Name: ________________________________ **"Alphabetic" Student No.:** [ ]

HOMEWORK HANDOUT #2: Motion in 2-D (Phys 207, Fall 2005)

DUE on MONDAY, Sept. 12 by 9pm (turn in at recitation room)

Remember QUIZ #1 over HW #1 on Thursday (Sept. 8)

The quiz will be during the first 15 minutes of class and will consist of one problem "similar" to HW. Since no calculators will be allowed, the math will not be complicated.

Problem #1: Vector Addition and Subtraction (see attached HANDOUT)

Problem #2: INSTANTANEOUS Velocity and Acceleration Vectors (see attached HANDOUT)

Problem #3: Initial Velocity for Projectile Motion

Using a super slingshot, a troublemaker shoots a rock downward from a window located **50 m** above the ground. After flying through the air for **3 s**, the rock barely misses a person on the ground and lands **42 m** away from the bottom of the building.

(a) Draw a **picture** of the problem with the origin located on the ground below where the rock is shot. Draw the **x-y axes** with the **origin** labeled (0,0), sketch the **path** of the rock, and indicate ALL known **values**, e.g. x_0, y_0, x & y at $t = 3$ s.

(b) Find an algebraic expression for the **initial horizontal velocity** v_{x0} of the rock and then find its numerical value.

(c) Find an algebraic expression for the **initial vertical velocity** v_{y0} of the rock and then find its numerical value. Note: Start from the y-equation for projectile motion.

(d) Find the **magnitude and angle of the total velocity** v_0 using the Pythagorean theorem and tangent relationship.

Problem #4: Flight Time and Range for Projectile Motion

A mini-rocket is shot from the roof of a building that is **70 m tall**. It is launched at an **angle of 50°** above the horizontal with an initial speed of **30 m/s**.

(a) Draw a **picture** of the problem with the origin located on the ground below where the rocket is shot. Draw the **x-y axes** with the **origin** labeled (0,0), sketch the **path** of the rocket, and indicate ALL known **values**, e.g. x_0, y_0, and v_0.

(b) Write the ***x*- and y-equations** of the rocket in algebraic form AND then rewrite them with any known values substituted.

(c) Find the **flight time *t*** of the rocket. Remember that this is the time solution for the y-equation when the projectile returns to the ground, i.e. when $y = 0$.

(d) Find the **range *x*** of the rocket using the x-equation and flight time.

<u>Problem #1 HANDOUT</u>: Vector Addition and Subtraction

(a) Show on the grids below the graphical representation of $\vec{A}+\vec{B}$ and $\vec{B}-\vec{A}$ for:
$\vec{A}=5\hat{i}-6\hat{j}$ and $\vec{B}=4\hat{i}+4\hat{j}$. CLEARLY label all vectors.

$\vec{A}+\vec{B}$ $\vec{B}-\vec{A}$

(b) Find the magnitude (length) of the following four vectors: $\vec{A}$, $\vec{B}$, $\vec{A}+\vec{B}$, and $\vec{B}-\vec{A}$.

<u>Problem #2 HANDOUT</u>: INSTANTANEOUS Velocity and Acceleration Vectors

In the path shown below, the locations of a car driving around a track are shown at EQUAL time intervals where **Δt = 5 s**. The car starts with speed **40 m/s at x_0** and uniformly **slows down** to 20 m/s from x_0 to x_2. The car then travels at a **constant** speed from x_2 to x_6. The first corner at x_3 has a smaller radius curve (r_1 = 50 m) and the second corner at x_5 has a larger radius curve (r_2 = 100 m). At **point** x_6, the car starts to **slow down** and is traveling at 10 m/s at point x_8. Assume that the car continues to slow down after point x_8.

(a) On the first drawing, draw the **INSTANTANEOUS velocity vectors** v_0 to v_8 of the car at points x_0 to x_8 around the path. Show both an appropriate length and direction for each vector**,** and **label** the **magnitude** of the vectors v_0 to v_8.

(b) On a separate sheet, calculate the **<u>magnitude</u>** (no plus or minus signs) of the **<u>INSTANTANEOUS</u> accelerations** a_0 to a_8 at the points x_0 to x_8 around the path.

(c) On the second drawing, draw the **<u>INSTANTANEOUS</u> acceleration vectors** of the car at points x_0 to x_8**.** Show both an appropriate length and direction for each vector**,** and **label** the **magnitude** of the vectors a_0 to a_8.