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Momentum & Collisions Lab

# Introduction:

To Increase immersion in games collisions between objects need to behave realistically otherwise the immersion is gone. When two object collide, momentum may be transferred from one to the other, and the conservation law states that the total momentum of a system before a collision must equal the total momentum of a system afterword.

# Methods:

When two objects collide the total of momentum of the system before must equal the momentum after as well. In algebra this look like

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With including the use of this equation of a generic velocity equation that includes a coefficient of restitution that will handle the amount of reflection it will cause.

We can use that equation to solve for either the final velocity of the first or second object then plug in the velocity into the momentum equation from before. And we can find the final velocity of both objects that might look like this equation after substituting in the solution to the second final velocity.

When we hit a surface objects usually hit back at an angle from the direction the object started. Using the surface normal we can reflect vectors or objects against surfaces. Using this reflection equation

to find the reflection vector. The coefficient variable ε controls if it’s a perfect reflection (elastic), somewhere in between, or no bounce at all (inelastic collision).

# Results:

Collision Results

## Collision1:

Velocity1: 15 Velocity2: 2  
Mass1: 2 Mass2: 10  
Coefficient: 0   
Results: both velocities are 4.17 m/s

Description:  
The coefficient of 0 creates a hit and stick, both the objects are headed the same direction and collide and because the mass of the slow on was so much larger it sped up and the fast one mass was really little so it slowed down to stick.

## Collision2:

Velocity1: 5 Velocity2: -5  
Mass1: 10 Mass2: 10  
Coefficient: 1  
Results: Velocity1 results in -5 m/s and Velocity2 results in 5 m/s

Description:  
The coefficient of 1 creates a perfect elastic collision, both objects are headed towards each other and because both of the objects mass are equal the resulting velocities are perfectly opposite separating from each other.

# Conclusion:

Collisions are easy to calculate with a couple functions, and can result in a realistic behavior. This is where mass becomes important to behave realistically. The velocity equation that includes the coefficient of restitution helps generalize the problems too giving us a general approach to these resolutions.

# Post-Lab:

1. Take the current velocity’s axis separately and define the velocities separately.   
The line of action would be the vector of an object minus the other when the 2 are touching.

2. When two objects collide with a coefficient of 0 they will hit and stick and the final velocity of both object will be the same. And move on as 1 object.

3. It goes into creating sound, maybe light, heat or shockwaves.