

37.15 A $10lb_m$ mass hangs from a spring and damper assembly. The spring has a spring constant of $100\frac{lb_f}{in}$. The damping ratio is 0.6. What is the damped frequency of the system?

- A. $6Hz$
- B. $8Hz$
- C. $10Hz$
- D. $12Hz$

Find the natural frequency of the system as though no damping was present. The **undamped natural circular frequency** is given by the equation below.

$$\omega_n = \sqrt{\frac{kg_c}{m}} = \sqrt{\frac{\left(100\frac{lb_f}{in}\right) \left(12\frac{in}{ft}\right) \left(32.2\frac{lb_m \cdot ft}{lb_f \cdot s^2}\right)}{10lb_m}} = 62.2\frac{rad}{s}$$

Find the **Damped Natural Frequency** which accounts for the damping ratio.

$$\omega_d = \omega_n \sqrt{1 - \zeta^2} = \left(62.2\frac{rad}{s}\right) \sqrt{1 - (0.6)^2} = 49.7\frac{rad}{s}$$

Since the answer choices are in Hz , find the corresponding damped *linear* frequency. Note the final units of “cycles per second” is the same as Hz .

$$f_d = \frac{\omega_d}{2\pi} = \frac{49.7\frac{rad}{s}}{2\pi\frac{rad}{cycle}} = 7.9Hz$$

Answer B