ME 274: Basic Mechanics II
Spring 2026

Quiz #8

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Questions from Prof. James Gibert and Information adapted from “DYNAMICS: A Lecturebook”

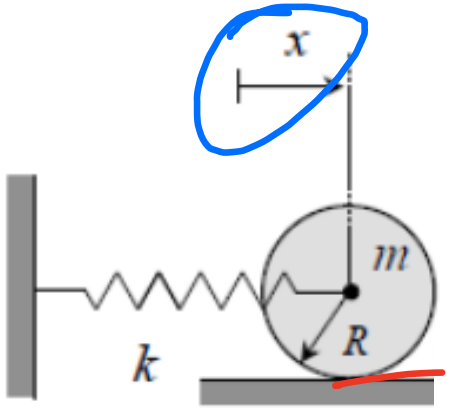
By Charles M. Krousgrill, Jeffrey F. Rhoads

Question #1

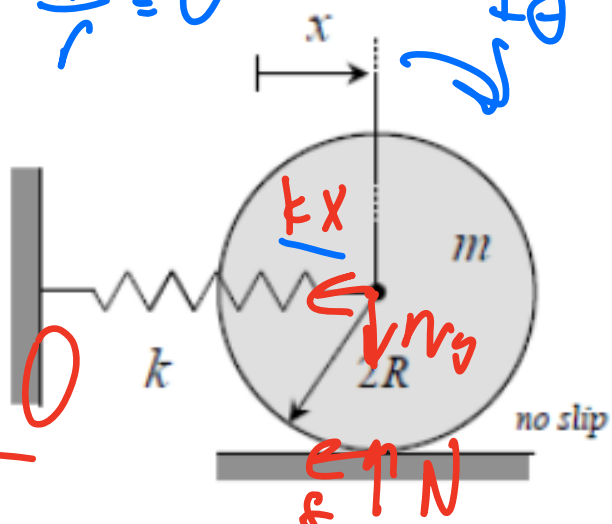
$$M\ddot{x} + C\dot{x} + Kx = f(t)$$

$$\omega_n = \sqrt{K/M}$$

- Let $(\omega)_A$ and $(\omega)_B$ represent the natural frequencies of Systems A and B, respectively. Circle the statements below that most accurately describes the natural frequencies of these two systems:
  - $(\omega)_A < (\omega)_B$
  - $(\omega)_A > (\omega)_B$
  - $(\omega)_A = (\omega)_B$
  - Not enough info



System A



System B

general radius r

IC

$\dot{x} = \dot{\theta} r$

$\frac{\ddot{x}}{r} = \ddot{\theta}$

$\sum M_c = \frac{3}{2} m r^2 \ddot{\theta} = -rkx$

$\frac{3}{2} m r \ddot{\theta} = -kx$

$\frac{3}{2} m r \left(\frac{\ddot{x}}{r}\right) = -kx$

$\frac{3}{2} m \ddot{x} - kx = 0$

$\omega_n = \sqrt{\frac{2k}{3m}}$

Question #2

$$M\ddot{x} + C\dot{x} + Kx = f(t)$$

- How do you determine if an EOM is freely vibration?
  - $f(t) = 0$
  - $f(t) \neq 0$
  - $f(t) = \text{Constant}$
  - $M = K$
  - $M = C$

· multiple correct answers

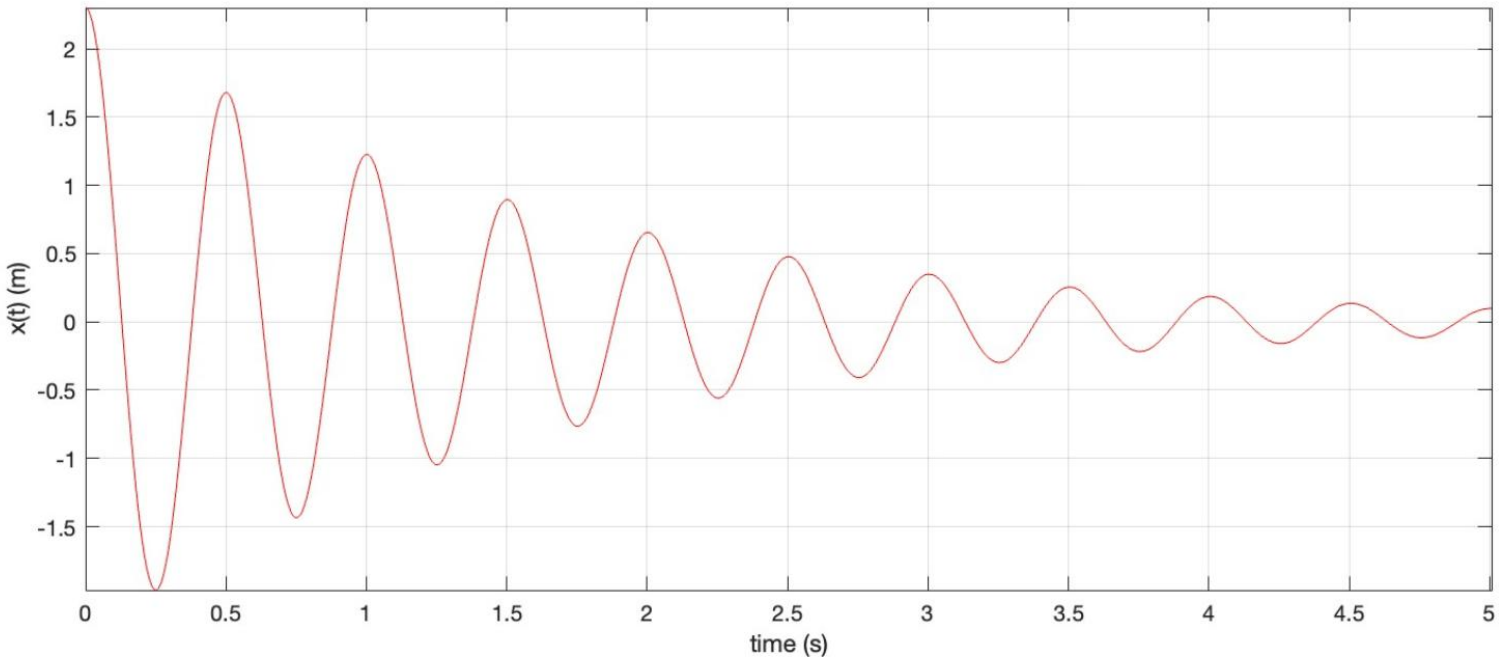
$\dot{x} = \ddot{x} = 0$

$x_{st} = G/K$

$z = x - x_{st}$

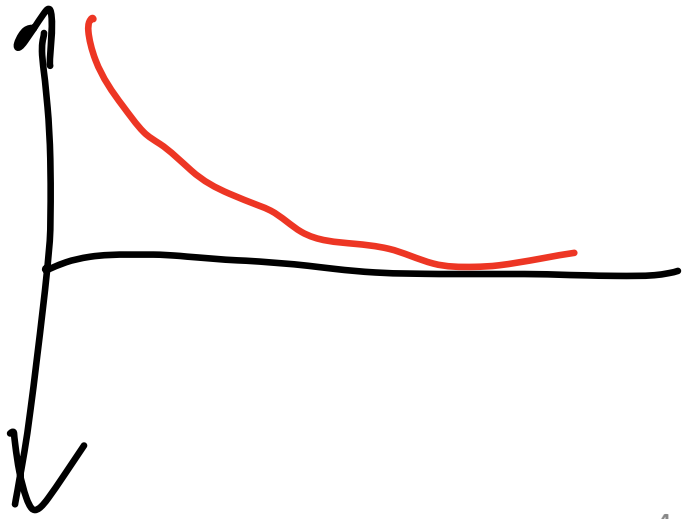
Question #3

$$M\ddot{x} + C\dot{x} + Kx = f(t)$$



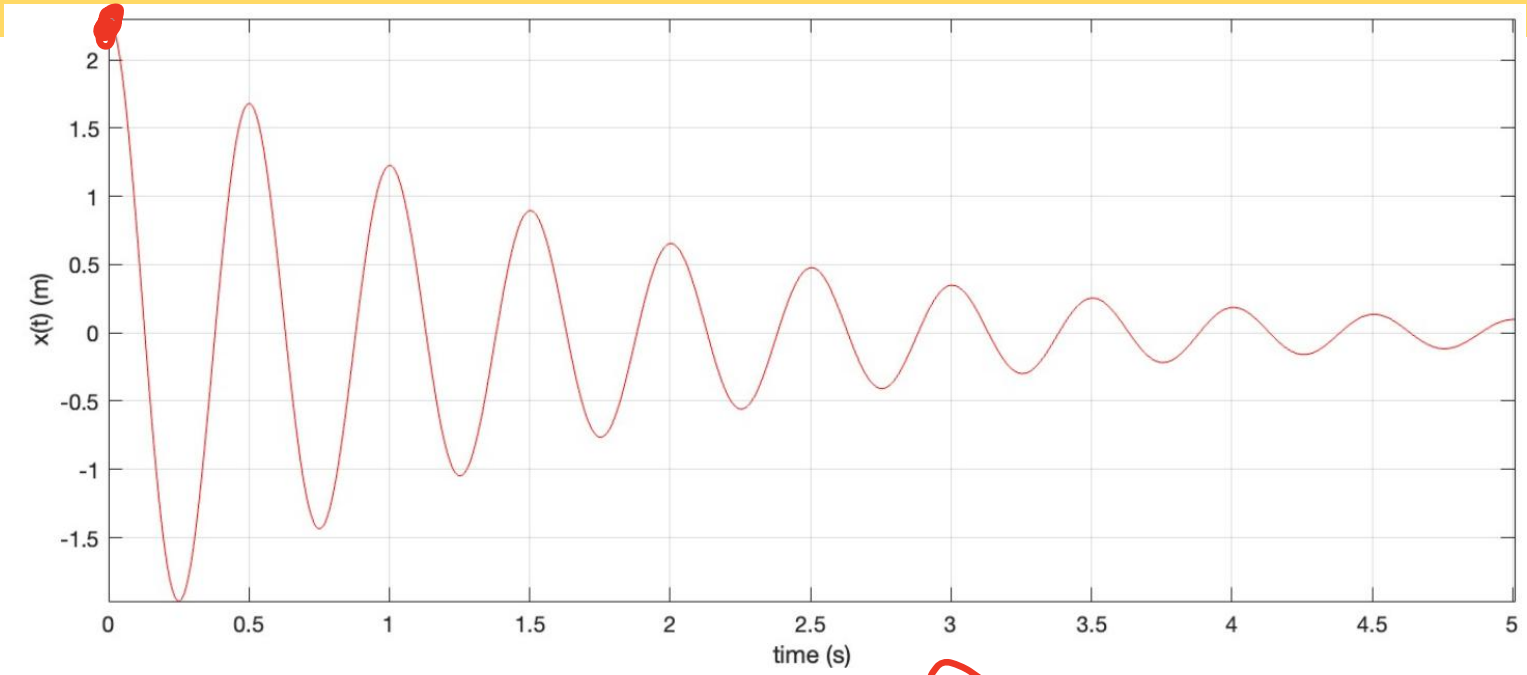
$M\ddot{x} + C\dot{x} + Kx = 0$ with $x(0) = x_0$ and $\dot{x}(0) = v_0$.

- The response shown above is…
  - Overdamped
  - Critically damped
  - Underdamped
  - Undamped



Question #4

$$M\ddot{x} + C\dot{x} + Kx = f(t)$$



$X(t)$

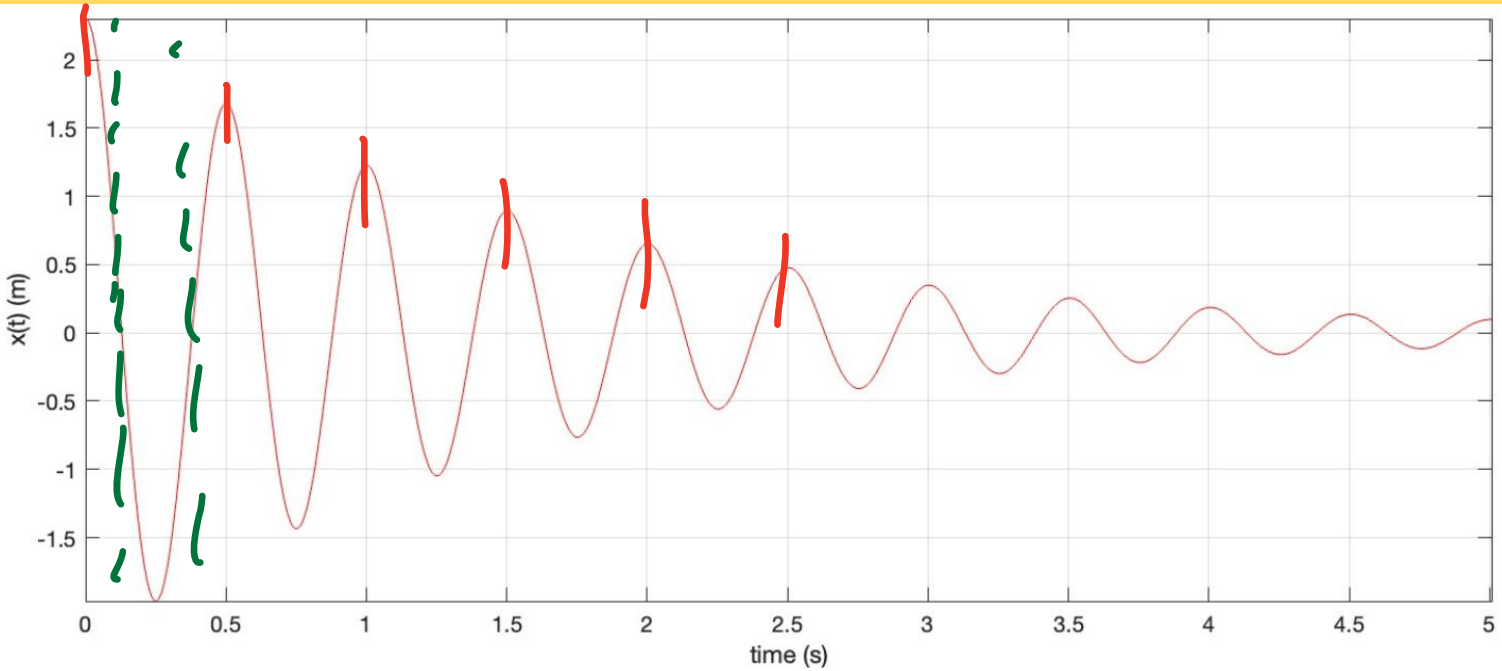
$M\ddot{x} + C\dot{x} + Kx = 0$ with $x(0) = x_0$ and $\dot{x}(0) = v_0$.

- The initial displacement is…
  - $x_o = 0$
  - $x_o > 0$
  - $x_o < 0$
  - Not enough info.

$X(t=0)$

Question #5

$$M\ddot{x} + C\dot{x} + Kx = f(t)$$

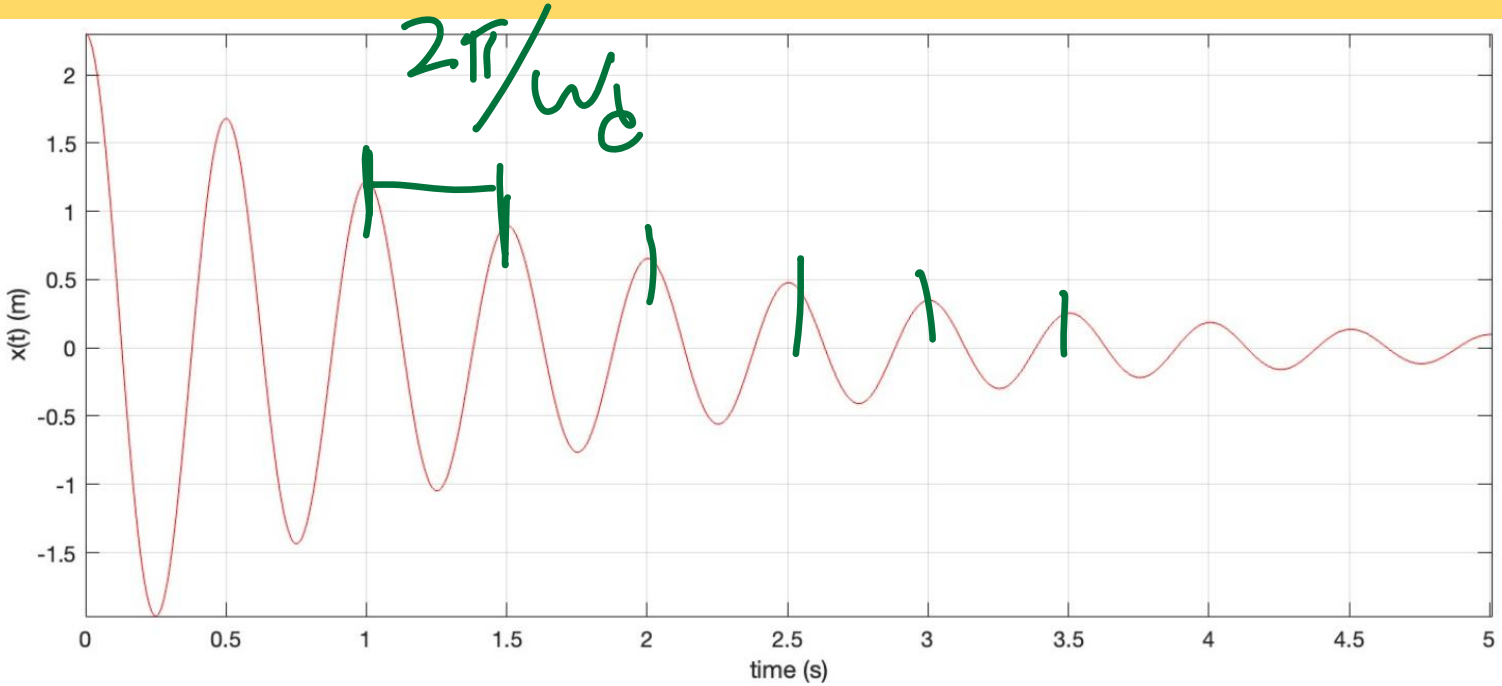


$M\ddot{x} + C\dot{x} + Kx = 0$ with $x(0) = x_0$ and $\dot{x}(0) = v_0$.

- The initial velocity is…
  - $v_o = 0$
  - $v_o > 0$
  - $v_o < 0$
  - Not enough info.

Question #6

$$M\ddot{x} + C\dot{x} + Kx = f(t)$$



$M\ddot{x} + C\dot{x} + Kx = 0$ with $x(0) = x_0$ and $\dot{x}(0) = v_0$.

- What is the period of oscillations?

0.5 sec

· time for one cycle to happen

- What is the dampening natural frequency?

$\omega_d = \frac{1}{0.5\,\text{sec}} = 2\,\text{Hz}$ $\left[\frac{\text{rad}}{\text{s}}\right]$

$\omega_d = \frac{2\pi}{0.5}\ \frac{\text{rad}}{\text{s}}$