Measuring Inelasticity

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AP Physics C – Mechanics

Objective

You will be working with a system to quantify the inelasticity of collisions. Most collisions in the real world are inelastic (but not perfectly so). Therefore, it is important to gain an understanding of them.

Pre-lab Questions

1. What is an inelastic collision? Describe it in words, and state which quantities are/are not conserved if there are no external forces.
2. What is the name of the coefficient that measures elasticity? List the formula below.
3. Would air resistance be negligible for a falling tennis ball in a classroom? If so, what does the formula from Question 2 simplify to for a collision between the ball and the ground, if the tennis ball bounces back up to a height *h* after starting at an initial height *H* and hitting the ground (hint: which law is best for relating heights and speed)?
4. Where can the kinetic energy go during inelastic collisions?

Materials

- Meter sticks
- Tennis balls
- Ping pong balls
- Stopwatches/phones
- Anything else you need

Procedural Requirements

One of the experiments is to quantify the elasticity for a bouncing tennis ball, using the formula you derived above. Do 2-3 trials for one constant drop height. The other experiment will have you measure the elasticity of a bouncing ping pong ball. You will need to determine what else to measure for both systems to quantify the elasticity!

To determine the elasticity, we only need to measure height before and after the collision when the velocity is 0 because we can calculate what the velocity is at those times using energy and with that we can get the velocity before and after and we divide the absolute value of the velocity after the collision by the absolute value of the ball before the collision.

Experiment

Final height of tennis ball (cm.)	**Final height of ping pong ball (cm.)**
48	**63**

53	**61**
55	**58**

Results and Discussion

Analyze your systems by characterizing the elasticity of the collision for each situation. Include data and calculations, as well as assumptions for each situation (did you assume conservation of something? Any neglected forces?). Does the coefficient characterizing elasticity vary with dropped height for each ball? Also discuss sources of error in the lab and how they may have affected your results.

The requirements asked for a constant drop height. We assumed conservation of mass. We neglected air resistance. There may also be a large amount of error from being unable to effectively measure max height after the bounce. The coefficient of elasticity would also theoretically decrease as drop height increases because collisions become less elastic because more energy is lost during these collisions. Another source of error could have been air resistance.

Post-lab Questions

1. Based on your data, can the coefficient that characterizes elasticity be any number between 0 and 1? How does this compare with your expectations? Use what you know about the different types of collisions to justify your answer. This is true because there is still energy in collisions where momentum is conserved so if you had an extremely massive thing in the system then it would significantly decrease but there would still be some so it would be greater than 0 and if it was greater than 1 it would be an explosion
2. Are there any values of the coefficient that are predicted by the theory but not realizable in a laboratory setting? Which one(s)?0 and 1 because it is impossible to have a truly elastic or inelastic collision.
3. How could the elasticity of collisions be changed to ensure safety to the objects' state before collisions (for example, if you throw an egg at a wall, what could you change to prevent cracking/splattering of the egg?)? 2 ways you could do this the first is not throw the egg. The second way you could do it is put some padding on the wall to slow the duration of the impact.
4. Why might it be important to know elasticity of collisions in the real world? It would be important to know to calculate the velocity something has when it bounces off of something to calculate the force it experiences such as Mr. Shah's wrist on the ground.