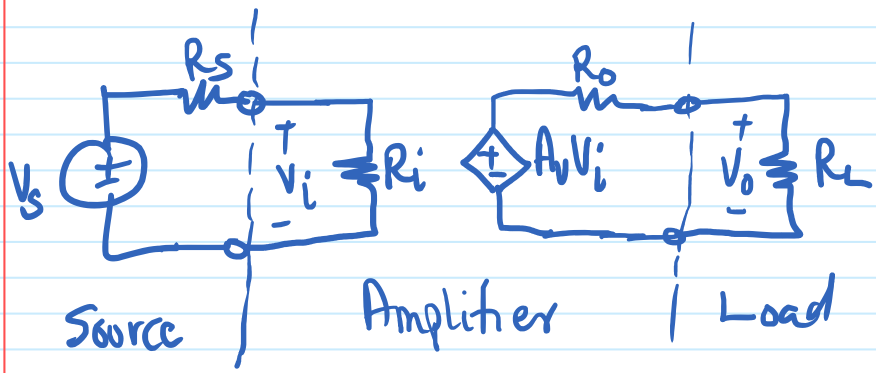
Opamp-Based Circuits

Monday, January 22, 2024 4:10 PM

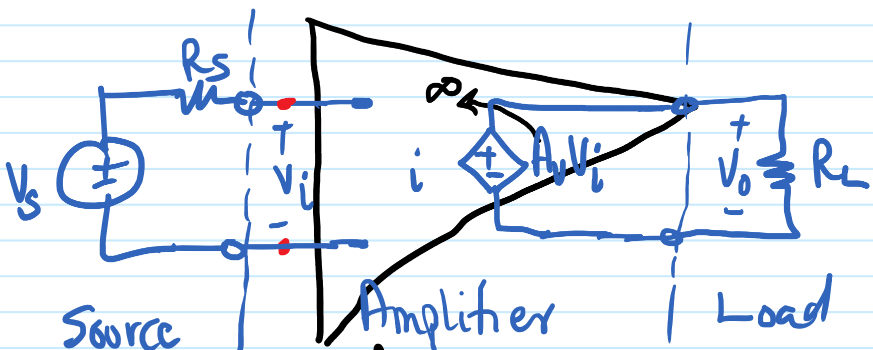


$$\frac{V_o}{V_s} = \frac{R_i}{R_s + R_i} A_v \times \frac{R_L}{R_L + R_o}$$

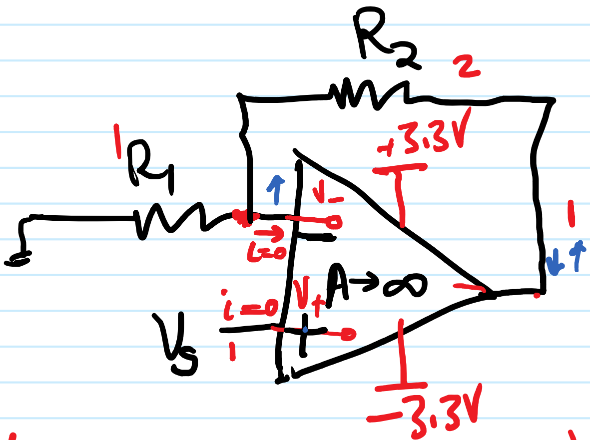
Ideal:
1. Input resistance, $R_i \to \infty$
2. Output resistance; $R_o \to 0$

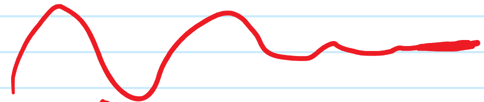
Difficult to get exact A_v

→ Make A_v very large → ∞
then use feedback to achieve desired gain



Ideal Op-amp
operational amplifier



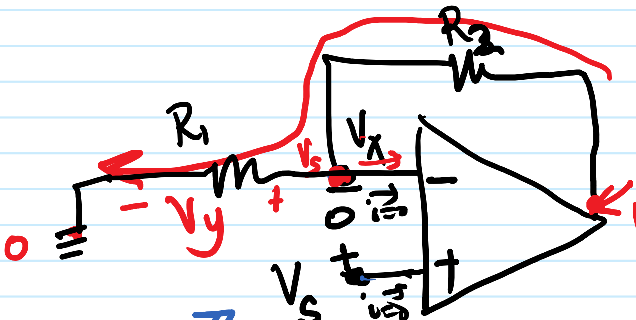


$V_o = \overset{\infty}{A}(V_+ - V_-)$

If $V_o \to 1V$.

What is $V_+ - V_-$?

$V_+ - V_- = 0$



$A \to \infty$

$V_+ = V_- = ?$

Virtual short

$V_x = V_s$ — 1

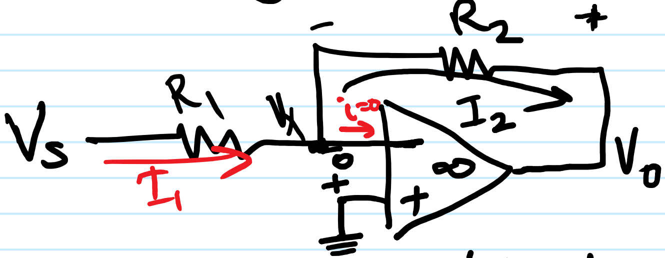
$V_y = V_o \cdot \frac{R_1}{R_1+R_2}$ $\qquad V_y = V_x$

$V_s = V_o \cdot \frac{R_1}{R_1+R_2}$

$\frac{V_o}{V_s} = \frac{R_1+R_2}{R_1} = \boxed{1+\frac{R_2}{R_1} = \frac{V_o}{V_s}}$

Non-inverting Amp

Inverting Amp

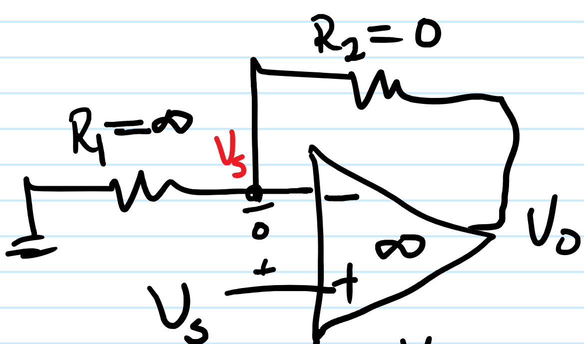


$V_x = 0 \to$ virtual short.

$$V_o = -R_2 I_2 = -R_2\left(\frac{V_s - V_x}{R_1}\right) = -\frac{R_2 V_s}{R_1}$$

$$\boxed{\frac{V_o}{V_s} = -\frac{R_2}{R_1}}$$

Buffer



$$1 + \frac{R_2}{R_1} = 1 + \frac{0}{\infty} = 1$$

$$\frac{V_o}{V_s} = 1$$