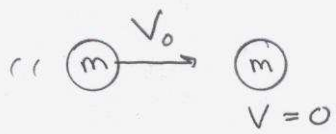
2 Types of Collisions

① Kinetic Energy is conserved : "ELASTIC Collision".

* objects do NOT permanently bend or deform to lose KE.

Ex) Two Billiard Balls

BEFORE



$\vec{p}_0 = m\vec{v}_0$

$K_0 = \frac{1}{2}mv_0^2$

AFTER (we'll prove this later...)

$\vec{p}_f = m\vec{v}_0$

$K_f = K_0 = \frac{1}{2}mv_0^2$

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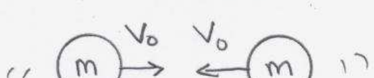
② KE is NOT conserved : "Inelastic Collision".

* objects can bend or deform to lose KE.

Ex: "completely" inelastic collision ⇒ Bodies stick together
(or "perfectly")

Ex) Clay or mud.

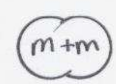
BEFORE



$\vec{p}_0 = m\vec{v}_0 + (-m\vec{v}_0) = 0$

$K_0 = 2(\frac{1}{2}mv_0^2) = mv_0^2$

AFTER



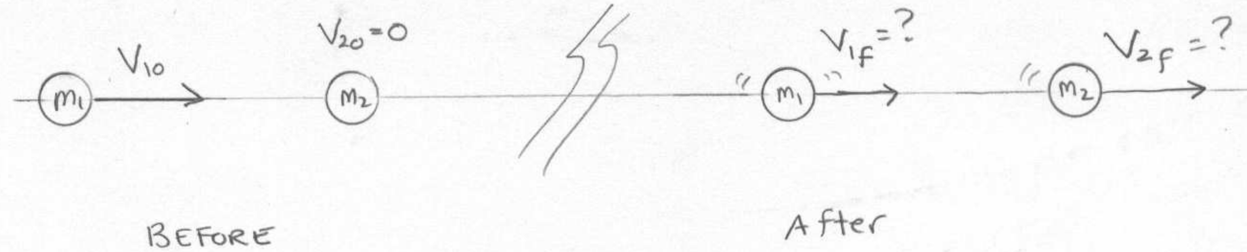
$\vec{p}_f = 0 \quad \therefore \quad V_f = 0$

but $K_f = 0$

so $K_0 \neq K_f$!

Elastic Collisions in 1-Dimension

* Let's look at a special case of $V_{2o} = 0$.



$(P_o = P_f)_{sys}$ $\qquad$ $K_o = K_f$

① $m_1 V_{1o} = m_1 V_{1f} + m_2 V_{2f}$, ② $\frac{1}{2} m_1 V_{1o}^2 = \frac{1}{2} m_1 V_{1f}^2 + \frac{1}{2} m_2 V_{2f}^2$

Solve Eq's ① & ② for V_{1f} & V_{2f}.

arrange ② $m_1 (V_{1o}^2 - V_{1f}^2) = m_2 V_{2f}^2$

arrange ① $m_1 (V_{1o} - V_{1f}) = m_2 V_2$

factor ② $m_1 (V_{1o} - V_{1f})(V_{1o} + V_{1f}) = m_2 V_{2f}^2$

① $m_1 (V_{1o} - V_{1f}) = m_2 V_2$

Do $\frac{②}{①}$

$V_{1o} + V_{1f} = V_{2f}$ ③

Now subs ③ into ①

$m_1 V_{1o} = m_1 V_{1f} + m_2 (V_{1o} + V_{1f}) \Rightarrow$ Get $V_{1f} = \frac{(m_1 - m_2) V_{1o}}{m_1 + m_2}$

→

Solve ③ for V_{1f} & subs into ①

③ $V_{1f} = V_{2f} - V_{10}$

① $m_1 V_{10} = m_1 (V_{2f} - V_{10}) + m_2 V_{2f}$

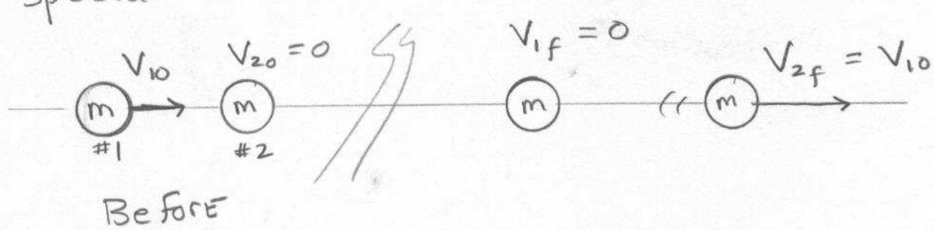
yields

$$V_{2f} = \frac{2 m_1 V_{10}}{m_1 + m_2}$$

previously:

$$V_{1f} = \frac{(m_1 - m_2) V_{10}}{m_1 + m_2}$$

* special case of $m_1 = m_2 = m$



$$V_{1f} = \frac{(m - m) V_{10}}{m + m} = 0$$

$$V_{2f} = \frac{2m V_{10}}{m + m} = V_{10}$$