Assignment: HW4 [40 points]

Assigned: 2016/10/27
Due: 2016/11/03

P4.1 [6 points]

Goldstein (3rd Ed): Problem 4.21 (Coriolis deflection in vertical motion, P182).

A particle is thrown up vertically with initial speed v_0 reaches a maximum height and falls back to ground. *[Assume the maximum height to be small enough so that any change in the acceleration due to gravity, and the centripetal force on the particle, over the course of its motion can be ignored.] Show that the Coriolis deflection when it again reaches the ground is opposite in direction, and four times greater in magnitude, than the Coriolis deflection when it is dropped from rest at the same maximum height.*

P4.2 *[10 points]*

Goldstein (3rd Ed): Problem 4.23 (Foucault Pendulum, P183).

The Foucault pendulum experiment consists in setting a long pendulum in motion at a point on the surface of the rotating Earth with its momentum originally in the vertical plane containing the pendulum bob and the point of suspension. Show that the pendulum's subsequent motion may be described by saying that the plane of oscillation rotates uniformly $2\pi \cos\theta$ radians per day, where θ is the co-latitude. What is the direction of rotation? The approximation of small oscillations may be used, if desired.

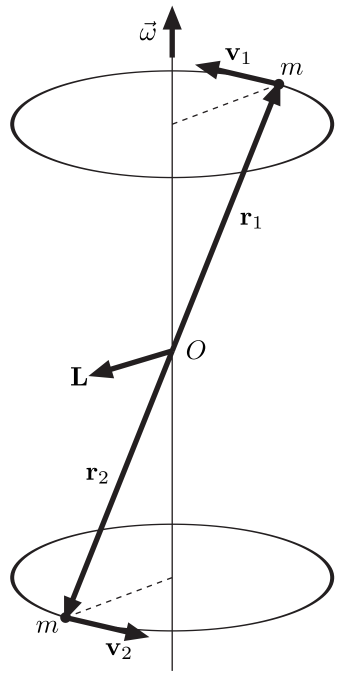
P4.3 *[8 points]*

Goldstein (3rd Ed): Problem 5.15 (principal moments of inertia, P235).

Find the principal moments of inertia about the center of mass of a flat rigid body in the shape of a 45° right triangle with uniform mass density. What are the principal axes? Although it is not stated explicitly in the textbook, assume that the axis is perpendicular to the plane of the triangle.

P4.4 *[6 points]*

Consider the symmetric dumbbell rotating in a "double cone" about its CM as shown in the figure below: two equal point masses m connected by a massless inextensible link of length 2ℓ. Find the angular momentum of the system and the torque required to maintain the motion.



<u>**P4.5**</u> *[10 points]*

Goldstein (3rd Ed): Problem 5.30 (tilted door, P237).
A door is constructed of a thin homogeneous material. It has a height of 2 m and a width of 0.9 m. If the door is opened by 90° and released from rest, it is observed that the door closes itself in 3 s. Assuming that the hinges are frictionless, what angle do these hinges make with the vertical?