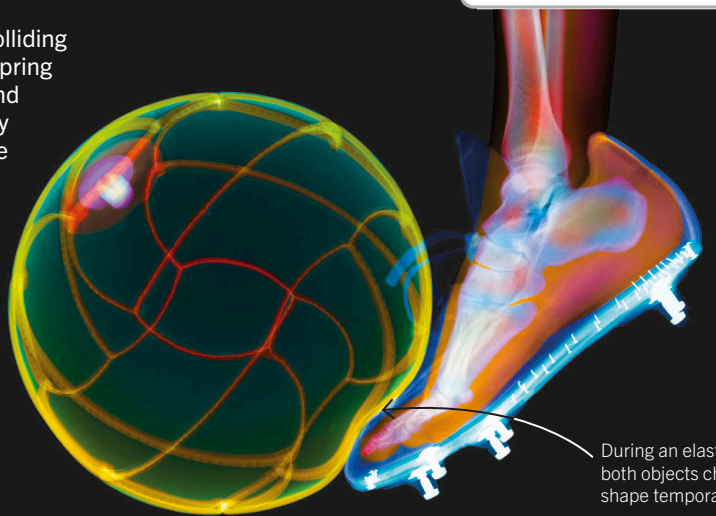
# Elastic and inelastic collisions

When objects collide, the total momentum before and after the collision is conserved (see page 100). However, kinetic energy may not be. Whether kinetic energy is conserved or not depends on whether a collision is elastic or inelastic.

## Key facts

- ✓ **Collisions can be elastic or inelastic.**
- ✓ **Kinetic energy is conserved in an elastic collision and lost in an inelastic collision.**
- ✓ **Total momentum is the same before and after a collision.**

**Elastic collisions**
During an elastic collision, the colliding objects change shape but then spring back into their original shapes and separate. The total kinetic energy of the moving objects is the same before and after the collision. Few collisions in the real world are perfectly elastic, as some kinetic energy is usually lost. For example, when a foot kicks a ball, some kinetic energy is transferred to sound.

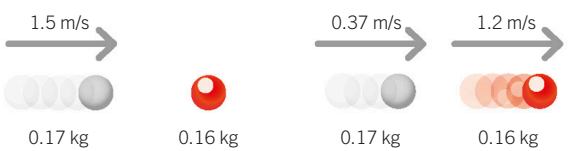


During an elastic collision, both objects change shape temporarily.

## Calculating kinetic energy

Most collisions result in a loss of some kinetic energy. We can find out how much is lost by calculating the kinetic energy before and after the collision.

**Question**
During a game of billiards, a 0.17 kg white ball traveling at 1.5 m/s hits a stationary red ball with a mass of 0.16 kg. The red ball moves forward at 1.2 m/s and the white ball at 0.37 m/s. How much kinetic energy was lost?



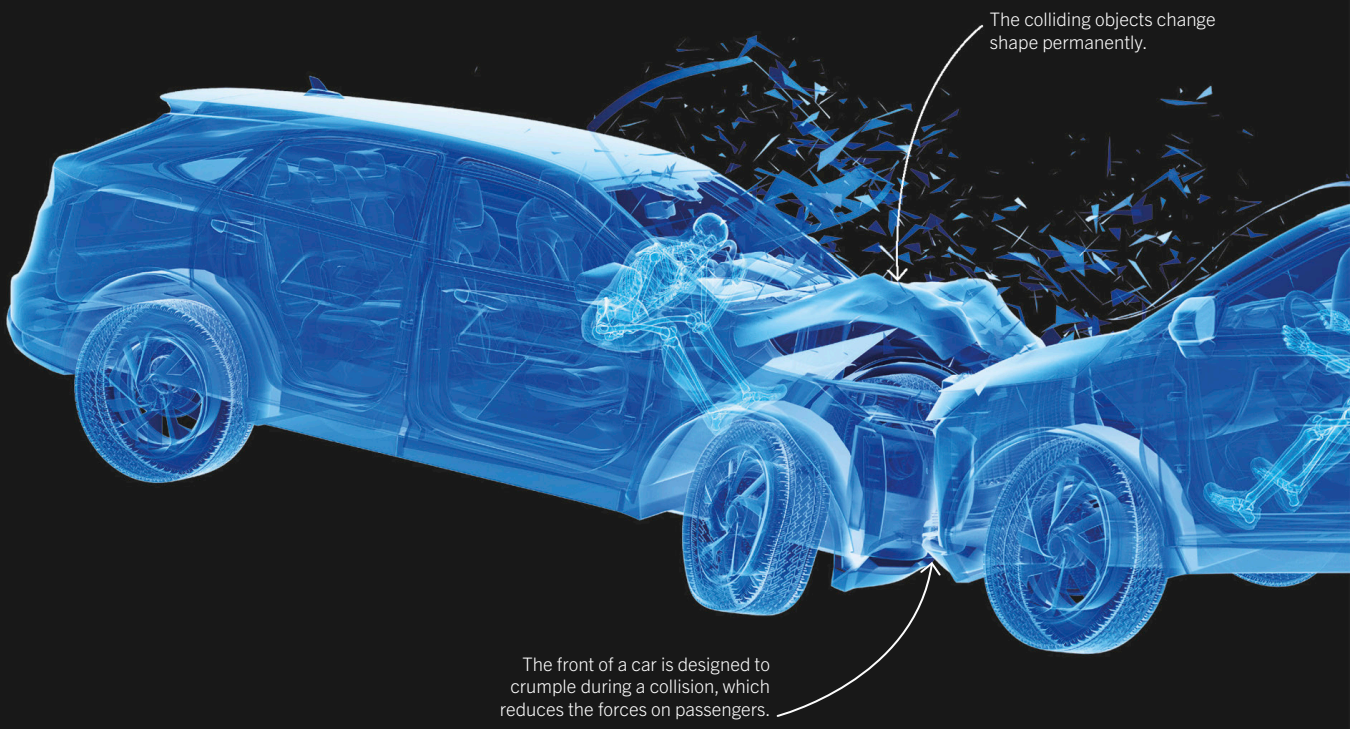

**Answer**
Use the equation for kinetic energy from page 52 ($E_k = ½ \times m \times v^2$) to work out the total kinetic energy before and after the collision.

Kinetic energy before collision $= ½ \times 0.17 \times 1.5^2$
$= 0.19$ J

Kinetic energy after collision
$= (½ \times 0.17 \times 0.37^2) + (½ \times 0.16 \times 1.2^2)$
$= 0.13$ J

The energy lost $= 0.19 - 0.13$ J
$= 0.06$ J

**Inelastic collisions**
In an inelastic collision, the colliding objects can change shape permanently and may join together. Kinetic energy is transferred to sound, internal energy, and other energy stores. For example, the car collision shown below is inelastic. Instead of rebounding like a soccer ball off a shoe, the cars lose kinetic energy and come to a halt. The shape of both cars is permanently changed.




## Explosions

In an explosion, momentum is conserved but kinetic energy is not. An unexploded bomb has zero kinetic energy when it's stationary, but the exploding fragments have a huge amount of kinetic energy. However, momentum stays the same. The total momentum of a stationary bomb is zero, and the total momentum of the fragments is also zero. (Momentum is a vector quantity, and the fragments all travel outward in different directions.)