1. A transfer function magnitude at some frequency $\omega_1$ is $|H(j\omega_1)| = 0.20$. What is this magnitude in dB?

\[ |H(j\omega)| = \text{____________________ dB} \]

\[ \text{in dB: } 20\log_{10}|H| = 20 \log 0.2 \]
\[ = -13.98 \text{ dB} = -14 \text{ dB} \]
2. a) A filter has a transfer function \( H_1(j\omega) = \frac{10 + j\omega}{j\omega} \). What is the magnitude \(|H_1|\) of this transfer function [or the amplitude of \((H_1)\)] at \( \omega = 20 \text{ rad/s} \)?

\[
|H_1| = \left| \frac{10 + j20}{j20} \right| = \frac{\sqrt{10^2 + 20^2}}{20} = 1.12
\]

b) What is the phase of this transfer function [or the angle \((H_1)\)] at \( \omega = 20 \text{ rad/s} \)?

\[
\text{angle}(H_1) = \text{angle} \left( \frac{10 + j20}{j20} \right) = \text{angle}(10 + j20) - \text{angle}(j20)
\]

\[
= \arctan \frac{20}{10} - 90^\circ \\
= 63.4^\circ - 90^\circ = -26.6^\circ
\]
3) What are the magnitude and phase of the complex number \(-10 + j1\) ?

a) magnitude or amplitude = \(\text{not in dB}\)

\[ |-10 + j1| = \sqrt{(-10)^2 + 1^2} = 10.05 \]

b) Phase or angle = degrees

\[ \phi = \tan^{-1} \frac{1}{10} = 5.7^\circ \]

\[ \Theta = 180 - \phi = 174.3^\circ \]

complex number in 2nd quadrant
4: In lab, the signal generator is outputting a sinusoidal signal:
\[ v(t) = B \cos(100t + 70^\circ) \]. You measure this signal using a Digital Multimeter (DMM) and the DMM reads 2.0V_{rms}.

a) What is the peak voltage of this sinusoidal signal? 

\[ \frac{\text{peak}}{\sqrt{2}} = \text{rms} \]

\[ \Rightarrow \text{peak} = \sqrt{2} (\text{rms}) = \sqrt{2} (2.0) = 2.83V \]

\[ \sqrt{2} \]

B

b) What is the phasor representation for this signal?

\[ \tilde{V} = B \angle 70^\circ = 2.83 \angle 70^\circ \]

or \[ 2.83 e^{j70^\circ} \]
5. Find the transfer function $H(j\omega) = \frac{V_0(j\omega)}{V_{in}(j\omega)}$ for the circuit below. (The answer should be in the form of a ratio of two complex expressions like ‘a + jb’, where a and/or b may be a function of $\omega$.)

\[ H(j\omega) = \frac{Z_2}{Z_1 + Z_2} \]

\[ Z_1 = 10 + j\omega = 10 + j\omega \quad \quad Z_2 = \frac{10 \cdot 10}{10 + 10} = 5 \cdot 10 \]

\[ H = \frac{V_0}{V_{in}} = \frac{Z_2}{Z_1 + Z_2} = \frac{5}{10 + j\omega + 5} \]

\[ = \frac{5}{15 + j\omega} \]
6. a) Draw the approximate Bode magnitude (or amplitude) plot \(|H|\) in dB vs. \(\omega\) on a log scale for the transfer function \(H(s) = \frac{10s}{1+s}\). (Set \(s = j\omega\).) (A Bode plot using only straight-line segments is requested here.)

\[|H_1|_{dB} = 10\]
\[|H_2|_{dB} = 20\]

Add these 3 plots to get answer.
b) Draw the approximate Bode phase (or angle) plot \([\text{angle}(H) \text{ vs. } \omega \text{ on a log scale}]\) for the transfer function \(H(s) = \frac{10s}{1+s}\). (Set \(s = j\omega\).) (A Bode plot using only straight-line segments is requested here.)

Add these 3 plots.
7. In the circuits below, assume the op amp is ideal.

a) For the circuit below, what $R$ value gives $V_o / V_{in} = -12$

$$\frac{V_o}{V_{in}} = -\frac{R}{1k\Omega} = -12$$

$$\Rightarrow R = 12k\Omega$$

b) For the circuit below, what is the output voltage, $V_o$? (The current source and voltage source are DC sources.)

$$V_o = \_\_\_\_\_\_\_\_$$

$$V_+ = V_- = 6V$$

$$I_{CL}: 2mA + \frac{V_o - V_-}{2k\Omega} = 0$$

$$\Rightarrow V_o = -2mA(2k\Omega) + V_-$$

$$= -4V + 6V = 2V$$