

Op-amps with complex feedback.

I covered the most general case in Discussion 4.
This will be a repeat of the same.

Bode plots by hand!

See graph paper. (2)

open time for questions if any / as walking to MH.

Bode plots.

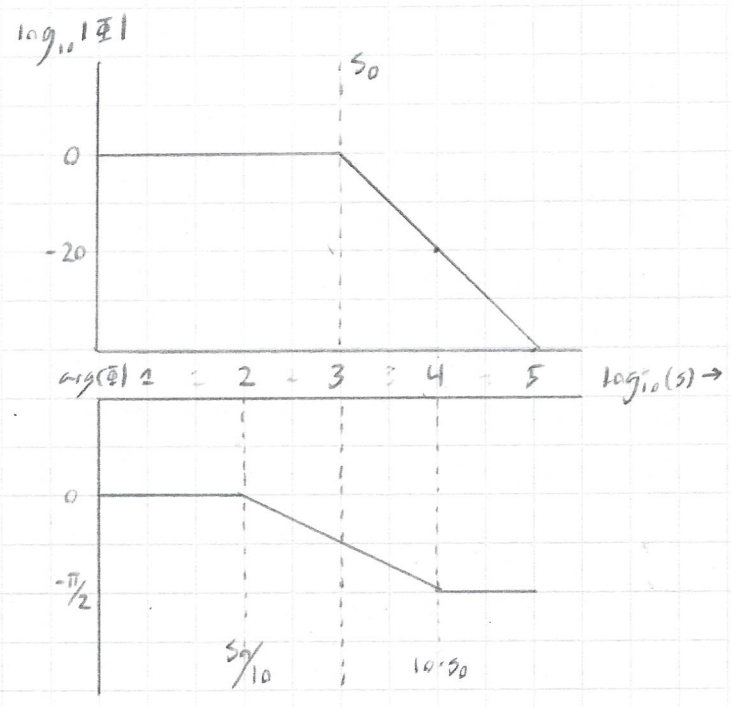
Ex. 1: a pole.

$$\Phi(s) = \left(\frac{s}{1000} + 1\right)^{-1}$$

⇒ Pole at $s_0 = -1k$.

Magnitude: 0 to pole
-20dB/dec after

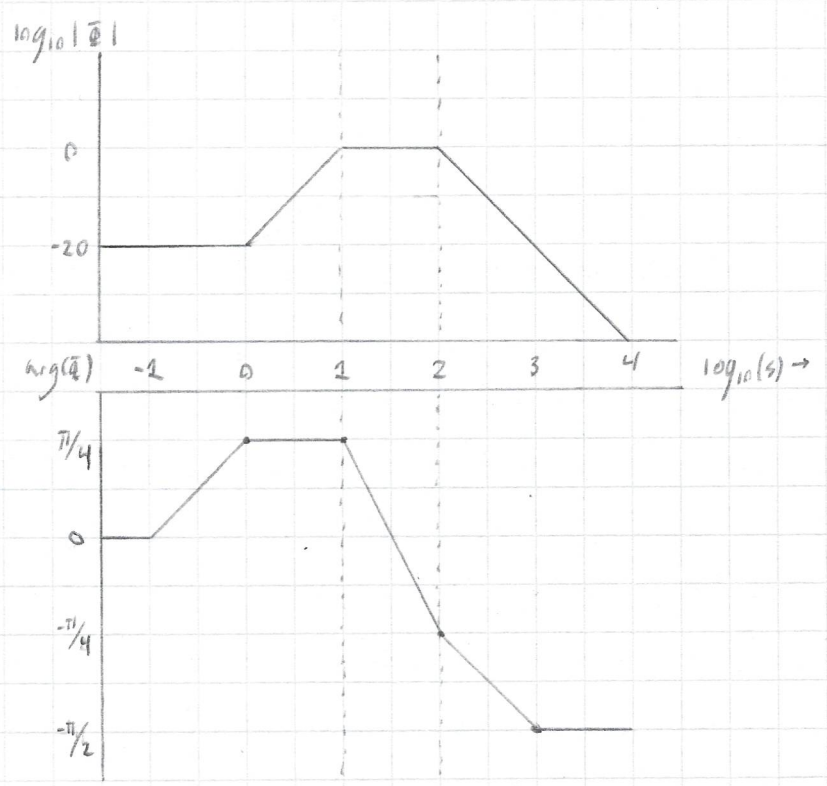
Phase: 0 to $\frac{\pi}{10}$
- $\frac{\pi}{2}$ after $10 \cdot s_0$
Linear connection



Ex. 2. 2 poles & a zero.

$$\begin{aligned} \Phi(s) &= 100(s+1)(s+10)^{-1}(s+100)^{-1} \\ &= 0.1(s+1)\left(\frac{s}{10}+1\right)^{-1}\left(\frac{s}{100}+1\right)^{-1} \end{aligned}$$

⇒ constant at 0.1 → -20dB
poles at 10, 100 as
in Ex. 1.
zero at $s=1$, 0 to s_0
then +20dB/dec after.
phase is 0 up to $s_0/10$,
rises to + $\frac{\pi}{2}$ at $10 \cdot s_0$.



Remember, behaviors stack! That's what's responsible for the "band" effects between $s=10^1$ & $s=10^2$ in Ex. 2

For blue books: decade width isn't so important, just label all of them! Vertical scale is more important.