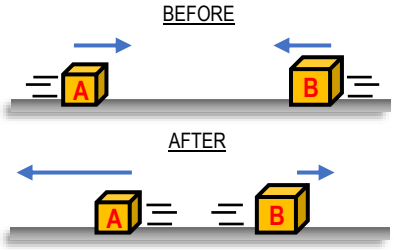
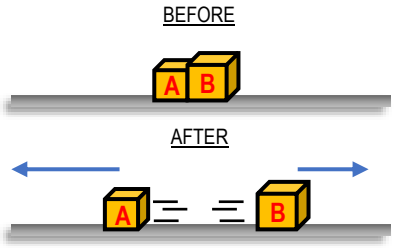
CONCEPT: "PUSH-AWAY" PROBLEMS

- 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 ($p_{sys,i}$ = __). So the **Conservation of Momentum** simplifies:

$$m_1v_{1i} + m_2v_{2i} = m_1v_{1f} + m_2v_{2f}$$ (Simplifies to) _____ = _____

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

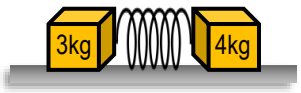
PROBLEM**:** A 70.0 kg football player is gliding across very smooth ice at 2 m/s**.** He throws a 0.450 kg football straight forward**.** What is the players velocity afterward if the ball is thrown at 15 m/s relative to the player?

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