Collisions

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Contents

1 Introcution

1.1 Aim of the Experiment

In this experiment, we will investigate the changes of energy and momentum before and after a collision. This investigation aims to determine the extent to which the laws of conservation of energy and momentum hold true for different types of collisions.

1.2 Different Kinds of Collisions

There are several types of collisions in physics, including elastic collisions, perfect inelastic collisions, and partially inelastic collisions.

An elastic collision is a collision where the objects collide and bounce off each other without any loss of kinetic energy. In other words, the total kinetic energy of the two objects before and after the collision remains the same.

A perfectly inelastic collision is a type of inelastic collision where two objects stick together after the collision, losing all of their kinetic energy.

A partially inelastic collision is a type of inelastic collision where two objects stick together after the collision, but only lose some of their kinetic energy.

1.3 Apparatuses

1. air track
2. gliders
3. digital timer
4. air pump
5. light gates
6. digital balance
7. sticks

2 Procedure of the Experiment

2.1 Data Collecting

To start the experiment, I set up the air track and the air pump. Then, I placed a glider on the track and adjusted the air track until the glider remained still. After that, I installed light gates on one side of the track to monitor the time and velocity of the gliders. As the experiment

involved gliders with varying masses, I loaded weights onto multiple gliders. I collected 4 sets of data from 4 different scenarios of the collisions:

- Elastic (with elastic rings on gliders), $m_1 = m_2$.
- Elastic (with elastic rings on gliders), $m_1 \neq m_2$.
- Elastic (with elastic rings on gliders), $m_1 = m_2$.
- Total inelastic(with stickers on gliders), $m_1 = m_2, u_2 = 0$.

where the velocity of m_1 is measured by light gate 1 and the velocity of m_2 is measured by light gate 2.

All the data collected from the experiment are included in the raw data table enclosed in the appendix.

2.2 Data Processing Examples

2.2.1 Momentum Example

The formula for calculating momentum is

$$P = P_A + P_B = m_1u_1 + m_2u_2$$

Thus,

$$\begin{aligned} P &= m_1u_1 + m_2u_2 \\ &= 0.179kg \times 0.374ms^{-1} + 0.179kg \times (-0.267ms^{-1}) \\ &= 0.0669kgms^{-1} + (-0.0478kgms^{-1}) \\ &= 0.0191kgms^{-1} \end{aligned}$$

2.2.2 Kinetic Energy Example

The formula for Kinetic energy is

$$K_e = \frac{1}{2}m_1{v_1}^2 + \frac{1}{2}m_2{v_2}^2$$

Thus,

$$\begin{aligned} K_e &= \frac{1}{2} \times 0.179kg \times (0.374ms^{-1})^2 + \frac{1}{2} \times 0.179kg \times (-0.267ms^{-1})^2 \\ &= 0.0125J + 0.00638J \\ &= 0.00189J \end{aligned}$$

3 Conclusion and Evaluation

3.1 Conclusion

The results showed that the momentum was always conserved in every kind of collision.

In elastic collisions, the total kinetic energy before and after the collision remains constant. In inelastic collisions, the total kinetic energy decreases significantly.

From the provided data, we can see that momentum was conserved in experiment A, and both momentum and kinetic energy underwent significant changes in experiments C and D.

3.2 Evaluation

In experiments A and B, according to theory, both kinetic energy and momentum were expected to be conserved. However, in practice, the momentum in experiment B showed significant changes, indicating that the experiment was not accurate.

To improve the accuracy of the experiment, we can use other apparatuses to help us adjust the air track.

4 Appendixes

4.1 Raw Data Table

	$m_1(kg)$	$m_2(kg)$	$u_1(ms^{-1})$	$v_1(ms^{-1})$	$u_2(ms^{-1})$	$v_2(ms^{-1})$
A	0.179	0.179	0.374	0.353	0.267	0.247
B	0.179	0.221	0.511	0.349	0.251	0.466
C	0.179	0.180	0.817	0.112	0.914	0.259
D	0.179	0.179	1.01	0.392	0	0.392

4.2 Processed Data Table

	$P'(kgms^{-1})$	$P(kgms^{-1})$	$K'_e(J)$	$K_e(J)$
A	0.0191	0.0189	0.0189	0.0166
B	0.036	-0.0404	0.0303	0.0348
C	-0.0173	-0.0263	0.135	0.007
D	0.181	0	0.0913	0.0275