# PHYS 3200 - Fall 2025

End of Topic Quiz 7

December 2nd, 2025

Name and ID #:

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**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 simple pendulum consists of a mass $m$ attached to a massless rigid rod of length $l$, swinging under gravity in a vertical plane.

   (a.) Choose a **single** appropriate generalized coordinate and determine the kinetic energy and potential energy of the system.

   (b.) Find the generalized momentum of the system and use it to find an expression for the generalized velocity in terms of the generalized momentum.

   (c.) Find the Hamiltonian for this system.

   (d.) Write down the Hamilton equations for this system.

   (e.) Using the Hamilton equations derive the equation of motion for this system. (Assume small oscillations, use the small angle approximation $sin\theta = \theta$, to rewrite the equation in terms of the natural frequency $\omega$.)

2. A particle of mass $m$ moves in the xy plane under the potential: $U(x, y) = \frac{1}{2}k(x^2 + y^2) + \lambda xy$ where $k$ and $\lambda$ are positive constants.

   (a.) Determine the Kinetic and Potential energy of the system.

   (b.) Find the generalized momenta of the system and use them to find expressions for the generalized velocities in terms of the generalized momenta.

   (c.) Find the Hamiltonian for this system.

   (d.) Write down the Hamilton equations for this system.

   (e.) Using the Hamilton equations derive the equations of motion for this system.