Experiment #4
Momentum

Demolition Derby

Concepts
Momentum; Impulse; Conservation of Momentum; Collisions

Introduction
Suppose you were standing at the bottom of a long hill and two objects were hurling down the hill toward you. One object is a kid on a skateboard and the other object is a Mack truck. Which one would you rather hit you? The answer is obvious. The reason is because the kid on the skate board has much less momentum, which means that the kid will exert less of an impulse on you when you collide, which means less force, which means less pain, and we all want less pain!

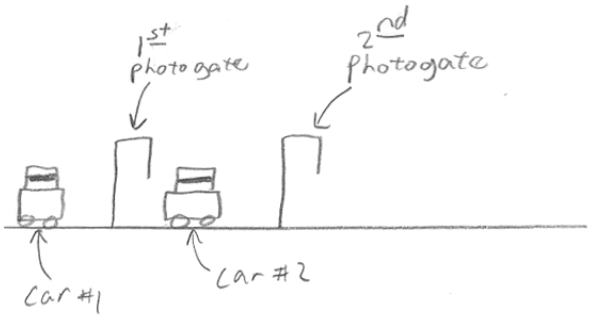
In this Lab you will learn all about collisions and how momentum and impulse play a part. The best way to do this is to actually make things collide, so that is what we will do, make car crashes!

Procedure

- Find the mass of the following items (be as precise as the scale):

Car 1 with flag	Car 2 with flag
Needle	Pin cushion
Rubber band bouncer	Jousting stick

- Level the track
    - Use an un-loaded car
- Set up the cars as shown in the picture.
    - Ensure that the gates are only 1 to 2 cm wider than the width of your car collision



- Notice the conditions for the collisions on the Chart below.

Condition	Masses	Type of Collision
A	Car1 = Car 2	Inelastic
B	Car1 > Car 2	Inelastic
C	Car1 < Car 2	Inelastic
D	Car1 = Car 2	Elastic
E	Car1 > Car 2	Elastic
F	Car1 < Car 2	Elastic

- Put the appropriate masses on the cars so that they match the conditions for the first collision (ensure that the cars are within 1 gram of each other).
- Launch car #1 toward car #2
    - The launch time should always be within ± .005s
    - Use the work energy theorem to find the two launch positions with a bouncer on the end (experimentally fine tune this answer)
- Record the times after each collision in Table 1.
- Repeat for all the collision conditions
    - If one car is supposed to be more massive than the other car, make it much more massive by putting 4 (50g) masses on the heavier car.
    - If the cars are supposed to have the same mass, get them within 1 gram of each other
    - For inelastic collisions, put the needle on car 1, and the pin cushion on car 2
    - For elastic collisions, put the jousting stick on car 1 and the bouncer on car 2.
- Calculate the data for tables 2, 3, and 4.
- Answer the questions.
- Clean up

Lab Reporting Sheet

Name:_____

Laboratory #4

Date:_____

Demolition Derby

Table 1

	Photo Gate 1		Photo Gate 2	
Collision	Time 1	Total Time	Time 1	Total Time
A				
B				
C				
D				
E				
F				

Table 2

	Before the Collision				After the Collision	
Collision	Mass of Car 1	Mass of Car 2	Velocity of Car 1	Velocity of Car 2	Velocity of Car 1	Velocity of Car 2
A						
B						
C						
D						
E						
F						

Table 3

Before the Collision		After the Collision			
Collision	Momentum of Car 1	Momentum of Car 1	Momentum of Car 2	Δv Car 1	Δv Car 2
A					
B					
C					
D					
E					
F					

- **In Collision A, which car would you rather be in?**

- **In Collision B, which car would you rather be in?**

- **In Collision C, which car would you rather be in?**

- **In Collision D, which car would you rather be in?**

- **In Collision E, which car would you rather be in?**

- **In Collision F, which car would you rather be in?**

- **If you had to choose a car and a collision, which one would you choose? Why?**

- **This experiment shows 2 things you should look for in a "crash safe" car. What are they?**
  1.
  2.

Explain how your data backs up these two statements

Table 4

Before the Collision		After the Collision		
Collision	Kinetic Energy	Kinetic Energy of car 1	Kinetic Energy of Car 2	Final Kinetic Energy
A				
B				
C				
D				
E				
F				

Table 5

Collision	ΔKE_{system}	% KE Lost	ΔP_{system}	% P Lost
A				
B				
C				
D				
E				
F				

- **Under what condition(s) is kinetic energy conserved (explain how your data backs this up)?**

- **Under what condition(s) is momentum conserved (explain how your data backs this up)?**