Totally Inelastic Collisions

- Totally inelastic collisions: objects stick together, final velocities all the same
- Use conservation of momentum to solve

$$\sum m_i \vec{v}_i = M \vec{v}_f$$

$$m_1 \vec{v}_{1i} + m_2 \vec{v}_{2i} = (m_1 + m_2) \vec{v}_f$$ (two objects)

Elastic Collisions

- Objects “bounce” off each other
- Each object has its own final velocity, more variables
  - To solve, need more info than conservation of momentum
  - Perfectly elastic: KE conserved
    - no energy lost to friction/deformation, change in PE negligible over time of collision

Elastic Collisions

- Special case: 1D, two particles
  - Two unknown final velocities, need to solve momentum and energy conservation at same time

$$m_1 v_{1ix} + m_2 v_{2ix} = m_1 v_{1fx} + m_2 v_{2fx}$$

$$\frac{1}{2} m_1 v_{1i}^2 + \frac{1}{2} m_2 v_{2i}^2 = \frac{1}{2} m_1 v_{1f}^2 + \frac{1}{2} m_1 v_{1f}^2$$

Elastic Collisions

- Special case: 1D, two particles
  - Two unknown final velocities, need to solve momentum and energy conservation at same time

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  - Solution (if masses and initial velocities known):

$$v_{1fx} = \frac{m_1 - m_2}{m_1 + m_2} v_{1ix} + \frac{2 m_2}{m_1 + m_2} v_{2ix}$$
$$v_{2fx} = \frac{2 m_1}{m_1 + m_2} v_{1ix} + \frac{m_2 - m_1}{m_1 + m_2} v_{2ix}$$

2D Collisions

- Will need to use conservation of momentum in each component
  - Ex: $$m_1 v_{1ix} + m_2 v_{2ix} = m_1 v_{1fx} + m_2 v_{2fx}$$ $$m_1 v_{1iy} + m_2 v_{2iy} = m_1 v_{1fy} + m_2 v_{2fy}$$
- Might need to relate velocity components to speeds using angles
- If elastic, use conservation of KE (which uses speeds!)