UNIVERSITY OF MARYLAND

Department of Physics

University of Maryland M. Laurenzi
Physics 161
10-07-05 Name_____
Exam I
Chapters 1, 2, 3 and 4.

Each question is worth a total of 100 pts. The points will be distributed evenly by dividing 100 by the number of sub-questions. The grade you receive will be a percent grade. ***For problems which involve numbers use only one significant figure.***

Solve the following problems completely for full credit. **Please do your work under the problem on the exam page NEATLY.** Please write on only on the side of the paper where the problem located. **Please make a box around your final answer.** The test is closed books, notes and classmates. Do the questions that you find less challenging first. Then follow up with those that seem to be more difficult. Best of Luck…..

$$x_f - x_i = v_0 t + \frac{1}{2} a t^2$$

$$v_f^2 = v_0^2 + 2a(x_f - x_i)$$

$$v_f = v_0 + at$$

$$v_j = v_o \sin\theta$$

$$v_i = v_0 \cos\theta$$

1. A projectile is fired from the origin of a Cartesian coordinate system with an angle of elevation θ relative to the horizontal x-axis with magnitude of velocity V_o. Assume that the air resistance can be neglected and the only external force is due to gravity.

a) By integration and the use of boundary conditions, find the position $\vec{r}_j(t)$ of the projectile in the $\hat{j}$ direction given $\vec{a}(t) = -g\hat{j}$.

b) By integration and use of boundary conditions, find the position vector $\vec{r}_i(t)$ in the $\hat{i}$ direction given $\vec{v}_i(t) = V_o \cos\theta$.

c) Now find the total position vector $\vec{r}\ (t) = \vec{r}_i(t) + \vec{r}_j(t)$.

2. In a snowball fight it is possible to distract your opponent by throwing a snowball at a high angle (θ) relative to the horizontal. While your opponent is watching the first snowball you immediately throw a second snowball at a low angle (φ) relative to the horizontal aimed more directly. Set the origin so that the guy throwing the snowball is at the origin of your coordinate system. Assume that both snowballs start and end at y = 0, are thrown with an initial velocity of 30m/s and the first snowball is thrown at θ = 70° relative to the horizontal.

a) Find the time t_1 that it takes the first snowball to land.

b) Find the displacement in the $\hat{x}$ direction of the first snowball.

c) Find the time t_2 it will take the second snowball to land as a function of φ.

d) Using the results from part b) solve the equation $x_f - x_i = v_{0x} t_2$.

e) Using the trigonometric identity $\sin(2\varphi) = 2\sin(\varphi)\cos(\varphi)$ and your results from d) find the angle φ that the second snowball must be thrown at in order to make it land in the same position as the first snowball.

3. Consider the vector $\vec{V}$ whose tail is positioned at the origin and extends to the position $x = \sqrt{2}, y = \sqrt{2}, z = 2$ in a Cartesian coordinate system. This vector has dimensionless units.

a) Find the magnitude of the vector $\vec{V}$.
b) Express the vector in (unit vector) component form.
c) Find the angles between the vector and the axes of the coordinate system.

Now consider the projection of the vector $\vec{V}$ onto the x-y plane (do this by setting the z-component equal to zero).

d) Express this new vector in polar coordinates (this means a radial vector $\vec{r}(t)$ and angle θ).