CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
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Project Number
J0723

Project Title
Factors that Affect a Magnetic Linear Accelerator Projectile Distance

Abstract

Objectives/Goals
To determine the affect that magnet spacing, ball bearing mass and number of magnets has on the distance a home made linear accelerator can project a steel ball bearing. Which combination can launch the ball bearing the farthest?

Methods/Materials
To make the linear accelerator I used high powered neodymium-iron-born magnets, a length of three sided aluminum channel, steel ball bearings, duct tape and a wooden base. To determine the affect of magnet spacing I launched the ball bearing horizontally from a fixed height of 75 cm and measured the distance. I tested the spacing of the four magnets, at 5, 6, 7 and 8 cm. Using the best magnet spacing I tested the affect of mass using steel ball bearings weighing l6.5 and 3.6 grams. I then added more magnets to the linear accelerator. I tested how far the linear accelerator launched the larger ball bearing using four, five, six, seven and eight magnets. Finally, with the six magnet linear accelerator, I used a ballistic pendulum to determine the speed of the projectile.

Results
In my first experiment the five centimeter magnet spacing didn#t work because the magnets pulled the ball bearings apart. The six cm magnet spacing projected the ball bearing an average of 144 cm. The seven cm magnet spacing projected the ball bearing an average of 80 cm and eight cm spacing projected it an average of 84.5 cm. On my second test the 3.6 gram ball bearing went 209 cm and the 16.5 gram one went an average of 144 cm. On my third experiment, with five magnets the average distance was 180 cm, with six the average was 191 cm, seven averaged 199 cm and eight magnets averaged 203 cm. Nine magnets gave the lowest distances averaging 126 cm.

Conclusions/Discussion
On my first two experiments my hypothesis was correct, the six cm magnet spacing was best and the smaller ball bearing went farther. My last experiment showed that increasing the number of magnets increased the distance. Adding more than eight magnets gave lower distances. I think this is because the tape couldn#t hold the last magnets in place due to too much power.

Summary Statement
To determine the affect that magnet spacing, ball bearing mass and number of magnets has on the distance a home made linear accelerator can project a steel ball bearing.

Help Received
My Uncle and Dad helped me build the ballistic pendulum.