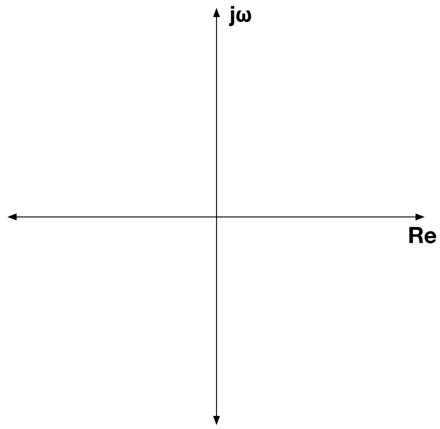
1. All-Pass Filter

(a) Place an "x" and an "o" on the complex plane to construct an "all-pass" filter that has the same magnitude at all frequencies. Label the real part of the "o" σ_0 on the real axis.



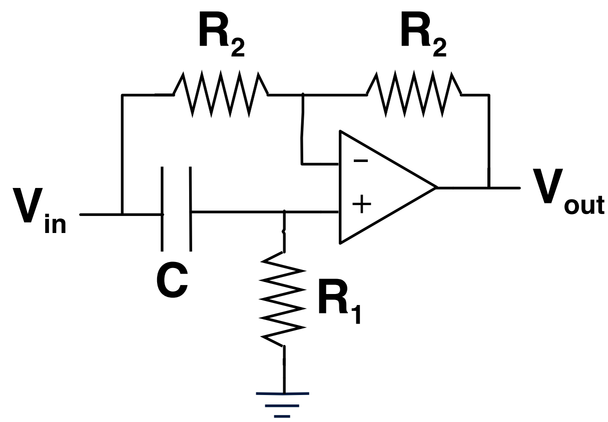
(b) On the plot above, draw vectors that show the filter's response when $\omega = 0$, $\omega \to \infty$, and $\omega = \sigma_0$.

(c) Write $|H(\omega)|$ in terms of arrows (as in lecture), and sketch a plot. Label the frequencies from part (b).

(d) Write $\angle H(\omega)$ in terms of arrows (as in lecture), and sketch a plot. Label the frequencies from part (b).

(e) Construct $H(\omega)$ by placing the vector from the "o" in the numerator and the vector from the "x" in the denominator.

2. All-Pass Filter, Continued



(a) Find the frequency response $H(\omega)$ of the circuit, and sketch a Bode plot ($20\log_{10}|H(\omega)|$ and $\angle H(\omega)$ versus ω, plotted on a logarithmic scale).

(b) What is the relationship between σ_0 of Problem 1 and the values of the components in this circuit?

(c) If $V_{in}(t) = \sin(2\pi(1GHz)t)$, choose values for R, C, and R_Z such that $V_{out}(t) = \cos(2\pi(1GHz)t)$. (This could be useful for generating the phase-shifted signals for I/Q downconversion for radios.)