Homework 09

Prerequisites: Read chapter 9.

Problem 1 (5 points):

In class we found that the vector of the acceleration due to gravity is modified by the centrifugal force. Find the deviation of the free fall acceleration from the vertical (i.e. direction to the Earth center) as function of **latitude** in a functional form. Do this for the body at rest with respect to the Earth. Assume that the Earth is spherical, and unmodified acceleration due to gravity is $g = 9.8\ m/s^2$. What is the deviation angle in Williamsburg?

Problem 2 (5 points):

We also discussed that a dropped (moving) body does not fall along the direction calculated in the previous problem since we have to take in account the Coriolis force. Read the discussion of this problem in section 9.8.

Now find the displacement of a ball which is thrown vertically up with velocity v_0 by the time it reaches the top most point. Show the functional form. Which way does the ball deflect in the Northern hemisphere? What about the Southern hemisphere?

You can safely disregard the correction due to centrifugal force (calculated in the 1st problem), and assume that $\vec{g}$ is directed vertically.

Problem 3 (5 points):

Naively, you would expect that if you throw a ball vertically up it will come exactly at the same point. Calculate the displacement and direction of the displacement in this case.

Problem 4 (5 points):

Explain the above scenario from an inertial point of view. Think what happens with the ball and the Earth surface in the inertial reference frame. Is the answer more obvious now?

Make a sketch of the ball and the starting point on the ground trajectories. It is convenient to choose the reference frame where one of the planes (let's say 'xy') contains the ground point trajectory.