Lecture 22: Inelastic and Superelastic Collisions

Announcements

- End-of-Term Individual Meetings Open
    - 30 minute time slots to discuss anything before the final ungrading.
        * Wednesday: 10:00 – 11:30 a.m., 3:30 – 5:00 p.m.
        * Thursday: 10:00 a.m. – 2:00 p.m., 4:00 p.m. – 5:30 p.m.
        * Friday: 11:00 – 11:30 a.m., 3:30 – 5:00 p.m.
    - Must be booked at least 5 hours in advance (recommended to book far sooner).
    - Only 21 slots; ask me if you need to meet and nothing is available.

L22-1: Bumper Cars

- Two bumper cars collide with each other and get tangled together.

- Car 1 (m_1) moves north at v_1. Car 2 (m_2) moves south at v_2.

- Case 1
    - Car 1 (100 kg) moves north at 4 m/s.
    - Car 2 (200 kg) moves south at 3 m/s.
    - Find the final velocity of the cars.
    - Determine the initial and final kinetic energies of the cars.
    - Compare the total kinetic energy before and after the collision.

- Case 2
    - Car 1 (100 kg) moves north at 4 m/s.
    - Car 2 (200 kg) moves south.
    - Find the initial velocity of Car 2 assuming they both end at rest.
    - Determine the initial and final kinetic energies of the cars.
    - Compare the total kinetic energy before and after the collision.
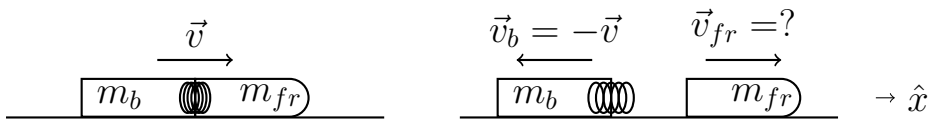
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- Case 2
    - Car 1 (100 kg) moves north at 4 m/s.
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    - Find the initial velocity of Car 2 assuming they both end at rest.
    - Determine the initial and final kinetic energies of the cars.
    - Compare the total kinetic energy before and after the collision.

L22-2: Springloaded Sled

You are designing a sled with a compressed spring inside, which can be released to separate the sled into two pieces of equal mass $(m/2)$. You are racing the sled across level snow at speed v when you trigger the separation.

Right after the two halves push apart, the back end of the sled is moving backward with speed v. What is the velocity of the other piece? How much kinetic energy did the system gain?

$$\vec{v} \qquad\qquad \vec{v}_b = -\vec{v} \qquad \vec{v}_{fr} = ?$$

$$\boxed{m_b} \;\text{⦿}\; \boxed{m_{fr}} \qquad\qquad \boxed{m_b}\;\text{⦿} \quad \boxed{m_{fr}} \qquad \to \hat{x}$$

Main Ideas

- When kinetic energy is lost in a collision, the collision is *inelastic.*

  - A collision in which the objects stick together and move with the same velocity is *perfectly inelastic.*

- When kinetic energy increases in a collision, the collision is *superelastic.*