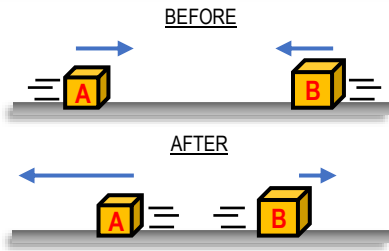


CONCEPT: "PUSH-AWAY" PROBLEMS

- Interactions between objects usually fall into 2 broad problem types:
 - Regardless of the type, we'll solve ALL problems where objects interact using **Conservation of Momentum!**

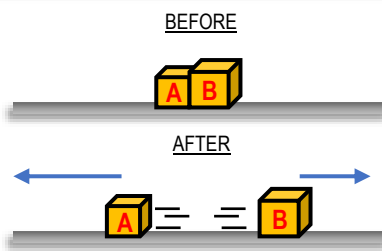
1) COLLISIONS

→ Objects move toward each other, then collide



2) "PUSH-AWAY" PROBLEMS

→ Objects initially together, then push away from each other (Action-Reaction!)



Common Examples:

- Throwing / recoil
- Mutual Push-Away
- Explosions

- In most push-away problems, objects are initially at rest ($p_{sys,i} = \underline{\hspace{1cm}}$). So the **Conservation of Momentum** simplifies:

$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f} \quad \text{(Simplifies to)} \quad \underline{\hspace{1cm}} = \underline{\hspace{1cm}}$$

EXAMPLE: A 4-kg sniper rifle shoots a 5-g bullet with a muzzle speed of 600m/s. Calculate the recoil speed of the rifle.

CONSERVATION OF MOMENTUM

- 1) Draw Diagrams for Before & After
- 2) Write **Conservation of Momentum** EQ
- 3) Plug in values & solve

- Conceptual:** Momentum is conserved ONLY IF the system is _____ (i.e. all Forces are internal).

PROBLEM: An 80-kg astronaut is stranded floating in space is 30 m away from his spaceship. He wants to return to his spaceship in 20 s. How fast must he throw his 2-kg space hammer, directly away from the spaceship, to accomplish this?

CONSERVATION OF MOMENTUM

- 1) Draw Diagrams for Before & After
- 2) Write Conservation of Momentum EQ
- 3) Plug in values & solve

PROBLEM: A 70.0 kg football player is gliding across very smooth ice at 2 m/s. He throws a 0.450 kg football straight forward. What is the players velocity afterward if the ball is thrown at 15 m/s relative to the player?

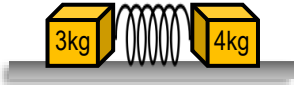
CONSERVATION OF MOMENTUM

- 1) Draw Diagrams for Before & After
- 2) Write Conservation of Momentum EQ
- 3) Plug in values & solve

CONCEPT: PUSH-AWAY PROBLEMS WITH ENERGY

- When problems ask for energy before or after a “push-away”, use _____ AND _____ Conservation.

EXAMPLE: Two blocks (3kg and 4kg) are on a smooth floor, pressed against a light spring of force constant 800 N/m between them. When the blocks are released, the 3kg block is launched at 10m/s. Calculate **a)** the recoil speed of the 4kg block; **b)** how much energy was stored in the spring; **c)** how much the spring was compressed before launching the blocks.



CONSERVATION OF MOMENTUM

- 1) Draw Diagrams for Before & After
- 2) Write Conservation of Momentum EQ
- 3) Plug in values & solve