Physics 321 – Spring 2017

Homework #2, Due at beginning of class Wednesday Jan 25.

1. [5 pts] A pendulum consists of a point mass swinging back and forth at the end of a massless string of length R. The motion is in a vertical plane. The string makes a maximum angle of 90° with respect to the vertical direction. You can use energy conservation to relate the velocity to the angle, as discussed in class.

   (a) Find the angle at which the acceleration vector is horizontal.

   (b) Find the magnitude of the acceleration at that angle.

   (c) Find the angle at which the horizontal component of the acceleration is maximum.

   (d) Find the magnitude of the acceleration at that angle.

2. [5 pts] The following questions relate to the pendulum in the previous problem. First derive the answers in the form of definite integrals. Then evaluate those integrals using some numerical method. I recommend Mathematica.

   (a) How long does it take the pendulum to travel from $\theta = 90°$ (where it is at rest) to $\theta = 45°$?

   (b) How long does it take the pendulum to travel from $\theta = 45°$ to $\theta = 0°$ (still with the initial condition that it was at rest at $\theta = 90°$?

3. [5 pts] A bicycle rider experiences air resistance proportional to v^2 and rolling resistance proportional to v, such that

$$\frac{dv}{dt} = -Bv - Cv^2 \, .$$

   The rider begins coasting on a straight level course with initial velocity v_0.

   (a) Find her velocity as a function of time.

   (b) Find her position as a function of time.

4. [5 pts] Taylor problem 2.14

(Last updated 1/17/2017.)