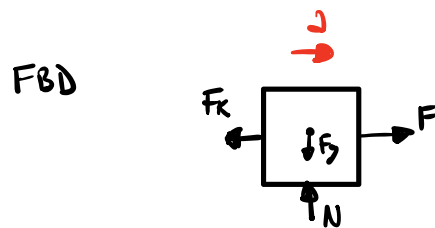
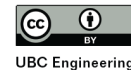
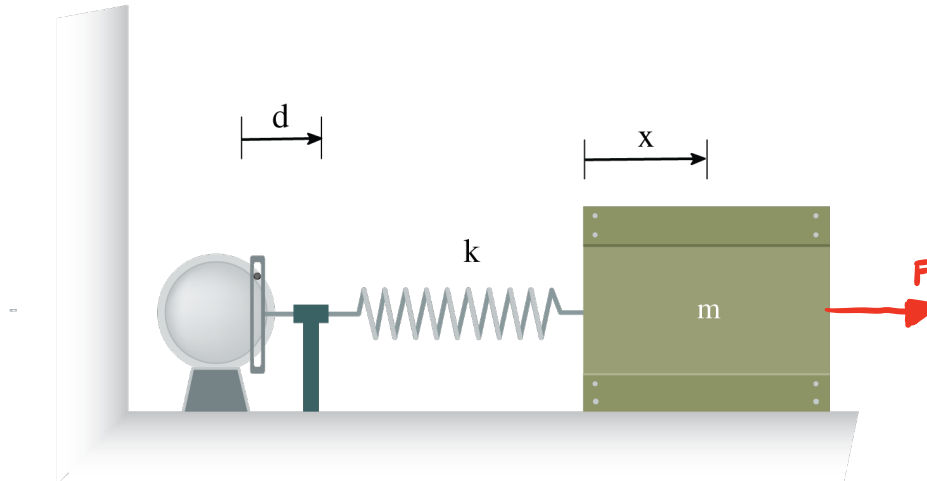


A 2kg box of orange juice contains the instructions “shake well”. An engineering student decides to get smart and connect the juice box with a spring, which has a spring constant $k = 25\text{N/m}$, and applies a periodic force.

The periodic force is described as $F = 5\sin(5t)$. What is the maximum amplitude of the periodic motion and Magnification Factor at steady state?



$$F - F_k = m\ddot{x}$$

$$5\sin(5t) - Kx = m\ddot{x}$$

$$m\ddot{x} + Kx = \underbrace{5}_{F_0} \sin(\underbrace{5t}_{\omega_0 t})$$

$$\omega_n = \sqrt{\frac{K}{m}} = \sqrt{\frac{25\text{N/m}}{2\text{kg}}} = \sqrt{\frac{25}{2}} \frac{\text{rad}}{\text{s}}$$

$$x_p = \frac{F_0/K}{1 - (\omega/\omega_n)^2} \sin(\omega_0 t)$$

$$x_{\max} = \frac{(5\text{N})/(25\text{N/m})}{1 - (5\text{rad/s}/\sqrt{25}\text{rad/s})^2} = \boxed{0.2\text{m} = x_{\max}}$$

v2

$$MF = \frac{1}{1 - (\omega_0/\omega_n)^2} = \frac{1}{1 - (5 \text{ rad/s} / \sqrt{\frac{8}{2}} \frac{\text{rad}}{\text{s}})^2} = \boxed{-1 = MF}$$