

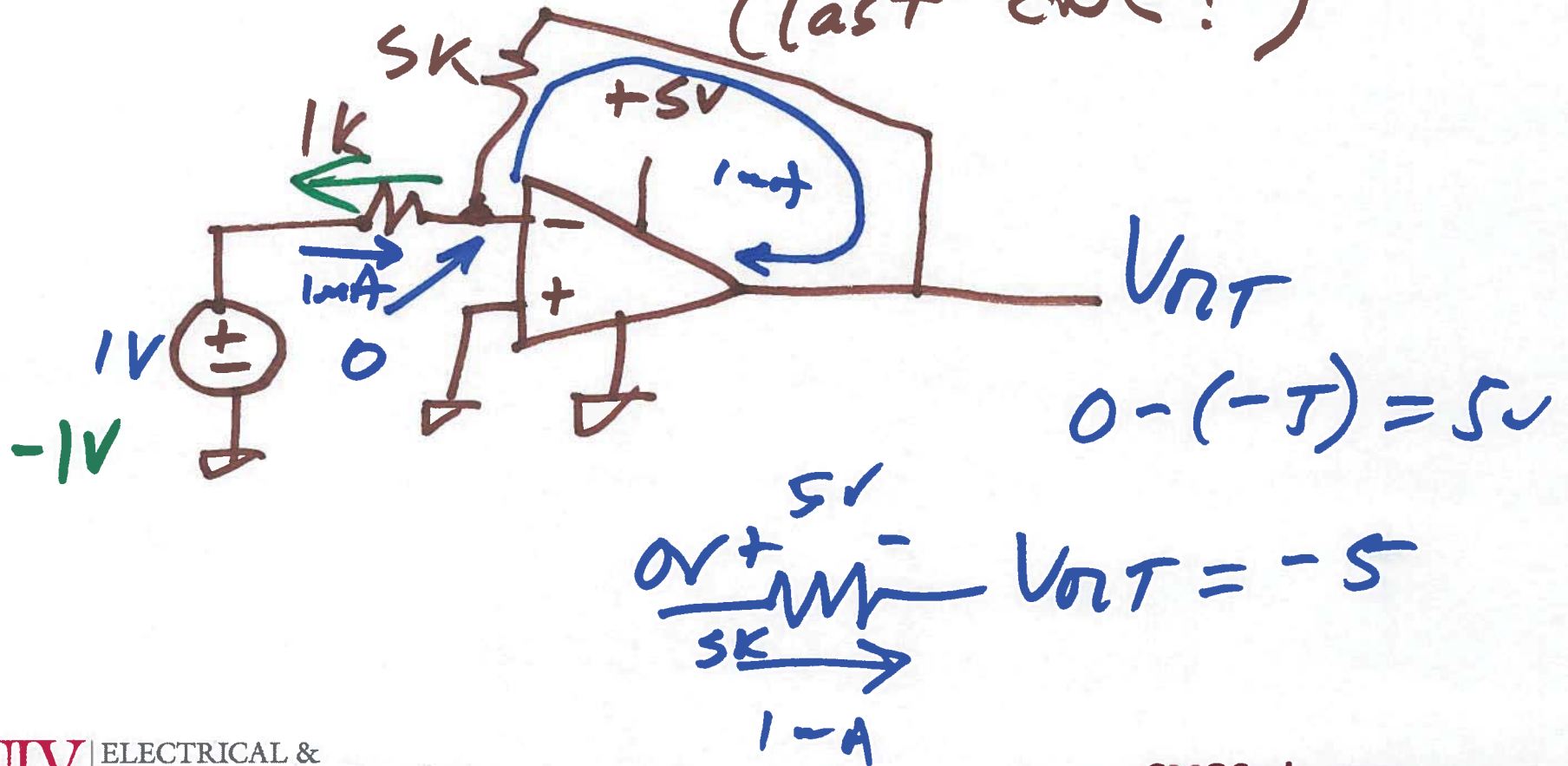
Circuits II

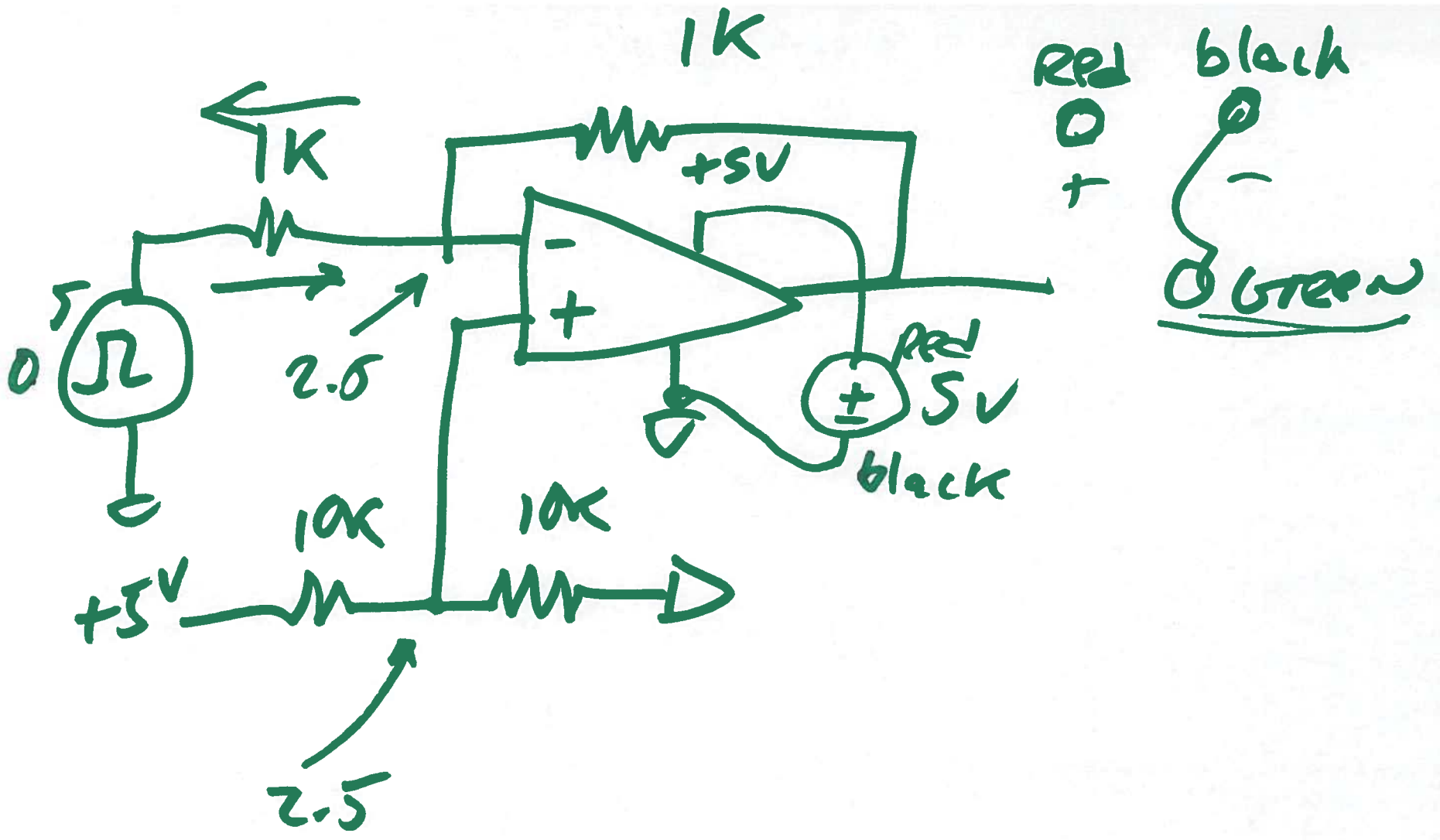
EE 221

May 8, 2019

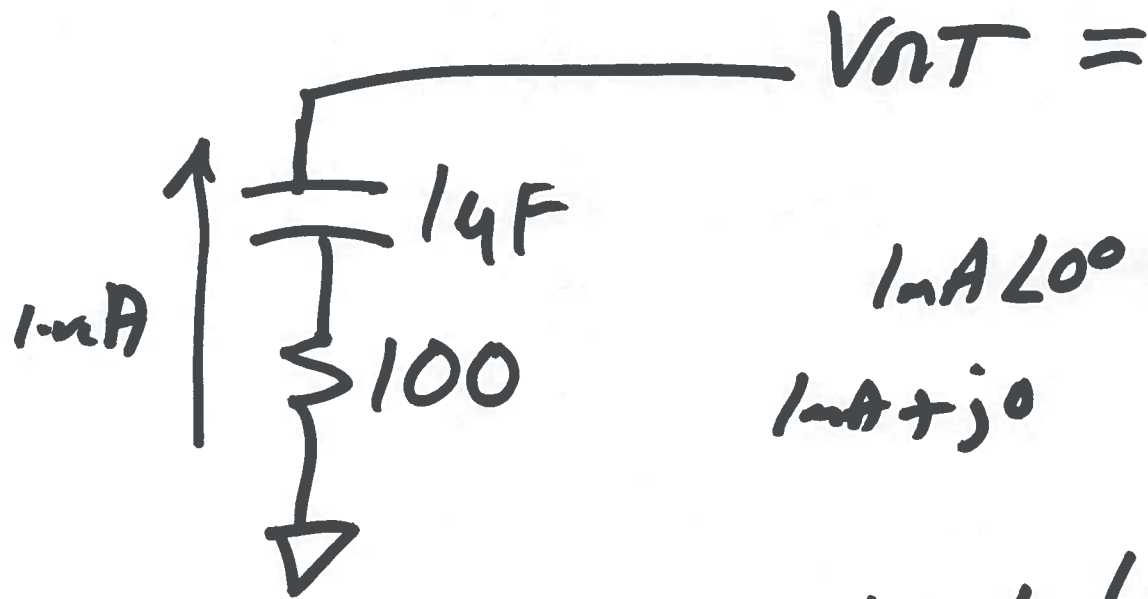
Lecture 26

(last one!)





2)



$$1mA \angle 0^\circ \cdot \left(100 + \frac{1}{j\omega \cdot 10^{-8}} \right)$$

$$1mA + j0$$

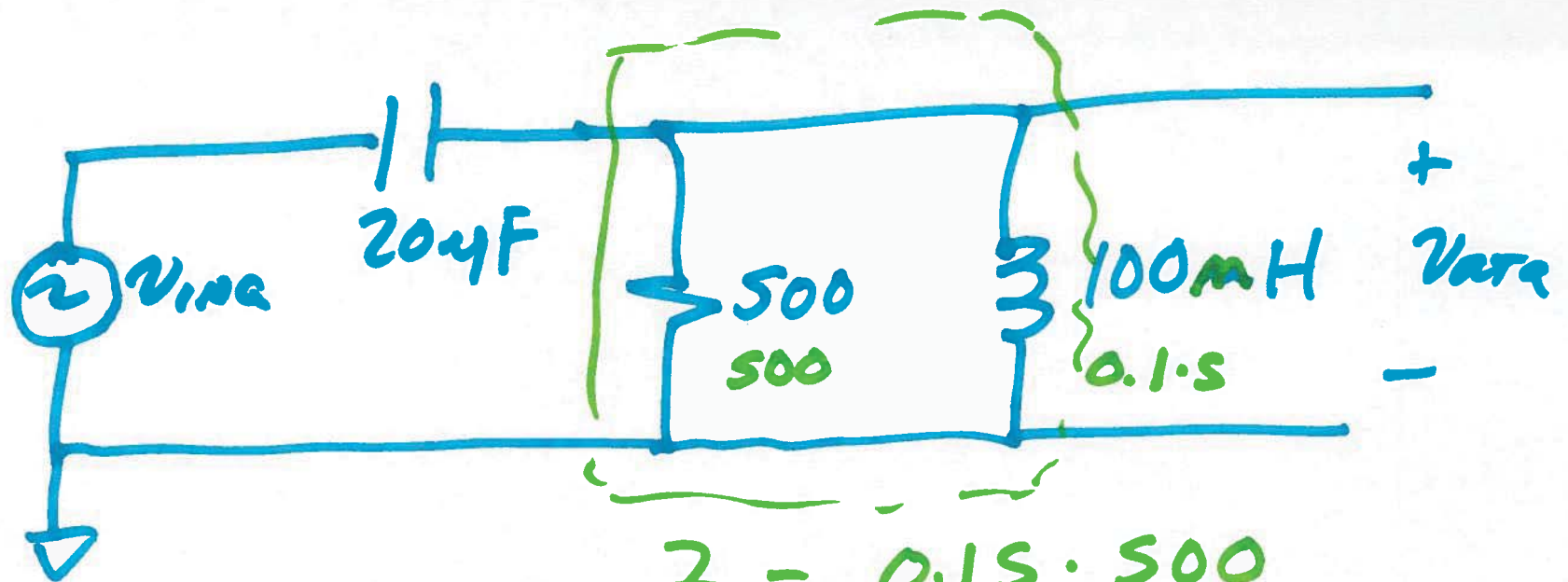
$$1 = 1mA \angle 0 \left(100 + \frac{1}{j2\pi f \cdot 10^{-8}} \right)$$

$$\frac{1,000}{100} = \frac{100}{100} + \frac{1}{10^2 \cdot j \cdot 2\pi f \cdot 10^{-8}}$$

$$10 = 1 + \frac{1}{j \cdot 2\pi f \cdot 10^{-4}}$$

$$9 = \left| \frac{1}{j \cdot 2\pi f \cdot 10^{-4}} \right|$$

$$f = \frac{1}{2\pi \cdot 9 \cdot 10^{-4}}$$



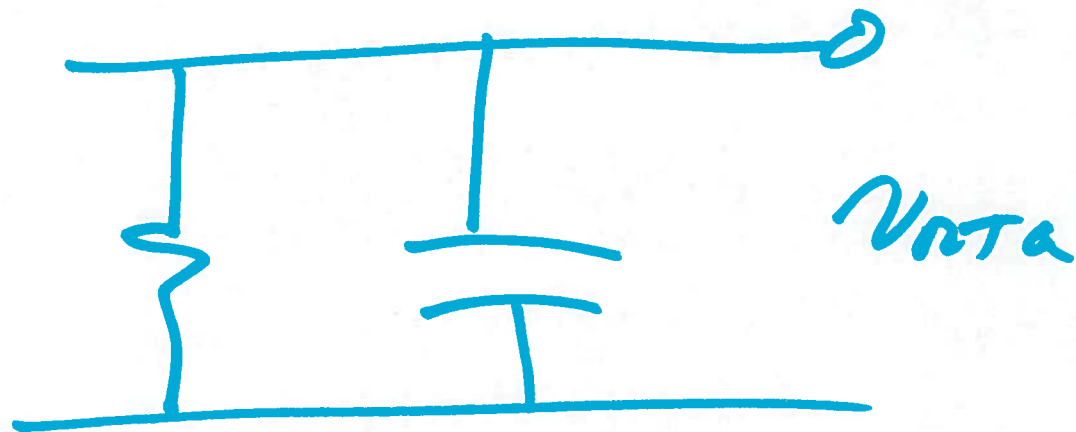
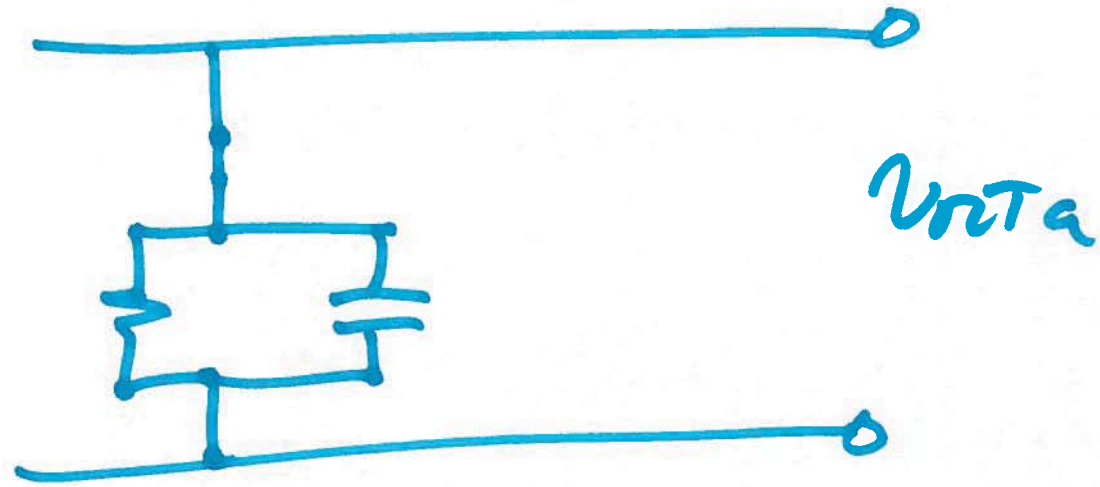
$$\frac{V_{out}(s)}{V_{in}(s)} = \frac{500 \cdot \frac{s}{s+5k}}{500 \cdot \frac{s}{s+5k} + \frac{1}{5 \cdot 20 \cdot 10^{-6}}}$$

$$= \frac{500 \cdot s}{500 \cdot s + \frac{s+5k}{5 \cdot 20 \cdot 10^{-6}}}$$

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

$$= \frac{50 \cdot s}{0.1s + 500}$$

$$= 500 \cdot \frac{s}{s+5k}$$



5)

$$\frac{V_{rTA}}{V_{inA}} = \frac{500 \cdot s \cdot s \cdot 20 \cdot 10^{-6}}{500 \cdot s \cdot s \cdot 20 \cdot 10^{-6} + s + 5k}$$

$$10,000 \cdot 10^{-6} = 10^4 \cdot 10^{-6} = 10^{-2}$$

$$|0 + j\omega| \cdot |0 + j\omega|$$

$$\omega \cdot \omega = \omega^2$$

$$s^2 \cdot \cancel{20} \cdot 10^{-2}$$

$$s^2 \cdot 10^{-2} + s + 5k$$

$$\frac{V_{rTA}}{V_{inA}} = \frac{s^2}{s^2 + 100 \cdot s + 500k}$$

$$s^2 = -\omega^2 + j0$$

$$\sqrt{(-\omega^2)^2 + 0^2} = \omega^2$$

$$V_{rTA} = \left| \frac{s^2}{s^2 + 100 \cdot s + 500k} \right| \cdot 170 \angle 0^\circ$$

$$f = 60$$

b)

$$V_{out} = \left| \frac{(2\pi \cdot 60)^2}{(j \cdot 2\pi \cdot 60)^2 + 100 \cdot j\pi 60 + 500k} \right| \cdot 170$$

$\sqrt{-1} \cdot \sqrt{-1}$

$$V_{out} = \frac{170 \cdot (2\pi \cdot 60)^2}{\left| j \cdot 6k \cdot 2\pi + (500k - (2\pi 60)^2) \right|}$$

$i \rightarrow f \cdot 100$ Re

$$V_{out} = \frac{170 \cdot (2\pi \cdot 60)^2}{\sqrt{(500k - (2\pi 60)^2)^2 + (6k \cdot 2\pi)^2}}$$

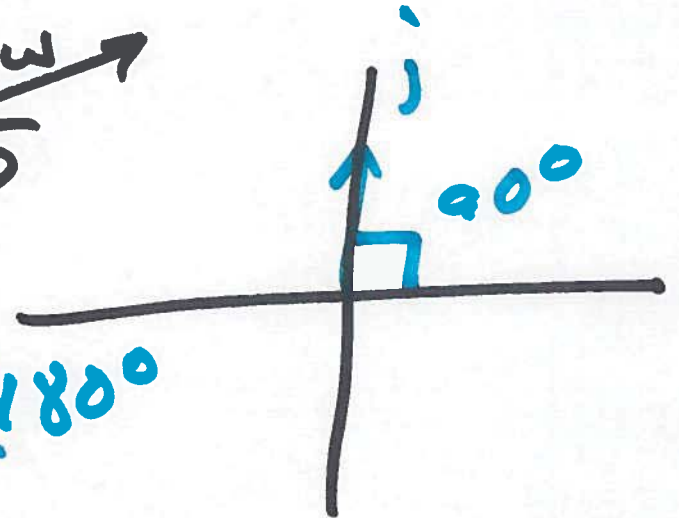
7)

$$V_{out} = \angle \frac{s^2}{s^2 + 100 \cdot s + 500k} \cdot \angle 0^\circ$$

$$s = j\omega$$

$$\omega \angle 90^\circ$$

$$\tan^{-1} \frac{j\omega}{0}$$



$$\omega \angle 90^\circ \cdot \omega \angle 90^\circ = \omega^2 \angle 180^\circ$$

$$V_{out} = \angle 180^\circ$$

$$\angle s^2 + 100 \cdot s + 500k$$

2,000,000

-1,990,000

$$s_{1,2} = \frac{-100 \pm \sqrt{10k - 4 \cdot 500k}}{2}$$

$$-50 \pm j \frac{1,410}{2} \Rightarrow -50 \pm j 705$$

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$$\begin{aligned}
 \angle 180^\circ \\
 \text{Phase} &= \frac{\angle 180^\circ}{(s + 50 - j705)(s + 50 + j705)} \\
 \angle a + jb & \quad \begin{array}{c} b \\ + \\ \text{I} \\ \text{---} \\ - \\ a \end{array} \\
 \tan^{-1} \frac{b}{a} &= \frac{\angle 180^\circ}{(50 + j(2\pi 60 - 705))}.
 \end{aligned}$$

$$(50 + j(2\pi 60 + 705))$$

$$\begin{aligned}
 \angle 180^\circ \\
 &= \frac{\angle 180^\circ}{\tan^{-1} \frac{2\pi 60 - 705}{50} \cdot \tan^{-1} \frac{2\pi 60 + 705}{50}}
 \end{aligned}$$

a)