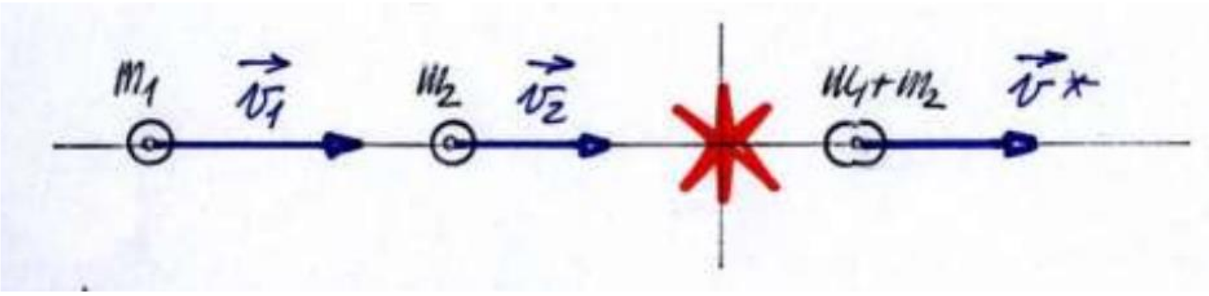
Impact of particles – ideal plastic impact

we consider the collinear motion of two spheres of masses m_1 and m_2, as Figure, moving with velocities $v1$ and $v2$ before the impact. After the impact occurs they transformed into one with the sum of masses and velocity v^*.



Given:

The masses of two spheres $m1$ and $m2$, velocities $v1$ and $v2$ before the impact

Task:

Velocity v^* after the impact

The kinetic energy difference after and before the impact.

Solution:

Using the law of conservation of momentum:

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

So we get the velocity after the impact:

$$v^* = \frac{m_1 v_1 + m_2 v_2}{m_1 + m_2} \tag{1}$$

The kinectic energy of the system of twe spheres before the impact is:

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

And after the impact:

$$K^* = \frac{1}{2} (m_1 + m_2) v^{*2} \tag{3}$$

Substitute (1) to (3), we have:

$$K^* = \frac{1}{2} (m_1 + m_2) \left(\frac{m_1 v_1 + m_2 v_2}{m_1 + m_2} \right)^2 \tag{4}$$

(5)

$$K^{*}=\frac{1}{2}\frac{m_1^2 v_1^2+2m_1 m_2 v_1 v_2+m_1^2 v_1^2}{m_1+m_2} \qquad (6)$$

So the kinetic energy difference is:

$$K^{*}-K=\left(\frac{1}{2}\frac{m_1^2 v_1^2+2m_1 m_2 v_1 v_2+m_1^2 v_1^2}{m_1+m_2}\right)-\left(\frac{1}{2}m_1 v_1^2+\frac{1}{2}m_2 v_2^2\right) \qquad (7)$$

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