**Analysis Worksheet**

1. **Include a photo of your raw data with your TA’s signature.**

Table

Description automatically generated

1. **Create a table to show all your data as described in the Analysis & Submission section of the lab manual. Clearly indicate which method was used for calculating the speeds and show a sample calculation.**



The values for velocity in the x-direction and velocity in the z-direction is calculated using the *central difference method.*

1. **Create the four graphs as described in the Analysis & Submission section of the lab manual.**

**x vs t**

Chart, line chart

Description automatically generated

**z vs t**

**Chart, line chart

Description automatically generated**

**vx vs t**

**Chart, line chart

Description automatically generated**

**vz vs t**

Chart, line chart

Description automatically generated

1. **Create a table for the least squares analysis of the *vx* vs *t* data, as described in the Analysis & Submission section of the lab manual.**



1. **Determine the slope and intercept, along with their uncertainties. This should be done by hand using the average column values in the table above.**

Diagram

Description automatically generated

Shape

Description automatically generated

Text, letter

Description automatically generated

1. **Create a table for the least squares analysis of the *vz* vs *t* data, as described in the Analysis & Submission section of the lab manual.**



1. **Determine the slope and intercept, along with their uncertainties. This should be done by hand using the average column values in the table above.**

Diagram

Description automatically generated

Shape

Description automatically generated

Text, letter

Description automatically generated

1. **State the initial horizontal and vertical components of velocity and acceleration of the projectile. (Simply state the quantities using proper significant figures.)**



Since we are using a *Velocity Vs. Time* graph chart, the slope of our graphs should be the acceleration of the object and the intercept should be the velocity at time, t=0 or, initial velocity. Since we used to measure the components in the respective x and z direction, we should be able to derive the slope, A in each graph as the Horizontal and Vertical Acceleration, intercept, B in each graph as the Initial Horizontal and Vertical Velocity respectively.

In short,

A (Vx vs T) = Horizontal Acceleration = -0.94859 m/s2 =

B (Vx vs T) = Initial Horizontal Velocity = 0.96624 m/s = or, Vxo

A (Vz vs T) = Vertical Acceleration = -0.44698 m/s2 =

B (Vz vs T) = Initial Vertical Velocity = 0.78465 m/s =

1. **State the expected values of the components of the acceleration. Perform a statistical test for whether your measured acceleration component values agree with your expectations.**

Expected Acceleration Formula in the x-axis,

Ax(exp)  = = = = -0.471375

Az(exp)  = = = = -0.2216304

The formula used for measuring the numerical accuracy of an experiment that follows a Gaussian probability distribution is:

t =

Let the two quantities x1 and x2 be Ax and Ax(exp),

tAx = = = -0.935235100532665 ≈ -0.9

Now, let the two quantities x1 and x2 be Az and Az(exp),

tAz = = = -0.484999889684925 ≈ -0.5

If the value of the numerical accuracy test, or t-test stays between -2 and 2, such that **-2 < < 2** we can conclude that the findings from that given experiment is consistent. Here, both values we found from A and B stays between -2 and 2. Therefore, the result from our experiment is consistent with our findings.

1. **Respond to the following questions/instructions:**

**(a) Were any assumptions or approximations involved in performing these calculations? List them and state how you think they might affect the results if they were not valid.**

Yes, some approximations were taken while carrying out this experiment, such as

(1) Vx at time t=0 and t=0.5 are taken to be 0 (m/s) due to the *central difference method*.

(2) The gravitational acceleration and other forces involved in interfering with the object’s upward and downward projectile were taken to be 0, resulting in the acceleration components in each time to be 0 (m/s2).

(3) Expected acceleration values in each axis were taken from the measured average velocity components in each component.

**(b) What do your statistical tests indicate? What are the implications of the results?**

Statistical Analysis tests in both acceleration components show that the measured amount is consistent with the expected values of acceleration. tAx, statistical analysis of the expected and measured values in the acceleration component in the x-axis is found to be -0.9, indicating that the result from our findings in this experiment is consistent in both cases (also for tAz).

**(c) What is the initial speed of your projectile? What is the initial angle from horizontal of the projectile?**

The initial speed of the projectile is V =

=

= 1.244716591 (m/s)

≈ 1.24 (m/s)

*where,*

*Vx(o) = BVx = Initial Velocity at x-axis*

*Vz(o) = BVz = Initial Velocity at z-axis*

Again,

Vx =

=

***Answer: Initial Speed, V = 1.24 (m/s);***