PHYS-3202 Homework 8 Due 24 Nov 2021

This homework is due to `https://uwcloud.uwinnipeg.ca/s/wxqoYpEEa8WT2LX` 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*.

REVISED

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 colatitude. Use the same approximations as in the class notes on the deflection of a falling object. *Hint*: 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_0. Show that the Coriolis force deflects the trajectory $(4\omega v_0^3/g^2)\cos\theta\sin^2\alpha\cos\alpha$ 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. **Hyperloop**

   The hyperloop is a proposed high-speed transit system in which a pod travels through a sealed tube at approximately 1200 km/hr. Consider a hyperloop route starting at a latitude of 34 degrees and running due north along a longitude line. Is the magnitude of the Coriolis force on the hyperloop pod larger or smaller than magnitude of the force that the tube must provide to hold the pod to the surface of the earth? (Even in the rotating reference frame of the earth, the surface of the earth is still curved, so the hyperloop moves in a circle and the force from the tube provides the required centripetal acceleration.) Explain briefly. Treat the earth as a perfect sphere of radius 6400 km.