H. Hergert
Facility for Rare Isotope Beams
and Department of Physics & Astronomy

MICHIGAN STATE UNIVERSITY

PHY422/820: Classical Mechanics

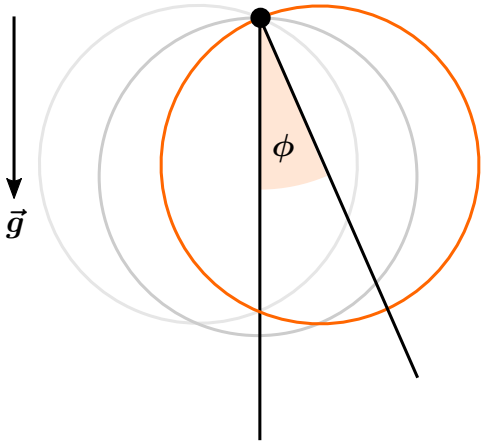
FS 2020

Exam Preparation

December 1, 2020

Problem P14 – Physical Pendulum

A thin uniform hoop of mass M and radius R is suspended from a nail, and able to swing back and forth under the influence of gravity (see figure).



1. Compute the hoop's moment of inertia for rotations around the nail.

2. Construct the Lagrangian for the pendulum motion about the nail, using the angle ϕ as the generalized coordinate. Derive the Lagrange equation.

3. Determine the frequency of small oscillations around equilibrium. How does it compare to the frequency of a simple pendulum with mass M and length R, $\omega_{\text{simple}} = \sqrt{g/R}$?