31.2: Perfectly Inelastic Collisions

The easiest type of one-dimensional collision to analyze is a perfectly inelastic collision. In this type of collision, all of the initial kinetic energy is converted into heat and into work that deforms the bodies. After the collision, the two bodies stick together, forming a single combined mass equal to the sum of the original masses. Momentum is conserved, but not kinetic energy.

To analyze this situation, consider two bodies moving along the x axis: one of mass m_1 moving with initial velocity v_{1i}, and one of mass m_2 moving with initial velocity v_{2i}. After the collision, the two bodies stick together, forming a single body of mass m_1+m_2 moving with velocity v. The question is: given the masses m_1 and m_2 and initial velocities v_{1i} and v_{2i}, what is the final velocity v of the combined mass?

To answer this question, we make use of the principle of conservation of momentum. Before the collision, the initial momentum p_i of the system is the sum of the momenta of all the bodies in the system:

$$p_i=m_1v_{1i}+m_2v_{2i}. \tag{31.2.1}$$

After the collision, the total energy of the system is

$$p_f=(m_1+m_2)\,v \tag{31.2.2}$$

Since momentum is conserved, the initial and final momenta must be the same: $p_i=p_f$, so

$$m_1v_{1i}+m_2v_{2i}=(m_1+m_2)\,v \tag{31.2.3}$$

The final velocity v is then

$$v=\frac{m_1v_{1i}+m_2v_{2i}}{m_1+m_2} \tag{31.2.4}$$

31.2: Perfectly Inelastic Collisions is shared under a CC BY-NC-SA 4.0 license and was authored, remixed, and/or curated by LibreTexts.