Name: _____

PHY 105 Test 1 October 1, 2004 50 minutes

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Do all work in the blue book! If you use your calculator to answer a question, briefly describe how. All answers must be in MKS units unless otherwise specified.

1. The world's largest roller coaster, the *Kingda Ka* will be built at Six Flags Great Adventure in NJ. It will be able to launch passengers at 128 miles/hour, reaching this speed in 3.0 sec. (**16 pts**)

   a) What is the average acceleration during launch? (Express your answer in both m/s^2 and gees)

   b) How far does a passenger travel in going from 0 to 128 mph at launch?

   c) At some time after the launch, the passengers will be at the highest point of the roller coaster. Assuming that coming down from this point will be very close to free-fall, how tall must the roller coaster be if the same speed of 128 mph is achieved at the bottom?

2. Assuming that the earth moves in a circular orbit around the sun, calculate the magnitude of centripetal acceleration of the earth (avg earth-sun distance = 1.5×10^{11} m) (**6 pts**)

3. A 0.5 kg ball falls near the surface of the earth, but is subject to a horizontal wind force of 3 N and an air resistance of 2 N. Draw a diagram indicating the direction and magnitude of the forces acting on the ball, assuming that the wind force is in the positive *x*-direction. Calculate the magnitude and direction of the acceleration of the ball. (**14 pts**)

4. The positions of two particles moving in 2-D are described by the vectors $\vec{r}_1(t) = 2t^2\,\hat{i} - 3t\,\hat{j}$; $\vec{r}_2(t) = 4\hat{i} + t^3\,\hat{j}$ where the units are m and s. (**18 pts**)

   a) Calculate the instantaneous velocity of both particles at t = 2 s.

   b) Determine the velocity of particle #1 with respect to particle #2 at t = 2 s. (Show this graphically, but calculate analytically. Leave your answer in vector notation)

   c) Calculate the average acceleration of particle #2 from t=0 to t=4 s.

5. A ball is thrown from ground level at 35° towards an open window of an apartment building. The building is 25 m from the thrower, and the window is 10 m off the ground. What initial speed is needed for the ball to pass through the window? (**10 pts**)

6. Two masses sit on a frictionless floor and are pushed with a force P as shown. With appropriate figures, *describe* all of the forces acting on mass 1 and mass 2. i.e.do not show the forces acting on the floor or the earth. (Use the subscript convention developed in lecture. You may leave out the gravitational forces acting between the two masses.) If you can determine the magnitude of any of these forces in terms of the masses, g, and/or P, please do so. (**12 pts**)