

Bode Plots.

$$H(s) = \frac{K(s+Z_1)}{S(S+P_1)} = \frac{K \cdot Z_1 (1 + s/Z_1)}{S \cdot P_1 (1 + s/P_1)}$$

$S = j\omega$, $20 \log |H(j\omega)| \Rightarrow$ magnitude plot. in dB.

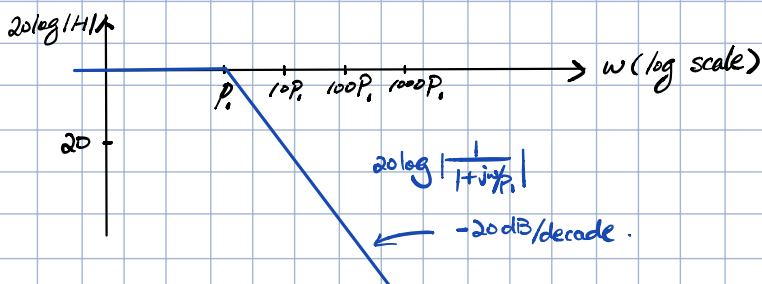
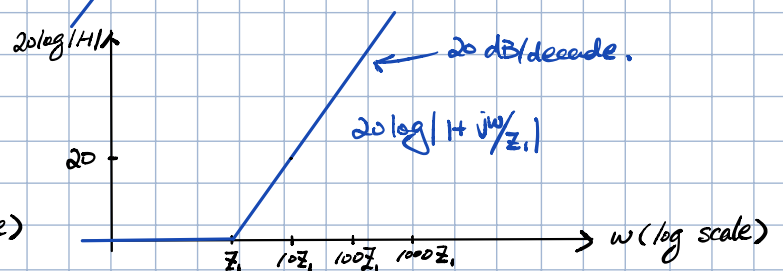
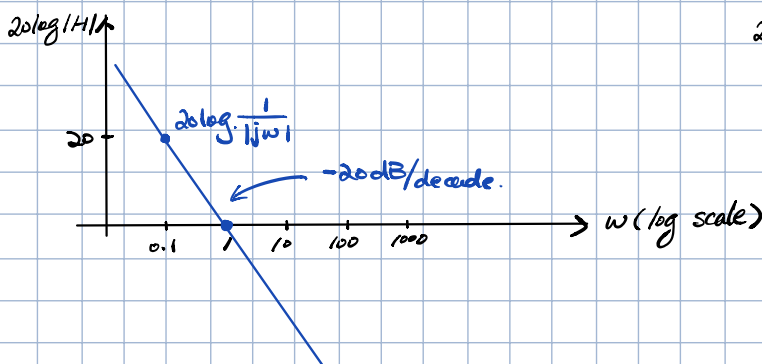
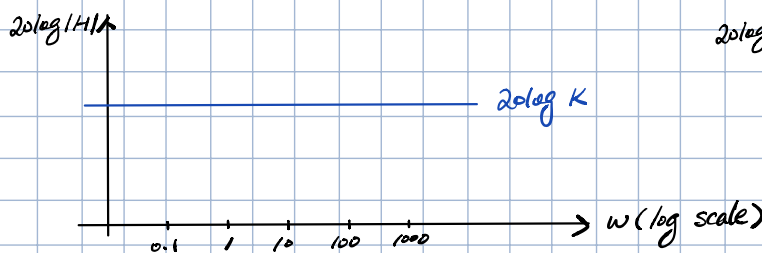
$$= 20 \log \left| \frac{K Z_1 (1 + j\omega/Z_1)}{j\omega P_1 (1 + j\omega/P_1)} \right|$$

$$= 20 \log (K Z_1) + 20 \log |1 + j\omega/Z_1| - 20 \log |j\omega P_1| - 20 \log |1 + j\omega/P_1|$$

- constant. term K

- Zeros and poles @ origin $|j\omega|$ or $|\frac{1}{j\omega}|$

- Zeros and poles not @ origin. $|1 + j\omega/Z_1|$ or $|\frac{1}{1 + j\omega/P_1}|$

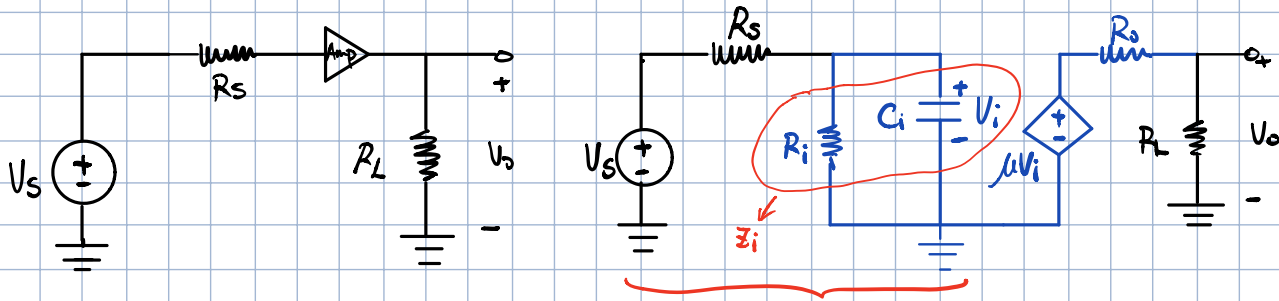


$$|1 + j\omega/Z_1| = \omega = 0, |1 + j0| = 1, 20 \log 1 = 0 \text{ dB}$$

$$\omega = Z_1, |1 + jZ_1/Z_1| = \sqrt{2}, 20 \log \sqrt{2} = 3 \text{ dB}$$

$$\omega = 10Z_1, |1 + j10Z_1/Z_1| = \sqrt{101}, 20 \log \sqrt{101} = 20 \text{ dB}$$

Amplifier. Example.



transfer function $\frac{V_o}{V_i}(j\omega)$

$$\frac{V_i}{V_s} = \frac{Z_i}{R_s + Z_i} = \frac{1}{1 + (R_s/R_i) + sC_i R_s}$$

$$Z_i = R_i // \frac{1}{sC_i} = \frac{R_i \frac{1}{sC_i}}{R_i + \frac{1}{sC_i}} \quad (\text{input side})$$

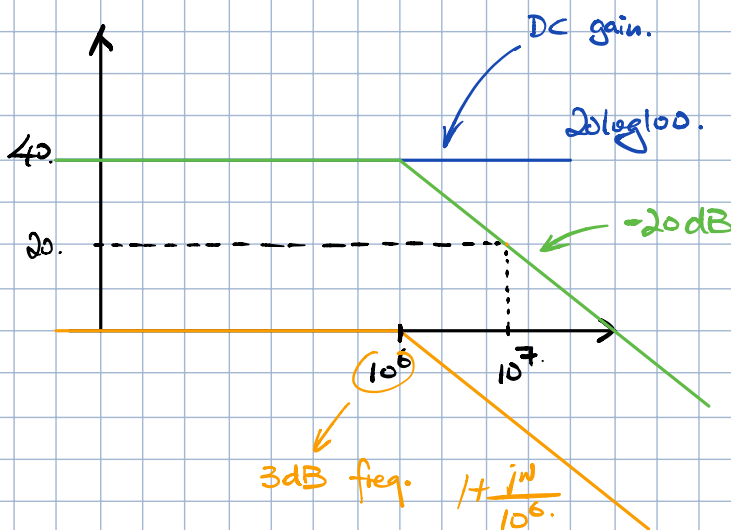
(output side) $V_o = \mu V_i \frac{R_L}{R_o + R_L} \cdot \frac{V_o}{V_i} = \mu \frac{R_L}{R_o + R_L}$

put all together, $\frac{V_i}{V_s} \cdot \frac{V_o}{V_i} = \frac{V_o}{V_s} = \frac{1}{1 + (R_s/R_i) + sC_i R_s} \cdot \mu \frac{R_L}{R_o + R_L}$

$$\therefore \frac{V_o}{V_s}(\omega) = \frac{K}{1 + j\omega/\omega_0}$$

$$= \underbrace{\mu \cdot \frac{1}{1 + R_s/R_i} \cdot \frac{1}{1 + R_o/R_L}}_K \cdot \frac{1}{1 + \underbrace{sC_i R_s R_i / (R_s + R_i)}_{\frac{1}{\omega_0}}}$$

$$\omega_0 = \frac{1}{C_i R_s R_i / (R_s + R_i)}$$



$$R_s = 20k\Omega \quad R_i = 100k\Omega$$

$$C_i = 60pF \quad \mu = 144$$

$$R_o = 200\Omega \quad R_L = 1k\Omega$$

$$\frac{V_o}{V_i}(\omega) = \frac{100}{1 + j\omega/10^6} //$$