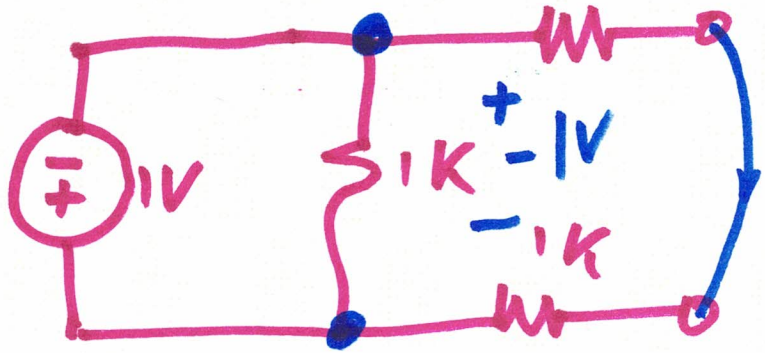
EE 221
Circuits 1
Lecture 5
Feb. 6, 2019

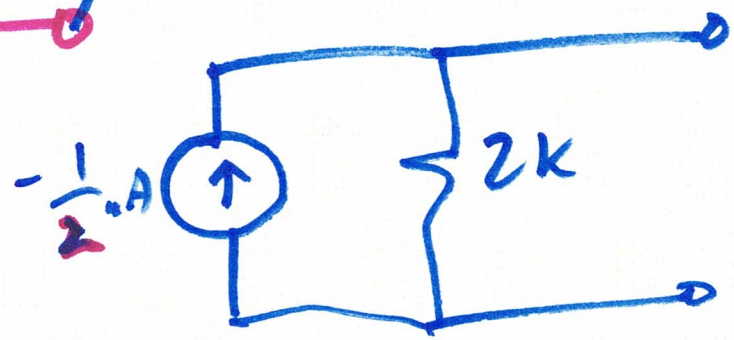
V_{TH}/I_N

$$R_{THN} = \frac{V_{OC}}{I_{SC}} = \frac{-1}{-\frac{1}{2}\text{-}A} = 2k$$

$R_{TH} = 2k$



$$I_{SC} = I_N = \frac{-1V}{2k} = -\frac{1}{2}\text{-}A$$

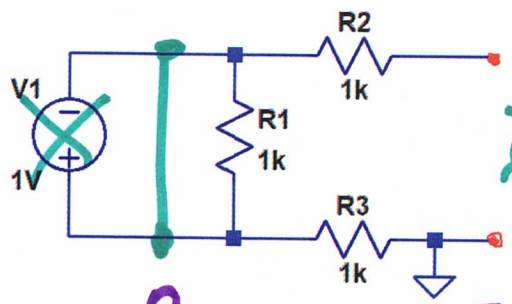


Quiz #4 EE 221 Spring 2019 Name:_____

Closed book and notes.

Show your work for credit.

1. Find the Thevenin and Norton equivalents of the following circuit at the red terminals indicated. (4 points)

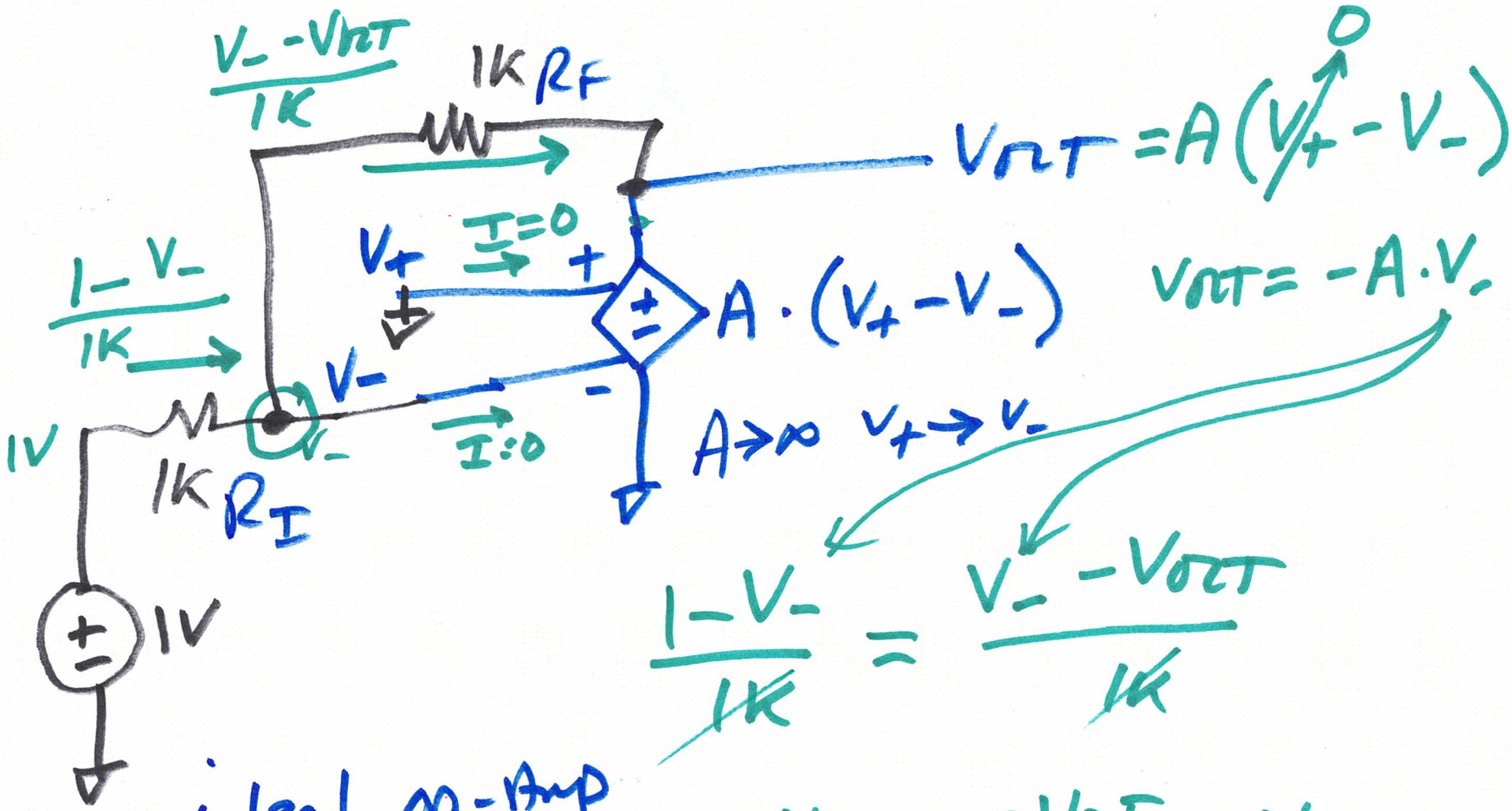


$R_{THev} = 2k$

$V_{OC} = V_{THev} = -1 - 0$

$V_{TH} = -1V$

2)



$$\frac{1 - V_-}{1K} = \frac{V_- - V_{OUT}}{1K}$$

ideal op-Amp

$A \to \infty$

$$1 + \frac{V_{OUT}}{A} = \frac{-V_{OUT}}{A} - V_{OUT}$$

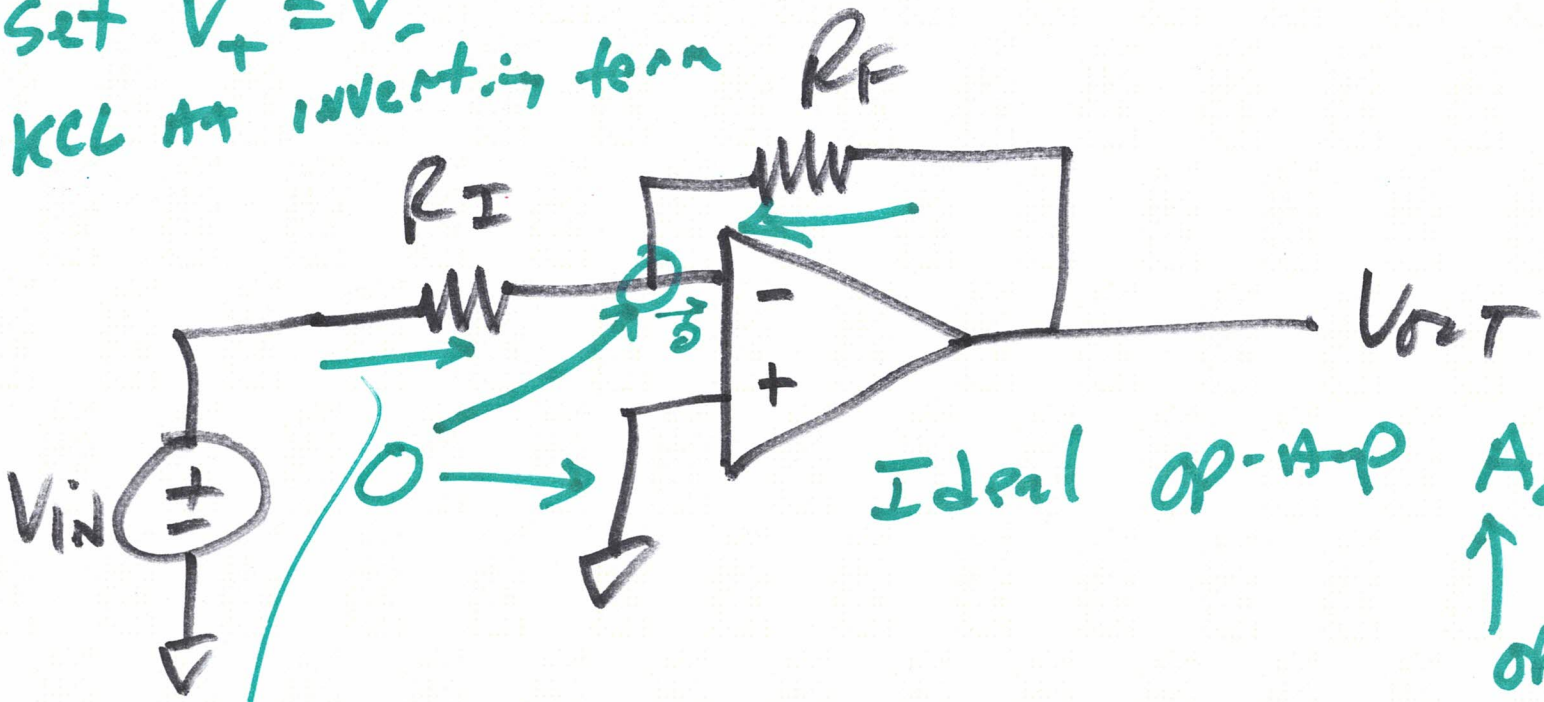
$$-1 = V_{OUT}\left(\frac{1}{A} + \frac{1}{A} + 1\right)$$

$$V_{OUT} = \frac{-1}{\frac{1}{A} + \frac{1}{A} + 1}$$

$$= -1 = \frac{-R_F}{R_I}$$

Inverting op-Amp

1) find V_+
2) Set $V_+ = V_-$
3) KCL at inverting term



Ideal op-Amp $A_{OL} \to \infty$

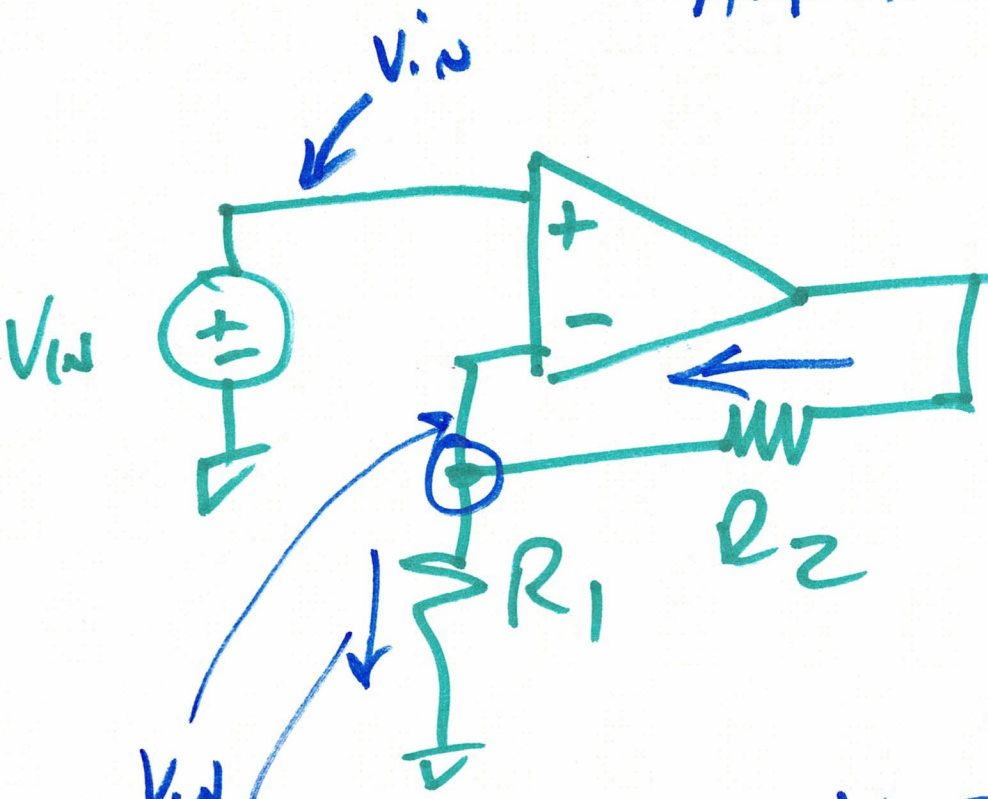
A_{OL}: open loop gain

$$\frac{V_{IN} - 0}{R_I} + \frac{V_{OUT} - 0}{R_F} = 0$$

$$\frac{V_{OUT}}{V_{IN}} = -\frac{R_F}{R_I}$$

NON-inverting Amplifier

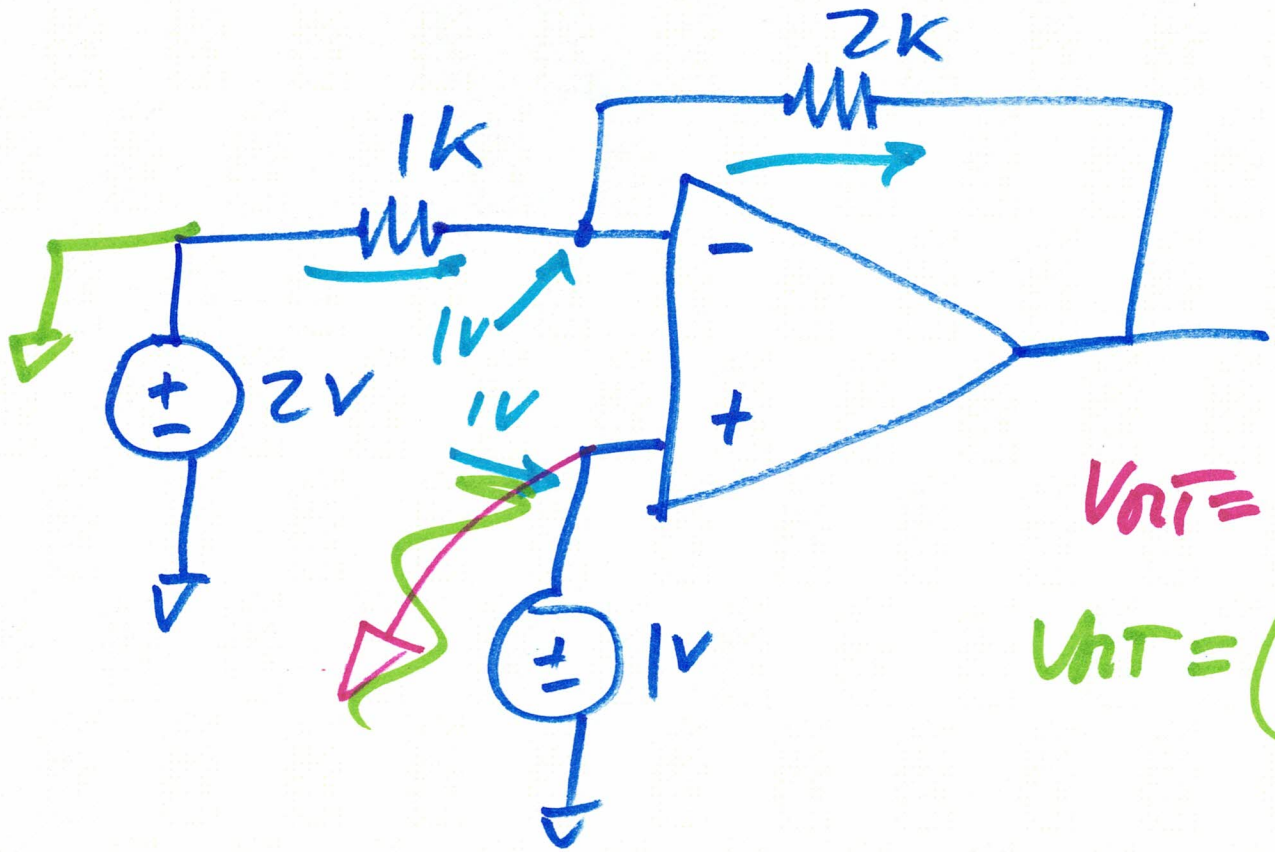
1) find V_+
2) set $V_+ = V_-$
3) KCL @ V_-



$$\frac{V_{OUT}}{V_{IN}} = 1 + \frac{R_2}{R_1} = \frac{R_1 + R_2}{R_1}$$

$$\frac{V_{in}}{R_1} = \frac{V_{OUT} - V_{in}}{R_2}$$

$$V_{IN}\left(\frac{1}{R_1} + \frac{1}{R_2}\right) = \frac{V_{OUT}}{R_2}$$



$$V_{OUT} = -\frac{2K}{1K} \cdot 2V = -4V$$

$$V_{OUT} = \left(1 + \frac{2K}{1K}\right) 1V = 3V$$

$-1V$

YAY!

$$\frac{2-1}{1K} = \frac{1 - V_{OUT}}{2K} = 1 = \frac{1}{2} - \frac{1}{2} V_{OUT}$$

$$\boxed{V_{OUT} = -1V}$$