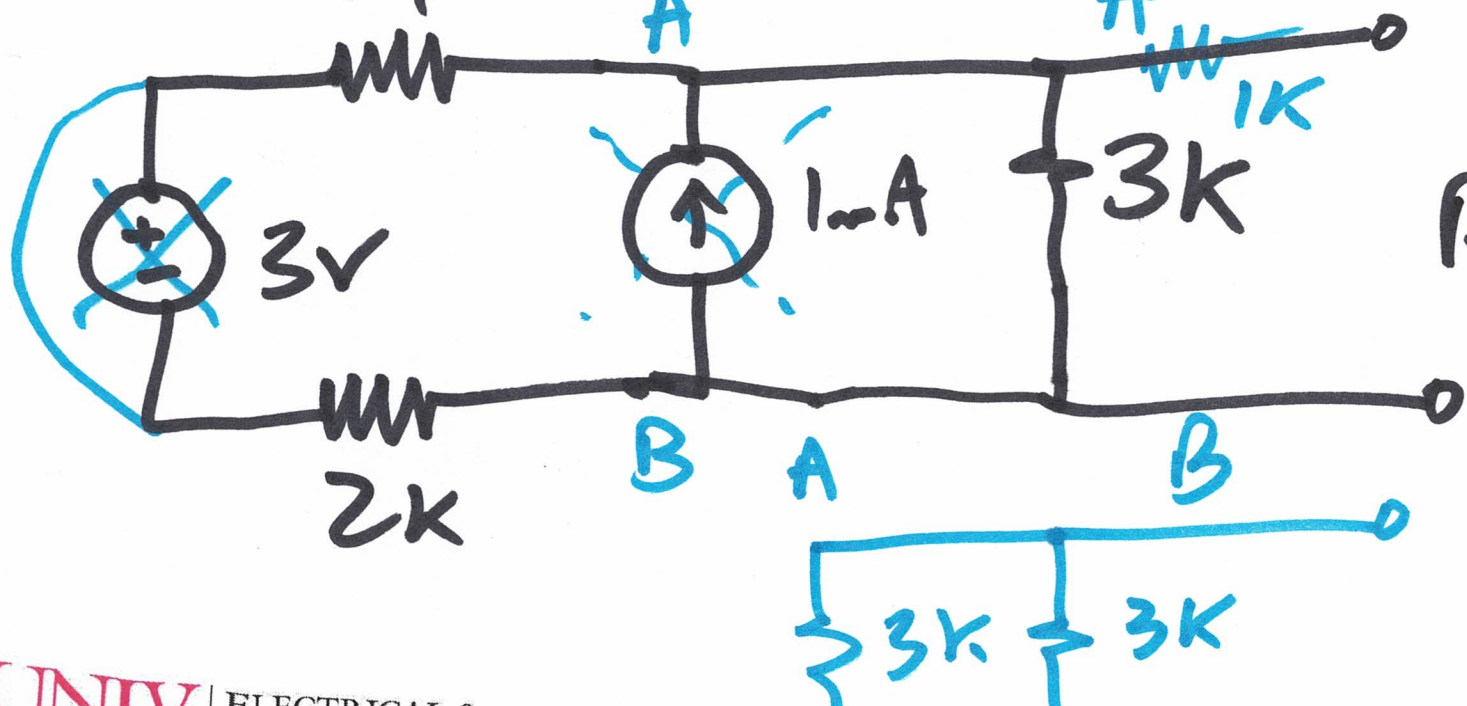
EE 221
circuits II

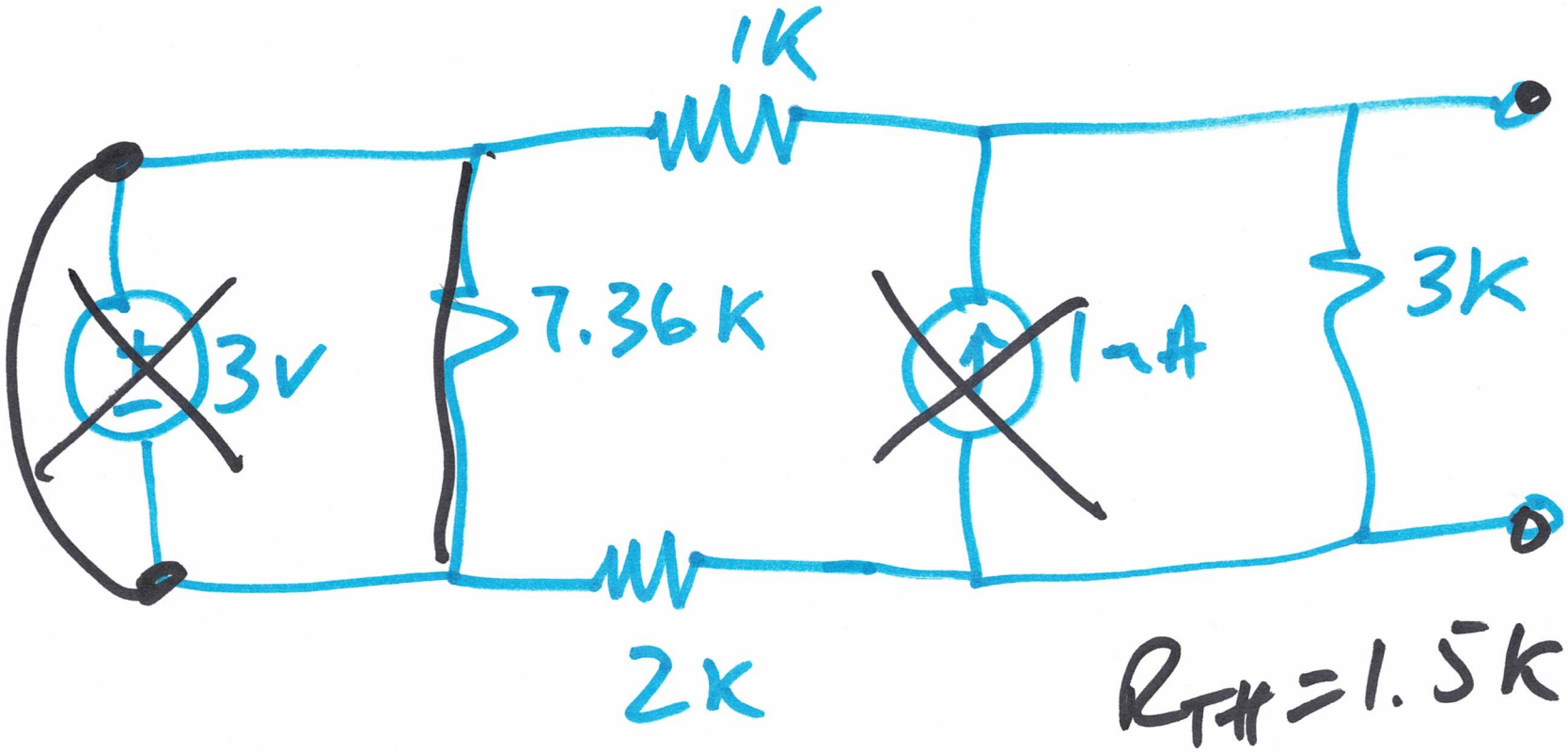
March 9, 2020

Lecture 13



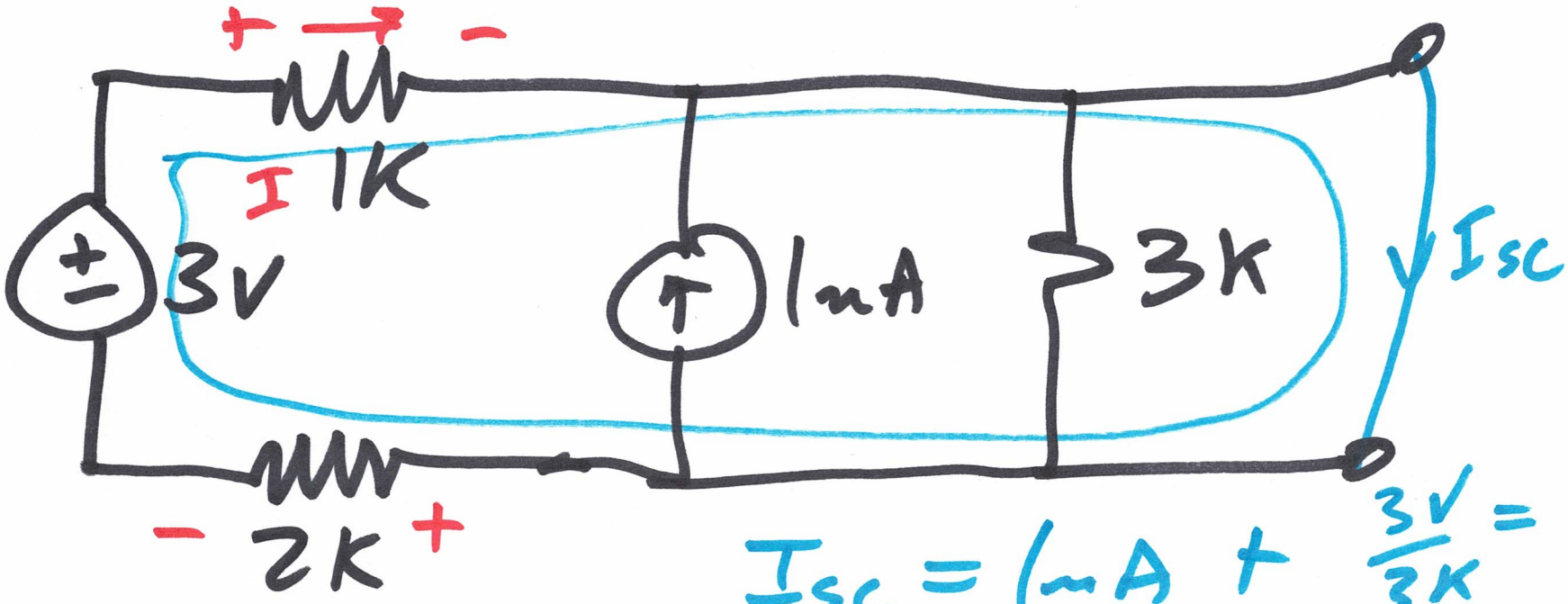
$R_{TH} = 1.5$

$R_{TH} = \frac{V_{oc}}{I_{sc}} =$



$R_{TH} = 1.5k$

2)



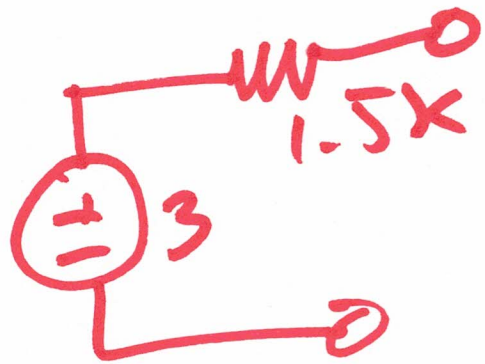
$$I_{SC} = 1mA + \frac{3V}{3K} =$$

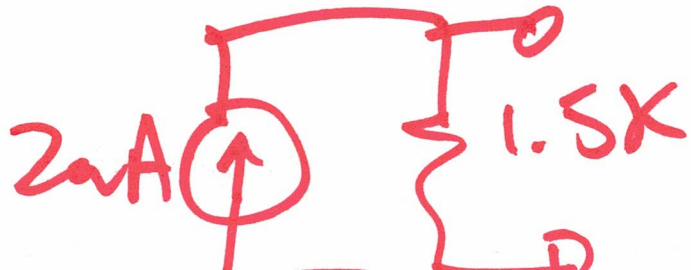
$$3V - I \cdot 1K - I \cdot 2K = 0 \qquad I = I_{SC} = \frac{3V}{3K}$$

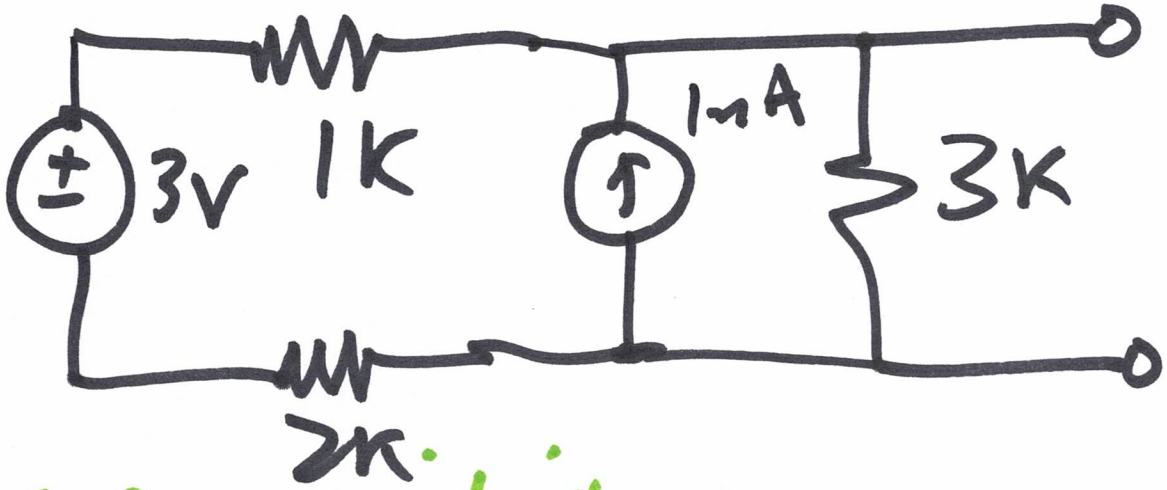
$$I_{SC} = 2mA$$

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

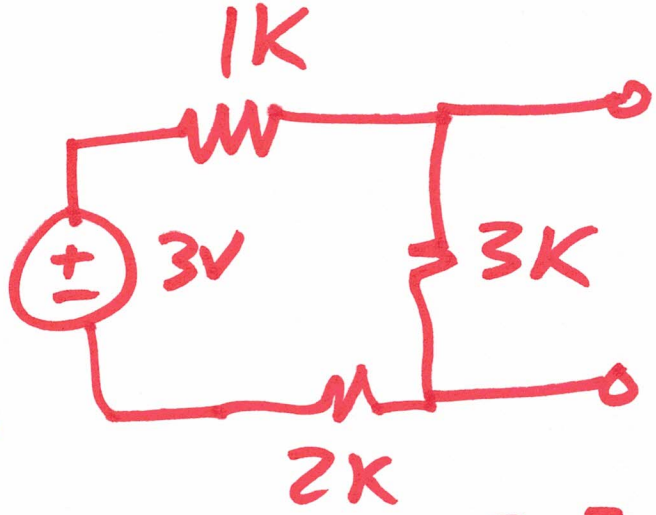
1.5K 2mA

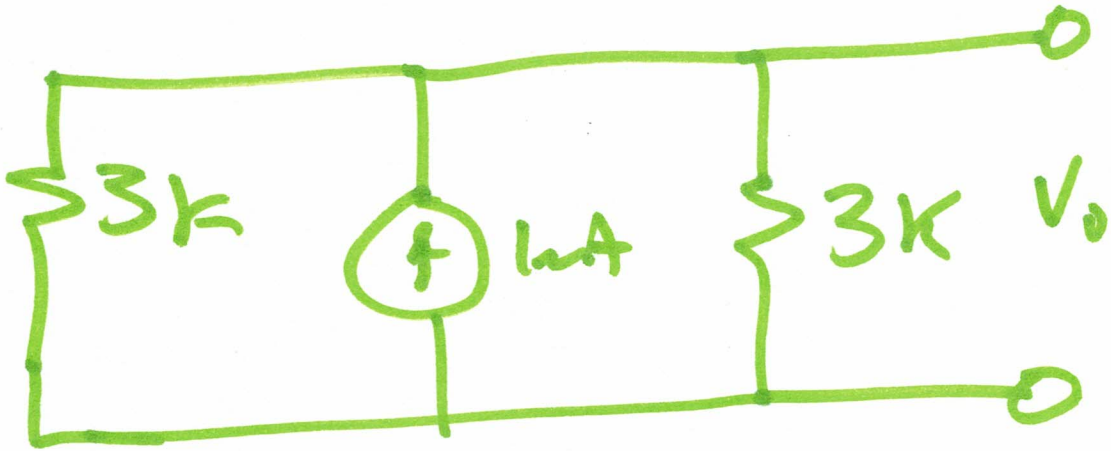






superposition





V_{OC1}

$V_{OC2} = \frac{3 \cdot 3}{1+2+3}$

$= \frac{9}{6}$

$= 1.5V$

$V_{Th} = 1.5 + 1.5$

$= 3V$

$V_{OC1} = 1.5V$

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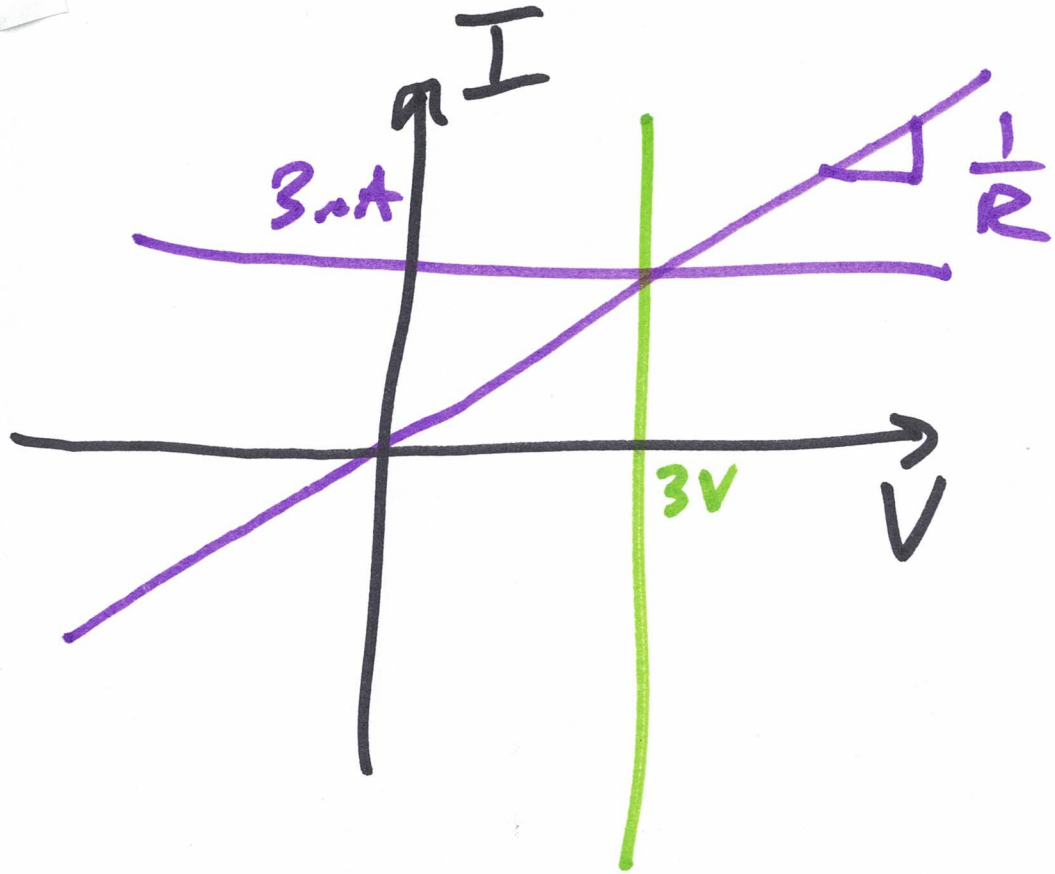
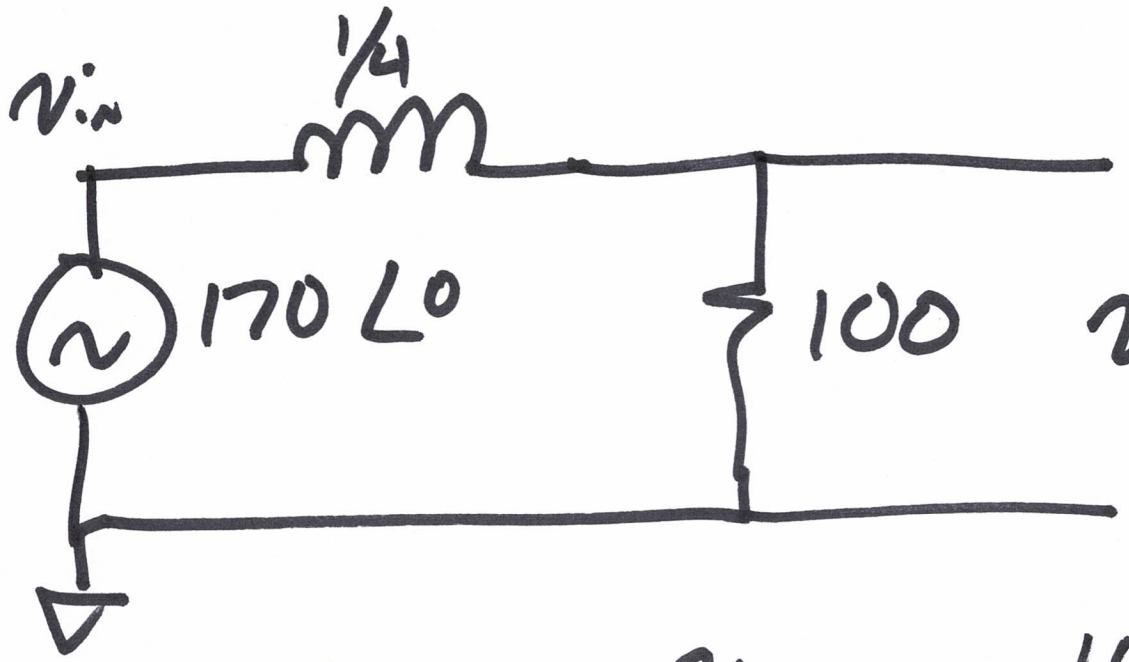
4)


I
3mA
1/R
3V
V



$$v_{out} = v_{in} \cdot \frac{100}{100 + j \cdot 2\pi f \cdot \frac{1}{4}}$$

$$\frac{v_{out}}{v_{in}} = \frac{1}{1 + j\frac{\pi}{200} \cdot f}$$

#6

$$|V_{OUT}| = 170\angle 0 \cdot \frac{1}{\sqrt{1+\left(\frac{\pi}{200}\cdot 60\right)^2}}$$

$$\frac{1}{60} = 16.67\ ms$$

$$|V_{OUT}| = 123.7V$$

$$t_d = 2ms$$

$$\angle V_{OUT} = \angle 0^\circ - tan^{-1}\frac{\pi}{200}\cdot 60$$

$$43 = t_d \cdot 60 \cdot 360$$

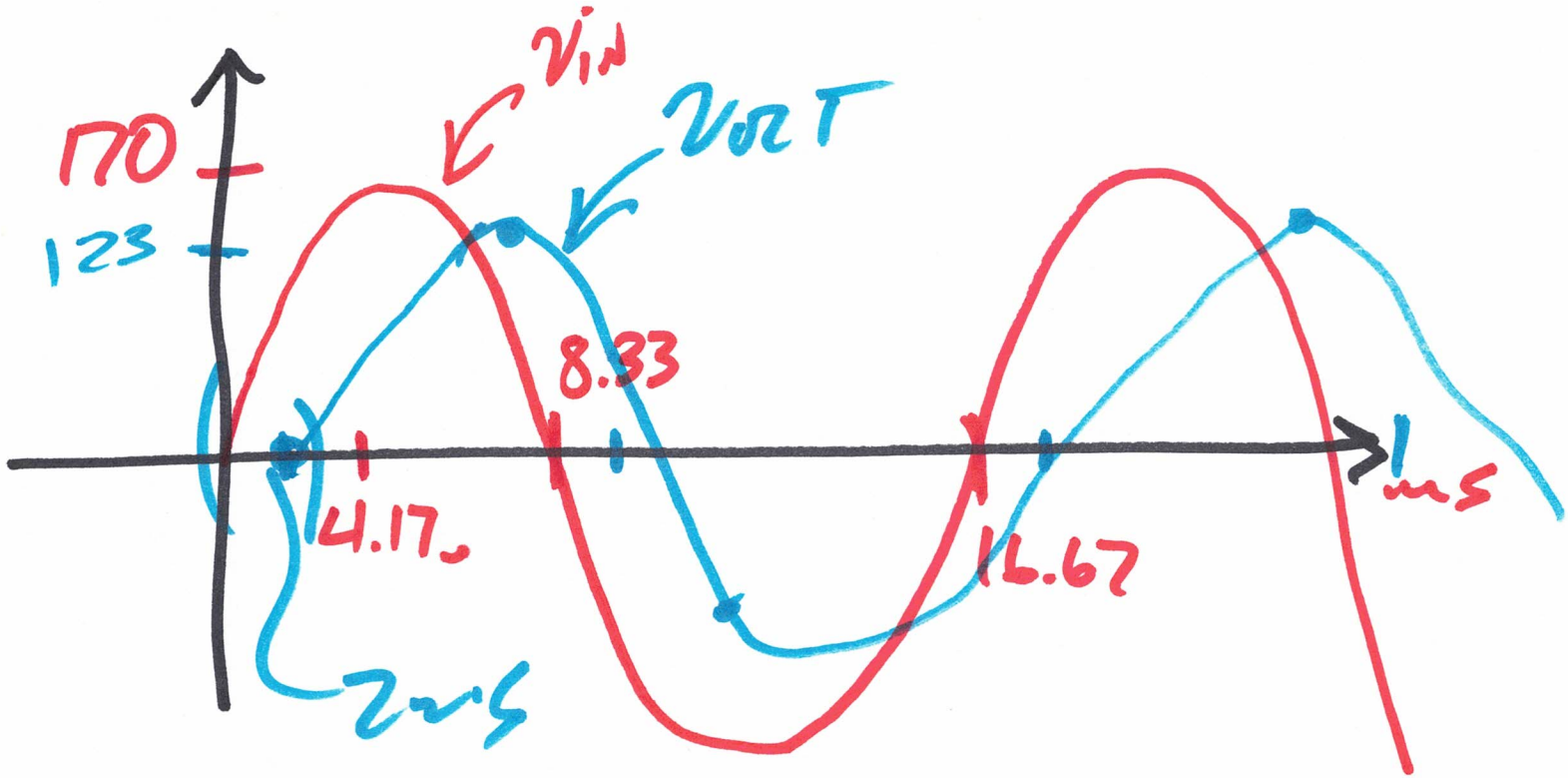
$$\simeq \frac{t_d}{\frac{1}{60}} \cdot 36$$

INPUT (TOP)

$$\angle V_{OUT} = -43^\circ$$

$$v_{IN} = 170 \sin(2\pi \cdot 60 \cdot t)$$

$$v_{OUT} = 123.7 \sin(2\pi \cdot 60 \cdot t - 43^{\circ})$$



$$\frac{v_{out}}{v_{in}} = \frac{1}{1 + j\frac{\pi}{200} \cdot f} = \frac{1}{1 + j\frac{f}{63.7}}$$

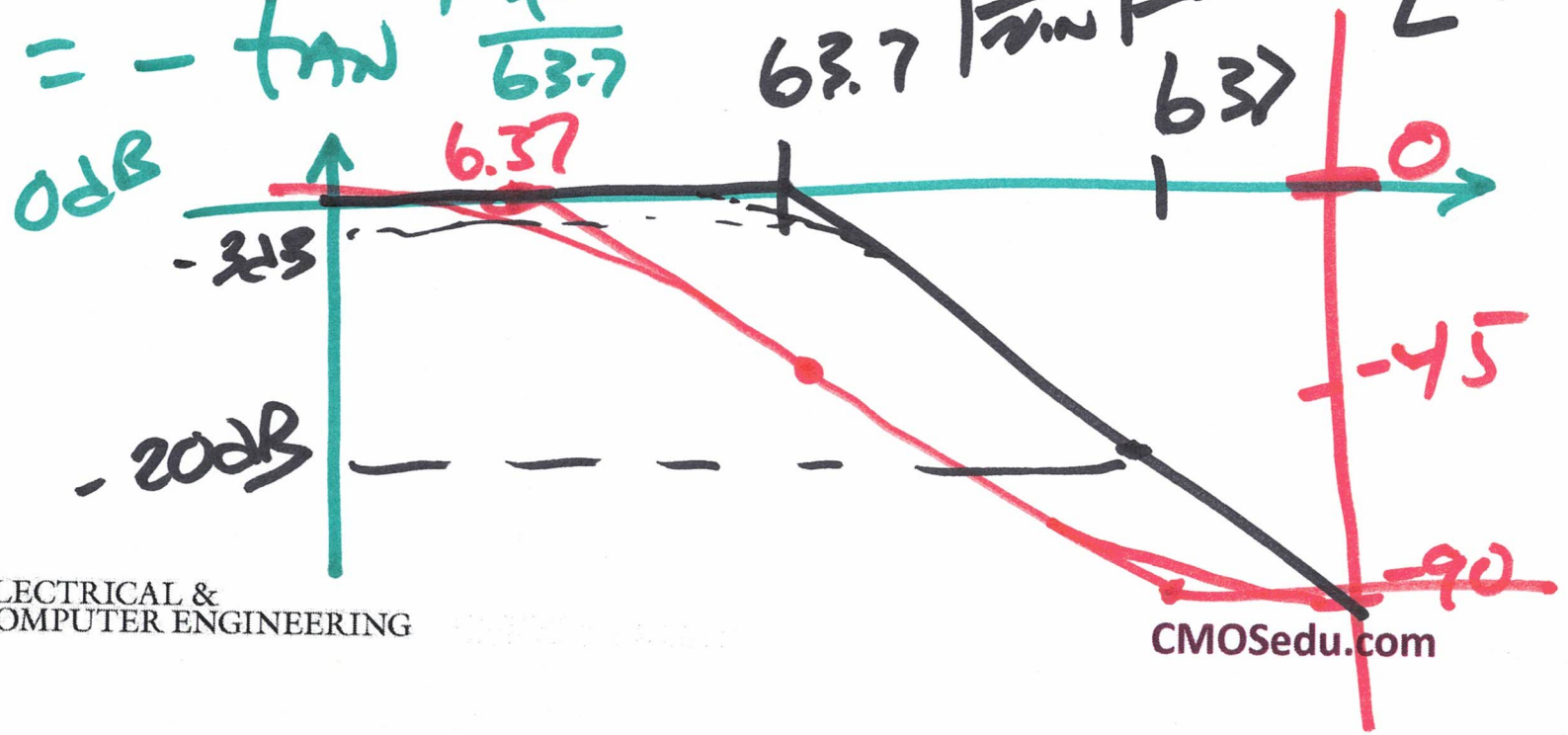
$$f_{3dB} = \frac{1}{\frac{\pi}{200}} = \frac{200}{\pi}$$

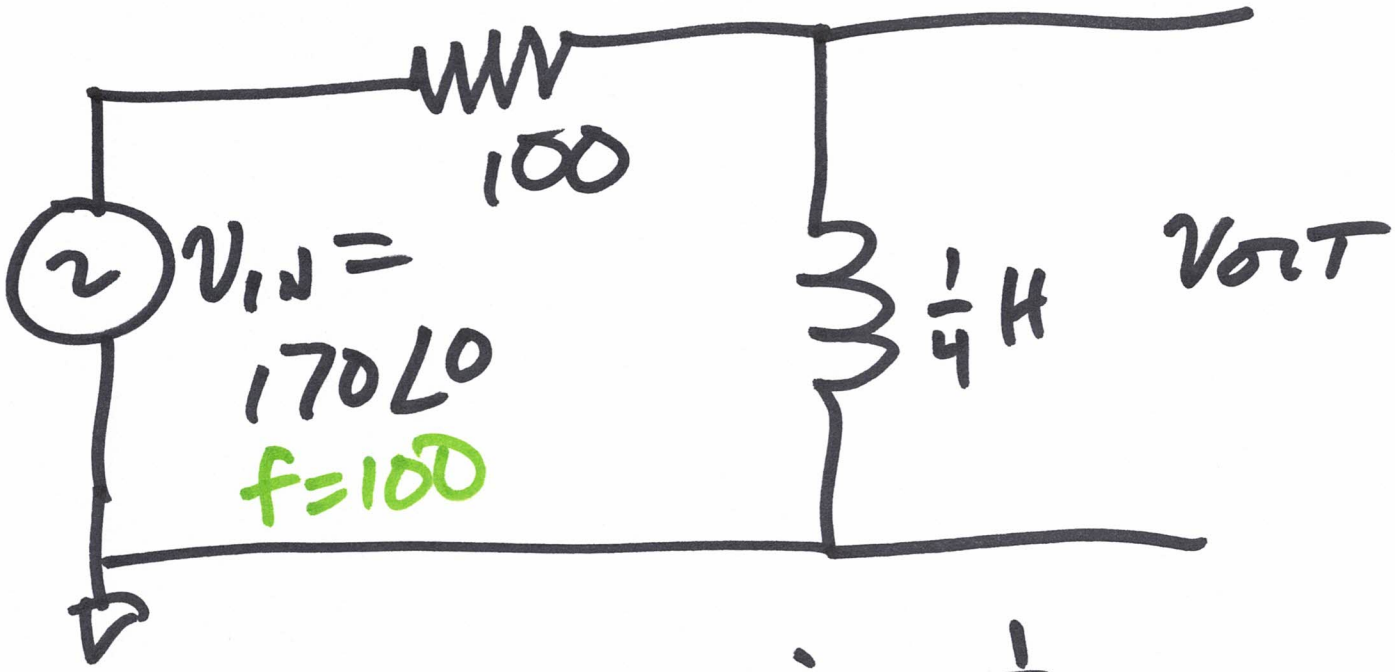
$$\left|\frac{v_{out}}{v_{in}}\right| = \frac{1}{\sqrt{1 + \left(\frac{f}{63.7}\right)^2}}$$

$$\angle\frac{v_{out}}{v_{in}} = -\tan^{-1}\frac{f}{63.7}$$

@60Hz $\left|\frac{v_{out}}{v_{in}}\right| \approx -3dB$

$\angle \approx -45$





$$\frac{V_{OUT}}{V_{IN}} = \frac{j\omega \frac{1}{4}}{100 + j\omega \frac{1}{4}}$$

$$j \cdot \frac{2\pi}{400} \cdot f$$

$$= \frac{}{1 + j\frac{2\pi}{400} \cdot f}$$

$$\frac{V_{OUT}}{V_{IN}} = \frac{0 + j\frac{f}{63.7}}{1 + j\frac{f}{63.7}}$$

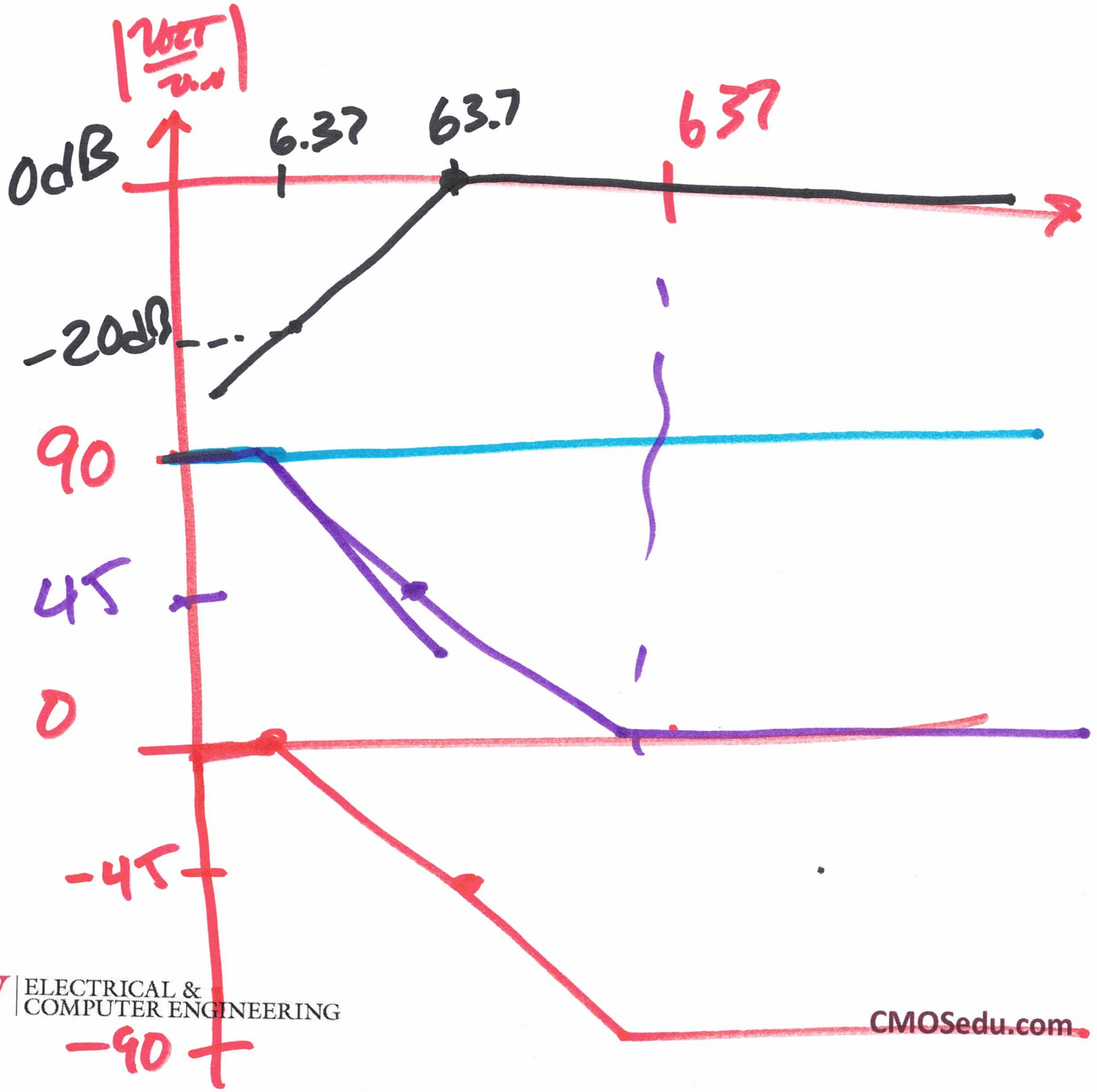
$$\left|\frac{V_{OUT}}{V_{IN}}\right| = \frac{\sqrt{0^2 + \left(\frac{f}{63.7}\right)^2}}{\sqrt{1^2 + \left(\frac{f}{63.7}\right)^2}} = \frac{\frac{f}{63.7}}{\sqrt{1 + \left(\frac{f}{63.7}\right)^2}}$$

$$\angle\frac{V_{OUT}}{V_{IN}} = 90 - \tan^{-1}\frac{f}{63.7}$$

$$\frac{\frac{63.7}{63.7}\,1}{\sqrt{1 + \left(\frac{63.7}{63.7}\right)^2}}$$

$-3dB \Leftarrow \frac{1}{\sqrt{2}}$

$20\log\frac{1}{\sqrt{2}} = -3dB$


|Vout/Vin|
0dB
6.37
63.7
637
-20dB
90
45
0
-45
-90