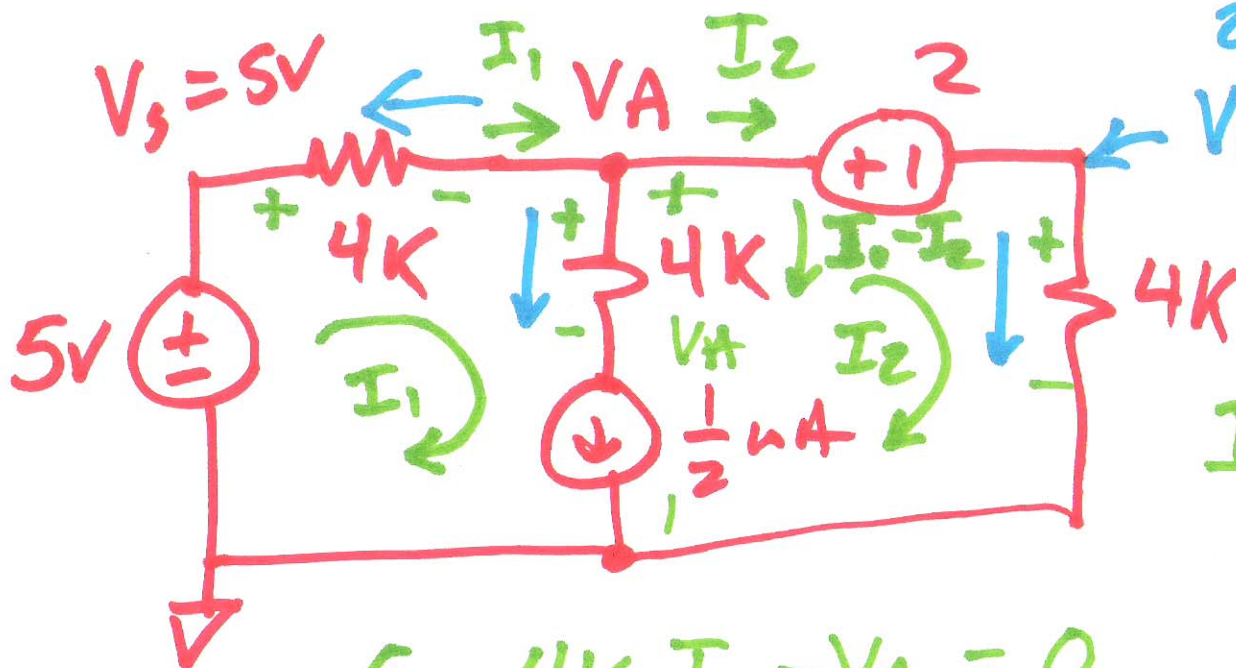
EE 220

July 7, 2014

Lecture 19



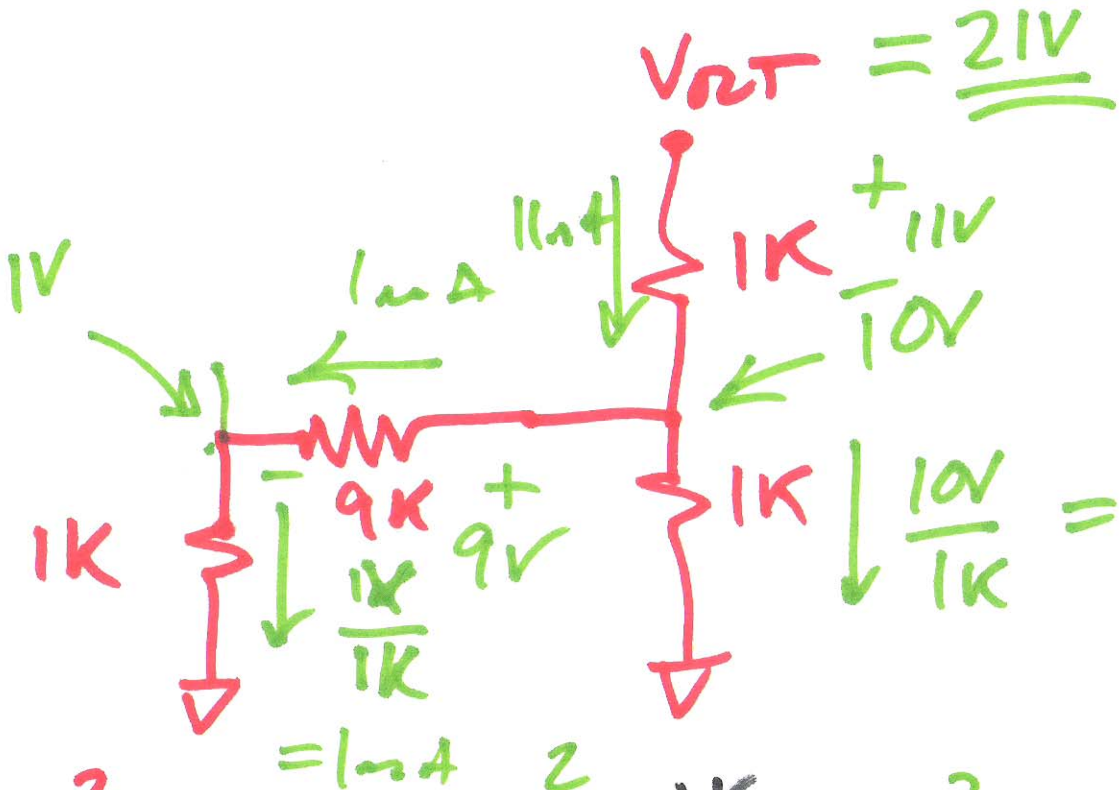
VA − 2

$$\frac{1}{2}\,mA + \frac{V_A - 2}{4K} + \frac{V_A - 5}{4K} = 0$$

$$I_1 - I_2 = \frac{1}{2}\,mA$$

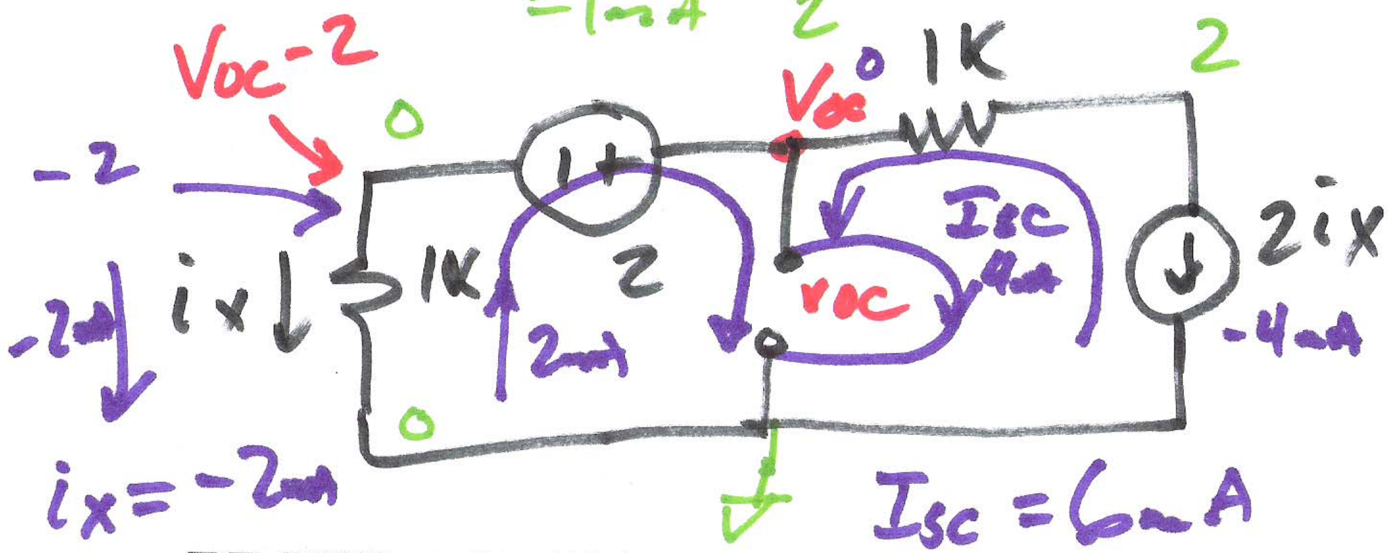
$$5 - 4K \cdot I_1 - V_A = 0$$

$$-2 + V_A - 4K \cdot I_2 = 0$$



$$R_{Thev} = \frac{2V}{6mA} = 333\Omega$$

$$i_x = \frac{V_{oc} - 2}{1K}$$

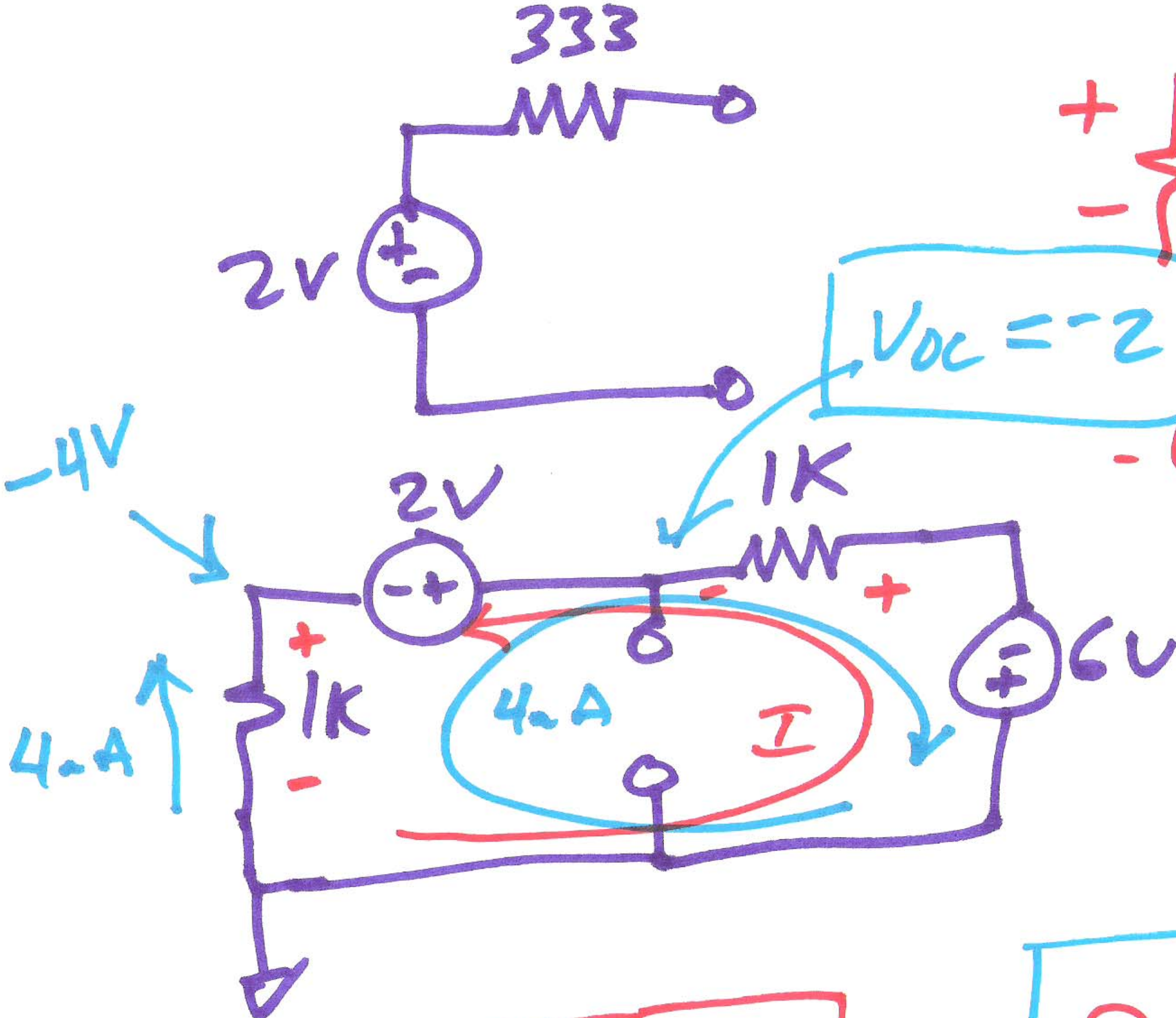


$$2i_x = -i_x$$

$$i_x = 0$$

$$\boxed{V_{oc} = 2}$$

b)

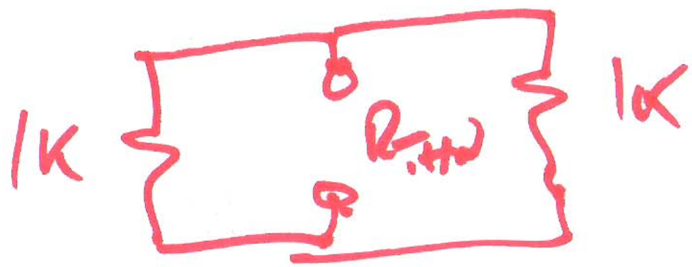


$V_{OC} = -2$

$-6 - 1K \cdot I - 2 - 1K \cdot I = 0$

$-2KI = 8$

$I = -4mA$



$R_{TH} = 500$

$$\left|\frac{v_{OUT}}{v_{in}}\right| = -4\text{ dB}$$

$f = 600\text{ KHz}$

$$\angle\frac{v_{OUT}}{v_{in}} = +50^\circ$$

$T = 1.67\,\mu s$

$$-4\text{dB} = 20\log\left|\frac{v_{OUT}}{v_{in}}\right|$$

$$\left|\frac{v_{OUT}}{v_{in}}\right| = 10^{-4/20} = 10^{-1/5} = 10^{-0.2}$$

$$= .631$$

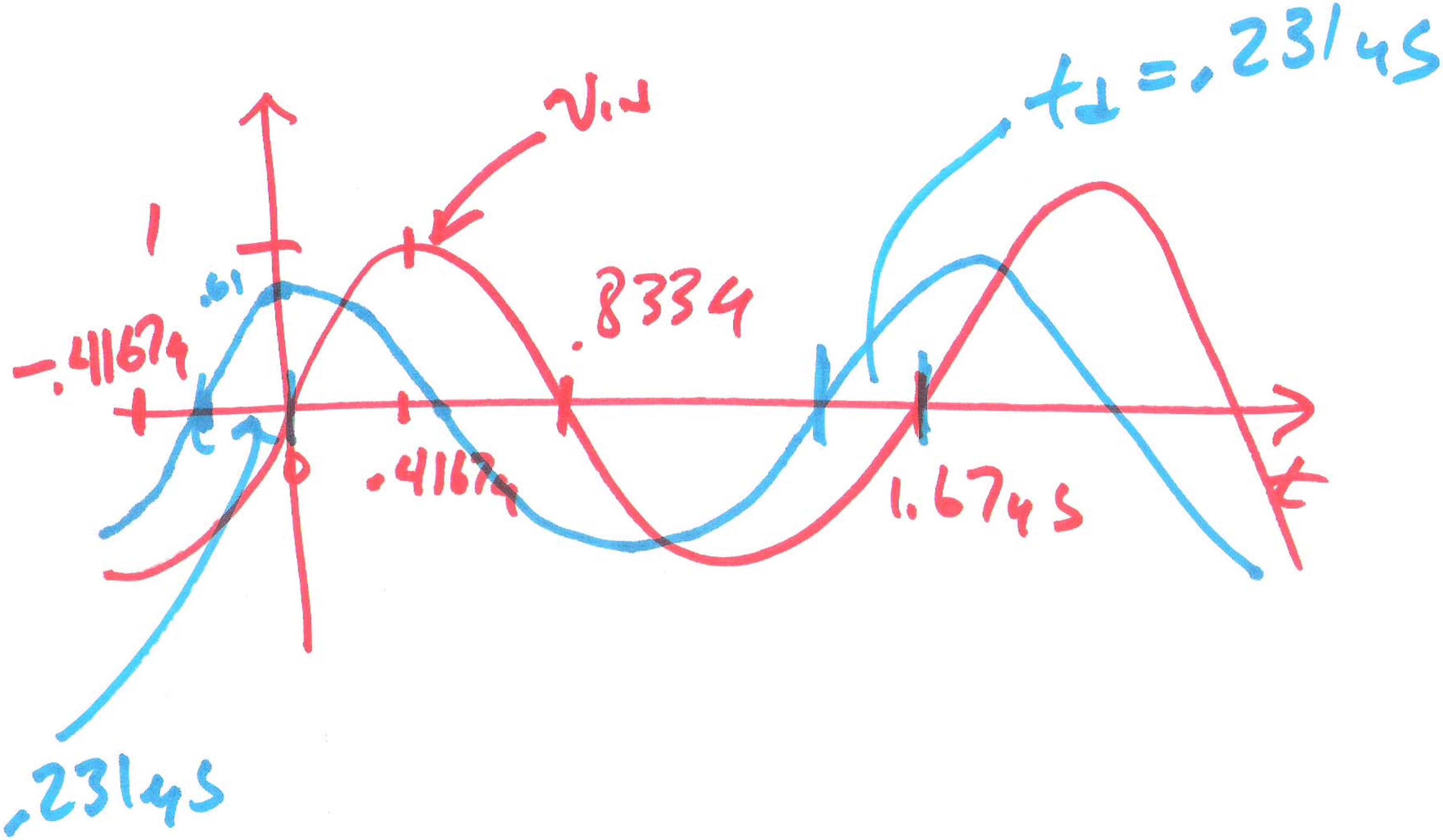
$$\theta = \frac{t_d}{T}\cdot 360$$

if $v_{in} = 1\text{V peak}$

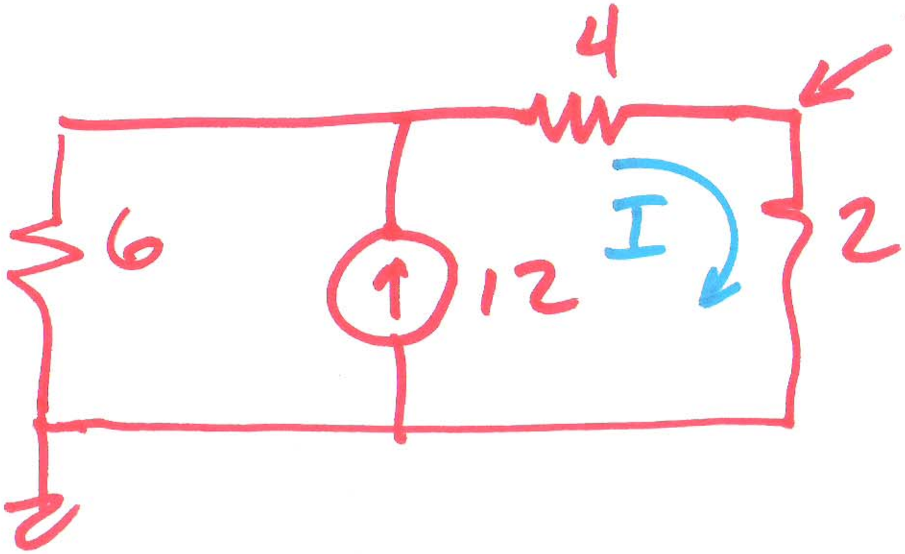
$v_{OUT} = .631$

$$\frac{50}{360}\cdot 1.67\,\mu s = t_d$$

$t_d = 0.23\,\mu s$



v_{in}
$t_d = .2314s$
1
.61
-.41674
0
.41674
.8334
1.674s
t
.2314s

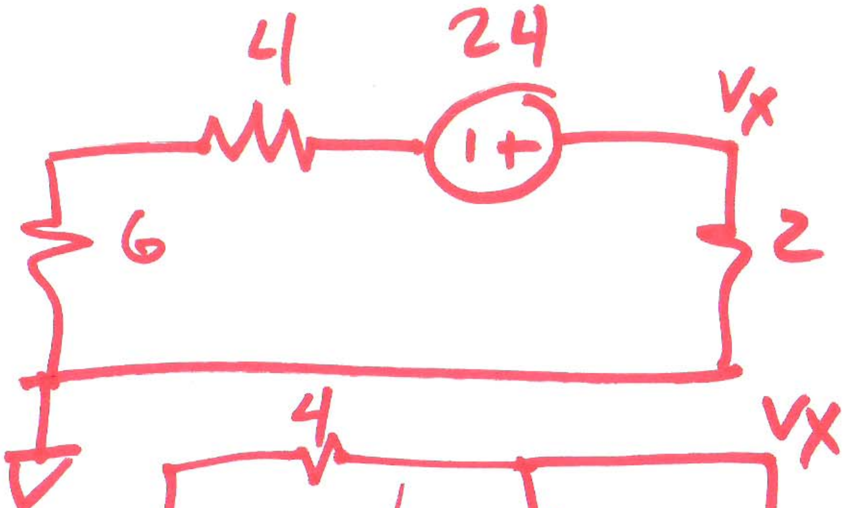


$V_x = 6 \cdot 2 = \underline{12\,V}$

$I = 12 \cdot \frac{6}{6+6}$

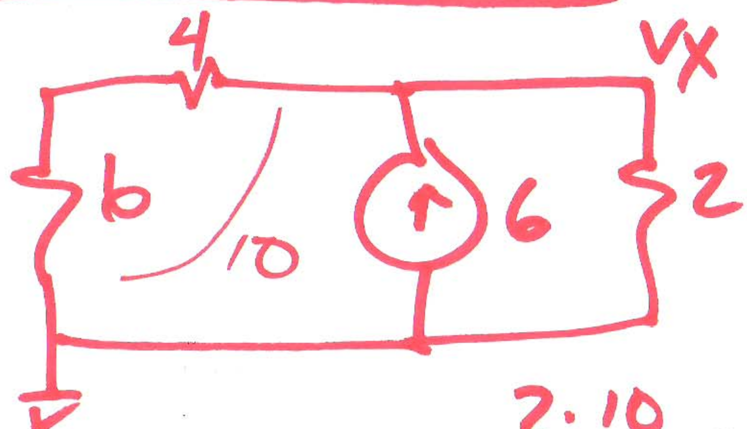
$= 12 \cdot \frac{6}{6+4+2}$

$I = \frac{1}{2} 12 = 6$



$V_x = 24 \cdot \frac{2}{2+4+6}$

$V_x = \underline{4\,V}$



$V_x = 6 \cdot 2 \parallel 10$

$\frac{2 \cdot 10}{12} = \frac{20}{12} = \frac{5}{3} = \underline{10\,V}$

1.666

$V_x = 12 + 4 + 10 = \underline{26\,V}$

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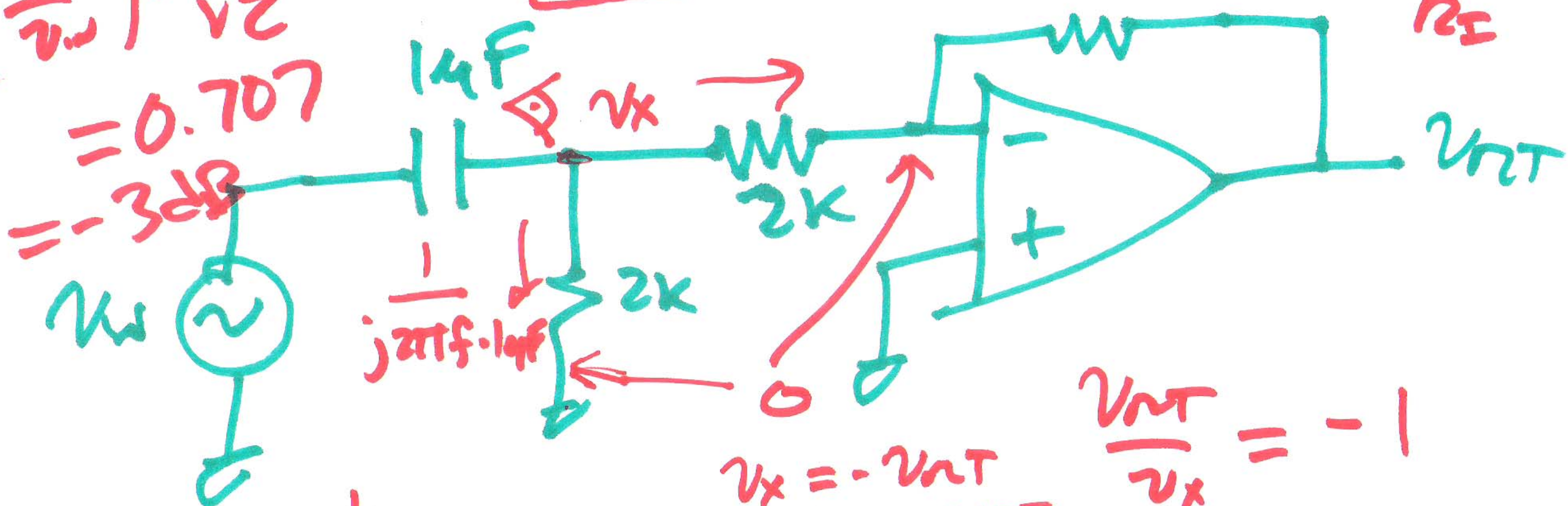
Find the frequency when $v_{out} = 0.707\, v_{in}$ (v_{out} is 3dB lower than v_{in}).

$f = 159$ Hz

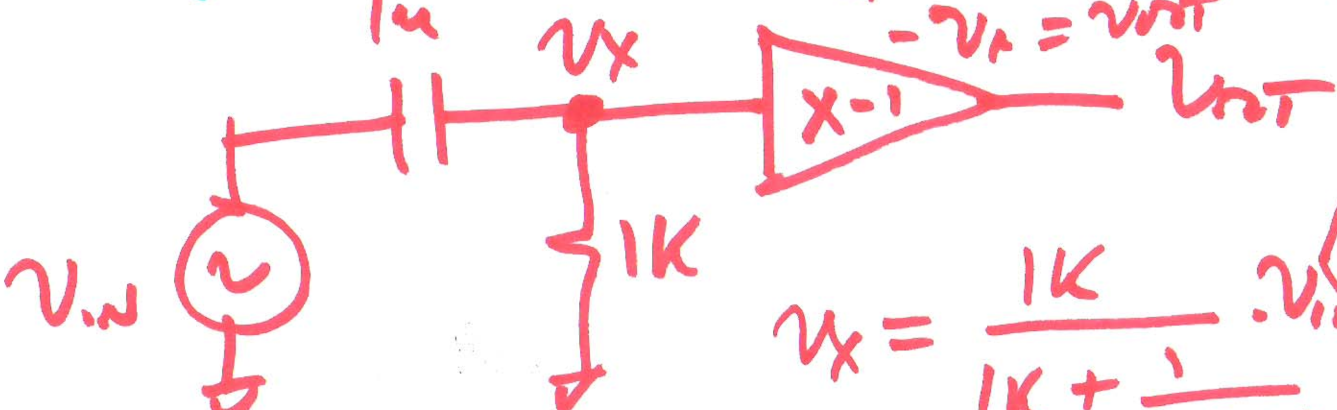
$$\left|\frac{v_{out}}{v_{in}}\right| = \frac{1}{\sqrt{2}} = 0.707 = -3\text{dB}$$



$$\frac{v_{out}}{v_x} = -1$$

$v_x = -v_{out}$

$-v_x = v_{out}$



$10^{-6} \cdot 10^{3}$

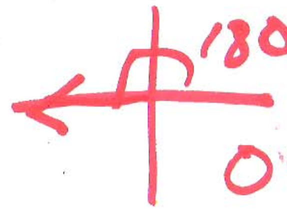
10^{-3}

$$v_x = \frac{1K}{1K + \frac{1}{j \cdot 2\pi f \cdot 10^{-6}}} \cdot v_{in} = -v_{out}$$

-1 sin cos

$\frac{1}{2\pi\cdot 10^{-3}} = 159 \qquad \frac{v_{OUT}}{v_{IN}} = -\frac{0 + j\cdot 2\pi f\cdot 10^{-3}}{1 + j\cdot 2\pi f\cdot 10^{-3}}$

$\frac{1}{159} = 2\pi 10^{-3}$



$\frac{1}{a+jb}$

$= -\frac{\left(0 + j\frac{f}{159}\right)}{1 + j\frac{f}{159}}$

$\angle 180 + 90 - \tan^{-1}\frac{f}{159}$

$$\left|\frac{v_{OUT}}{v_{IN}}\right| = \frac{1}{\sqrt{2}} = \frac{\sqrt{0^2 + \left(\frac{f}{159}\right)^2}}{\sqrt{1^2 + \left(\frac{f}{159}\right)^2}} = \frac{\frac{f}{159}}{\sqrt{1 + \left(\frac{f}{159}\right)^2}}$$

$$\frac{1}{2} + \frac{1}{2}\left(\frac{f}{159}\right)^2 = \left(\frac{f}{159}\right)^2, \quad \frac{1}{2} = \left(\frac{f}{159}\right)^2\left(1 - \frac{1}{2}\right)$$

$$\frac{f}{159} = 1 \qquad \boxed{f = 159}$$

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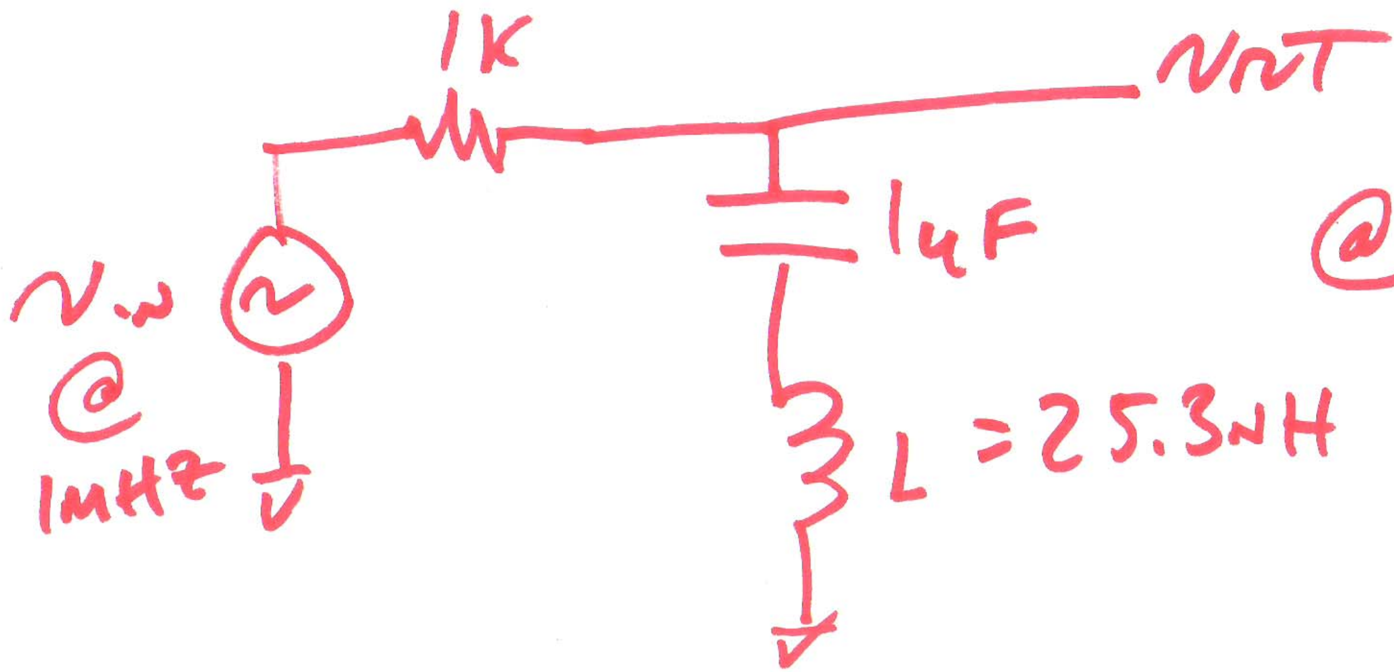

@ what value of L does vout go to zero?

$$L = \frac{10^{-6}}{(6.28)^2}\,H \qquad \frac{1}{j\cdot 2\pi\cdot 10^{6}\cdot 10^{-6}} + j\cdot 2\pi\cdot 10^{6}\cdot L = 0$$

$$L = \frac{1}{2\pi}\cdot\frac{1}{2\pi\cdot 10^{6}} \qquad \frac{-j}{2\pi} + j\cdot 2\pi\cdot 10^{6}\cdot L = 0$$

$$-\frac{1}{2\pi} + 2\pi\cdot 10^{6}\cdot L = 0$$