Phys202 - Dynamics - Spring 2007 Name: _____

Exam 1 Due at the beginning of class, Monday, March 5, 2007

Do the following problems and use as much paper as you need (no fringies). You are on your honor to work independently. Put your name on each sheet. Each solution should start with a restatement of the problem and a diagram. If you use $\vec{F} = m\vec{a}$, draw a force diagram. Describe what method you are using (including coordinate system) and why you can use it, then start using the method. My homework solution sets are a decent model of what I want each problem to look like.

1 Short-Answer

Explain in words the difference between kinetics and kinnematics. How does one affect the other?

Why is the acceleration in polar coordinates more complicated than in rectangular coordinates?

2 Golf

A golf ball is hit from a tee that is elevated 10 m above a level fairway. The initial velocity of the ball is 50 m/s, inclined up at 40° above the horizontal. Determine (a) the horizontal distance traveled by the ball; (b) the speed of the ball when it hits the fairway; and (c) the angle (instead of 40°) that would maximize the distance traveled by the ball. Neglect air resistance.

3 Motion in 2-D

The motion of a particle in the xy plane is defined by the parametric equations $x = q^2 + 4$ and $y = q^3 - 9t$. Determine the angle between the tangent to the path and the x-axis when $q = 4$. If $q(t) = 5t^2$, determine the velocity and acceleration when $t = 2$.

4 Potential and Force

The potential function for a force is given by $V = -\dfrac{x^2y^2}{2}$. Find the force that is responsible for this potential.

5 Space Station Sniper

The international space station is in a circular orbit at a height of 340 km. Use $R_{\text{earth}} = 6378\,\text{km}$, $m_{\text{earth}} = 5.974 \times 10^{24}\,\text{kg}$, and $G = 6.672 \times 10^{-11}\,\text{N} \cdot \text{m}^2/\text{kg}^2$. Derive the speed of the orbit. (Use $\vec{F} = m\vec{a}$.)

An astronaut fires a rifle with a muzzle velocity of 975 m/s horizontally (not toward or away from the earth). In what direction with respect to $\vec{v}_{ISS}$ can the bullet be fired so that it still has the same speed as ISS?

If the gun is fired in this direction, find the angle between the old and new angular momentum vector of the bullet.

6 Circular Pendulum on a Table

A mass m is sits on a frictionless table. It is tied to a string which passes through a hole in the table. The mass is then spun with initial speed v in a circle of radius R. (a) Calculate the tension F_{T} in the string. (b) If the string is slowly pulled from under the table, calculate the new tension as a function of ΔR, assuming no friction between the string and the table.

7 Package in a Drum

A package of mass m is placed inside a cylindrical drum of radius $R = 2.5\,\text{m}$ that rotates in the vertical plane at a constant angular speed of $\dot{\theta} = 1.36\,\text{rad/s}$. (a) If the package reaches a position $\theta = 45^\circ$ from straight down before slipping, determine the static coefficient of friction between the package and the drum. (b) How fast would the drum have to spin in order to have the package never slip or lose contact with the drum?