Daya Sharon, Section B September 24, 2016 Lab Partners: N. Dogar, S. Kamath

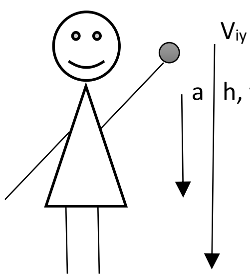
Introduction

The purpose of this lab was to determine if there was a relationship between the initial height of a penny and the time the penny takes to hit the ground. In other words, how does increasing the initial height from the ground to the bottom edge of a vertically dropped penny affect the time the penny takes to hit the ground without interruption? We hypothesize that if the initial height from the ground to the bottom of a vertically-dropped penny increases, then the time the penny takes to hit the ground without interruption will also increase.

Procedure and Materials

One special technique used to ensure precision was the distribution of tasks. Daya was always the timer and counted down, saying "3, 2, 1, go." Numaan always lined the bottom edge of the 2003 penny against the bottom edge of the tape marker, and dropped the penny when he heard Daya say the "g" sound in "go." The initial height increased by 25cm, starting at 1m and finishing with 2m. Daya stopped the stopwatch when she heard the penny hit the floor. Sameer recorded the times in his notebook. Numaan stood on a chair for the 2m drop.

Diagram



Constants and Equations

$m_p = 2.54$ g

$v_{iy} = 0$ m/s

$y_i = h$

$y_f = 0$ m

$a_T = -9.8$ m/s^2

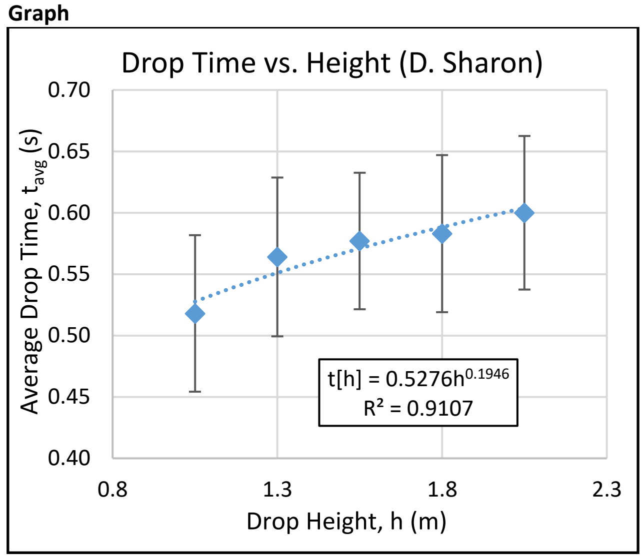
$$y_f = \frac{1}{2}at^2 + v_{iy}t + y_i$$

$$t_T[h] = \sqrt{\frac{-2h}{a_T}}$$

Data Summary

h	t_{avg}	STDEV	%RSD	t_T	|%err|
(m)	(s)	(s)	of t_{avg}	(s)	of t
1.000	0.52	0.06	12.30	0.45	14.66
1.250	0.56	0.06	11.47	0.51	11.67
1.500	0.58	0.06	9.63	0.55	4.29
1.750	0.58	0.06	10.97	0.60	2.45
2.000	0.60	0.06	10.42	0.64	6.09
		Avg	**10.96**	Avg	**7.83**

Graph



Analysis

The precision of our data was constant, as seen in the unchanging standard deviation (STDEV). In addition, our average times increased as the initial height increased. The trend wasn't constant, though. For example, the difference in average time between the first and second drops was much greater than the difference between the third and fourth drops. The percentage of error between our times and the theoretical time, which was derived using $t_T[h]$, decreased for the most part as the initial height increased, suggesting that our data got more accurate as the initial height increased. The only outlier in this case was the percentage of error for the 1.75m drop.

Conclusions

From this experiment, we can determine that the time a penny takes to hit the ground increases in a positive relationship with the initial height from which the penny was dropped. This result matches our hypothesis perfectly. Even though we did our best to be as precise and accurate as possible, there were a few errors during our testing. On a few occasions, the penny hit the table, or a foot, during the drop. The times from these botched drops weren't even read, and discarded immediately. Since we didn't have a target time range, our results weren't higher or lower than expected, but our precision was higher than expected. We thought we would make more mistakes while dropping the penny, but we kept the mistakes to a minimum. Since we did not read the times for the few botched falls that we had, that data did not affect our calculations at all. As a follow-up to this lab, one option would be to add more drop heights. We weren't allowed to stand on the classroom tables for our drops, so our range was limited, but adding in 3m or 4m drops would provide more interesting data.