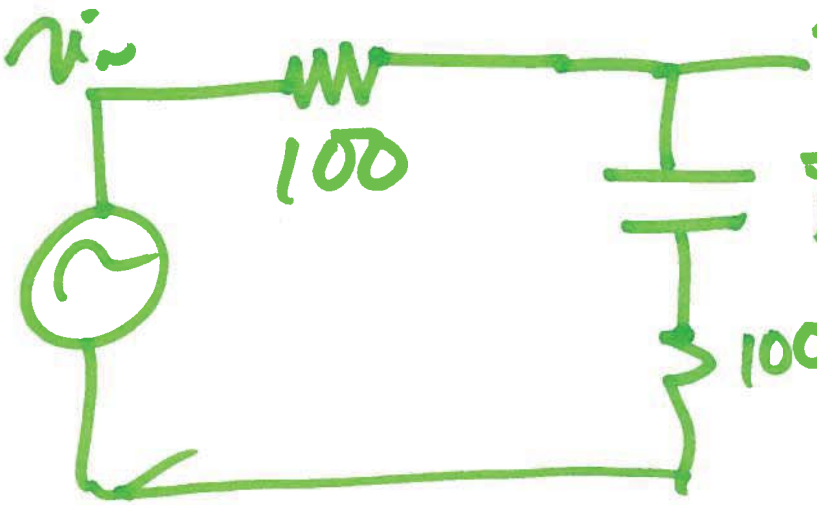
EE 220

Circuits I

Lecture 26

Review for final



$$\frac{v_{out}}{v_{in}} = \frac{100 + \frac{1}{j\omega 10^{-6}}}{200 + \frac{1}{j\omega 10^{-6}}}$$

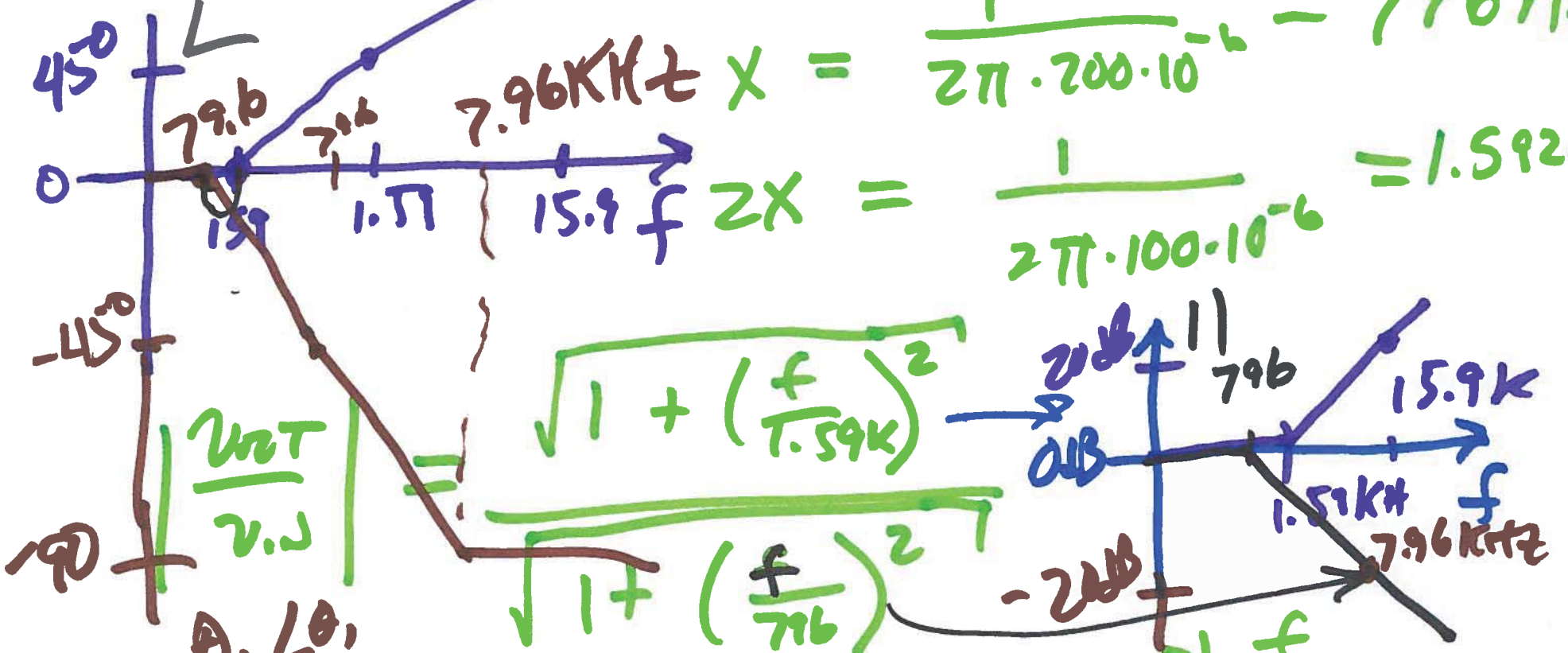
$$= \frac{1 + j\omega\, 100 \cdot 10^{-6}}{1 + j\omega\, 200 \cdot 10^{-6}}$$

$\omega = 2\pi f$

$$\frac{V_{out}}{V_{in}} = \frac{1 + j \cdot 2\pi f \cdot 100 \cdot 10^{-6}}{1 + j \cdot 2\pi f \cdot 200 \cdot 10^{-6}} = \frac{1 + j\frac{f}{1.59K}}{1 + j\frac{f}{796}}$$

$$X = \frac{1}{2\pi \cdot 200 \cdot 10^{-6}} = 796\,Hz$$

$$2X = \frac{1}{2\pi \cdot 100 \cdot 10^{-6}} = 1.592K$$

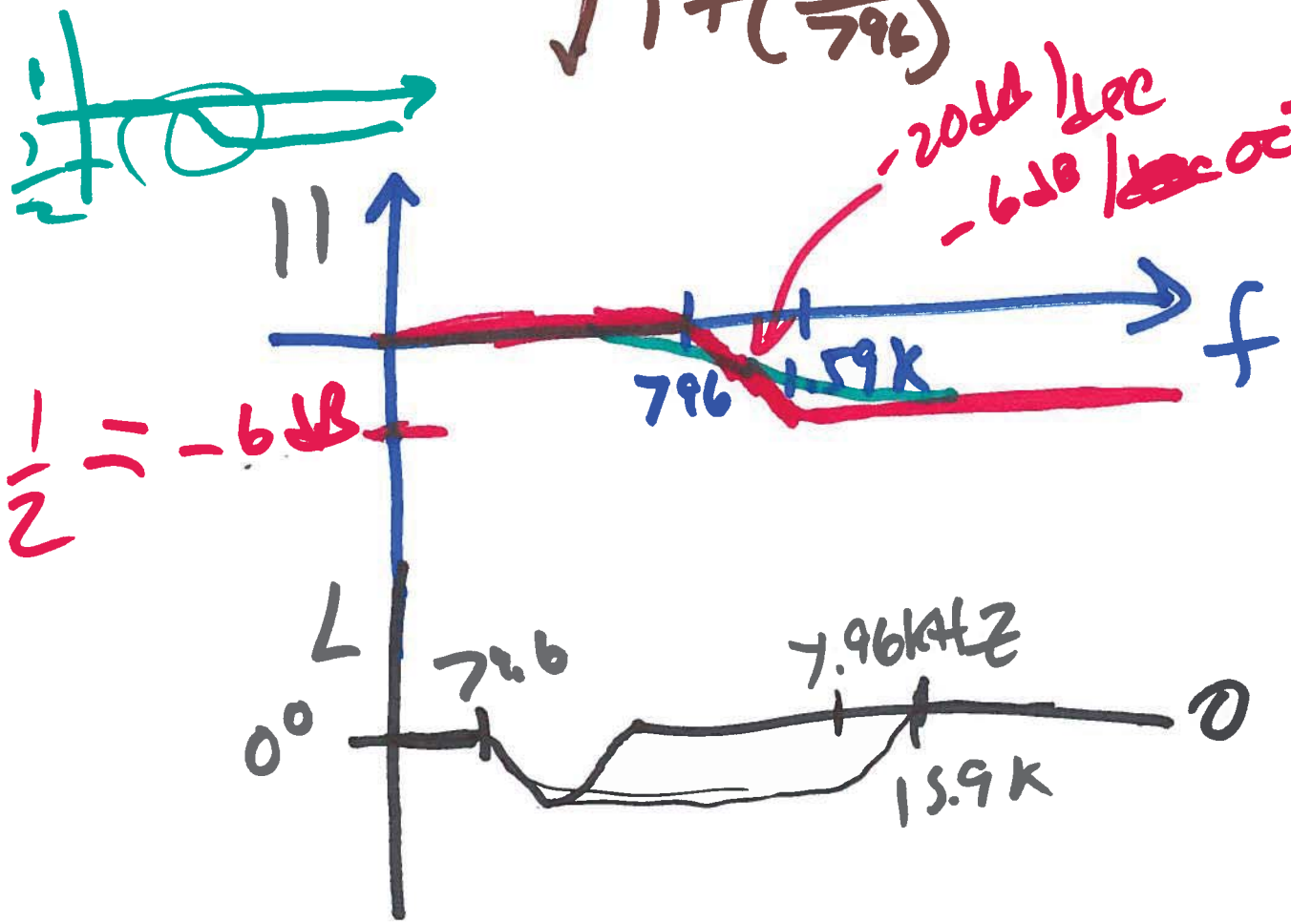


$$\angle \tan^{-1}\frac{f}{1.59K} - \tan^{-1}\frac{f}{796}$$

$A_1/A_2 \quad \angle\theta_1 - \theta_2$

2)

$$\left|\frac{2\pi f}{\omega_{-3dB}}\right| = \frac{\sqrt{1+\left(\frac{f}{1.59K}\right)^2}}{\sqrt{1+\left(\frac{f}{796}\right)^2}} \qquad \angle \tan^{-1}\frac{f}{1.59K} - \tan^{-1}\frac{f}{796}$$



↘10 ↗10

11 f

↘ ↗ f_2

2

11 f

-6dB → ÷2

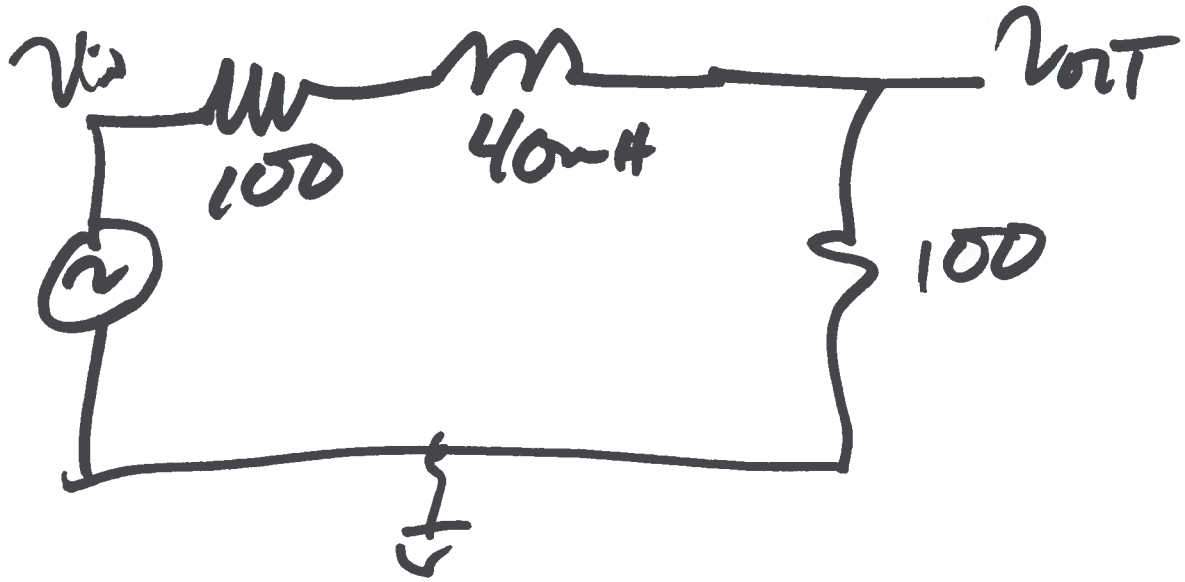
-20dB → ÷10

-3dB → $\frac{1}{\sqrt{2}}$

X.707

$\frac{1}{\sqrt{2}} \cdot \frac{1}{\sqrt{2}} = \frac{1}{2}$

-3dB + -3dB = -6dB



$f \cdot 6.28 \cdot .2 \cdot 10^{-3}$

$f \cdot 6.28 \cdot 10^{-3}$

$f \cdot \frac{1}{1.256}$

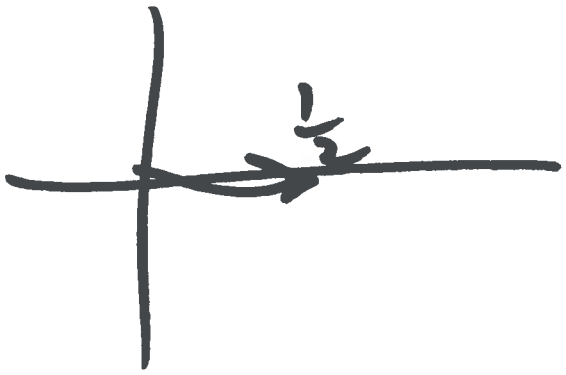
$$\frac{V_{OUT}}{V_{in}} = \frac{100}{200 + j \cdot 2\pi f \, 40 \cdot 10^{-3}}$$

$$\frac{1}{1.256 \cdot 10^{-3}} = \frac{\frac{1}{2}}{1 + j \, 2\pi f \, 0.2 \cdot 10^{-3}}$$

$$= \frac{\frac{1}{2}}{1 + j \cdot f \cdot 1.256 \cdot 10^{-3}} = \frac{\frac{1}{2}}{1 + j \frac{f}{796}}$$

4)

$$\frac{V_{out}}{V_{in}} = \frac{\frac{1}{2} + j0}{1 + j\frac{f}{796}} \Rightarrow \frac{\frac{1}{2}\angle 0^\circ}{\sqrt{1^2 + \left(\frac{f}{796}\right)^2}\angle \tan^{-1}\frac{f}{796}}$$



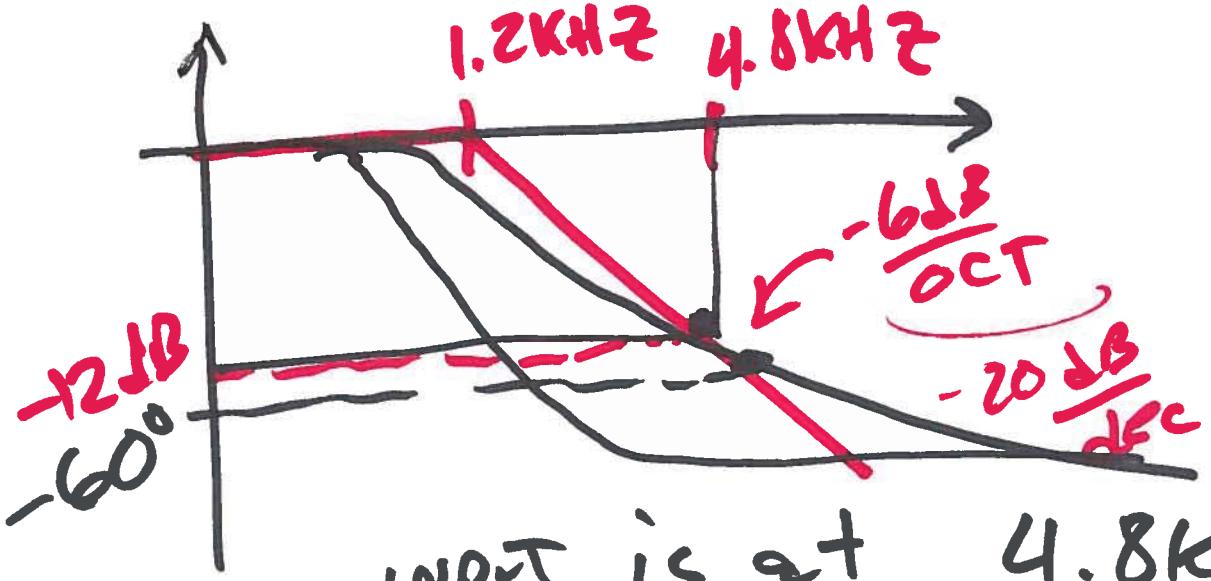
$$\left|\frac{V_{out}}{V_{in}}\right| = \frac{\frac{1}{2}}{\sqrt{1 + \left(\frac{f}{796}\right)^2}}$$

$20\log\frac{a}{b} = 20\log a - 20\log b$

$$20\log\left|\frac{V_{out}}{V_{in}}\right| = 20\log\left|\frac{\frac{1}{2}}{\sqrt{1+\left(\frac{f}{796}\right)^2}}\right| = 20\log a + 20\log\frac{1}{b}$$

$$= 20\log\frac{1}{2} + 20\log\frac{1}{\sqrt{1+\left(\frac{f}{796}\right)^2}}$$

$-6\,dB$



$dB = 20 \log \frac{V_{out}}{V_{in}}$

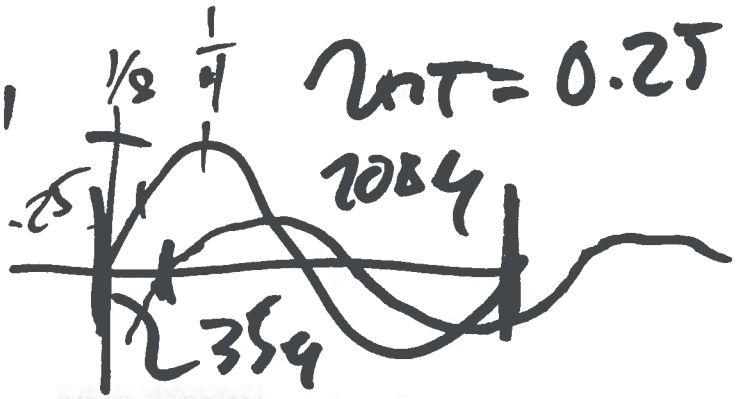
$\frac{V_{out}}{V_{in}} = 10^{dB/20}$

Input is at 4.8KHz Vpeak 1V

Sketch V_{out} & V_{in} of the plot

$V_{in} = 1 \cdot \sin(2\pi \cdot 4.8K \cdot t)$

$V_{out} = 0.25 \sin(2\pi \cdot 4.8K \cdot t - 60°)$

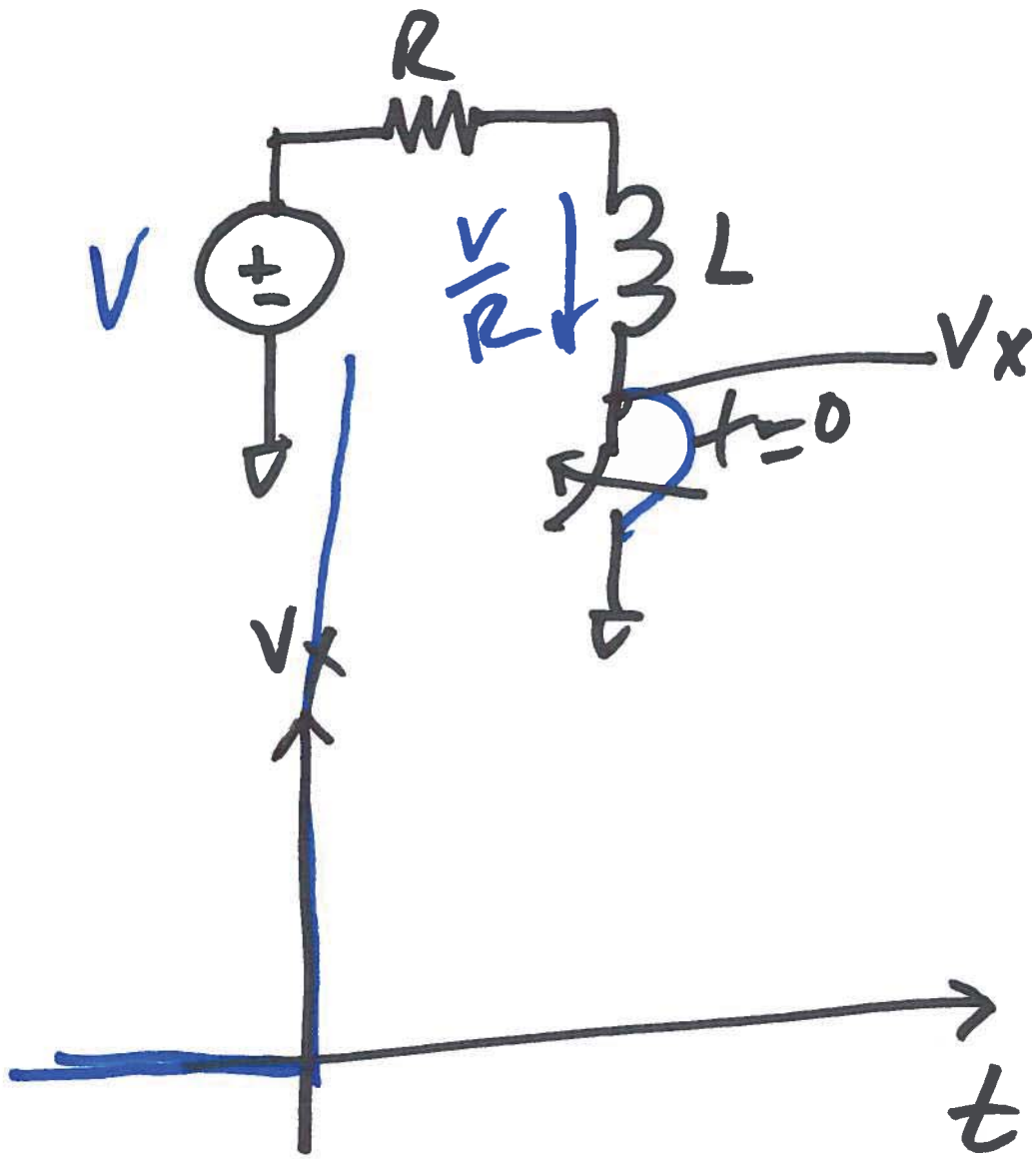


$\theta = \frac{t_d}{T} \cdot 360 = t_d \cdot f \cdot 360$

$\frac{60}{4.8KHz \cdot 360} = t_d = 35.4\,\mu s$

$T = 208\,\mu s$

6)


R
V
+
−
V/R
L
Vx
t=0
Vx
t