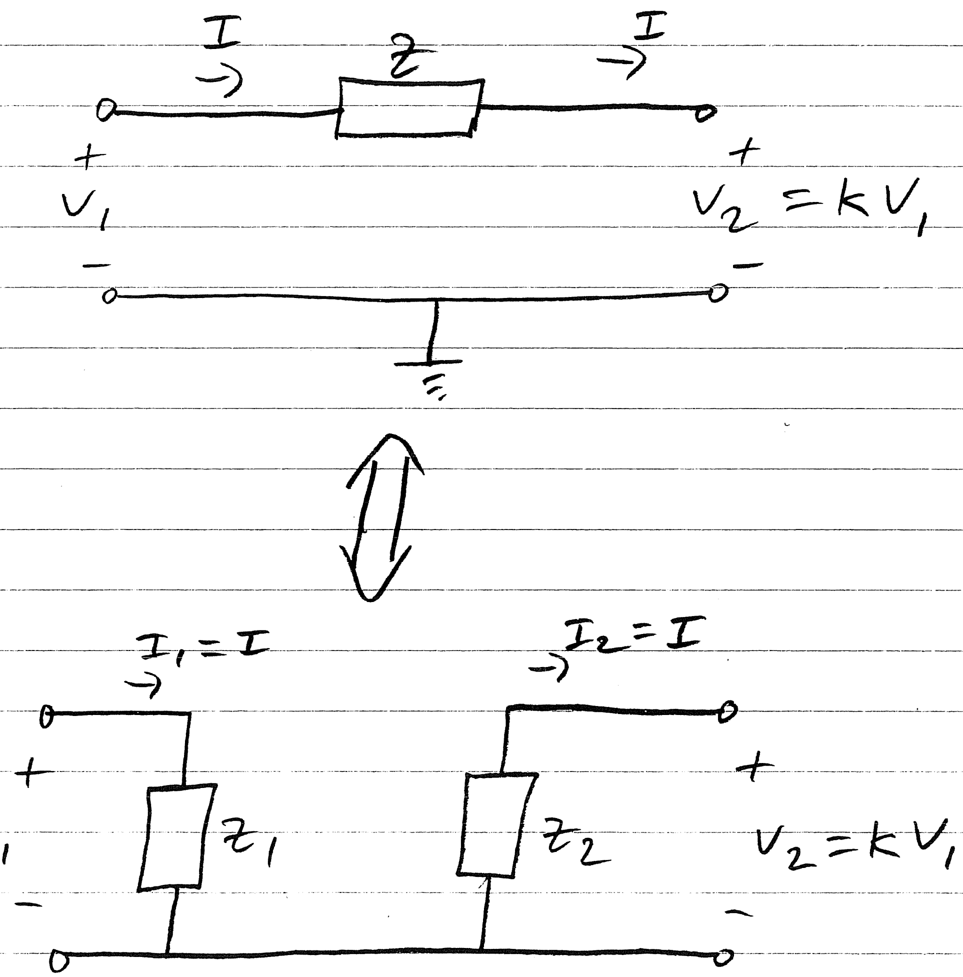
MILLER'S THEOREM

- USED TO BREAKUP A COUPLING IMPEDANCE BETWEEN 2 NODES

GIVEN $V_2 = kV_1$ k IS GAIN FACTOR



$$Z_1 = Z/(1-k)$$

$$Z_2 = Z/\left(1-\frac{1}{k}\right)$$

MT2

PROOF $I_1 = \frac{V_1}{Z_1} = I = \frac{V_1 - kV_1}{Z} \Rightarrow Z_1 = \frac{Z}{1-k}$

$$I_2 = \frac{0 - V_2}{Z_2} = I = \frac{V_1 - kV_1}{Z} \Rightarrow Z_2 = \frac{Z}{\left(1 - \frac{1}{k}\right)}$$

NOTE CANNOT USE MILLER'S THEOREM WHEN RATIO OF $\frac{V_2}{V_1}$ CHANGES SUCH AS CHANGING LOCATION OF SIGNAL-SOURCE WHEN FINDING OUTPUT IMPEDANCE

IN CASE $Z = R \Rightarrow$ $R_1 = \frac{R}{1-k}$

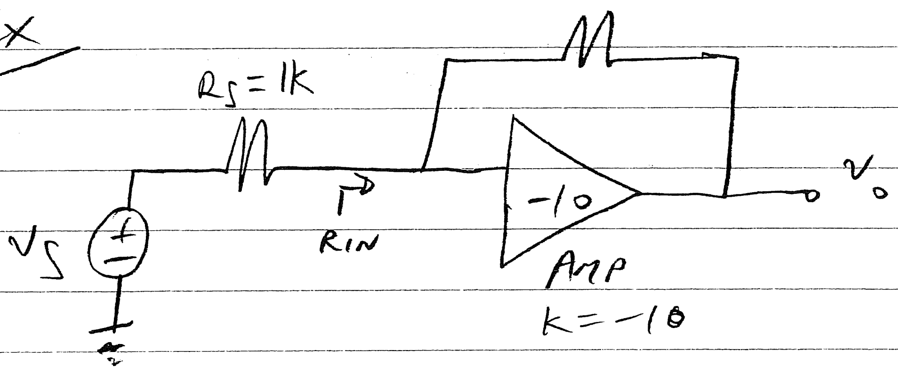
$$R_2 = \frac{R}{\left(1 - 1/k\right)}$$

IN CASE $Z = \frac{1}{SC} \Rightarrow$ $C_1 = C(1-k)$

$$C_2 = C\left(1 - \frac{1}{k}\right)$$

MT3

Ex



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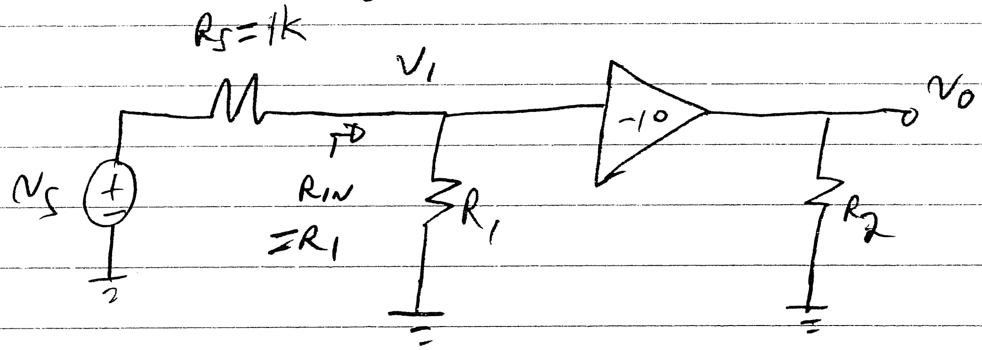


$$R_1 = \frac{R}{1-k} = \frac{10k}{1-(-10)} = \frac{10k}{11} = 909.1\,\Omega$$

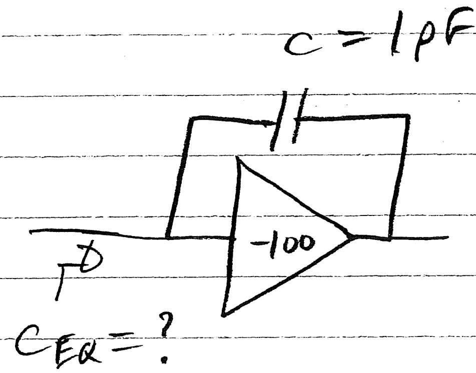
$$v_1 = \frac{R_1}{R_1+R_S} v_S = 0.476\, v_S$$

$$v_o = -10\, v_1 = -4.76\, v_S$$

$$R_2 = \frac{R}{1-\frac{1}{k}} = \frac{10k}{1+\left(\frac{1}{10}\right)} = 9.1k \approx R$$

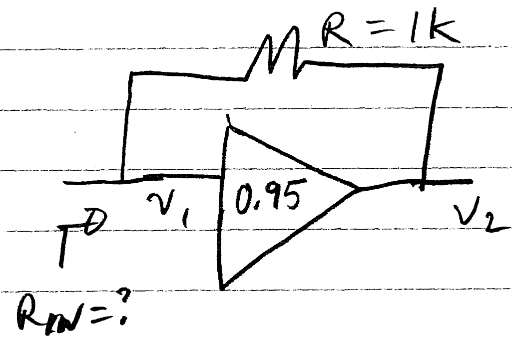
NOT MUCH CHANGE

Ex



$$C_{EQ} = C(1+100) = 101\,C = 101\,pF$$

Ex BOOTSTRAPPING



$$R_{IN} = \frac{R}{1-0.95} = \frac{R}{0.05} = 20\,R = 20k\,\Omega$$

SINCE $V_2 \simeq V_1$ LITTLE CURRENT FLOWS THROUGH R AND IMPEDANCE INCREASED