Second Order System Frequency Response

$m := 15 \cdot slug$ mass

$k := 500 \cdot \frac{lbf}{ft}$ spring constant

$b := 20 \cdot \frac{lbf \cdot sec}{ft}$ damping coefficient

$\omega_n := \sqrt{\frac{k}{m}} = 5.774 \ \frac{rad}{s}$ natural frequency

$\zeta := \frac{b}{2 \cdot \sqrt{k \cdot m}} = 0.115$ damping ratio

$\omega_r = \frac{\omega}{\omega_n}$ frequency ratio

$A(\omega_r) := \frac{1}{\sqrt{\left(1 - {\omega_r}^2\right)^2 + 4 \cdot \zeta^2 \cdot {\omega_r}^2}}$ amplitude ratio as a function of frequency ratio

$A(1) = 4.33$ amplitude ratio at resonance

$\phi(\omega_r) := -\text{angle}\left(\frac{1}{\omega_r} - \omega_r, 2 \cdot \zeta\right)$ phase angle as a function of frequency ratio

$\phi(1) = -90 \ deg$ phase angle at resonance

$$\omega_r := 0.01, 0.05 .. 2$$