PHYS 3200 - Fall 2025

End of Topic Quiz 4

October 16th, 2025

Name and ID #:

Instructions:

1. You may use:
   - A calculator that has no internet connection, and no stored reference material. Connecting to the internet or using reference material other than that provided on the equation sheet is cheating and you will fail the exam if you do so.
   - Notes.
   - Writing utensil: pencil and eraser are best.
2. Always start word problems with a drawing of the situation.
3. If you have a question about a problem (confused about the situation, need some missing piece of information, etc.), please raise your hand and ask!
4. $\boxed{\text{Box your final answer}}$ for each part.
5. Credit will not be given if your answers are too messy or obscure to read. Remember - a grader who isn't squinting and spending extra time trying to decipher mysterious scratches is a happy grader.
6. This quiz must be turned in by the end of the class period.

1. A small box with mass m is attached to a spring with spring constant k. The system is set into motion on a frictionless horizontal surface by displacing the box by a distance A from the equilibrium position and released from rest.

   (a.) Write down the equation of motion for the system.

   (b.) Find the initial total energy of the system.

   (c.) Find an expression for the potential energy as a function of position x.

   (d.) Using the initial total energy and your expression for potential energy, find an expression for the kinetic energy as a function of position x only.

   (e.) At what displacement are the potential energy and kinetic energy equal?

2. Utilizing the same spring and mass as the previous problem, the mass now undergoes a damping force proportional to its velocity,$F_d = -bv$.

   (a.) Write down the modified *differential* equation of motion for the system, in terms of x (along with its derivatives), β, and ω_0.

   (b.) Write down the general solution for the case that $\beta < \omega_0$.

   (c.) What is the expression for the damped angular frequency in this case?

   (d.) If $m = 1kg$, $k = 6N/m$, and $b = 2\sqrt{2}kg/s$, what is the value of the damped angular frequency?