

Conserving Momentum Collisions and Explosions

14 April 2020

When is momentum conserved?

- This is discussed in the book, or in the pre-lecture video.

When is momentum conserved?

- Define the system.
- What forces are acting on the system?
 - What forces are internal?
 - What forces are external?
- If forces are internal, then total momentum of the system is conserved.
- If forces are external, total momentum of the system is not conserved.
- Momentum can be conserved in one direction, but not another.

Projectile motion: is momentum conserved?

- We shoot a cannon that is aimed 30 degrees above horizontal.
- As the cannonball flies through the air (after being shot) is momentum conserved:
 - In the x-direction?
 - How do we know?
 - In the y-direction?
 - How do we know?
- What about while the cannon is shooting the cannonball?

Collisions and Explosions

- Completely elastic
 - Both kinetic energy and momentum conserved.
- Inelastic
 - Some kinetic energy lost.
 - Momentum is conserved.
- Completely inelastic
 - After the collision, the objects are stuck together.
 - Momentum is conserved, but kinetic energy is not.
- Explosions are like this, but there is one object before, and more than one after – like running the video backwards.

As part of a circus act, Dimitri, a 136 kg strongman, catches cannonballs fired at his chest. If a 34 kg cannonball is fired at him with a speed of 32 km/hr, with what speed does the combination of Dimitri and cannonball move backward once he catches it?

- Qualitative Representation
- Variables (knowns, unknowns) and Equations

As part of a circus act, Dimitri, a 136 kg strongman, catches cannonballs fired at his chest. If a 34 kg cannonball is fired at him with a speed of 32 km/hr, with what speed does the combination of Dimitri and cannonball move backward once he catches it?

- Solution

- Reasonability Check

Ballistic pendulum

- Go to video clip

In our video clip, the ballistic pendulum swung to a height that was 12.8 cm higher than its' initial height. If the ball has a mass of _____ g and the pendulum has a mass of _____ g, what was the initial speed of the ball?

- Qualitative Diagrams
- Variables (known, unknown) and equations

In our video clip, the ballistic pendulum swung to a height that was 12.8 cm higher than its' initial height. If the ball has a mass of 70 g and the pendulum has a mass of 270 g, what was the initial speed of the ball?

- Solution

- Reasonability Check

A billiard ball moving at 5.00 m/s strikes a stationary ball of the same mass. After the collision, the first ball moves at 4.33 m/s , at an angle of 30.0° with respect to the original line of motion. Assuming an elastic collision, and ignoring friction and rotational motion, find the struck ball's velocity.

- Qualitative Representation
- Variables (knowns, unknowns) and Equations

A billiard ball moving at 5.00 m/s strikes a stationary ball of the same mass. After the collision, the first ball moves at 4.33 m/s , at an angle of 30.0° with respect to the original line of motion. Assuming an elastic collision, and ignoring friction and rotational motion, find the struck ball's velocity.

- Solution

- Reasonability check

Rules? When do I conserve momentum? Total energy?
Kinetic energy?