

Conservation of Momentum

Momentum is one of the small number of quantities in the universe that is conserved.

Law of Conservation of Momentum:

The total momentum of all objects before a collision is equal to the total momentum of all the objects after a collision, provided the system is isolated from external forces.

$$p_{\text{before}} = p_{\text{after}}$$

$$p_i = p_f$$

We will start with three types of one-dimensional collisions:

1. Two objects collide and stay as two separate objects after the collision.

A 0.2 kg tennis ball traveling at 2 m/s [R] hits a stationary basketball of 0.9 kg and gives it a velocity of 0.5 m/s [R]. What is the final velocity of the tennis ball?

2. Two objects collide and move as one object after the collision.

A loaded railway car of 6000 kg is rolling to the right at 2 m/s when it collides and couples with an empty railway car of 3000 kg rolling to the left on the same track at 3 m/s. What is the velocity of the pair after the collision?

3. One object breaks apart (explosion).

Calculate the recoil velocity of an unconstrained rifle of mass 5 kg after it shoots a 50 g bullet at a velocity of 300 m/s to the west.