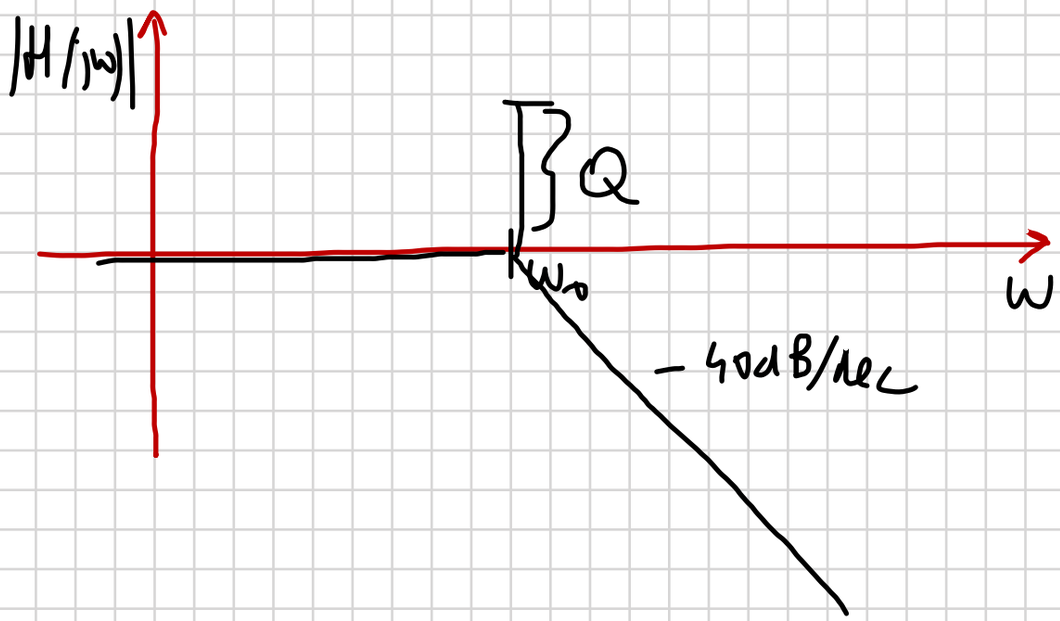
$$H(s) = \frac{1}{\frac{s^2}{\omega_0^2} + \frac{s}{Q\omega_0} + 1}$$

$$H(j\omega) = \frac{1}{1 - \frac{\omega^2}{\omega_0} + \frac{j\omega}{Q\omega_0}}$$

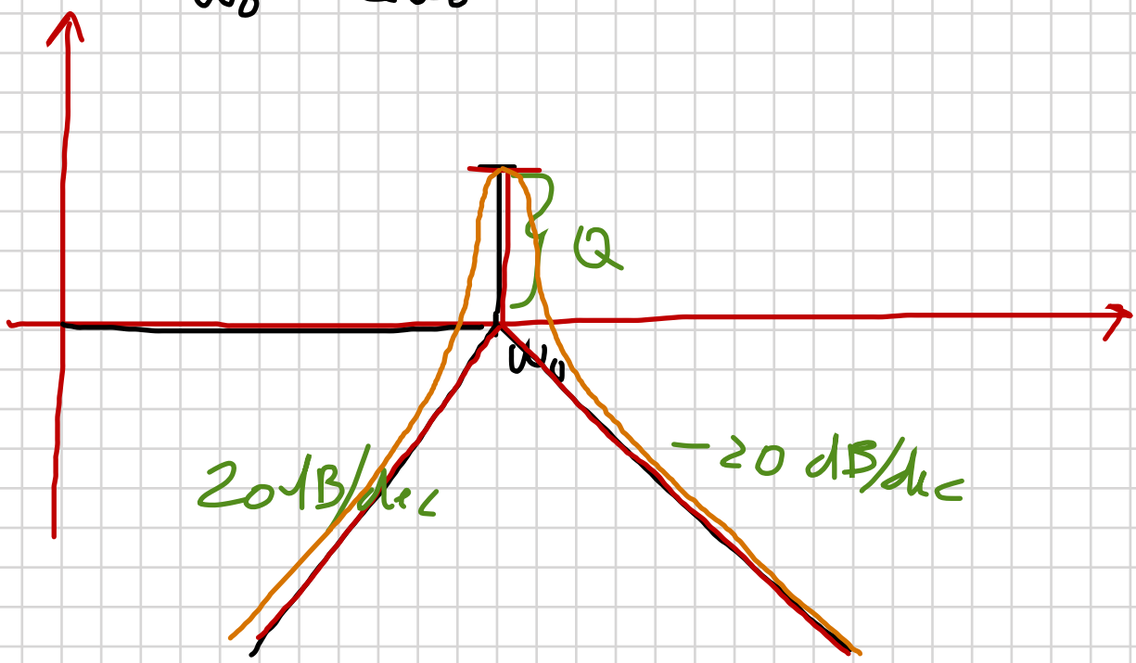
$$|H(j\omega)|^2 = \frac{1}{\frac{\omega^2}{Q^2\omega_0^2} + \left(1 - \frac{\omega^2}{\omega_0^2}\right)^2}$$

$$|H(j\omega_0)|^2 = \frac{1}{\frac{1}{Q^2}} = Q^2$$

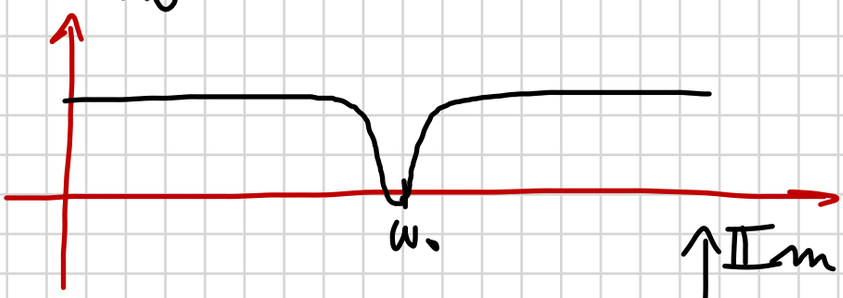
$$|H(j\omega_0)| = Q$$

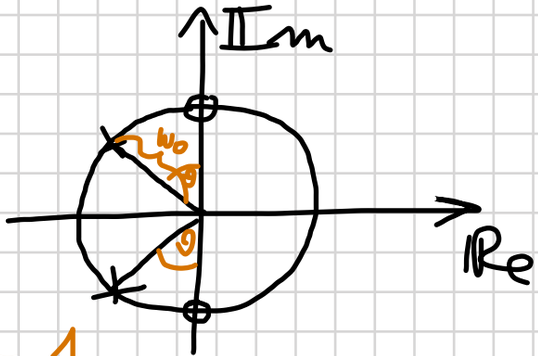


$$H(s) = \frac{ks}{\frac{s^2}{\omega_0^2} + \frac{s}{Q\omega_0} + 1}$$



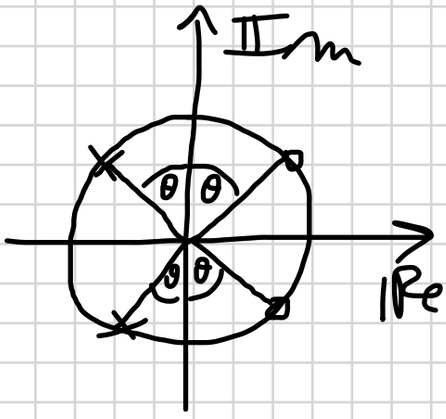
$$H(s) = \frac{\frac{s^2}{\omega_0^2} + 1}{\frac{s^2}{\omega_0^2} + \frac{s}{Q\omega_0} + 1}$$

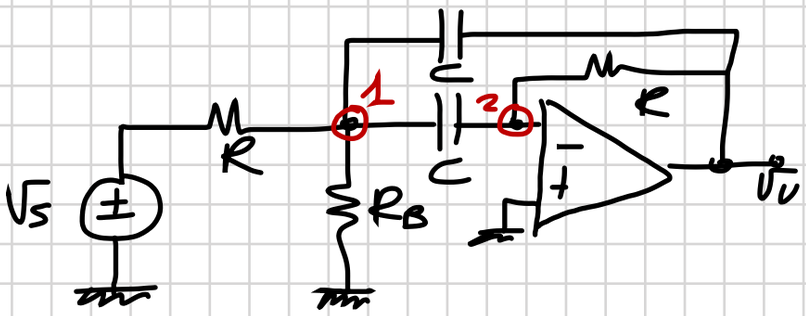




$$Q = \frac{1}{\sin\theta}$$

$$H(s) = \frac{\frac{s^2}{\omega_0^2} - \frac{s}{Q\omega_0} + 1}{\frac{s^2}{\omega_0^2} + \frac{s}{Q\omega_0} + 1}$$





$$\begin{cases} \dfrac{V_1 - V_S}{R} + \dfrac{V_1}{R_B} + V_1 C s + (V_1 - V_U) C s = 0 \\ V_U = -RCs V_1 \Rightarrow V_1 = -\dfrac{V_U}{RCs} \end{cases}$$

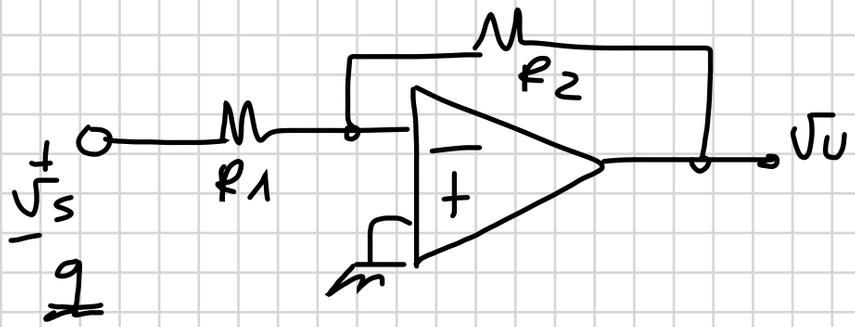
$$V_1 \left[\frac{1}{R} + \frac{1}{R_B} + Cs + Cs + RC^2 s^2 \right] = \frac{V_S}{R}$$

$$V_1 \left[1 + \frac{R}{R_B} + 2RCs + R^2 C^2 s^2 \right] = V_S$$

$$V_1 = \frac{V_S}{R^2 C^2 s^2 + 2RCs + \dfrac{R_B + R}{R_B}}$$

$$\boxed{V_U = -\frac{RCs\, V_S}{R^2 C^2 s^2 + 2RCs + \dfrac{R_B + R}{R_B}}}$$

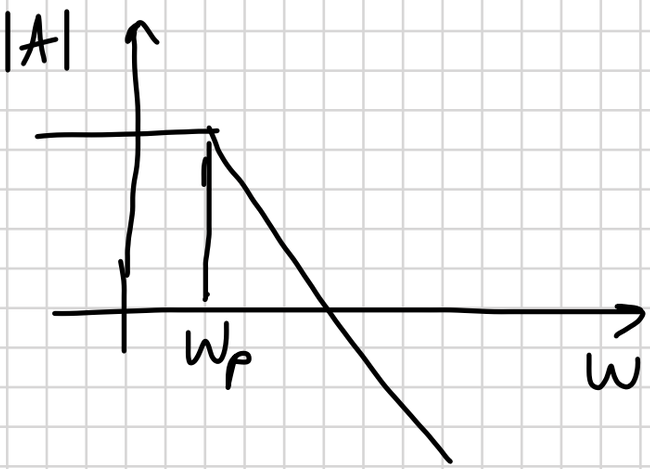
$$H(s) = \frac{V_U}{V_S} = \frac{-RCs}{R^2 C^2 s^2 + 2RCs + \dfrac{R_B + R}{R_B}}$$



$$\frac{V_U}{V_S} = -\frac{R_2}{R_1}$$

$$A = A_{VOL\phi}$$

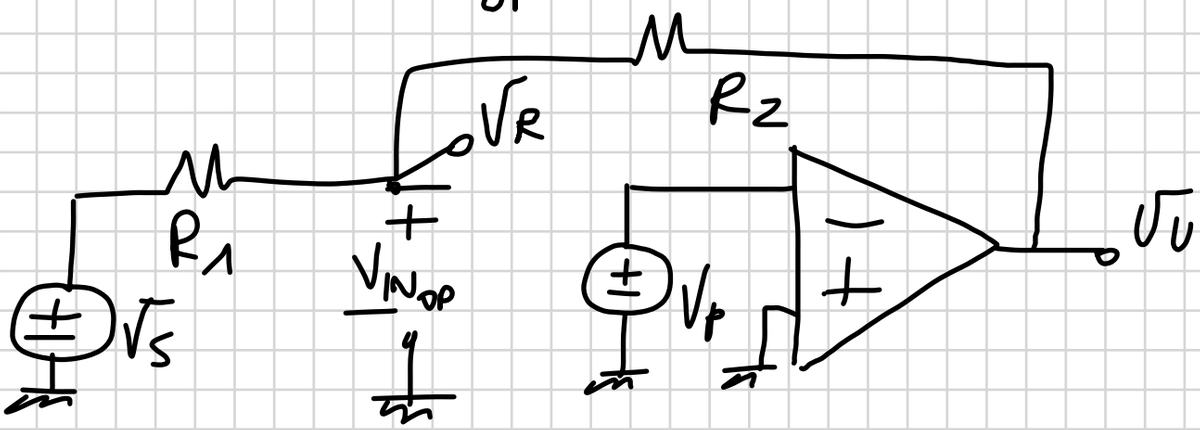
$$A = \frac{A_{VOL\phi}}{1 + \frac{S}{\omega_p}}$$



$$V^- \simeq V^+$$

$$V_{IN_{OP}} \ll V_S$$

$$V_U = A V_{IN_{OP}}$$



$$V_{IN_{OP}} \ll V_S \qquad V_{IN_{OP}} = V_R$$

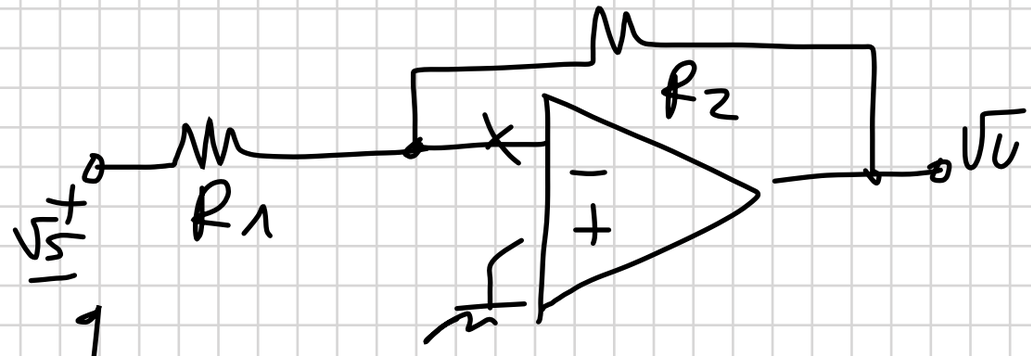
$$V_R = \frac{\alpha V_S}{1 - \beta A} \ll V_S$$

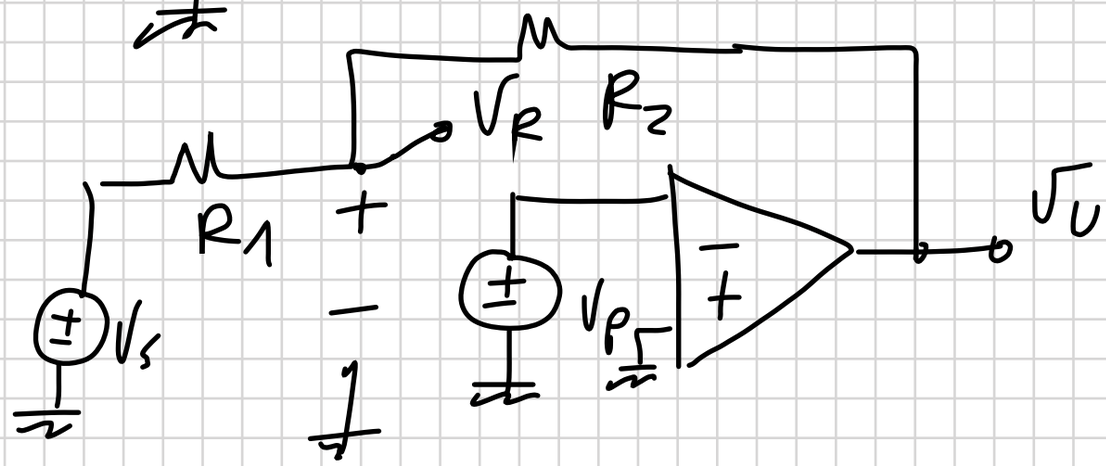
$$\alpha \ll 1 - \beta A \qquad |\beta A| \gg 1$$

$$\alpha << |\beta A|$$

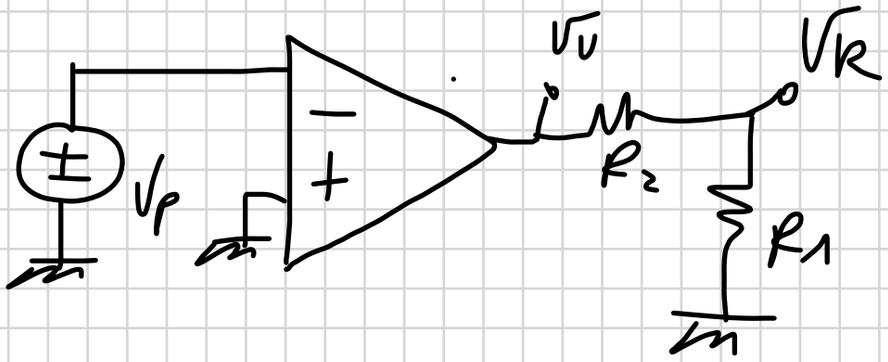
$$\alpha \simeq \alpha_0 < 1$$

$$\boxed{|\beta A| >> 1}$$

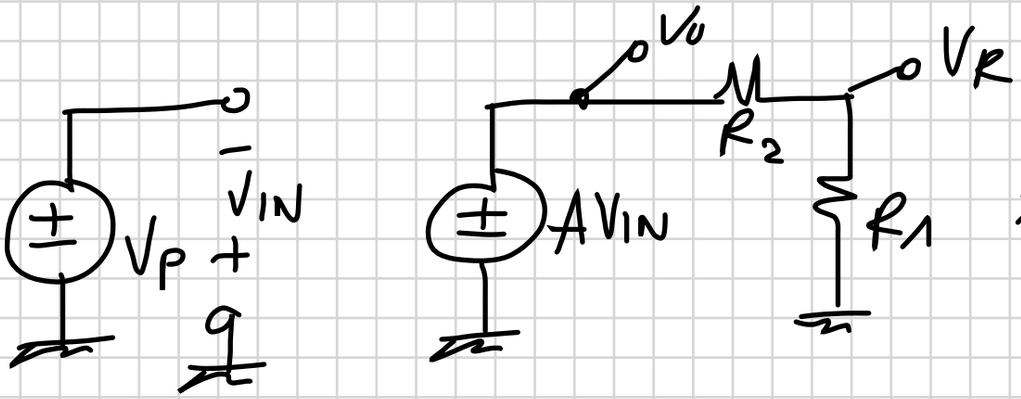




$$\beta A = \left.\frac{V_R}{V_p}\right|_{V_s=0}$$



$$\beta A =$$



$$A = \frac{A_{VOL0}}{1 + \frac{s}{\omega_p}}$$

$$\beta A = \left.\frac{V_R}{V_P}\right|_{V_S=0} \Rightarrow$$

$$V_O = A V_{IN} \qquad V_{IN} = -V_P$$

$$V_O = -A V_P = -\frac{A_{VOL0} V_P}{1 + \frac{s}{\omega_p}}$$

$$V_R = \frac{R_1}{R_1 + R_2} V_O$$

$$V_R = \frac{R_1}{R_1 + R_2}\left(-\frac{A_{VOL0}}{1 + \frac{s}{\omega_p}}\right) V_P$$

$$\beta A = \frac{V_R}{V_P} = -\frac{A_{VOL0}\frac{R_1}{R_1+R_2}}{1 + \frac{s}{\omega_p}}$$

$$|\beta A| \gg 1 \qquad |\beta A| > 10$$

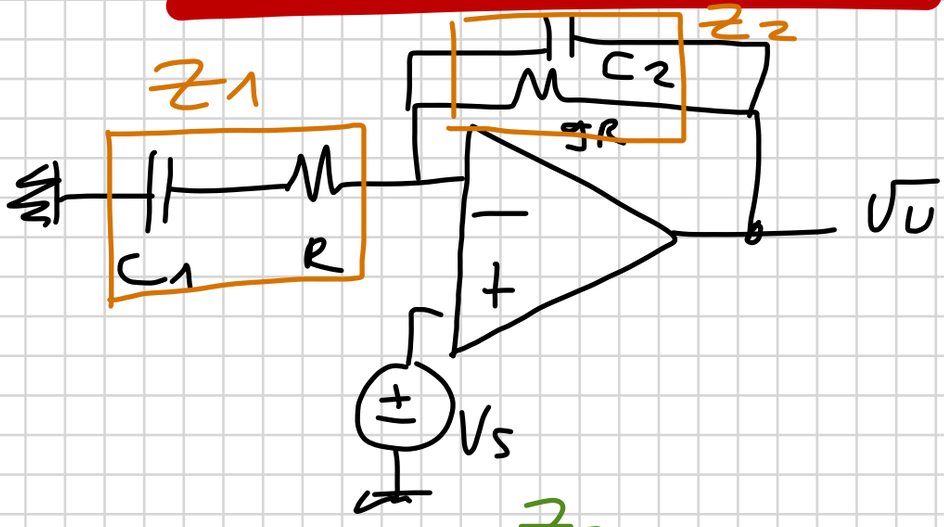
$$|\beta A| = \frac{A_{VOL0}\frac{R_1}{R_1+R_2}}{\sqrt{1 + \frac{\omega^2}{\omega_{p2}}}} = 10 = A_L$$

$$\frac{A_{VOL\phi}\frac{R_1}{R_1+R_2}}{\sqrt{1+\frac{\omega^2}{\omega_p^2}}} = A_L = 10$$

$$\frac{A_{VOL\phi}^2\left(\frac{R_1}{R_1+R_2}\right)^2}{A_L^2} = 1+\frac{\omega^2}{\omega_p^2}$$

$$\omega = \omega_p\sqrt{\frac{A_{VOL\phi}^2\left(\frac{R_1}{R_1+R_2}\right)^2}{A_L^2} - 1} \quad \simeq$$

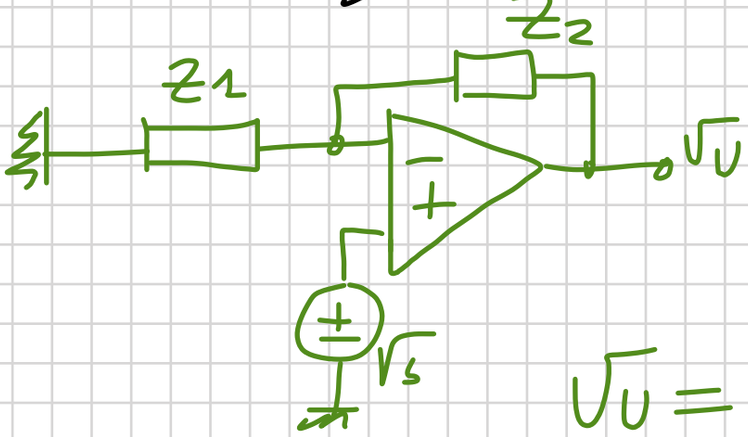
$$\simeq \omega_p \frac{A_{VOL\phi}}{A_L}\frac{R_1}{R_1+R_2}$$



$R = 1k\Omega$

$C_1 = 10\mu F$

$C_2 = 10nF$



$$V_U = \left(1+\frac{Z_2}{Z_1}\right)V_S$$

$$Z_1 = \frac{RC_1 s + 1}{C_1 s} \quad ; \quad Z_2 = \frac{R_2}{R_2 C_2 s + 1}$$

$$\sqrt{U} = \sqrt{S}\left[1 + \frac{R_2 C_1 s}{(R_2 C_2 s + 1)(RC_1 s + 1)}\right] =$$

$$= \frac{(S + z_1)(S + z_2)}{(S + p_1)(S + p_2)} \sqrt{S}$$

$$p_1 = \frac{1}{RC_1} \quad (f_1 = 15{,}9\ \text{Hz})$$

$$p_2 = \frac{1}{R_2 C_2} = 111\, p_1$$

$$z_1 = 1112\, p_1 \quad ; \quad z_2 = 0{,}09992\, p_1$$

$$H(S \to 0) = \frac{z_1 z_2}{p_1 p_2} = 1$$