Analog Oct 18

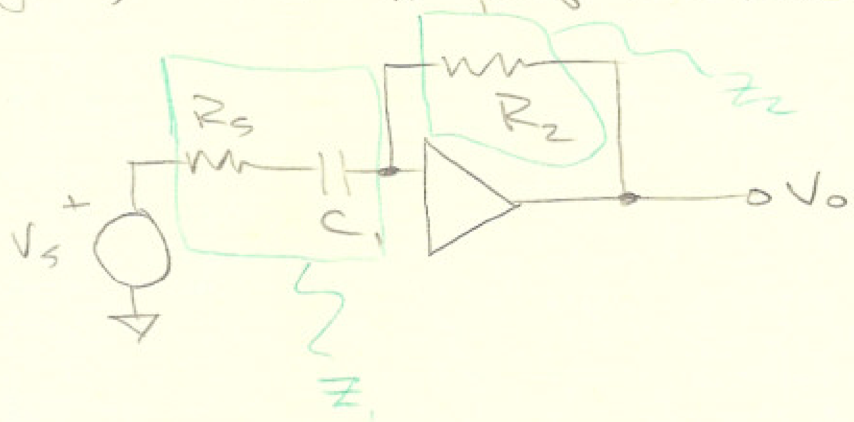
Assignment #4. 5.15, 5.17, 5.20, 5.30

Due tues Oct 30.

DP 5.22

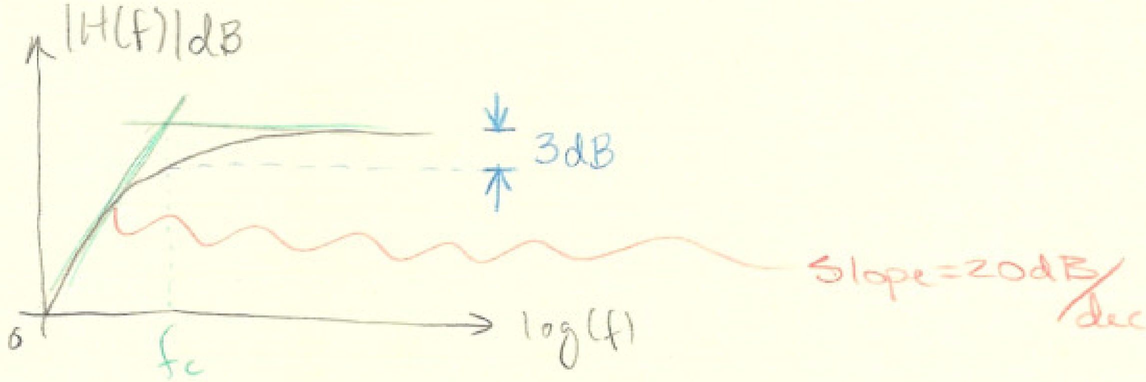
Design for cut off freq 100 kHz

A//



$$Z_1 = R_s + \frac{1}{j\omega C_1} \qquad Z_2 = R_2$$

$$H(f) = \frac{V_o}{V_s} = \frac{-R_2}{R_s + \frac{1}{j\omega C}} = \frac{-R_2 j\omega C_1}{1 + j\omega C_1 R_s}$$



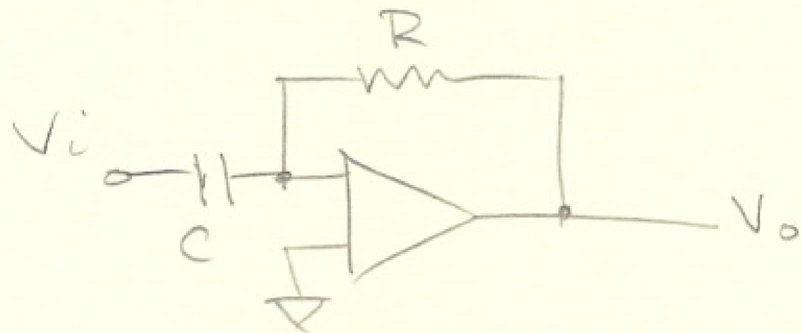
$$f \to \infty \implies |H(f)| = \frac{R_2}{R_s}$$

$$f \to 0 \implies |H(f)| = 0$$

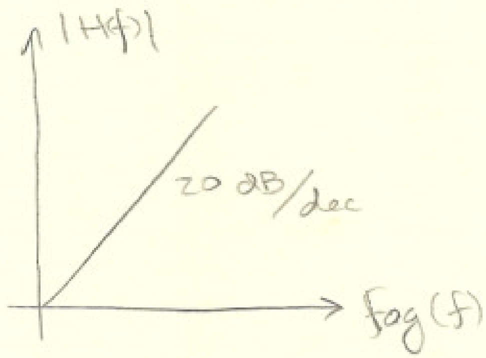
$$\omega_c R_s C_1 = 1 \Rightarrow f_c = \frac{1}{2\pi R_s C_1}$$

note:
$$20 \log\left(\frac{1}{\sqrt{2}}\right) = -3\,dB$$

Ideal Differential Cct.



$$\frac{V_o}{V_i} = -RC\frac{dV_i}{dt}.$$



EX: Continued from last example.

$$100\,kHz = \frac{1}{2\pi(1K\Omega)C_1}$$

$$C_1 \sim 1.6\,nF.$$

Take $R_S = R_2$ we have unity gain

b// $R_S \rightarrow 800\,\Omega$

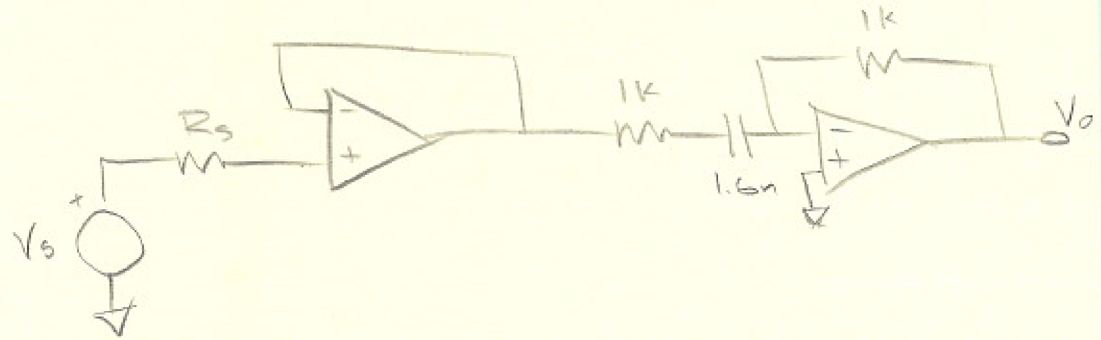
note: Gain also increase

$f_c = 124$ KHz

c// Make f_c independent of R_s.

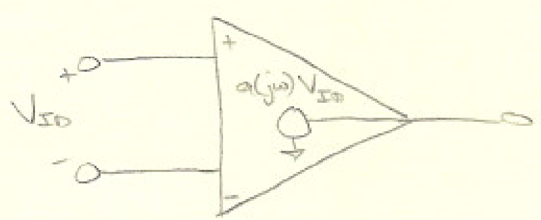
We can put a resistore in series or parrell so that R_S is neglected in f_c calculation. However here we are atenuating the input signal, hence increasing the signal to noise ratio

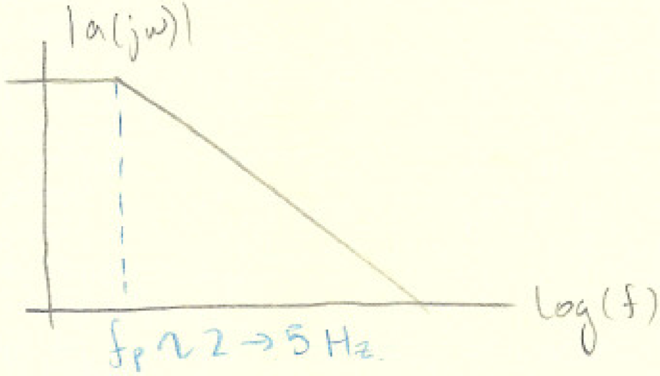
The best solution however would be to add a voltage follower before the circuit.



Non Ideal O.A. Characteristics

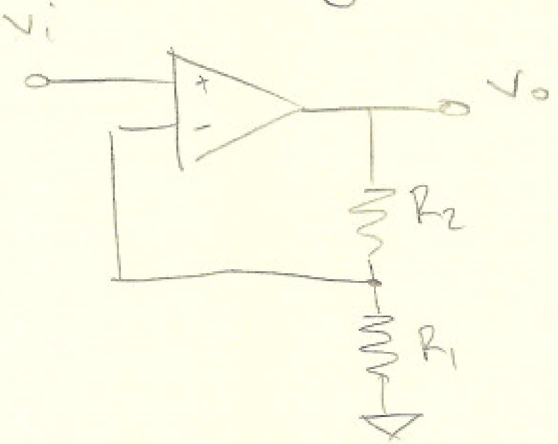
* Offset Voltage
* Finite gain
* Finite bandwidth (most important)





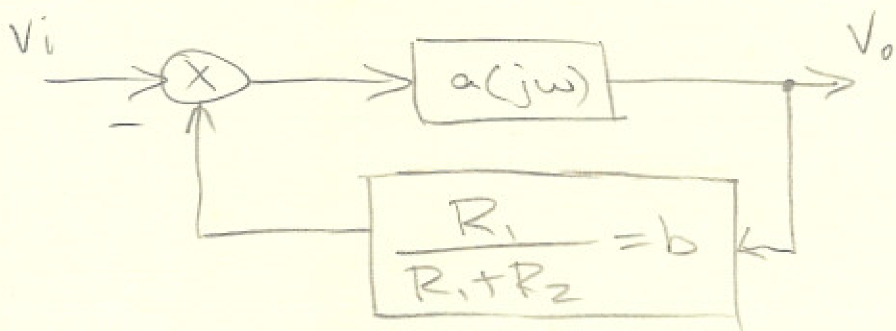
$$a(j\omega) = \frac{a_o}{1 + j\frac{\omega}{\omega_p}} \quad ; \quad \omega_p = 2\pi f_p.$$

Ex Non-inverting amp.



$$\frac{V_o}{V_i} = \frac{\dfrac{a_o}{1 + j\omega/\omega_p}}{1 + \dfrac{a}{1 + j\frac{\omega}{\omega_p}} \dfrac{R_1}{R_1 + R_2}}$$

$$= \frac{a_o}{1 + j\frac{\omega}{\omega_p} + a_o \frac{R_1}{R_1 + R_2}}$$



$$\frac{V_o}{V_i} = \frac{\dfrac{a_o}{1+a_ob}}{1 + j\dfrac{\omega}{\omega_p(a_ob+1)}}$$

$$\omega \to 0 \Rightarrow \frac{V_o}{V_i} = \frac{a_o}{1+a_ob}$$

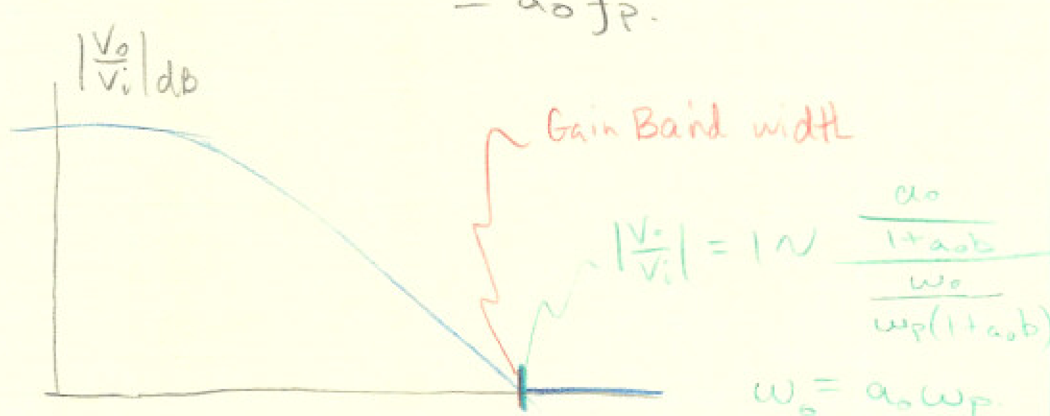
$$\text{if } a \to \infty \Rightarrow \frac{V_o}{V_i} = \frac{1}{b}$$

$$\text{Pole freq}, \; f_c = \frac{\omega_p(a_ob+1)}{2\pi}$$

$$= f_P(a_ob+1)$$

$$\text{Product } (\text{DC gain}) \times (f_c) = \frac{a_o}{1+a_ob} \cdot f_P(a_ob+1)$$

$$= a_of_P.$$



Inverting Amplifier

$$\frac{V_o}{V_i} = \frac{\dfrac{-R_2 a_o}{R_1(1+a_o)+R_2}}{1 + j\dfrac{R_1+R_2}{R_1(1+a_o)+R_2}\dfrac{\omega}{\omega_p}}$$

for high freq, imaginary part >> 1

$$\left|\frac{V_o}{V_i}\right| = 1 \cong \frac{\dfrac{R_2 a_o}{R_1(1+a_o)+R_2}}{\dfrac{R_1+R_2}{R_1(1+a_o)}\dfrac{\omega_o}{\omega_p}} \Rightarrow$$

some shit.. check the text.