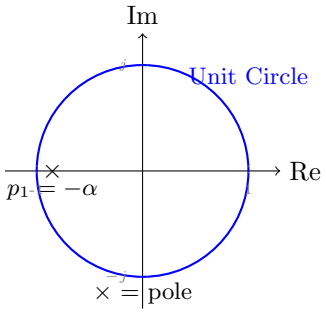
University of Nebraska-Lincoln
Digital Signal Processing: Quiz 6

November 7, 2025

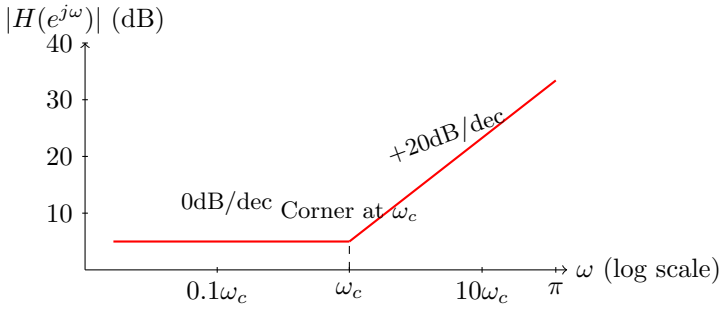
Name: _____ **Total Points: 10**

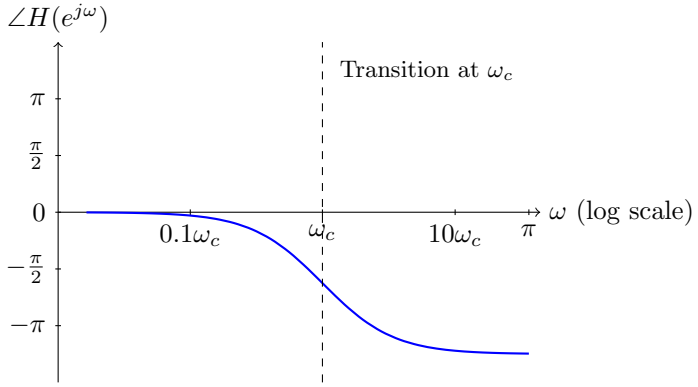
Given: A discrete-time LTI system has the following pole-zero plot in the z-plane:



The pole is located at $z = -\alpha$ (where $0 < \alpha < 1$).
The corner frequency is then: $\omega_c = \pi - \arccos(\alpha)$
Assume $10\omega_c$ is within the Nyquist frequency range ($10\omega_c < \pi$).

1. **(10 points)** Based on the pole-zero plot above,
   (a) **(6 points)** Sketch an approximation of the magnitude $|H(e^{j\omega})|$ and phase $\angle H(e^{j\omega})$ response.
   (b) **(2 points)** In 1-2 sentences, explain how the pole location influences the shape of the magnitude and phase responses.
   (c) **(2 points)** What type of filter does this system represent (e.g., low-pass, high-pass, band-pass, band-stop)?





Solution:

(b) Explanation:

At frequencies below ω_c, the system has constant gain (0 dB/dec). Above ω_c, the magnitude increases at +20dB/dec. The pole on the negative real axis causes the phase to transition from 0 at low frequencies to $-\pi$ at high frequencies, with $-\pi/2$ phase at ω_c.

(c) Filter Type:

This system represents a **high-pass filter** because it attenuates low frequencies (constant, lower gain) and passes high frequencies with increasing gain.