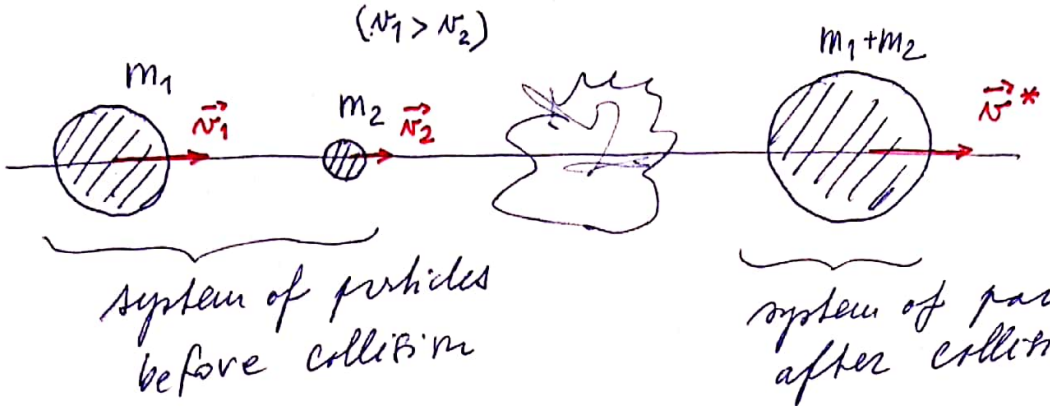
PERFECTLY INELASTIC COLLISION



Given: m_1, m_2, v_1, v_2 Task: $v^* = ?$

there is no external force $\sum_{(i)} \vec{F}_i^E = \vec{0}$

Law of change of momentum

$$\vec{p}_2 - \vec{p}_1 = \int_{t_1}^{t_2} \vec{F}^E \, dt = \vec{0}$$

$$\vec{p}_2 - \vec{p}_1 = \vec{0} \quad \ldots \text{law of conservation of momentum}$$

scalar form:

$x \rightarrow$

$$p_{2x} - p_{1x} = 0 \qquad (*)$$

momentum of the system of particles before collision:

$$p_{1x} = m_1 v_1 + m_2 v_2$$

momentum of the system of particles after collision:

$$p_{2x} = (m_1 + m_2) \cdot v^*$$

substitution in to (*)

$$m_1 v_1 + m_2 v_2 = (m_1 + m_2) \cdot v^*$$

$$\boxed{v^* = \frac{m_1 v_1 + m_2 v_2}{m_1 + m_2}}$$

velocity of particle (m_1+m_2) after collision

Ballance of kinetic energy:

Kin. energy before collision:

$$K_1 = \frac{1}{2} m_1 v_1^2 + \frac{1}{2} m_2 v_2^2$$

Kinetic energy after collision:

$$K_2 = \frac{1}{2}(m_1+m_2) v^{*2} = \frac{1}{2}(m_1+m_2) \frac{(m_1 v_1 + m_2 v_2)^2}{(m_1+m_2)^2}$$

$$K_2 - K_1 = \frac{1}{2}\left(\frac{m_1^2 v_1^2 + 2 m_1 v_1 m_2 v_2 + m_2^2 v_2^2}{m_1+m_2} - \frac{m_1(m_1+m_2) v_1^2 + m_2(m_1+m_2) v_2^2}{m_1+m_2} \right) =$$

$$= \frac{1}{2} \frac{m_1^2 v_1^2 + 2 m_1 v_1 m_2 v_2 + m_2^2 v_2^2 - m_1^2 v_1^2 - m_1 m_2 v_1^2 - m_1 m_2 v_2^2 - m_2^2 v^2}{m_1+m_2} =$$

$$= -\frac{1}{2} \frac{m_1 m_2 v_1^2 - 2 m_1 v_1 m_2 v_2 + m_1 m_2 v_2^2}{m_1+m_2} =$$

$$= -\frac{1}{2} \frac{m_1 m_2}{m_1+m_2} (v_1 - v_2)^2$$

$K_2 - K_1 < 0$ ... energy loss

$K_2 - K_1 = W^w$

↳ work of working forces

There is no applicable the law of conservation of mechanic energy. There is applicable the law of change of kinetic energy.