

CONCEPT: ELASTIC COLLISIONS

TYPES OF COLLISIONS	
ELASTIC	INELASTIC
	Completely Inelastic

- Remember: Momentum is ALWAYS conserved in ALL types of collisions.
 - In Elastic Collisions, _____ is also conserved. (K_i ___ K_f)
- For Elastic Collisions ONLY, we often MUST use an extra equation: _____ = _____
 - Because we have 2 EQs with the same unknowns, we must solve a System of EQs using _____:
 - EQ Addition:** Line up equations top-to-bottom, then add & eliminate 1 variable.
 - To 'line up' the EQs to cancel an unknown, you must often multiply an EQ by a number.

EXAMPLE: Two objects ($m_1 = 5\text{kg}$, $m_2 = 3\text{kg}$) on a smooth, frictionless surface undergo a head-on elastic collision. Initially, the 5kg block moves to the right at 2m/s, while the 3kg block moves to the left at 4m/s. Calculate the final velocities of both blocks after the collision.



CONSERVATION OF MOMENTUM & ELASTIC COLLISIONS

- 1) Draw Diagrams for Before & After
- 2) Write Cons. of Moment. & Elastic Coll. EQs
- 3) Solve Sys. of EQs by EQ Addition
- 4) Plug 1st target into EQs & solve other targets

MOMENTUM & ELASTIC COLLISIONS

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

$$v_{1i} + v_{1f} = v_{2i} + v_{2f}$$

PROBLEM: Two blocks of equal mass undergo a head-on elastic collision. Object **A** moves to the right at 5m/s, while Object **B** moves to the left at 3m/s. Calculate the magnitude & direction of the two blocks' final velocities after colliding.

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MOMENTUM & ELASTIC COLLISIONS

$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f} \text{ (All types)}$$

$$v_{1i} + v_{1f} = v_{2i} + v_{2f} \text{ (Elastic Collisions ONLY)}$$

- **PRO-TIP:** When 2 objects of equal mass elastically collide, they “_____” velocities.

CONCEPT: ELASTIC COLLISIONS WITH STATIONARY OBJECTS

- A common setup in elastic collisions is 1 moving object (m_1) hitting a stationary object (m_2).



- For these problems, $v_{2i} = \underline{\hspace{1cm}}$, which simplifies our equations.

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

$$v_{1i} + v_{1f} = v_{2i} + v_{2f}$$

- Combining both EQ's, we can get 2 extra equations for v_{1f} & v_{2f} :

$$v_{1f} = \underline{\hspace{1cm}}$$

$$v_{2f} = \underline{\hspace{1cm}}$$

EXAMPLE: In the following examples, a round boulder has a mass of 40kg and a golf ball has a mass 0.1kg. Calculate the final velocities of both blocks after the **elastic** collision for the following 3 cases:

a) Boulder hits with another boulder



- When $m_1 = m_2$ (Equal Masses):

$$v_{1f} \approx \underline{\hspace{1cm}}$$

$$v_{2f} \approx \underline{\hspace{1cm}}$$

b) Golf ball hits a boulder

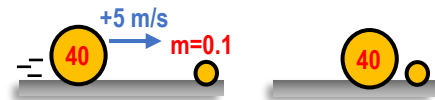


- When $m_1 \ll m_2$ (massive target):

$$v_{1f} \approx \underline{\hspace{1cm}}$$

$$v_{2f} \approx \underline{\hspace{1cm}}$$

c) Boulder hits a golf ball



- When $m_1 \gg m_2$ (massive projectile):

$$v_{1f} \approx \underline{\hspace{1cm}}$$

$$v_{2f} \approx \underline{\hspace{1cm}}$$

- After the collision, m_2 ALWAYS moves forward, but m_1 may move forward or backward depending on its mass.