PHYS 2210 Fall 2010 Homework Set 6

Due in at start of class on **Oct 7th, 2010**
Show your work!

1. (3 pts) Taylor 4.24, parts a-c.

2. A particle is dropped into a hole drilled straight through the center of the Earth from the North Pole to the South Pole.

   (a) (1 pt) Are rotational effects important in this situation? Why or why not? Would it make a difference if the hole ran through the equator instead?

   (b) (2 pts) Neglecting rotational effects, and assuming that the Earth has a constant density, show that the particle obeys the force law for a mass connected to a spring. What is the oscillation period for this motion if you assume that Earth has a mass of 6.0×10^{24} kg and a radius of 6.4×10^{6} m?

3. (2 pts) Calculate the centrifugal acceleration due to the Earth's rotation on a particle sitting at rest on the equator. How does this result compare to the gravitational acceleration from the Earth? Calculate the centrifugal acceleration on the particle due to the Earth's motion around the Sun and the centrifugal acceleration due to the motion of the solar system around the galactic center. (Some useful info: distance to galactic center = 25,000 light years, Sun's orbital period around the galactic center = 250 million years.) How do these compare? Can we neglect any of these accelerations?

4. (2 pts) In graduate school, Prof. Marino collected data at the Sudbury Neutrino Observatory, located in the bottom of a mine, 6800 ft below the Earth's surface, near Sudbury, Ontario, Canada. One of the mine safety rules is that when underground no one is permitted to stand within 20 ft of the mine elevator shaft. This is to avoid being struck by any falling objects that might bounce

out of the shaft. In a mine safety training class the safety instructor said that, "A hammer dropped *from rest on the surface at the center of the elevator shaft* would strike the walls before it reached the bottom due to the rotation of the Earth." Was the safety instructor correct? Some facts about shaft #9 in INCO's Creighton Mine (the home of the Sudbury Neutrino Observatory): 46^o N lattitude, 2200 m deep, elevator shaft is rectangular with a full width of 1.5m in the NS direction, and 3.8 m in the EW direction.