CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
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Project Number
S0217

Project Title
Tennis Players Need Resistance

Abstract

Objectives/Goals
To find whether air resistance affects the trajectory of a tennis ball. If one can predict an objects trajectory using the kinematic equations, and if air resistance is dependent on speed, then will the difference between the predicted horizontal distance and the real distance the ball lands at increase as speed increases?

Methods/Materials
Measure the initial speed of a tennis ball launched by the ball machine at five different speed settings by using a Ballistic Pendulum. Measure the change in height that the pendulum swings to and use the principle of Conservation of Linear Momentum to find the final and initial velocity. Then in a large, flat open area, launch ten balls each from the ball machine at 45o at five different speeds with spin setting off. Measure the range of all fifty ball landings. Compare the expected range of trajectory (without air resistance) to the average range of tennis balls in the experiment (with air resistance) by using the kinematics equations and the ball machine#s range results.

Results
As expected, the average range that the tennis balls traveled during the experiment increased as the speed increased. The ballistic pendulum also helped find the initial velocity of the tennis balls so that I could accurately predict the range the balls would travel without the influence of air resistance. The data from the experiment shows that from speeds 1-5, the range continues to increase, but not at the same rate as the range without resistance. Because the distances that the tennis balls travel arent the same value as that which is expected, the data reinforces how air resistance has a significant effect on the trajectory. The data also depicts how as the speed increased the effect of drag also increased, making the range increasingly different than that which is expected.

Conclusions/Discussion
This experiment shows how the force of drag on an object increases with velocity. The results of this experiment show a greater difference in projectile range between actual and calculated as speed increases. Using just kinematics equations alone will not accurately predict where an object will land because its trajectory is shortened by air resistance. These results support my hypothesis.

Summary Statement
Whether using the equations of kinematics for constant acceleration can accuratly predict where a tennis ball, affected by drag, will land.

Help Received