PHYS 2210 Fall 2010 Homework Set 2

Due in class on **Sept 2, 2010**
Show your work!

1. Taylor, Problem 1.10 A particle moves in a circle (center O and radius R) with constant angular velocity ω counter-clockwise. The circle lies in the xy plane and the particle is on the x axis at time t=0. Show that the particle's position is given by

$$\vec{r}(t) = \hat{x}Rcos(\omega t) + \hat{y}Rsin(\omega t) \tag{1}$$

Find the particle's velocity and acceleration. What are the magnitude and direction of the acceleration? Relate your results to well-known properties of uniform circular motion.

2. Taylor, Problem 1.39 A ball is thrown with initial speed v_0 up an inclined plane. The plane is inclined at and angle ϕ above the horizontal, and the ball's initial velocity is at an angle θ above the plane. Choose the axes with x measured up the slope, y normal to the slope, and z across it. Write down Newton's second law using these axes and find the ball's position a function of time. Show that the ball lands a distance $R = 2v_0^2 sin(\theta)cos(\theta + \phi)/(gcos^2\phi)$ from its launch point. Show that for given v_0 and ϕ, the maximum possible range up the inclined plane is $R_{max} = v_0^2/[g(1 + sin(\phi)]$.

3. Taylor, Problem 1.41 An astronaut in gravity-free space is twirling a mass m on the end of a string of length R in a circle with constant angular velocity ω. Write down Newton's second law in polar coordinates and find the tension in the string.

4. Boas, Chapter 8, Section 2, Problem 8 Separate the variables and find a solution containing one arbitrary constant. Then find the value of the constant to give a particular solution satisfying the given boundary condition.

$$y' + 2xy^2 = 0 \tag{2}$$

5. Boas, Chapter 8, Section 3, Problem 2 Find a general solution of the following differential equation.
$$x^2y' + 3xy = 1 \tag{3}$$

6. Boas, Chapter 8, Section 3, Problem 7 Find a general solution of the following differential equation.
$$(1 + e^x)y' + 2e^x y = (1 + e^x)e^x \tag{4}$$