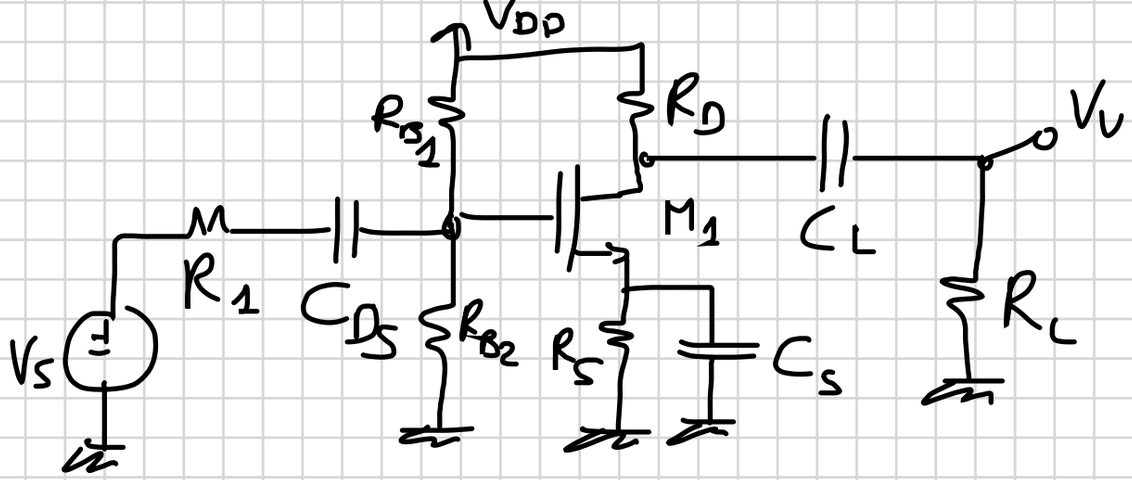
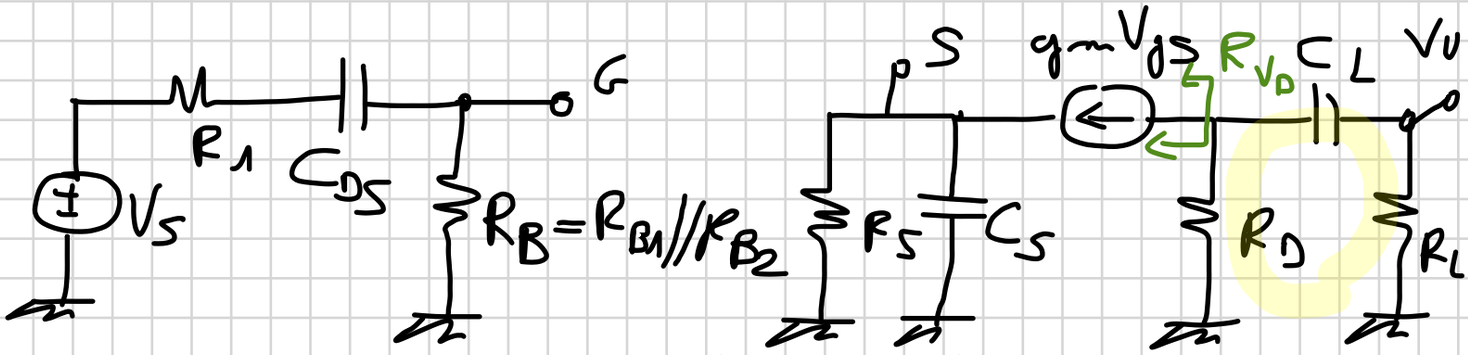


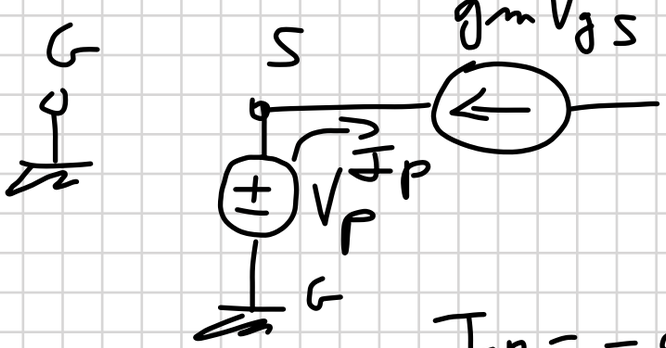


$$H(s) = \frac{V_U}{V_S} = \frac{K\, s^2 \left(\frac{s}{\omega_{z1}} + 1\right)}{\left(\frac{s}{\omega_{p1}} + 1\right)\left(\frac{s}{\omega_{p2}} + 1\right)\left(\frac{s}{\omega_{p3}} + 1\right)}$$

$$\omega_{p1} = \frac{1}{C_{DS} R_{V_{CDS}}} \; ; \; R_{V_{CDS}} = R_1 + R_B$$

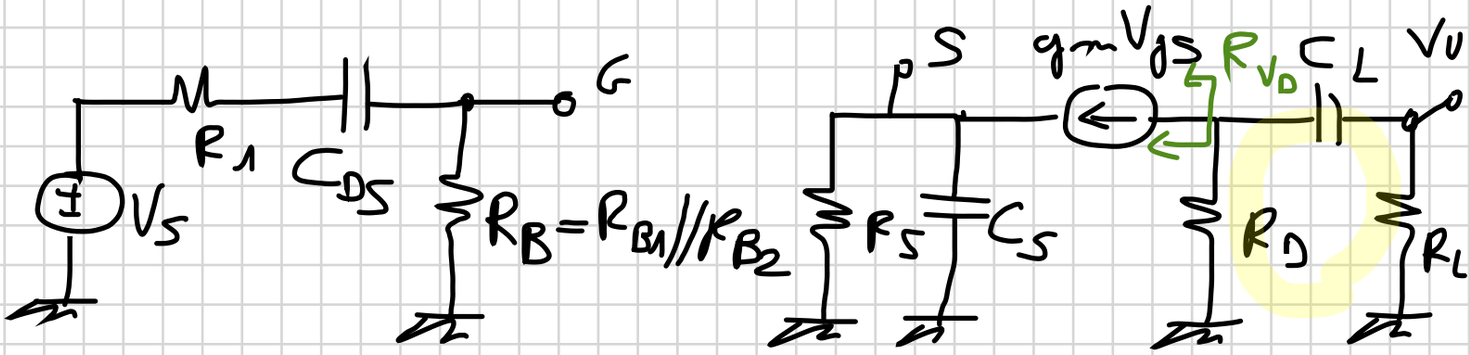
$$\omega_{p3} = \frac{1}{C_L R_{V_{CL}}} \; ; \; R_{V_{CL}} = R_L + R_D // R_{V_D} = R_L + R_D$$

$$\omega_{p2} = \frac{1}{R_{V_{CS}} C_S} \; ; \; R_{V_{CS}} = R_S // R_{V_S}' = \boxed{R_S // \frac{1}{g_m}}$$



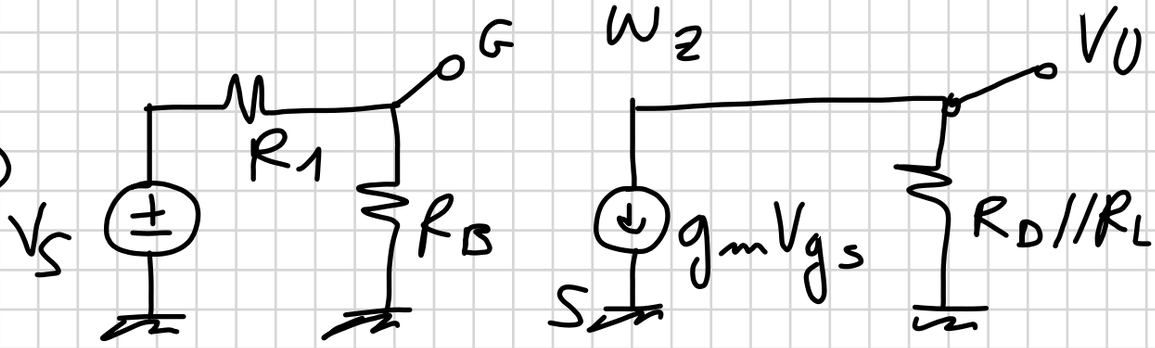
$$R_{V_S}' = \frac{V_p}{I_p}$$

$$I_p = -g_m V_{gs} \; \Big| \; V_p = -V_{gs} \; \Big| \Rightarrow R_{V_S}' = \frac{1}{g_m}$$



$$\lim_{S \to \infty} H(S) = A_{V\infty} = K \frac{W_{P1} W_{P2} W_{P3}}{W_Z}$$

$A_{V\infty} \Rightarrow$



$$V_U = -g_m R_D // R_L \, V_{gs}$$

$$V_{gs} = \frac{R_B}{R_1 + R_B} V_S$$

$$V_U = -g_m R_D // R_L \frac{R_B}{R_1 + R_B} V_S$$

$A_{V\infty}$

$W_{ZS} \Rightarrow \quad V_{GS} = V_G - V_S$

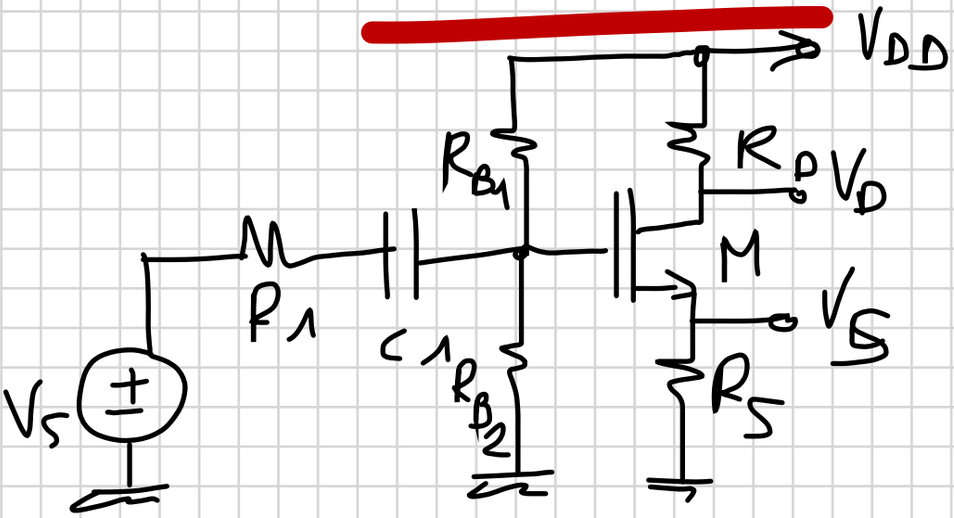
$$V_S = g_m V_{gs} \, R_S // \frac{1}{C_S}$$

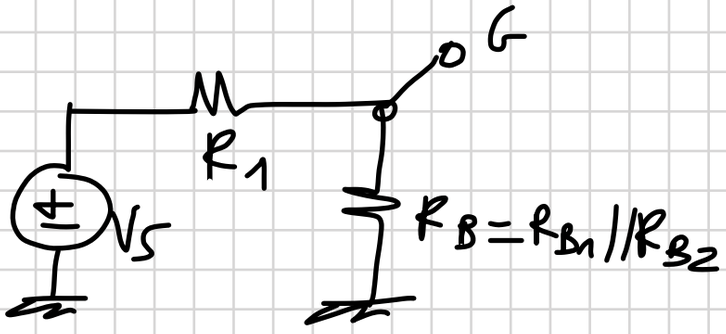
$$V_S = g_m V_{gs} \frac{\frac{R_S}{C_S}}{R_S + \frac{1}{C_S}} = \frac{g_m V_{gs} R_S}{1 + R_S C_S}$$

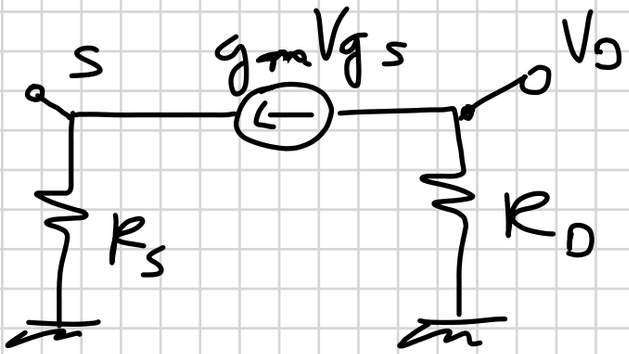
$$V_{gs} = V_G - \frac{g_m V_{gs} R_S}{1 + R_S C_S s}$$

$$V_{gs}\left[1 + \frac{g_m R_S}{1 + R_S C_S s}\right] = V_G$$

$$\omega_{zS} = \frac{1}{R_S C_S}$$







$$V_g = \frac{R_B}{R_1 + R_B} V_S \qquad V_{source} = R_S g_m V_{gs}$$

$$V_{gs} = V_g - V_{source} = \frac{R_B}{R_1 + R_B} V_S - R_S g_m V_{gs}$$

$$R_1 \ll R_B \Rightarrow V_g \simeq V_S$$

$$V_{gs} = V_s - g_m R_s V_{gs}$$

$$(1 + g_m R_s) V_{gs} = V_s$$

$$V_{gs} = \frac{V_s}{1 + g_m R_s}$$

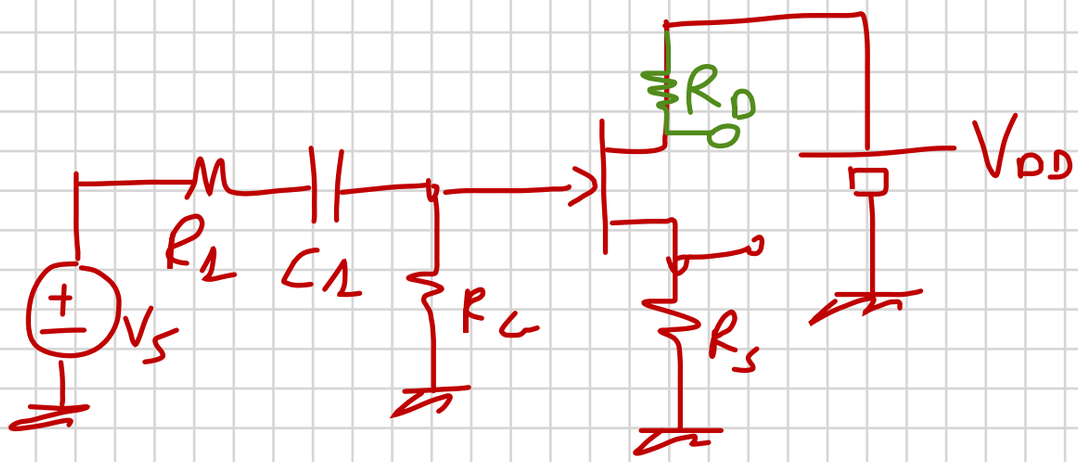
$$V_D = -g_m V_{gs} R_D$$

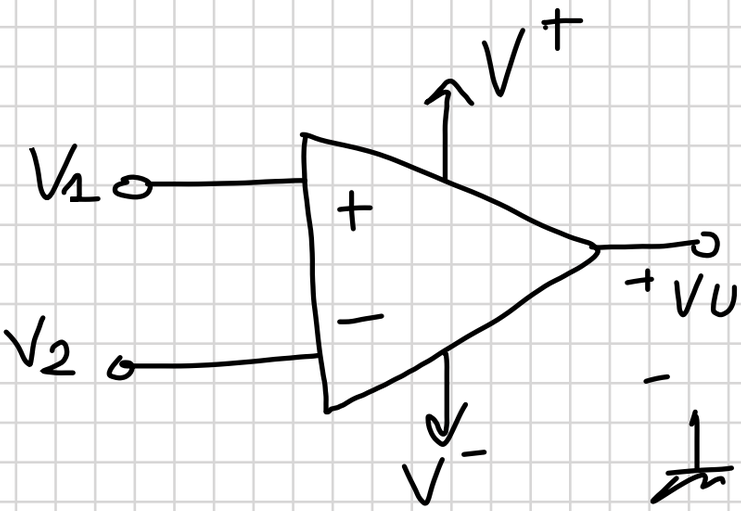
$$V_D = -\frac{g_m R_D}{1 + g_m R_s} V_s \Longrightarrow \boxed{A_{VD} = \frac{V_D}{V_s} = \frac{-g_m R_D}{1 + g_m R_s}}$$

$$g_m R_s \gg 1 \Longrightarrow A_{VD} = -\frac{R_D}{R_s}$$

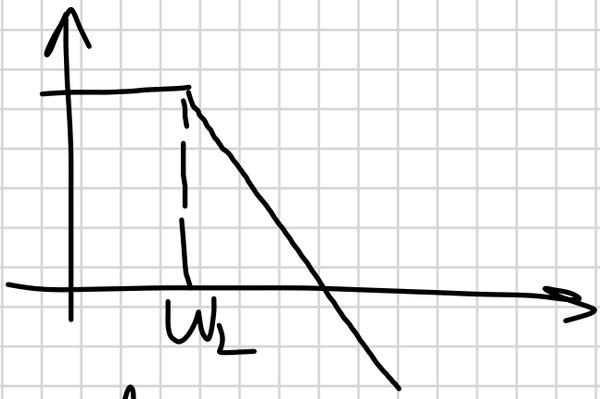
$$V_{source} = g_m R_s V_{gs} = \frac{g_m R_s}{1 + g_m R_s} V_s$$

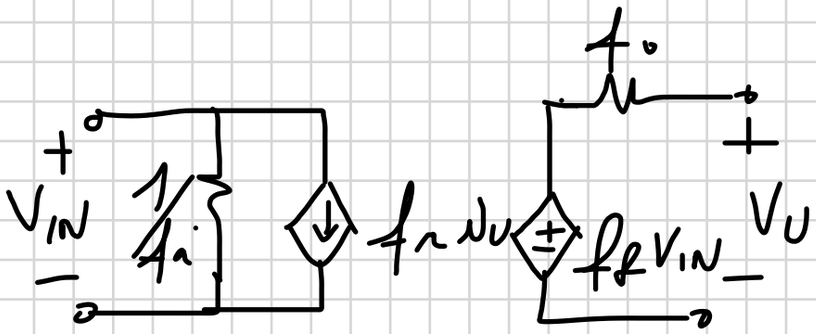
$$A_{VS} = \frac{V_{source}}{V_s} = \frac{g_m R_s}{1 + g_m R_s} \overset{g_m R_s \gg 1}{\simeq} 1$$





$$V_U = A(V_1 - V_2)$$



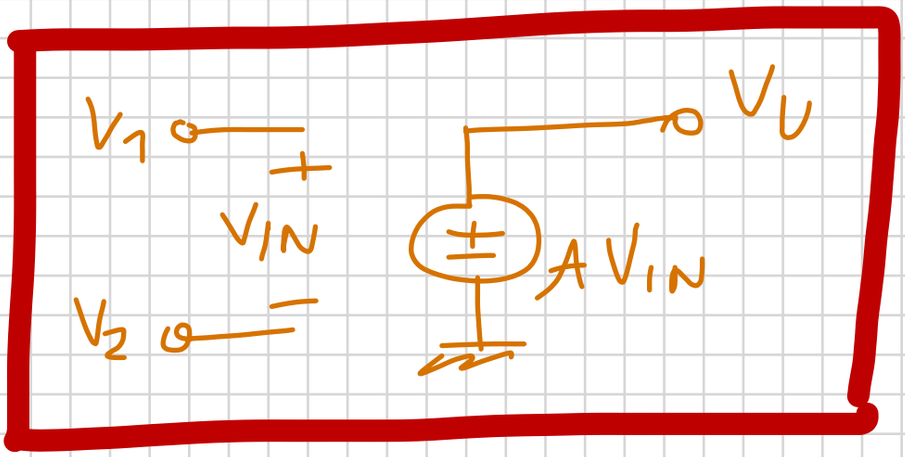


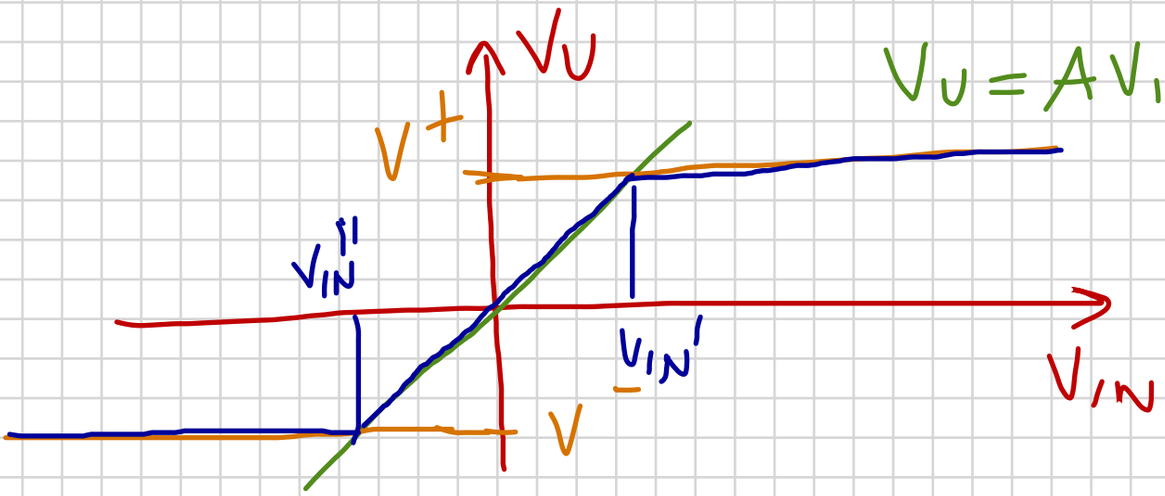
$f_0 = 0$

$f_2 = 0$

$f_f \to +\infty$

$\omega_L \to +\infty$





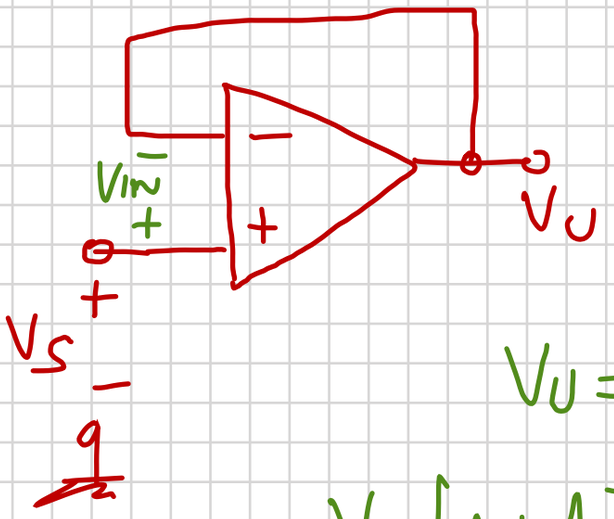
$V_U = A V_{IN}$

$V^+ = -V^- = 15\,V$

$A = 100\,000$

$V_{IN}' = -V_{IN}'' = \frac{15}{100\,000} =$

$= 150\,\mu V$



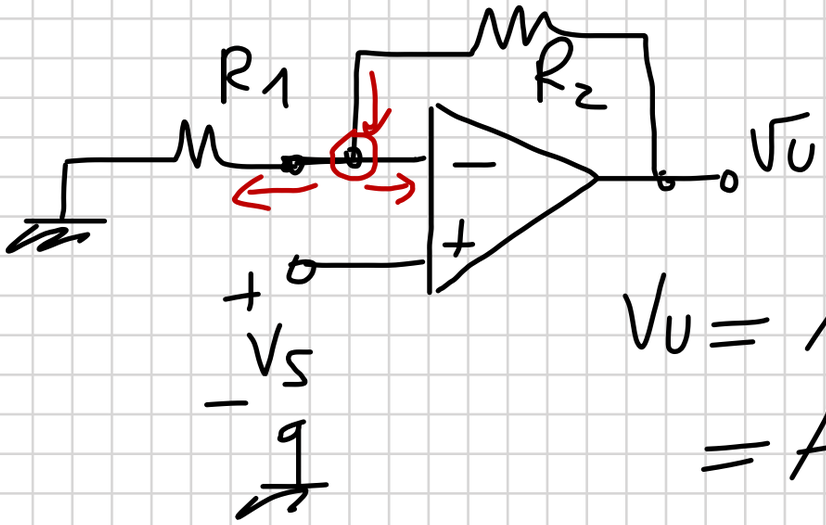
$$V_U = V_S - V_{IN}$$

$$V_U = A V_{IN}$$

$$V_U = V_S - \frac{V_U}{A}$$

$$V_U \left[1 + \frac{1}{A}\right] = V_S$$

$$V_U = \frac{A}{1+A} V_S \qquad A \to +\infty \Rightarrow \boxed{V_U = V_S}$$



$$V_U = A(V_1 - V_2) =$$

$$= A(V^+ - V^-)$$

$$V^+ = V_S \; ; \; V^- = \frac{R_1}{R_1 + R_2} V_U$$

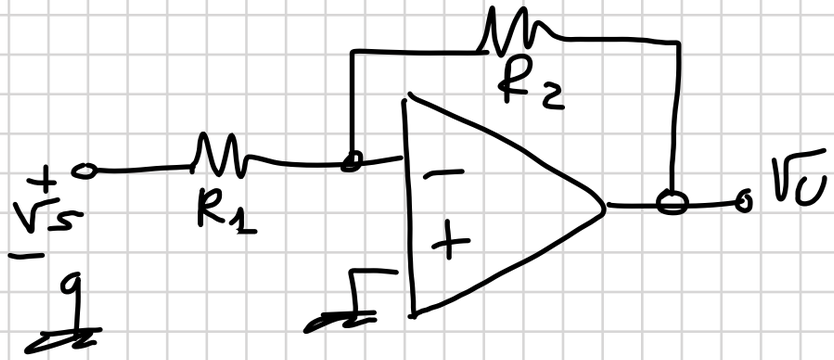
$$V_U = A\left(V_S - \frac{R_1}{R_1+R_2} V_U\right)$$

$$V_U \left[1 + \frac{A R_1}{R_1+R_2}\right] = A V_S$$

$$V_U = \frac{A}{1 + \frac{A R_1}{R_1+R_2}} V_S$$

$$A_V \overset{A \to +\infty}{=} \left(1 + \frac{R_2}{R_1}\right)$$

A_V



$$V_U = A(V^+ - V^-) \qquad V^+ = 0$$

$$V^- = \frac{R_2}{R_1+R_2} V_S + \frac{R_1}{R_1+R_2} V_U$$

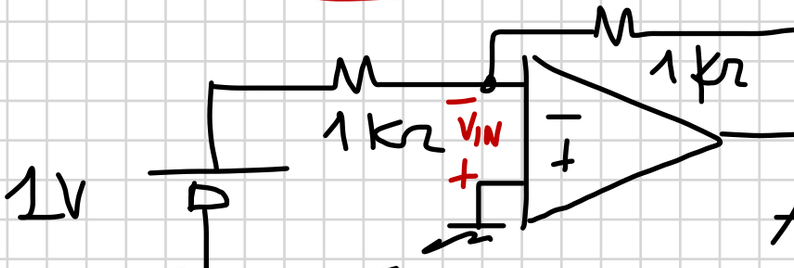
$$V_U = -A\left(\frac{R_2}{R_1+R_2} V_S + \frac{R_1}{R_1+R_2} V_U\right)$$

$$V_U\left[1 + \frac{A R_1}{R_1+R_2}\right] = -\frac{A R_2}{R_1+R_2} V_S$$

$$V_U = \frac{-\frac{A R_2}{R_1+R_2}}{1+\frac{A R_1}{R_1+R_2}} V_S$$

A_V

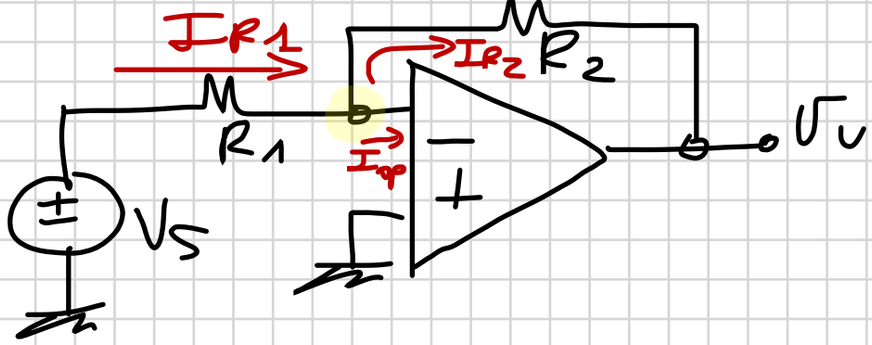
$$A_V \xrightarrow{A \to +\infty} -\frac{R_2}{R_1}$$



$$A_{VOLD} = \frac{V_U}{V_{IN}}$$

$$A_{VOLD} = 10^5$$

$$V_U = -1 \Rightarrow V_{IN} = -10\,\mu V$$



$V^- \simeq V^+ \qquad V^+ = 0 \Rightarrow V^- \simeq 0$

$$I_{R1} = \frac{V_S}{R_1}$$

$I_{R1} = I_{op} + I_{R2} \qquad I_{op} = 0$

$I_{R1} = I_{R2}$

$$V_U = -R_2 I_{R2} = -R_2 I_{R1} = -\frac{R_2 V_S}{R_1}$$

$$A_V = -\frac{R_2}{R_1}$$