Yesterday:

$$A_v = -\frac{R_2}{R_1}\frac{A_{OL}}{\frac{R_2}{R_1}+1+A_{OL}}$$

Target gain $= -\frac{R_2}{R_1}$

if $A_{OL} \to \infty$ $\quad A_v = -\frac{R_2}{R_1}$

if $A_{v\,target} \to \infty$ $\quad A_v = A_{OL}$

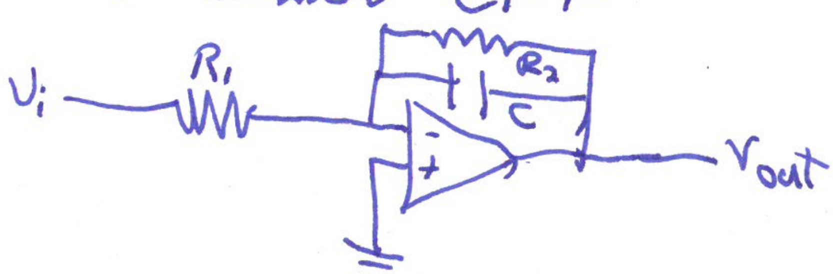
Examples:

$A_{OL} = 10^5$ $\quad$ 100dB

10^3 $\quad$ 60dB

$$V_- = -\frac{V_{out}}{A_{OL}}$$

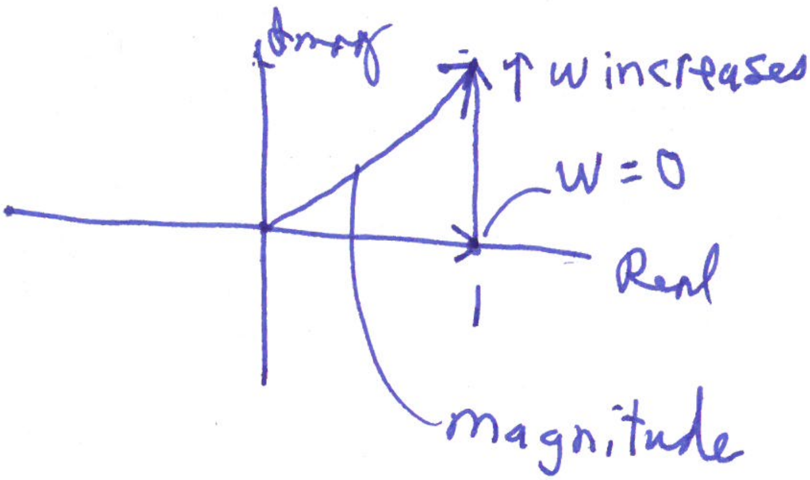
Remember LPF



$$A_v = -\frac{R_2}{R_1R_2j\omega C + R_1}$$

$$= -\frac{R_2}{R_1}\frac{1}{1+R_2j\omega C}$$

Denominator



$$\frac{1}{j} = \frac{j}{jj} = \frac{j}{-1} = -j$$

cutoff frequency

$$1 = R_2 w_c C \qquad w = 2\pi f$$

$$A_v = -\frac{R_2}{R_1} \frac{1}{1 + j w/w_c} = -\frac{R_2}{R_1} \frac{1}{1 + j\frac{f}{f_c}}$$

$$A_v(f) = A_v(0) \frac{1}{1 + j f/f_c}$$

Lorentzian

For a real op Amp

$$A_{OL}(f) = A_{OL}(0) \frac{1}{1 + jf/f_{BOL}}$$

characteristics of the op Amp

$$A_{VOL}(f) = -\frac{R_2}{R_1}\,\frac{A_{OL}(f)}{\frac{R_2}{R_1} + 1 + A_{OL}(f)}$$

A_{VOL} ← No Load ($R_L \to \infty$)

← Gain of the circuit

$A_{OL}(f)$ ← A_{OL} of the op Amp

$$A_{VOL}(f) = -\frac{R_2}{R_1}\,\frac{A_{OL}(0)\frac{1}{1+jf/f_{BOL}}}{\frac{R_2}{R_1} + 1 + A_{OL}(f)\frac{1}{1+jf/f_{BOL}}}$$

After some math

$$A_{VOL}(0)\ f_B = A_{OL}\ f_{BOL}$$

$A_{VOL}(0)$ ← gain, f_B ← bandwidth of the circuit

$A_{OL}\ f_{BOL}$ ← Gain Bandwidth of the op Amp

$$A_{VOL}(f) = -\frac{R_2}{R_1}\,\frac{1}{1+jf/f_B}$$

Gain - Bandwidth Product is Constant

$\cancel{A_{VOL}(0)\, f_{BO}}$

$$A_o\, f_{BOL} = 10^6\ Hz$$

If I ~~a~~sk for $A_{VOL}(0) = \cancel{20\,dB}\ 10\ (20\,dB)$

$$f_B = \frac{10^6\ Hz}{10} \qquad \left(\frac{\cancel{A_{VOL}}\, A_{OL} f_{BOL}}{A_{VOL}(0)} \right)$$

$$= 10^5\ Hz$$