PHY 504

Problem Set #1

due 4 September 2009

1. A circular platform rotates in the horizontal plane about its center with frequency ω. In this problem, you may ignore motion in the vertical direction and the effects of gravity.

   (a) Write down a coordinate transformation that relates the inertial reference frame of a person standing on the ground (at some distance from the platform) to the noninertial frame of a person riding on the platform. This should be a transformation of the form $x' = x'(x,y,t)$ etc., where the coordinates of the inertial frame are unprimed. (It may be convenient to first write down the transformation from the rotating frame to the inertial frame $x = x(x', y',t)$ and then invert it.)

   (b) In the absence of forces, the equation of motion of a particle in the inertial reference frame is $\frac{d^2x}{dt^2} = 0$. What is it in the rotating frame?

   (c) A particle is released by the person riding on the platform, at a distance r_0 from the center. Its initial velocity in the rotating frame is zero. Describe its subsequent trajectory in both reference frames.

2. Exercise 1.13. [Hint: Work in the inertial reference frame moving instantaneously with the rocket at time t.] Generalize the calculation at the end of the exercise.

3. Get acquainted with Mathematica. Solve the following problems:
   a) $2 + 2 =$
   b) $\int \tan^3(x)\,dx =$ (indefinite integral)
   c) $ax^3 + bx^2 + cx + d = 0$; solve for x.
   d) Plot $y = \sin(10x)\exp(-x^2)$.
   e) Plot a sample trajectory for problem 1(c), in the rotating frame.