Kinematic Motion Lab

Benjamin Davidson October 6, 2008 Lab Partners: Maura, Charlene

Introduction

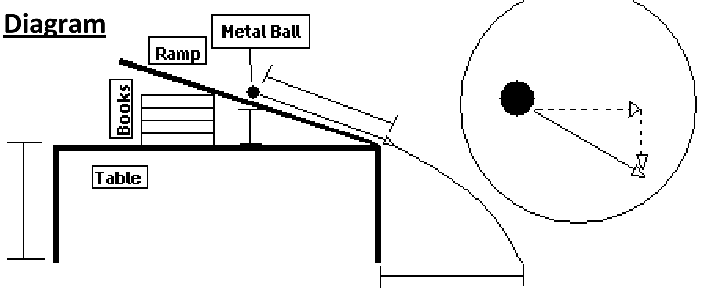
How does the distance and time that a metal ball travels on an angled ramp affect the horizontal distance that the ball travels in the air after it falls a set height?

The purpose of this lab was to attempt to prove equation 1 <attached> by experiment. We hypothesized that as both the distance that the metal ball traveled along the angled ramp and the time that it traveled along this ramp increased, the horizontal distance it traveled on its way to the ground would increase.

Procedure and Materials

First, the experiment was set up according to the diagram. The angle of the ramp was kept constant. A small metal ball was released from a variety of distances along the angled ramp. The distance and the time on the ramp were recorded. The metal ball rolled down the ramp, and fell a constant distance to the floor. This ramp worked to keep the velocity and angle of the metal ball constant per trial. The horizontal distance from directly under the ramp to the location that the metal ball landed on the ground was recorded using a meter stick that could measure to half of a millimeter.

Diagram



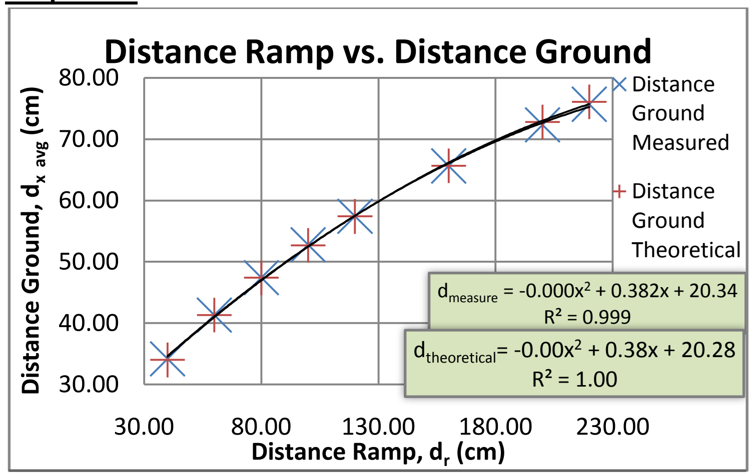
Equations and Constants

Constants		Equations
$\emptyset$	8.511°	$v_i = \sqrt{\frac{10h}{7}}$ <See attached>
h_{table}	75.00cm	$v_{ix} = v_i(\cos \emptyset)$
g	$-980 cm/s^2$	$v_{iy} = v_i(\sin \emptyset)$
		$v_x = d_{theo}/t_{fall} \rightarrow d_{theo} = v_x t_{fall}$
		$h_{ramp} = d_r \sin \emptyset$
		Equation 1 <attached>
		Equation 2 <attached>

Data

	T_{avg} (s)	D_{Ramp} (cm)	DG_T (cm)	Dg_{avg} (cm)	%error (cm)
1	0.85	40.00	34.01	34.20	0.56
2	0.98	60.00	41.32	41.35	0.06
3	1.10	80.00	47.40	47.45	0.10
4	1.37	100.00	52.69	52.80	0.22
5	1.41	120.00	57.41	57.45	0.07
6	1.61	160.00	65.67	65.65	-0.03
7	1.81	200.00	72.82	72.33	-0.67
8	1.85	220.00	76.08	75.70	-0.50

Graph One



Analysis

The data from graph one has a polynomial trend. This is evident from both the equations of the curve of best fit and from equation one. Equation one is a polynomial of degree two; therefore, the curve of best fit follows the equation. However, I do not think these equations are perfectly true. If the data trend continued, the data trend would suggest that at a large ramp distance, the ground distance would start to decrease relative to previous points. I do not think this is the case. Instead, I believe that the data trend would flatten off at a large ramp distance.

The data from graph two <attached> fit a linear trend. This relationship is clear by the *line* as well as the equations of both of the data trends. A linear trend means that the time will increase proportional with the distance.

I think my lab group and I collected very 'good' data. The data trends of both graphs display very clear trends. Additionally, the data was superbly accurate and precise. It was accurate because the measured values of distance came very close to the expected result. This is evident by the %error of each trial. The data was precise because the standard deviation of both the time values and the measured distance values was very small.

Conclusions

By experiment, my lab group and I were able to prove equation one. Additionally, our hypothesis was correct: as the ramp distance increases, the ground distance increases. In fact the relationship between ramp distance and ground distance is polynomial. The relationship between ramp time and ground distance is linear. One possible source of error may have been the assumption that $g = -980 cm/s^2$. A correct value of gravity would most likely have been higher, resulting in the theoretical difference of approximately five millimeters (lower)(around 1% difference). Another source of error may have been the lack of the account of friction, which would work to decrease the theoretical distance. A possible future extension to this lab would be to prove experiment one by means of constant ramp distance and varying ramp angle.