P H Y S I C S

Chapter 5: Momentum

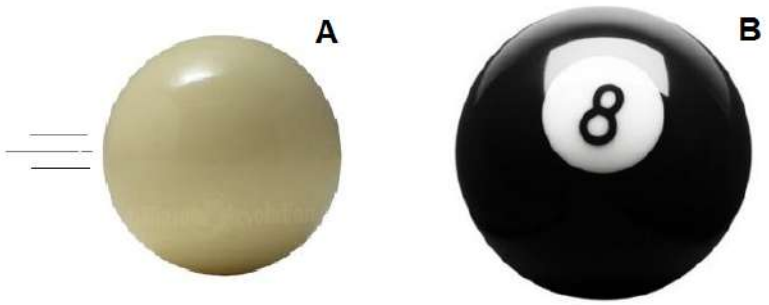
Section 5C: Conservation of Momentum (Elastic Collisions)

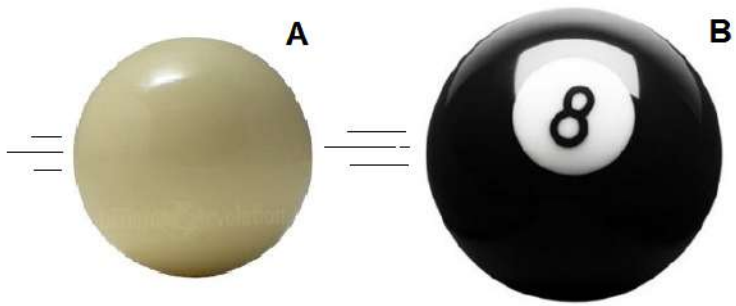
Bell Ringer

- A 40 kg miniature horse runs west at 8m/s. What is the force of impact if it hits a wall and comes to a stop in .5s?

Elastic Collisions

- Objects move separately after collision
- KE is conserved
- p is conserved





Conservation of Momentum

- Principle that states that the total momentum of an isolated system stays constant.
  - Total momentum before a collision equals total momentum after a collision

p = 30 kg·m/s p = 20 kg·m/s p = 20 kg·m/s p = 30 kg·m/s

Total = 50 kg·m/s Total = 50 kg·m/s

Conservation of Momentum Equation

$$p_{o\ (total)} = p_{\ (total)}$$

Unit: $\frac{kg \cdot m}{s}$

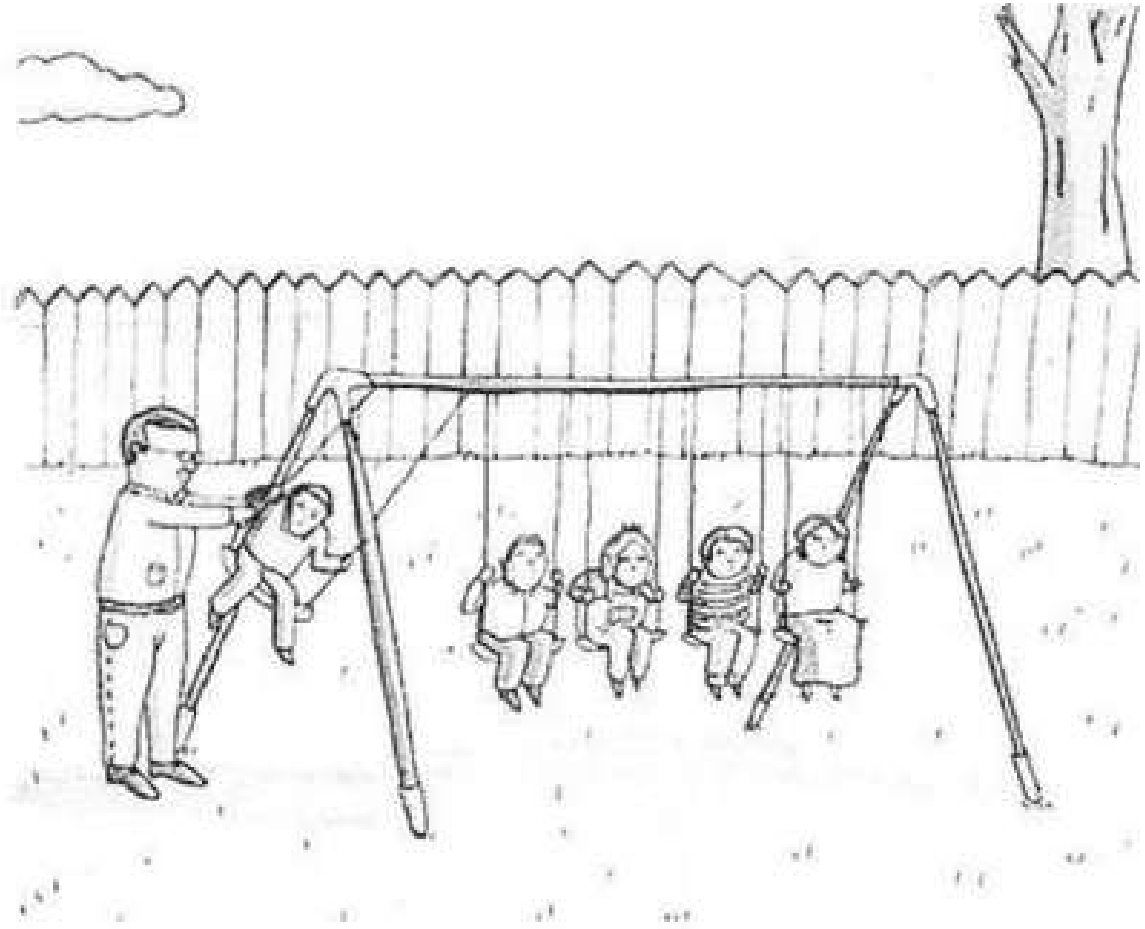
* Remember that velocities are vectors

- $p_{o\ (total)}$ → sum of initial momenta of all objects
- $p_{\ (total)}$ → sum of final momenta of all objects

Conservation of Momentum in Space

Demo: Newton's Cradle

Newton's Cradle

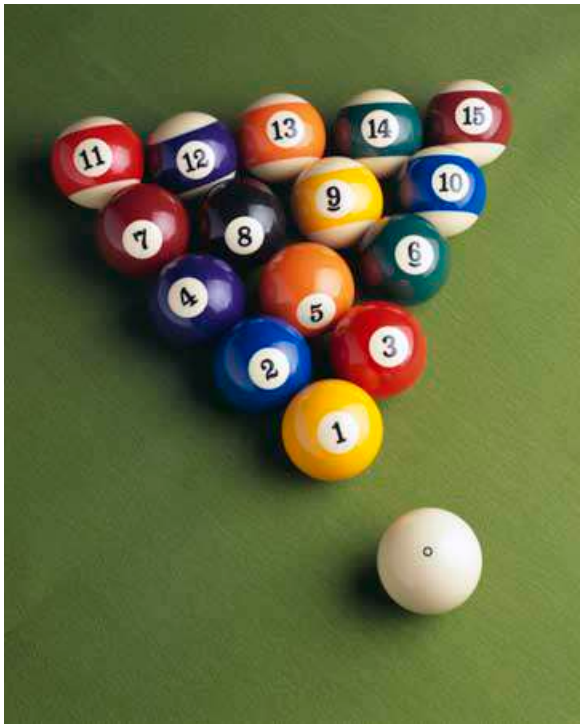


Why science teachers are not asked to monitor recess.

Demo:
Basketball and Tennis Ball

Conservation of Momentum in Two Dimensions

Conservation of Momentum in Two Dimensions



Before

After

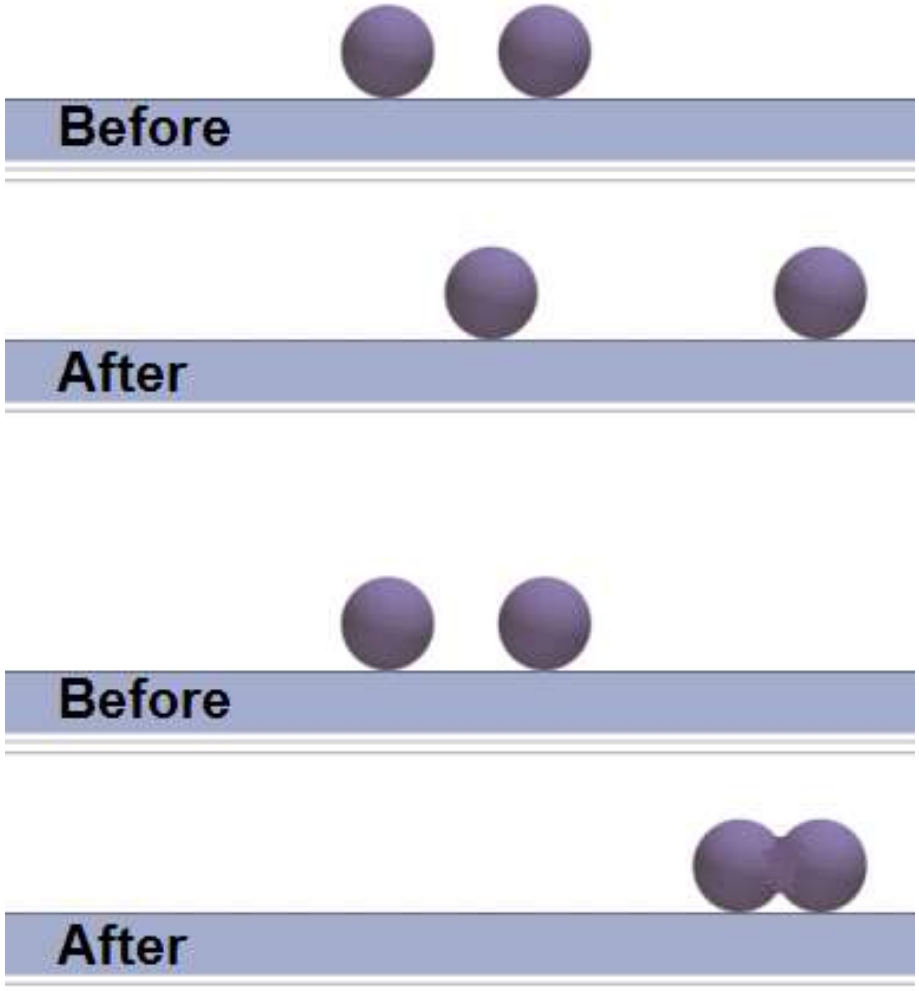
In-Class Problem #1

After a hold up, Robin Banks flees in his 1575 kg getaway car at 20 m/s. He crashes into a 45 kg highway barrel which is at rest. If Robin Bank's car moves at 18.9 m/s after the collision, how fast does the barrel move after being hit?

v = 38.9 m/s

Types of Collisions

- Elastic
- Inelastic
- Perfectly inelastic



Types of Collisions

Type	Kinetic Energy Conserved	Momentum Conserved	Stick Together
Elastic	✓	✓	
Inelastic	**Some KE converts to thermal energy**	✓	
Perfectly Inelastic		✓	✓

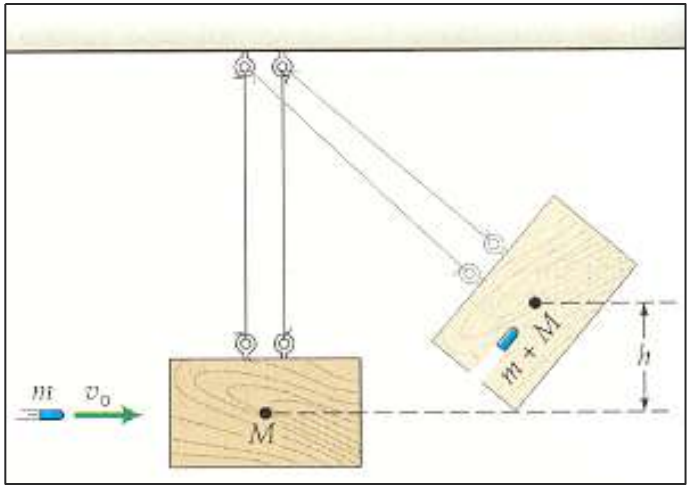
Conservation of Momentum

- Principle that states the total momentum of an isolated system stays constant

p = 40 kg·m/s p = 20 kg·m/s

Total = 60 kg·m/s Total = 60 kg·m/s

Examples of Perfectly Inelastic Collisions



Conservation of Momentum Equation

$$p_{o\ (total)} = p_{\ (total)}$$

Unit: $\frac{kg \cdot m}{s}$

* Remember that velocities are vectors

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- $p_{\ (total)}$ → sum of final momenta of all objects

In-Class Problem #1

A 1950 kg police car going 12.5 m/s rear-ends a 1500 kg sedan moving at 3.0 m/s. After the collision the two cars move together as one unit. What is their final velocity?

v = 8.37 m/s

In-Class Problem #2

A 79.5 kg defensive end tackles a 60 kg running back going north at 5 m/s. After the hit both players move together at 2.5 m/s south. How fast was the defensive end running before the tackle?

v = 8.16 m/s south