CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)
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Project Number
J1726

Project Title
The Sweet Spot

Abstract

Objectives/Goals
My project involves understanding how the impact point on a swinging wooden cylinder affects the force with which it hits a stationary object like a marble. I hypothesized that the force with which the cylinder hits the marble will increase linearly as the impact point distance increases.

Methods/Materials
To limit the number of factors that affect the outcome of my experiment, I designed and built a custom rig. The rig allowed me to change the impact point on the cylinder in steps. The independent variable is the impact point distance, which is the distance from the hanging end of the cylinder to the impact point. To limit the distance the marble travels after impact, I incorporated an incline plane while designing the rig. The dependent variable is the distance the marble travels on the incline plane after impact. Also, for each trial, I pointed a high speed camera at the expected region on the incline plane. Each time I released the cylinder, I started the high speed camera. Then I reviewed the pictures and chose the one where the marble was least blurred since it indicated the farthest point the marble reached. Next I took a visual estimate of where the leading edge of the marble aligned with a specific millimeter marking on the ruler already placed on the incline plane.

Results
From my experiment, I realized that for smaller impact point distances, the distance the marble travelled grew at a steady rate. However for larger impact point distances, the distance the marble travelled started to grow at a slower rate. In fact, for impact point distances closer to the length of the cylinder, the distance the marble travelled started to decrease. I realized that the marble travelled the farthest when it was hit at the #sweet spot# on the cylinder.

Conclusions/Discussion
Through my experiment, I found out that my hypothesis was incorrect. My analysis showed that if the impact point is above the sweet spot, the cylinder rotates clockwise after impact. If the impact point is below the sweet spot, the cylinder rotates anti-clockwise. If the impact point is on the sweet spot, the cylinder does not rotate at all right after impact. This is because maximum impact energy is transferred from the cylinder to the marble, and the marble travels the farthest. The most important factor that determines the distance the marble travels is the total momentum of the cylinder above and below the impact point.

Summary Statement
My project involves understanding how the impact point on a swinging wooden cylinder affects the force with which it hits a stationary object like a marble.

Help Received
I would like to thank my dad for helping me design and build the test rig to conduct my experiment.