Name Federico Tatur Date 09/19/2023

CRN 88842 GTA Name Merritt

Lab 3: Motion in Two Dimensions: Projectile Motion

PHYS 2305

Pre-lab Assignment

Question Pre-1. For a given initial projectile speed v_o, calculate what launch angle α gives the longest-range R. Show your work.

According to equation 3.6,

$$Range = \frac{v_0^2 \sin(2\theta)}{g}$$, where V_0 = initial velocity, and $g = -9.8\ m/s^2$. For R to be at its max $\sin(2\theta) = 1$, and this happens when $\theta = 45°$. So, this means that in order to get a maximum range at v_0, θ of the launch angle must be $45°$.

Question Pre-2. In a projectile motion experiment, you launch a projectile at a fixed speed and observe that it travels a certain distance R at a launch angle of $\alpha = 30$. If you maintain the same launch speed, what other launch angle will result in the same range R? Provide a conceptual explanation for why this angle provides the same range without resorting to a mathematical formula. Your argument should draw upon relevant physics concepts and principles.

If we interpret the formula $\sin(2\theta)$, it appears in range of R which is equal for

$\theta = 90 - \theta$

$\therefore \sin(2\alpha) = \sin(2\theta)$

$\sin(2(90-\theta)) = \sin(80^\circ - 2\theta^\circ) = \sin(2\theta)$

So, this means that R would be equal when θ is 60° and 30°.

Question Pre-3. Suppose you measure the range of a projectile for a variety of different launch angles α at a fixed initial velocity $\mathbf{v_o}$ You want to plot your data and determine if Equation 3. 6 models your data. One way to do this is to plot the range **R** on the y-axis versus a quantity on the x-axis that will produce a straight-line plot according to Equation 3. 6.

What quantity would you plot on the x-axis to produce a straight-line plot? Explain. Write your answer below and next to **Question 1.3** for reference during the lab.

The projectile horizontal displacement covered from the initial point of projectile is called as the Range. The range is measured as the displacement, and it would be taking during the time it takes to come back to the ground from the point of projection. This is also known as the time of flight (T_f). Also since there's no acceleration present in the a_x direction, V_o is constant. $V_x = V_o \cos(\theta)$. Range: $V_o \cos(\theta) \cdot T_f$, so, the curve would be drawn between the Range and the time of flight, and this would give us a straight line. So $\therefore$ Range (R) v.s. Time of Flight (T_f).