Class: Physics I, Dates: Lab performed 1/25/2021

Lab 6: Introduction to the Impulse Conservation Law

By

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In this lab, a cart released on a track at a slight angle collides elastically with a bumper and velocity before, V_1, and after collision, V_2, is measured. As expected according to the linear momentum conservation law, we observed $V_1+V_2=0$. **In this lab we had two equal balls 23.5cm apart. One of the balls gets pushed forward to hit the other ball. We are trying to find the velocity of both balls.**

1. Introduction

The momentum of an object is the product of its mass and velocity: P = mv, where P is momentum, m is mass, and v is velocity. Changing the momentum of an object requires force; the total force applied over time, called the impulse, is equal to the change of the momentum: $F\Delta t = \Delta P = Pf - Pi$. In the event of an elastic collision, each object comes out of the collision in the same shape and mass with which it entered, and total momentum is conserved; the sum of the momentum of each object before the collision should be equal to the same sum after the collision. In an inelastic collision, some energy may be lost to noise, vibration, heat and/or deformation, or the objects may even stick together upon collision; if energy is lost in the collision, total momentum may not be conserved.

2. Materials

Figure 1. Materials used are **track ramp, ping pong balls, video camera, and a ruler.**

2. Procedure

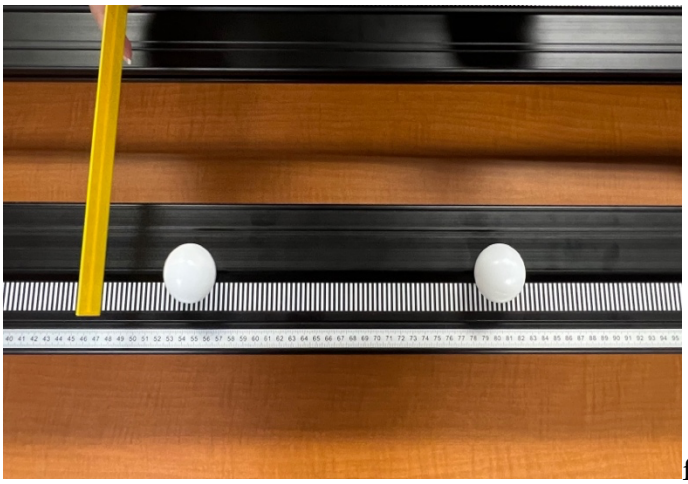
fig.1 Wen we hit the first ball.

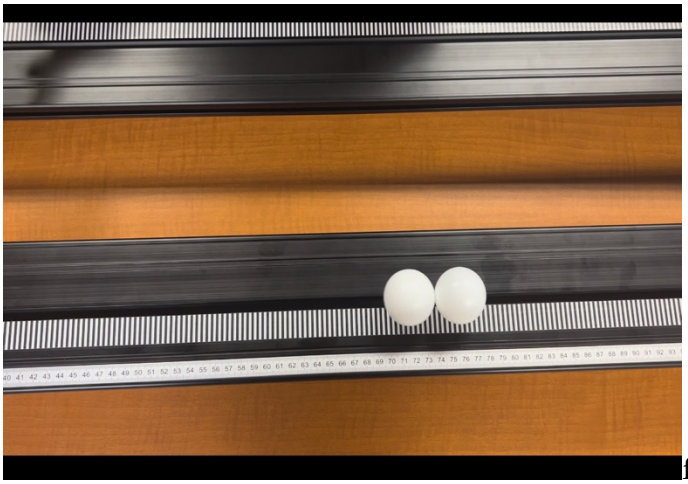
fig.2 When the collision occurs.

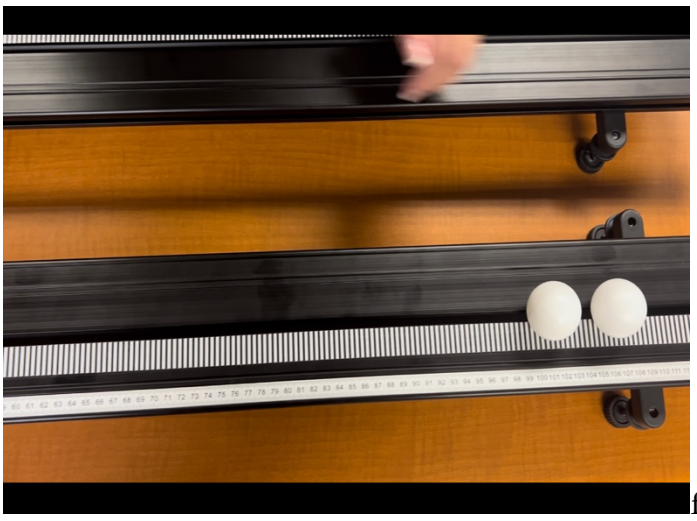
fig.3 When both balls kept moving before both felt out of the ramp.

1. **We lined up both ping pongs to be 23.5cm apart, and then we used a ruler to push ball #1. We push the first ball into the second ball. We measured the distance they were apart and the distance of the second ball when it fell off the ramp. We measured the time it took for the first ball to hit the second ball and we measured the time it took both balls to fall off the edge of the ramp. With both the times and distances we found the velocity of both balls.**

4. Results and Analysis

Before collision

v initial both balls= 0 m/s

First ball= (y)

Second ball= (x)

d(y)**=23.5cm =0.235m** **t**(y)**=0.20s** $\boldsymbol{v(y) = \frac{d}{t} = 0.235\ m/0.20s = 1.175\ m/s}$

After collision

d(x)**=48cm= 0.48m** **t**(x)**=2.39s** $\boldsymbol{v(x) = \frac{d}{t} = 0.48m/\ 2.39s = 0.20\ m/s}$

d(y)**=48cm= 0.48m** **t**(y)**=2.58s** $\boldsymbol{v(y) = \frac{d}{t} = 0.48m/\ 2.58s = 0.19\ m/s}$

5. Conclusion

During this lab we expected the first (y) ball to hit the second (x) ball and stop transferring the momentum to (x). Due to experimental error (y) continued to roll behind (x). We noticed that (y) had a faster velocity because the momentum had increased while (x) ball had a slower velocity due to the momentum decreasing despite going the same distance and direction.

6. Question.

If the mass of (x) ball was 5 times the mass of (y)ball. What would be the speed of the (x) ball after the collision?

$$v = 5\left(\frac{d}{t}\right) = 5\left(\frac{0.48m}{2.39s}\right) = 1.00m/s$$