

Inelastic collision

Key terms

Term (symbol)	Meaning
Inelastic collision	Collision which conserves momentum but not kinetic energy.
Totally inelastic collision	Collision where the objects stick together and have the same final velocity. Also called a perfectly inelastic collision.
Explosion	Reverse inelastic collision where momentum is conserved and kinetic energy increases.

How to determine if a collision is elastic or inelastic

If objects stick together, then a collision is perfectly inelastic. When objects don't stick together, we can figure out the type of collision by finding the initial kinetic energy and comparing it with the final kinetic energy. If the kinetic energy is the same, then the collision is elastic. If the kinetic energy changes, then the collision is inelastic regardless of whether the objects stick together or not. In either case, for collisions with no external forces, momentum is conserved.

Examples of inelastic collisions

The ballistic pendulum is a device in which a projectile such as a bullet is fired into a suspended heavy wooden stationary block. Some kinetic energy gets transformed into heat and sound, and some is used to deform the block. However, momentum is conserved. Consequently, the block swings away at some speed after the collision.

We can use both of these conservation laws to solve for different unknowns, depending on what variables we are given. For example, we can use the maximum height of the swing to determine the kinetic energy of the block after the collision, then using conservation of momentum we can find the initial speed of the projectile.

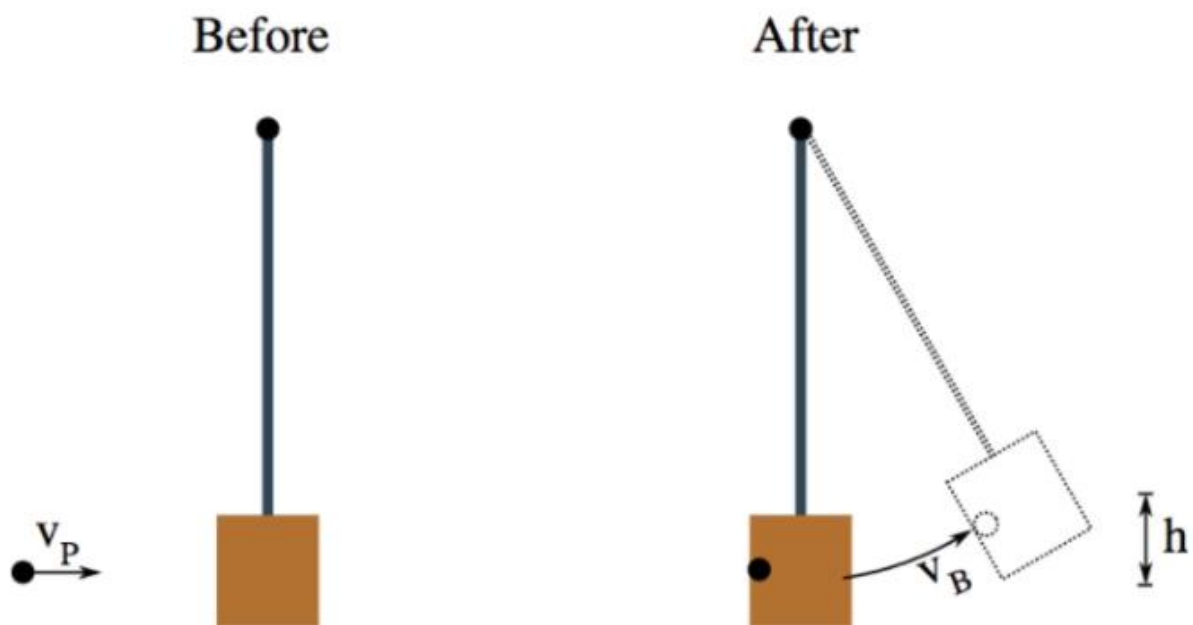


Figure 1. An inelastic collision in a ballistic pendulum.

Another example of an inelastic collision is a dropped ball of clay. A dropped ball of clay doesn't rebound. Instead it loses kinetic energy through deformation when it hits the ground and changes shape. Likewise, cars are designed to crumple when they collide. A car crash transforms some of the car's initial kinetic energy into heat, sound, and the deformation of the car.

Common mistakes and misconceptions

1. **People sometimes think that objects must stick together in an inelastic collision.** However, objects only stick together during a perfectly inelastic collision. Objects may also bounce off each other or explode apart, and the collision is still considered inelastic as long as kinetic energy is not conserved.
2. **Sometimes people think kinetic energy is only lost during inelastic collisions.** Collisions are considered inelastic when kinetic energy is not conserved, but this could be from either a loss or gain of kinetic energy. For example, in an explosion-type collision, the kinetic energy increases.
3. **It is common for people to try to conserve energy in a collision.** We can only do this if we are told the collision is perfectly elastic.