PHYS-3202 Homework 10 Due 7 Dec 2022

This homework is due to `https://uwcloud.uwinnipeg.ca/s/4tyDmt9EEN2RgCy` by 10:59PM on the due date. Your file(s) must be in PDF format; they may be black-and-white scans or photographs of hardcopies (all converted to PDF), PDF prepared by LaTeX, or PDF prepared with a word processor *using an equation editor*.

1. **Deflection of Thrown Object** *partly based on Cline 12.1 and other sources*

   Consider motion near the surface of the earth. The rotational frequency of the earth is ω, and θ is the colatitude.

   (a) Suppose I throw a ball straight upward with initial velocity v. Show that it lands west of me and determine how far in terms of v, the angular velocity of the Earth, and the latitude. Use the same approximations as in the class notes on the deflection of a falling object. *Hint*: You need to introduce an initial velocity to the formula derived in class. You can also see Cline example 12.7.

   (b) Suppose I throw the ball at an angle α from the vertical toward the east with initial speed v. Show that the Coriolis force deflects the trajectory $(4\omega v^3/g^2)\sin\lambda\sin^2\alpha\cos\alpha$ south compared to where it would land without the Coriolis effect (in addition to the westward deflection we discussed in the first two parts of the problem).

2. **Another Intertia Tensor of a Cube**

   A cube of mass M and uniform density fills the region $0 \le x \le L$, $0 \le y \le L$, $-L/2 \le z \le L/2$. Find its inertia tensor in this coordinate system. You may either calculate this directly or use the parallel axis theorem and the inertia tensor given in the lecture notes for rotation around the CM.