

# PHYS 3200 - Fall 2025

End of Topic Quiz 6

November 13th, 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. 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 write down the Lagrangian of the system.

(b.) Write down the Lagrange equation of the system.

(c.) Identify the generalized force and momentum of the system.

(d.) Solving the Lagrange equation write down the equation of motion for the system.

(e.) Assuming small oscillations (using small angle approximation) show that the natural frequency of oscillations can be expressed as  $\omega = \sqrt{g/l}$

2. A box of mass  $m$  is attached to a spring with a force constant  $k$  is set into motion along a flat frictionless surface in the  $x$  direction.

(a.) Choose a **single** appropriate generalized coordinate and write down the Lagrangian of the system.

(b.) Write down the Lagrange equation of the system.

(c.) Identify the generalized force and momentum of the system.

(d.) Solving the Lagrange equation, write down the equation of motion for the system.