Collision Experiment

Class Code : PHYS1010AE

Group : B

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Purpose

The purpose of this experiment was to study the elastic and inelastic impact of collision of two objects on the air table. An elastic collision is an encounter between two bodies in which the total kinetic energy of the two bodies remains the same and inelastic is one in which objects stick together after impact, and kinetic energy is not conserved.

Introduction

In the captivating realm of physics, collisions stand as a fundamental gateway to unraveling the intricate dynamics of motion, energy transfer, and momentum conservation. This experiment was not just a journey into the mechanics of collisions but a deliberate exploration into the essence of classical mechanics, laying the groundwork for a broader understanding of the laws governing the behavior of objects in motion.As we delved into elastic and inelastic collisions, alongside the trajectory and dynamics of a ball in projectile motion, the objective was not just to conduct experiments but to elevate our comprehension of the underlying principles. Beyond being a mere foray into physical phenomena, this endeavour aimed to deepen our insight into the ballet of energy, motion, and conservation laws.

For a collision to occur seamlessly, the potential energy of interacting bodies must maintain constancy at the moment of impact. In the context of projectile motion, where a solitary ball defies gravity at an angle ϕ with an initial velocity v_0, our exploration sought to dissect the delicate interplay between kinetic and potential energy. Through meticulous observations of the ball in motion, our aim was to unlock profound insights into the fundamental principles governing projectile trajectories and energy conservation.

Materials/Methods

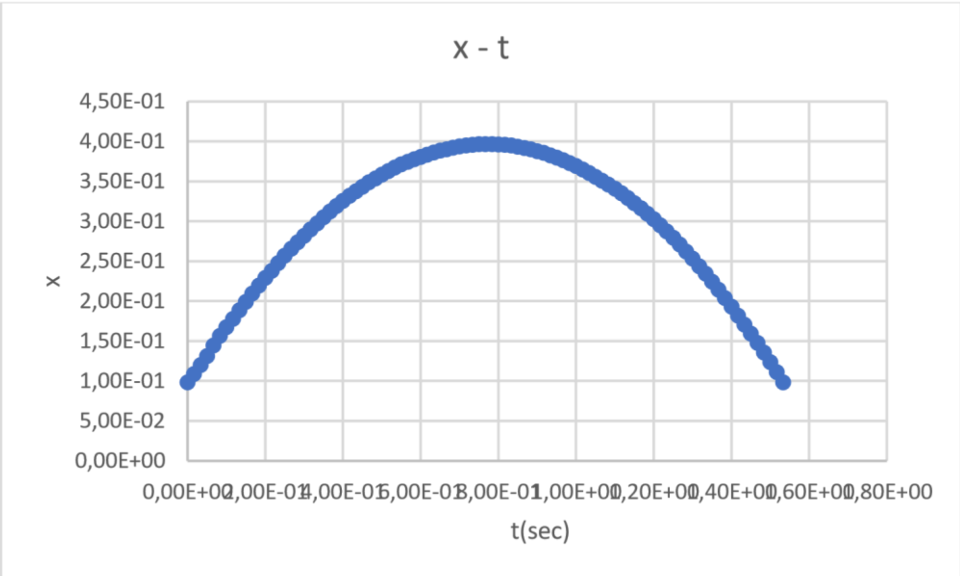
The experimental setup involved an air table equipped with two pucks for collision experiments and a single ball for projectile motion. The ball's trajectory during projectile motion was meticulously tracked and analysed to extract key parameters such as initial velocity and acceleration.

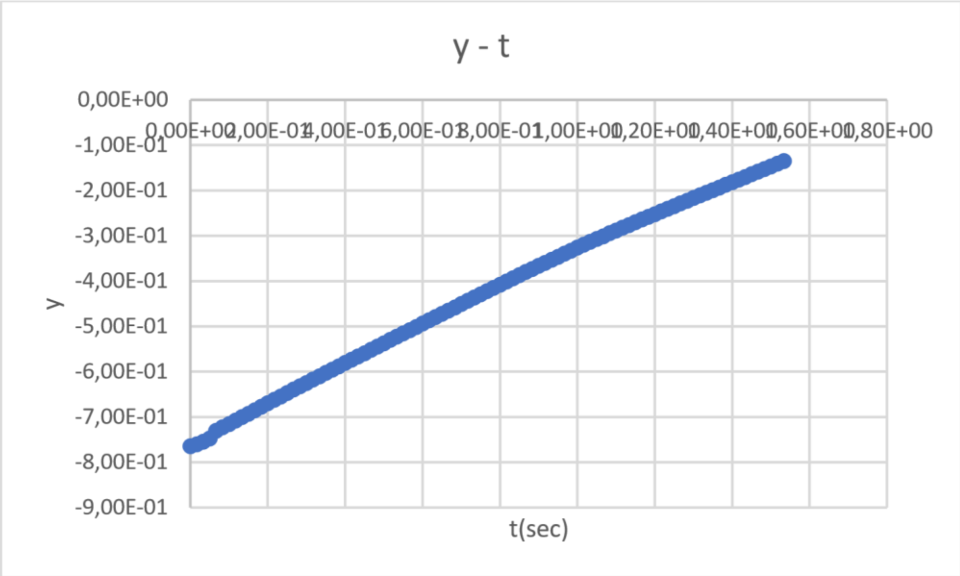
In the collision experiments, the air table minimized friction between the pucks, ensuring accurate observations of their interactions. The introduction of Velcro in the inelastic collision experiment facilitated the study of objects sticking together after impact, shedding light on the conservation of momentum in such scenarios. We used a system software called tracker to analyse the data with both moving balls to give justified measurements and change in energy and momentum.

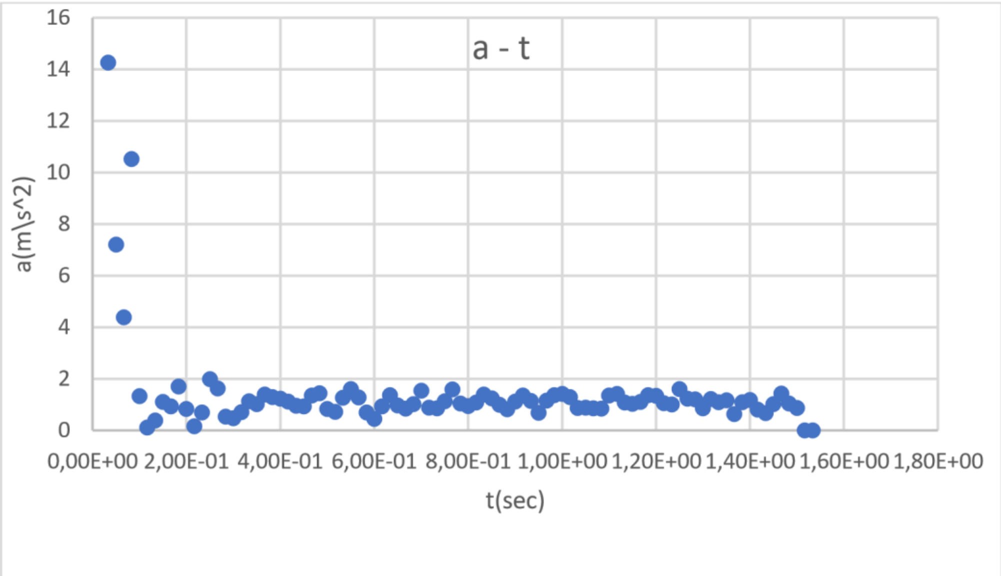
Results

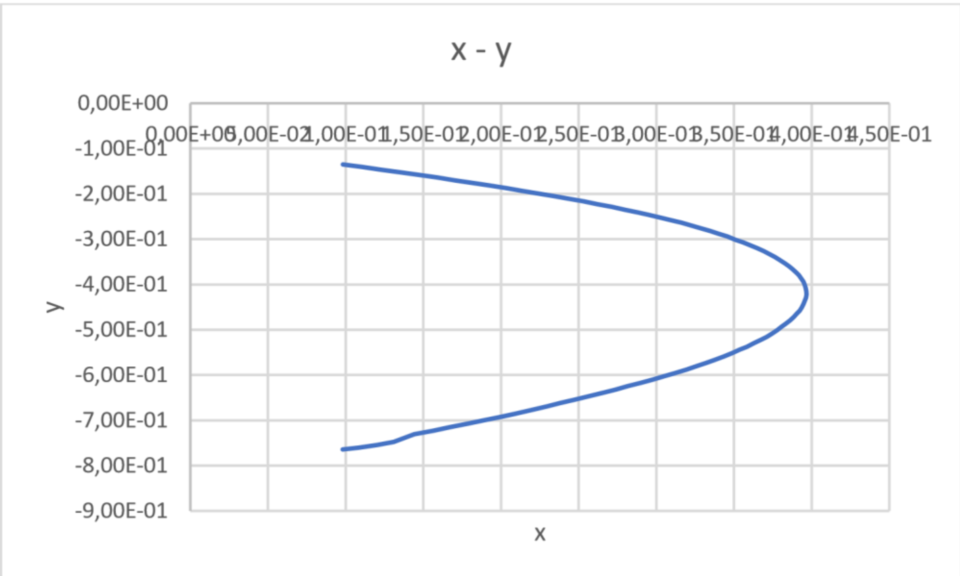
The results of the experiment were detailed and comprehensive, covering trajectory data and velocities for both the projectile motion and collision experiments. These results served as the foundation for a thorough analysis and discussion, allowing for a nuanced understanding of the underlying physics. The following are the results from unit ball (projectile motion experiment) the lab that were expressed in forms of tables and graphs;

m(mg)	0,079
V(m/s)	0,786062612
a(m/s^2)	-1,0205776
c	0,093154556
g	9,763633463
g-theory	9,8
Error%	0%




y - t
y
t(sec)
0,00E+00
-1,00E-01
-2,00E-01
-3,00E-01
-4,00E-01
-5,00E-01
-6,00E-01
-7,00E-01
-8,00E-01
-9,00E-01
0,00E+00
2,00E-01
4,00E-01
6,00E-01
8,00E-01
1,00E+00
1,20E+00
1,40E+00
1,60E+00
1,80E+00


a - t
a(m\s^2)
t(sec)
16
14
12
10
8
6
4
2
0
0,00E+00
2,00E-01
4,00E-01
6,00E-01
8,00E-01
1,00E+00
1,20E+00
1,40E+00
1,60E+00
1,80E+00


x - y
y
x
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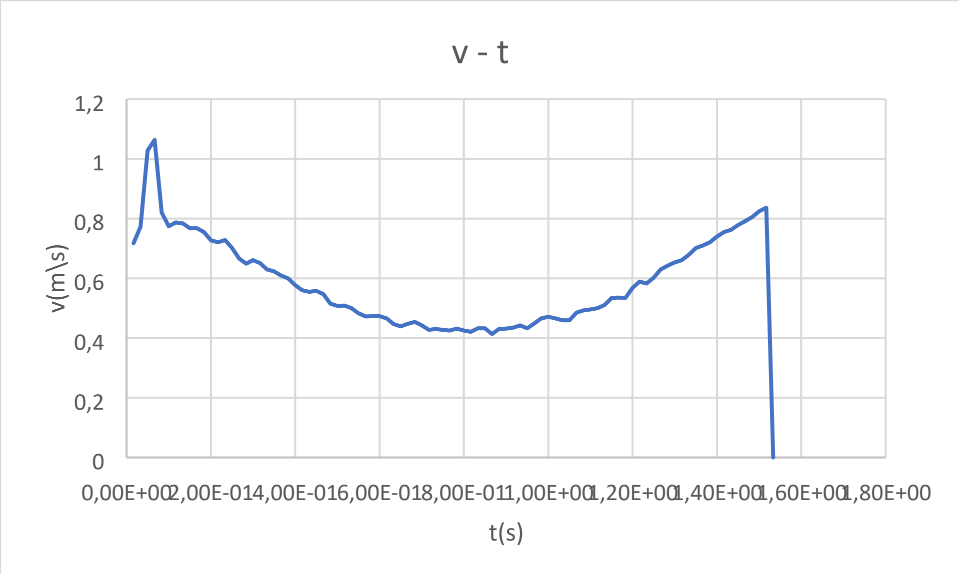
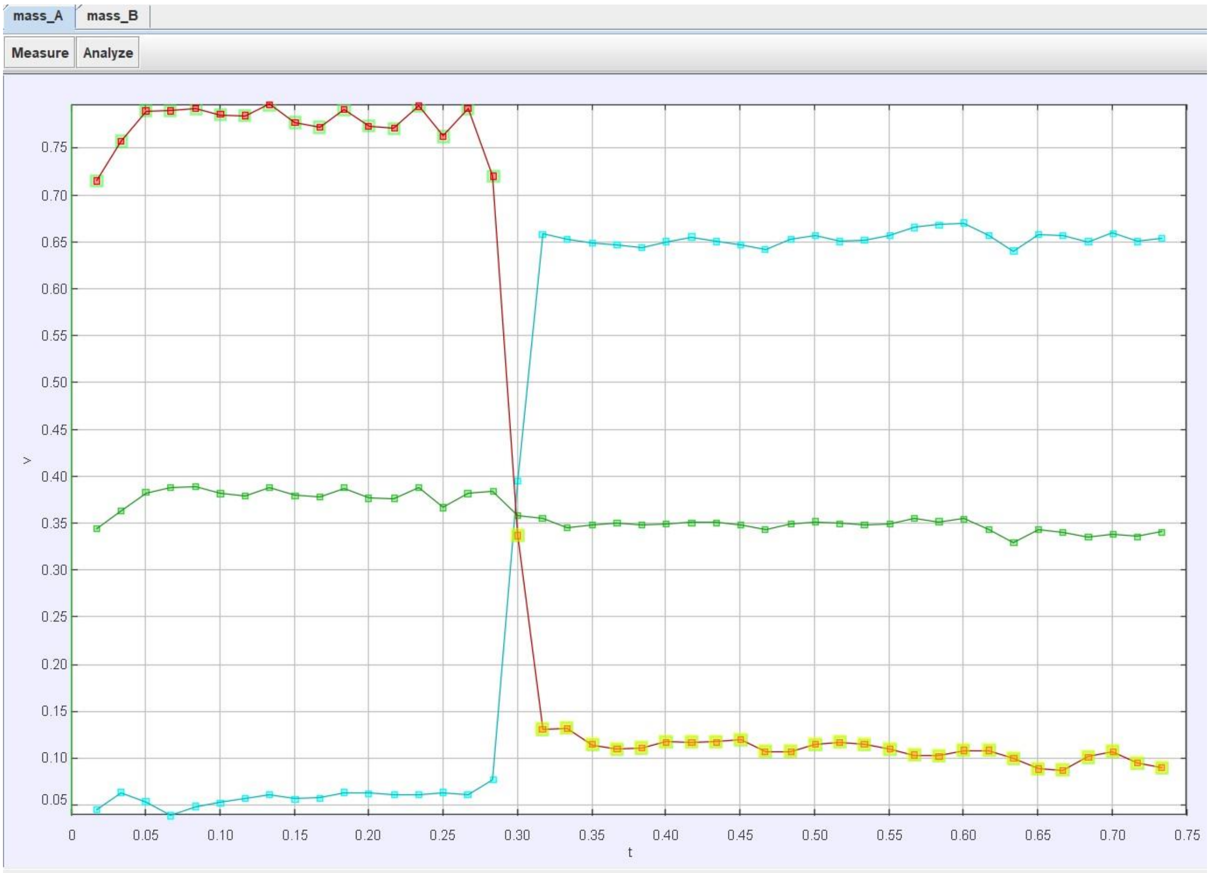
-6,00E-01
-7,00E-01
-8,00E-01
-9,00E-01
0,00E+00
5,00E-02
1,00E-01
1,50E-01
2,00E-01
2,50E-01
3,00E-01
3,50E-01
4,00E-01
4,50E-01



The following were the results we got from the collision experiment when looking for the change in momentum and energy and they are as follows;

Va	7,75E-01	Va+Vb	8,33E-01	Va'+Vb'	7,72E-01
Vb	5,81E-02				
Va'	1,18E-01	Va^2+Vb^2	6,04E-01	Va'^2+V'^b2	4,42E-01
Vb'	6,54E-01				



Discussion

The meticulous analysis of the collision videos using tracker software provided a wealth of insights into the intricate dynamics of both projectile motion and collision scenarios. In the case of projectile motion, the trajectory of the launched ball, captured with precision, allowed us to discern key characteristics of its path. The resulting parabola graph not only visually represented the journey of the ball but also facilitated a quantitative understanding of its initial velocity, acceleration, and the overall behaviour under the influence of gravity.

Moving on to the collision experiments, the behaviour of the pucks on the air table was scrutinized in great detail. For elastic collisions, where kinetic energy and momentum are expected to be conserved, the trajectory analysis was paramount. The tracker software not only provided accurate trajectories but also enabled the calculation of velocities and accelerations, allowing for a direct comparison with theoretical expectations.

In the inelastic collision experiment, the introduction of Velcro to the pucks aimed to simulate scenarios where objects stick together post-collision. The trajectory analysis in this case provided valuable data on the behaviour of the coupled system. The measured initial velocities, combined with the conservation of momentum principle, underscored the persistence of momentum even when kinetic energy was not conserved. This departure from elastic collisions highlighted the different facets of energy conservation and transfer in various collision scenarios.

The error, while indicative of potential inaccuracies, did not diminish the significance of the results. Instead, it served as a catalyst for a more profound exploration into the experimental process. Possible sources of error, such as air resistance, imperfections in the air table, or slight variations in initial conditions, were considered. These reflections prompted a deeper understanding of the experimental limitations and potential avenues for refinement in future iterations.

In essence, the discussion section went beyond a mere presentation of results and ventured into a critical examination of the experimental process. The interplay between theory and observation, the identification of discrepancies, and the consideration of potential sources of error enriched the overall analysis. This robust discussion not only deepened our comprehension of the presented results but also laid the groundwork for future experiments, encouraging a continuous refinement of our understanding of collision physics.

Conclusion

In conclusion, this experiment not only succeeded in its objectives but also opened avenues for further exploration. The 0 % margin of error, while indicative of less mistakes, significantly impact the integrity of the results. The understanding gained from the projectile motion experiment contributed not only to the specific insights into ball trajectories but also laid the groundwork for the broader discussion on collisions.

. Moreover, the in-depth analysis of inelastic collisions, where objects stick together after impact, underscored the persistence of momentum even in scenarios where kinetic energy is not conserved. This experiment is a testament to the elegance and precision of the fundamental principles of physics. The interplay of energy, motion, and conservation laws offers a profound understanding of the physical world, laying the foundation for further exploration and discovery.

Reference

- OpenStax Physics: Elastic and Inelastic Collisions
- Rice University Physics Lab: Collisions
- Michigan State University Physics Lab
- Video Reference: https://www.youtube.com/watch?v=bbRe2_EOmks
- Lab Resource: https://www.austincc.edu/physci_tf/Physics/labs/riogrande/phys1401/EGI7.pdf