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Magnetic Accelerator
#MAGLINE-01

Warning:

- **Not a toy; use only in a laboratory or educational setting.**
- **Contains small parts.**
- **California Proposition 65 Warning: This product may contain chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.**

Introduction

The Magnetic Linear Acceleration is a run demonstration of conservation of momentum, potential energy and magnetic force!

When a series of magnets and ball bearings are aligned, a simple magnetic linear accelerator is created. The magnetic fields stored energy is passed to the ball bearing which gives the ball a push through the chain of collisions.

Without a magnet, the balls will act similarly to Newton's cradle. The outgoing ball should move with a speed close to that of the incoming ball.

Add that magnet along with some extra balls, and the outgoing ball speeds away at a much greater speed than the incoming ball. Why?

You will measure how far the outgoing ball travels before hitting the ground and use that information to estimate the ball's speed. How do the number of magnets and number of balls affect this speed?

How to Use

1. Set up your magnet cannon track. Adjust the feet so that you have as little bending as possible from the masses of the magnets and balls. Place one end of the track near the edge of the table.

2. Measure the vertical distance from the floor to the track. Record this height. Be sure to report this value in your lab report.

3. Place a piece of carbon paper on top of a piece of white paper on the floor where you expect the balls to land. You may have to make some trial runs to determine where to put the paper.

4. Place the magnets and balls roughly in the middle of the track. You can vary the number of magnets, the number of balls on the outgoing side, and the number of balls on the incoming side. Use a method of launching the incoming ball that will give a fairly constant speed. Launch the ball. Measure the distance from the end of the track to where the ball landed.

5. Calculate the speed of the ball and record it.

Calculating the Speed

The ball leaves the track with a horizontal velocity that you will calculate and with no vertical velocity. The height you measured allows you to calculate the time the ball spent falling.

$$h = \frac{1}{2} g t^2$$

$$t = \sqrt{\left(\frac{2h}{g}\right)}$$

The horizontal distance leads directly to the speed.

$$d = vt$$

$$v = \frac{d}{t} = \frac{d}{\sqrt{(2h/g)}}$$

In this equation, **g** is the acceleration of gravity, $\mathbf{9.8 m/s^2}$. You have measured d and h.

You will measure the distance to the point where the ball lands on the floor and use the equation above to calculate its speed as it left the track.

Enter the number of steel balls on the incoming side of the magnets and the speed. Repeat for different numbers of incoming-side balls. You also should repeat the same measure three times and average the results if you have the time.