15.3: Characterizing Collisions

In a collision, the ratio of the magnitudes of the initial and final relative velocities is called the **coefficient of restitution** and denoted by the symbol e,

$$e = \frac{v_B}{v_A}$$

If the magnitude of the relative velocity does not change during a collision, $e = 1$, then the change in kinetic energy is zero, (Equation (15.2.21)). Collisions in which there is no change in kinetic energy are called elastic collisions,

$$\Delta K = 0, \quad \text{elastic collision}$$

If the magnitude of the final relative velocity is less than the magnitude of the initial relative velocity, $e < 1$, then the change in kinetic energy is negative. Collisions in which the kinetic energy decreases are called **inelastic collisions**,

$$\Delta K < 0, \quad \text{inelastic collision}$$

If the two objects stick together after the collision, then the relative final velocity is zero, $e = 0$. Such collisions are called **totally inelastic**. The change in kinetic energy can be found from Equation (15.2.21),

$$\Delta K = -\frac{1}{2}\mu v_A^2 = -\frac{1}{2}\frac{m_1 m_2}{m_1 + m_2} v_A^2, \quad \text{totally inelastic collision}$$

If the magnitude of the final relative velocity is greater than the magnitude of the initial relative velocity, $e > 1$, then the change in kinetic energy is positive. Collisions in which the kinetic energy increases are called **superelastic collisions**,

$$\Delta K > 0, \quad \text{superelastic collision}$$