Union College Spring 2021

**Physics 120: Lab 2 (Measurements of Launch Speed) Worksheet**

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Partners: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1) Derivation of equations for initial velocity of ball:

a) Max. height: A ball starts at height y0 and is given an initial velocity *v*0. What will its maximum height, *y*max be?

Rearrange the equation to give an expression for *v*0 in terms of *y*max and *y*0.

*v*0 =

b) Time of flight: A ball starts at height y0 with initial velocity *v*0, and ends at *y* = 0. Derive an equation for the initial speed, v0, in terms of t, the time for the ball to complete this motion.

Rearrange the equation to give an expression for *v*0 in terms of *t*.

*v*0 =

2) Which method do you expect to give better results and why?

a) What are some possible sources of systematic error and of random error in measuring the maximum height reached by the ball? How will you remove the systematic error?

b) What are some possible sources of systematic error and of random error in timing the motion of the ball? Will your reaction time be a source of random error, or of systematic error?

3) Number of launcher : \_\_\_\_\_\_\_\_\_\_\_\_\_ \*\*\*\* IMPORTANT \*\*\*

4) What is the initial height of the ball?

*y*0 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

5) For the time of flight measurements, what is the initial height?

*y*0 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

6) Estimated uncertainties:

(*y*) ~ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (*t*) ~ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Individual Data Table:**

|  |  |  |  |
| --- | --- | --- | --- |
| Time Trial | Time of Flight(s) | Height Trial | Height (m) |
| 1 |  | 1 |  |
| 2 |  | 2 |  |
| 3 |  | 3 |  |
| 4 |  | 4 |  |
| 5 |  | 5 |  |
| 6 |  | 6 |  |
| 7 |  | 7 |  |
| 8 |  | 8 |  |
| 9 |  | 9 |  |
| 10 |  | 10 |  |

**Calculations:**

Group’s average time:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Group’s average height\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Group’s stand. dev. in time (t): \_\_\_\_\_\_\_\_\_\_ Group’s stand. dev.in height (h):\_\_\_\_\_\_\_\_

Comparison of standard deviation with estimated uncertainties:

**Average time ± standard error using all the data for the group: \_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Average height ± standard error for group: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Launch Speed:**

*V*launch from *average time*: **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Average *V*launch *of individual trials*: **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Standard deviation of *V*launch: **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Standard error: **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Avg *V*launch ± standard error from time measurements: : \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

comparison with*V*launch from average time:

*V*launch from *average height*: **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Average *V*launch of *individual calculations*: **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Standard deviation of *V*launch: **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Standard error: **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Avg *V*launch ± standard error from height measurements: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

comparison with*V*launch from average height:

**Comparison of results using heights and results using times:**

**Horizontal Launch**:

Derivation ofEquation for predicted distance in terms of initial velocity:

Predicted distance:

Predicted maximum distance (using *v*ave + 2\*standard error) =

Predicted minimum distance (using *v*ave - 2\*standard error) =

Result: Did the ball land between the pieces of tape? If not, in which direction did it land? At a shorter distance or longer distance?

Which method for measuring the initial velocity is the result of the horitzontal more consistent with? Is this the method you thought would be more accurate?