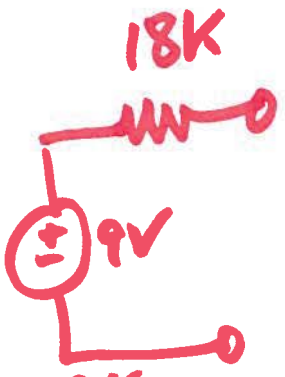
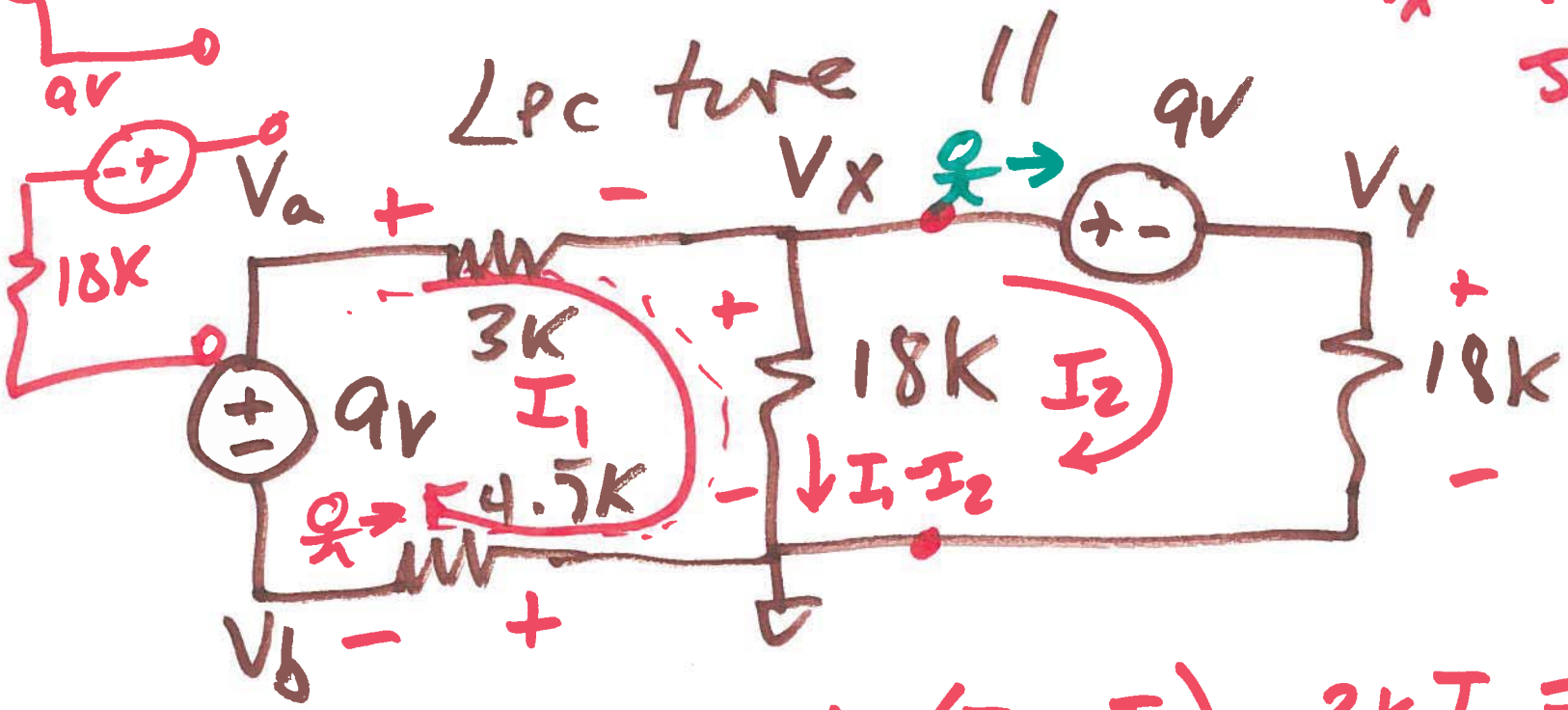
EE 220

Circuits I

Lecture 11





$V_x = 6.8\overline{3}\,V$

James's answer

$4.5k \cdot I_1 + 18k(I_1 - I_2) + 3k I_1 = 9$

$-9V - 18k\,I_2 + 18k(I_1 - I_2) = 0$

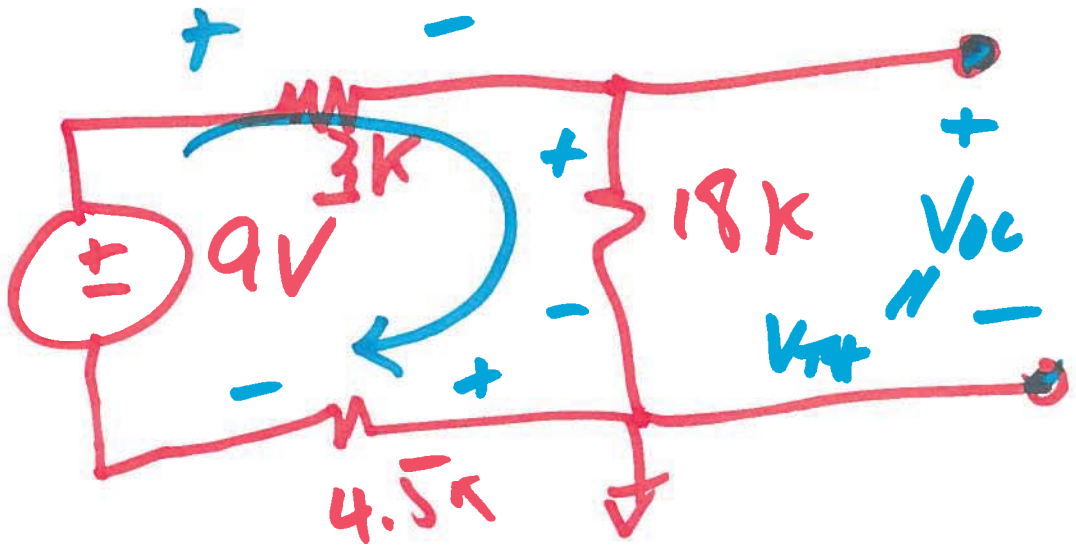
$\div 1.5k$

$3I_1 + 12(I_1 - I_2) + 2I_1 = 6mA$

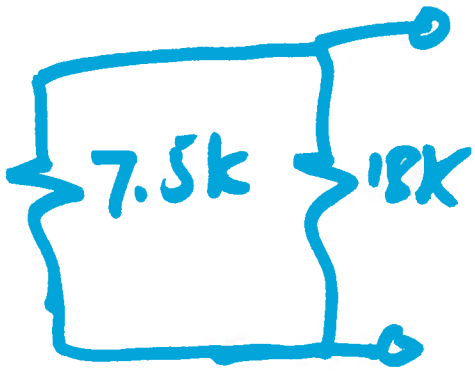
$\div 18k$

$-0.5mA - I_2 + I_1 - I_2 = 0$

1)



R_{TH} ⇒

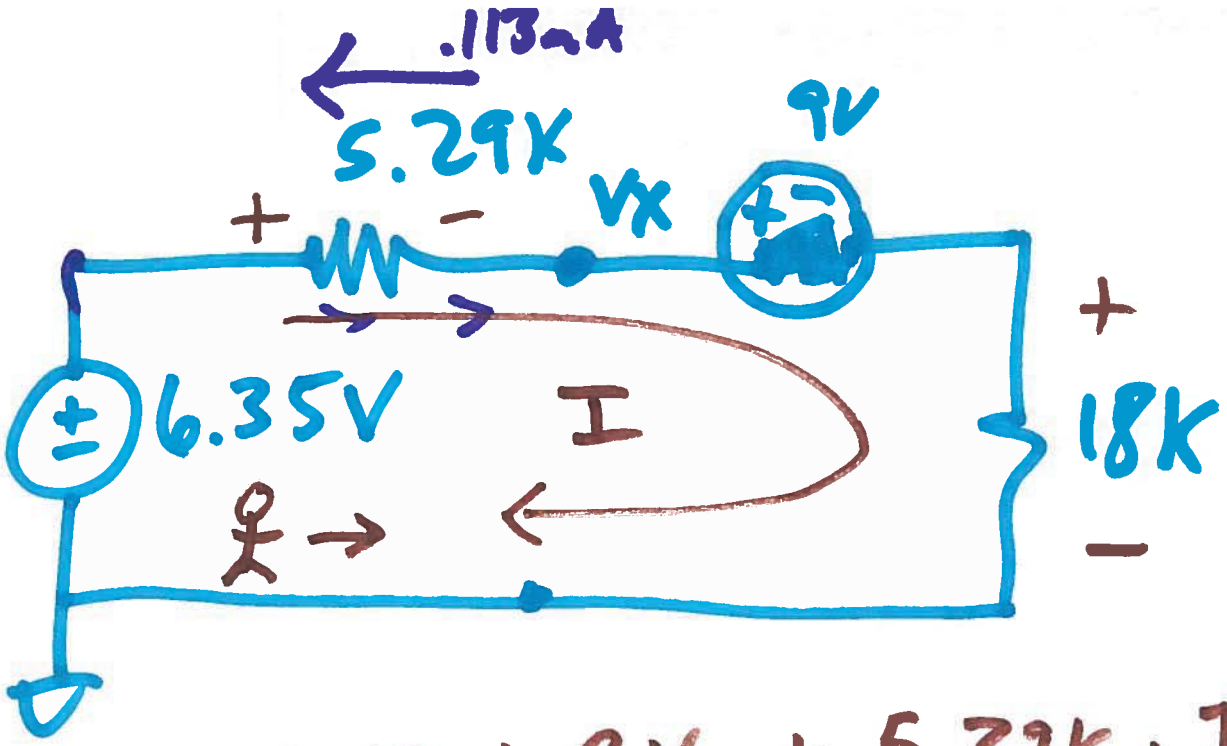


$R_{TH} = 5.29k$

$$0 = 9 - I \cdot 3k - I \cdot 18k - 4.5k I$$

$$V_{oc} = 18k \cdot I = \frac{9V \cdot 18k}{3k + 18k + 4.5k} = 350.4A \cdot 18k$$

$$V_{TH} = 6.35V$$



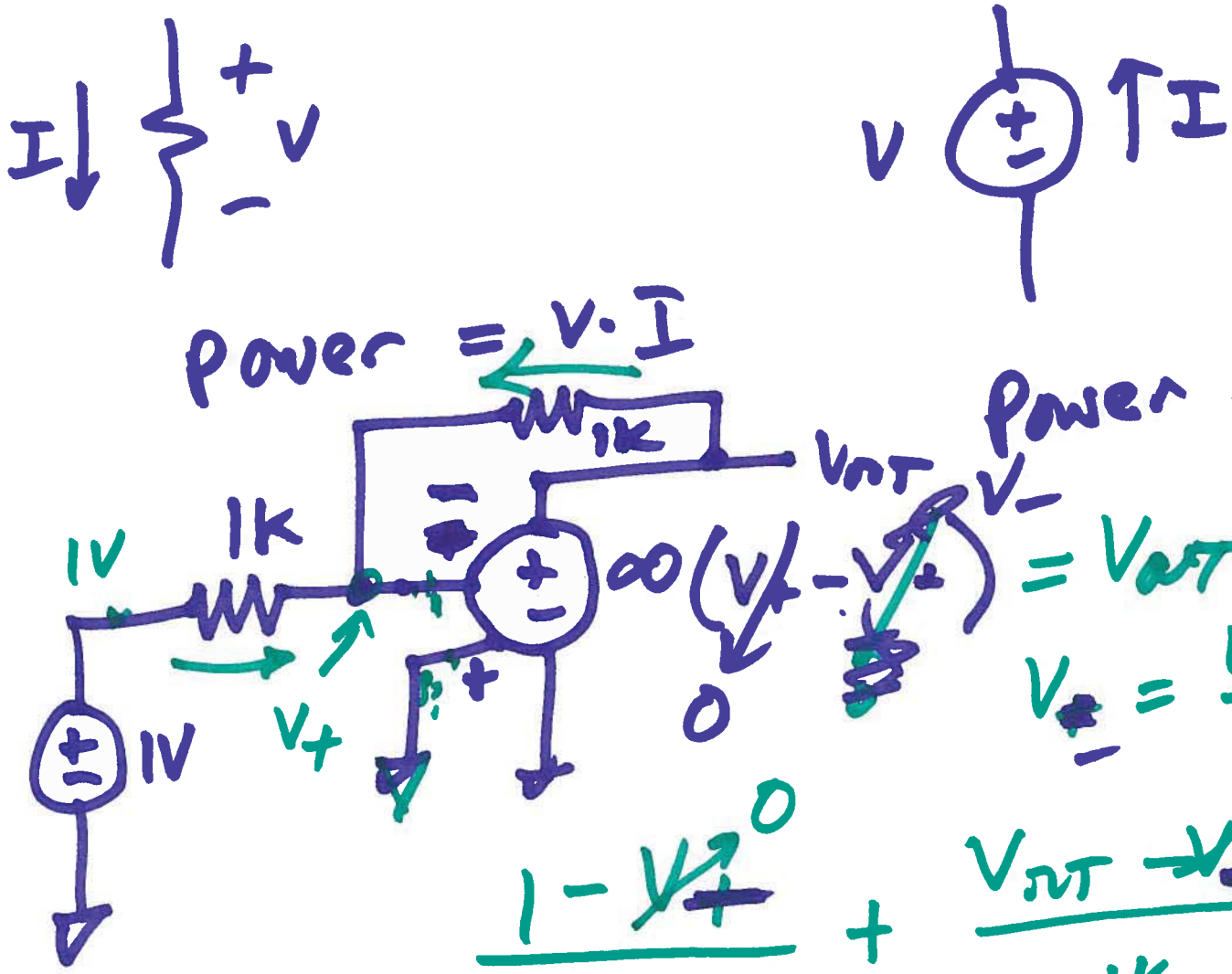
$$18K \cdot I + 9V + 5.29K \cdot I - 6.35V = 0$$

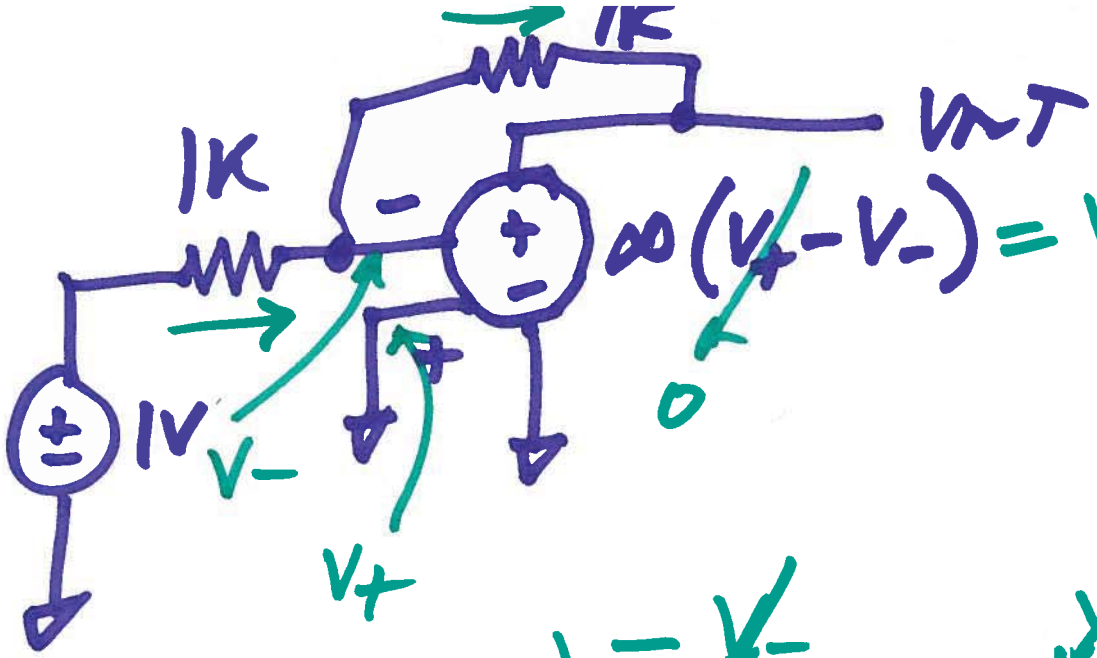
$$I = \frac{-2.65K}{23.29K} = -.113mA$$

$$-113\mu A$$

$$V_X = .113mA \cdot 5.29K + 6.35V$$

$$= 6.95V$$


I
+
V
−
V
+
−
I
Power = V · I
Power = V · (−I)
1K
V_{OUT}
1V
1k
∞
V_+
V_-
0
1V
V_+
$V_- = \frac{V_{OUT}}{\infty} = 0$
$\frac{1 - V_+}{1k} + \frac{V_{OUT} - V_+}{1K} = 0$
$V_{OUT} = \frac{-1K}{1k} = -1V$



$$V_- = \frac{V_{OUT}}{-\infty} \simeq 0$$

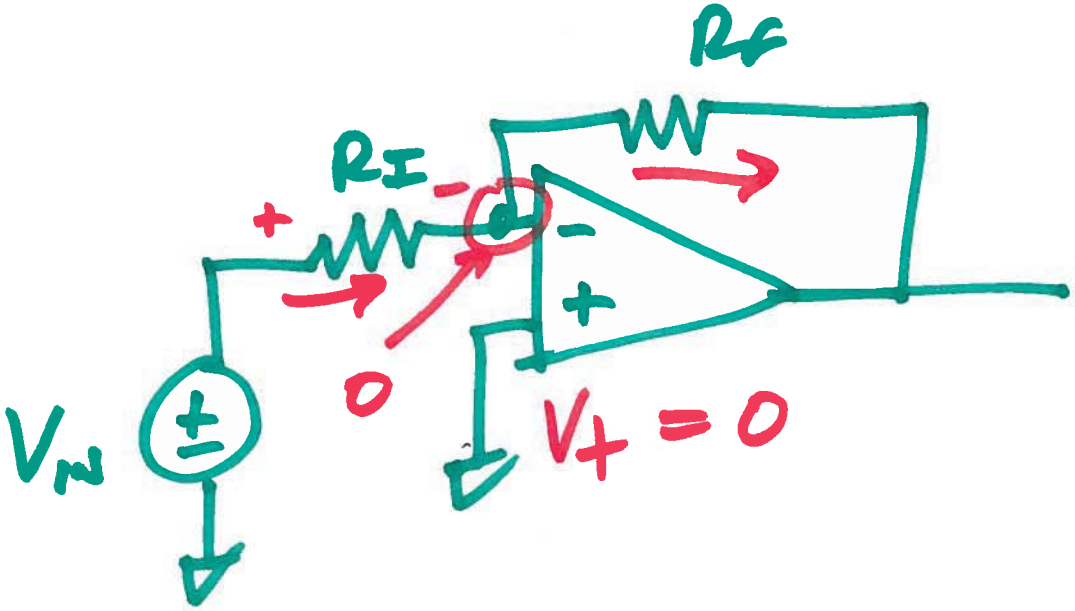
$$\frac{1 - \overset{0}{\cancel{V_-}}}{1K} - \frac{\overset{0}{\cancel{V_-}} - V_{OUT}}{1K} = 0$$

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

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

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

Inverting Op-Amp



& important!

$V_{OUT} = A_{OL}(V_+ - V_-)$

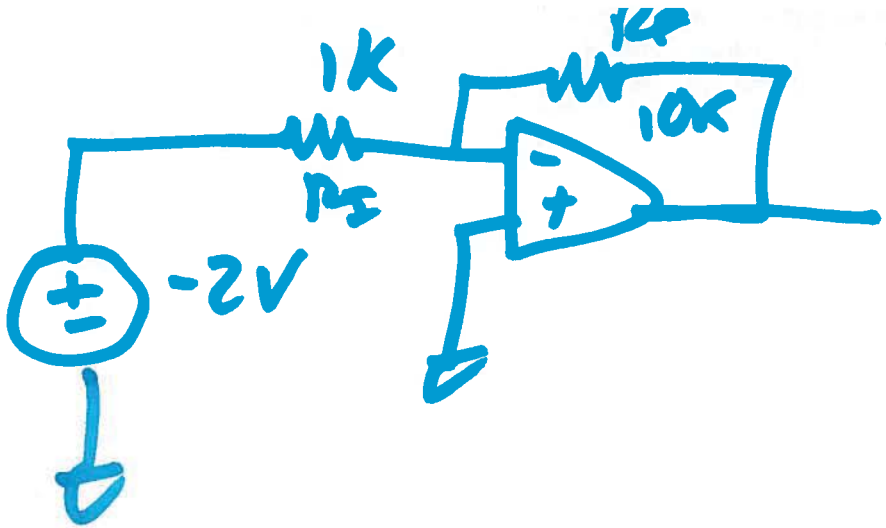
1) Determine V_+

2) SET $V_+ = V_-$

3) KCL at ~~Non~~-inverting (V_-) input

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

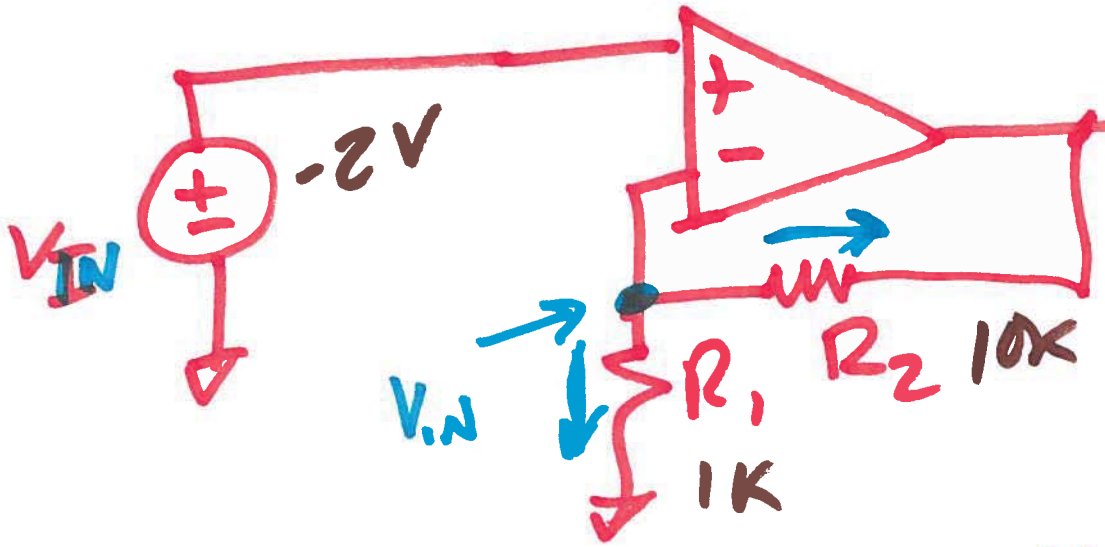
$$GAIN = \frac{V_{OUT}}{V_{IN}} = -\frac{R_F}{R_I}$$



$$V_{OUT} = -\frac{R_f}{R_1} \cdot V_{IN}$$

$$= 20V$$

NON-inverting op-Amp Amplifier



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

$= -22\,V$

$V_+ = V_{1N}$

$$\frac{V_{1N}}{R_1} + \frac{V_{1N} - V_{OUT}}{R_2} = 0$$

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

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