Physics 3210, Spring 2019 Homework #8

Due *in class* Thursday April 4^{th}

Fictitious Forces:

1. Consider a perfectly spherical rotating planet with an acceleration due to gravity $\vec{g}$ which is constant over the planet's surface. A bead lies on a frictionless wire that lies in the north–south direction across the equator. The wire takes the form of an arc of a circle; all points are the same distance from the center of the Earth. The bead is released from rest, a short distance from the equator. Because $\vec{g_{eff}}$ does not point directly toward the Earth's center, the bead will head toward the equator and undergo oscillatory motion. What is the frequency of these oscillations?

2. Hurricanes rotate in opposite directions in the Northern and Southern hemispheres due to the Coriolis force. A popular belief is that water swirls down the drain in opposite directions in the two hemispheres, for the same reason. Make a quantitative argument as to whether or not this belief is likely true.

3. A mass is dropped from a point directly above the equator. Consider the moment when the object has fallen a distance d. If we consider only the centrifugal force, then you can quickly show that the correction to g_{eff} at this point (relative to the release point) is an increase by $\omega^2 d$. There is, however, also a second-order Coriolis effect. What is the sum of these corrections? How do these effects compare to the variation of g with height?

4. *K&K* Problem 9.12.