CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

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Project Number

J1728

Project Title

Roller Coaster: From What Height Must One Release a Ball in Order for It to Complete a Loop?

Abstract

Objectives/Goals

The purpose of this project was to see from what height a ball must be released in order for it to complete a loop without falling. After carefully considering gravitational potential energy, translational kinetic energy, the moment of inertia of a sphere, angular velocity, rotational kinetic energy, conservation of energy, and centripetal force, it was hypothesized that the ball should be dropped from 10 cm higher (to account for friction) than the height of the loop plus 7/10 of the radius of the loop (or h of release = h of loop + (7/10)r + 10cm).

Methods/Materials

After the balls were massed, a cut PEX pipe (like PVC pipe, but more flexible) was screwed down to two, 2x4 pieces of wood that were connected together by a door hinge. The PEX pipe was sanded down to make a smooth and even track. A frame was built, a loop was formed from the PEX pipe, and this loop was attached to the framing. After measuring the diameter of the loop, the drop height was measured to determine from how high to drop the marbles in order to complete the loop without falling out. This was done multiple times and the results averaged.

Results

Although the hypothesis was incorrect (if 20 cm were added instead of 10 cm to account for friction, then it would have been accurate), the project was considered a success because for the most part, the masses of the balls did not matter (which matched the calculations).

Conclusions/Discussion

Even with the elimination of vibrational energy by attaching the track to the 2x4s, and the attempt to take out friction by having the ball ride on the edge of the PEX pipe (and by sanding down the pipe), the friction had more of an effect than originally thought. But it was shown that the masses of the balls did not matter in the drop height, as was calculated in the hypothesis (the masses canceled out). It just turns out that friction was too hard to overcome.

Summary Statement

The purpose of this project was to see from what height a ball must be released in order for it to complete a loop without falling.

Help Received

Father and neighbor cut the PEX pipe with a table saw (I simply fed it through, while they operated the blade)