

Bouncy Collision

Masses collide and bounce off each other & travel in opposite directions.



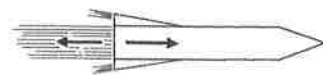
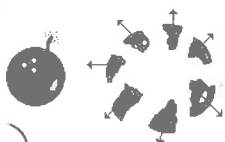
Sticky Collision

Masses collide and stick together such that the total mass travels at the same final velocity.



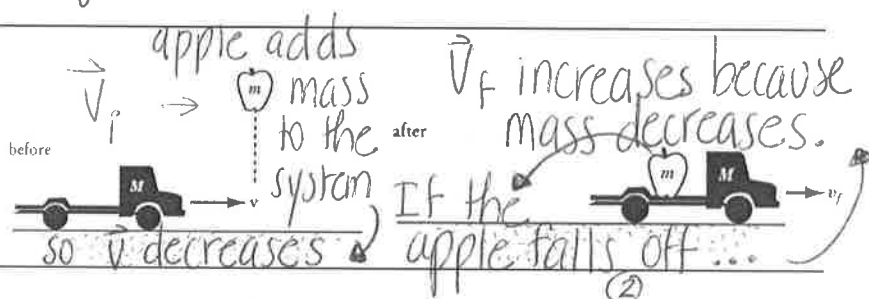
Explosion

Energy is added to the system and energy is transformed into kinetic energy (chemical \rightarrow KE, spring \rightarrow KE)



Momentum is conserved in each direction.

If apple falls straight down, \vec{p} is transferred to Earth.



1. A 1850 kg luxury sedan stopped at a traffic light is struck from the rear by a compact car with a mass of 975 kg. The two cars become entangled as a result of the collision. If the compact car was moving at a velocity of 22.0 m/s to the north before the collision, what is the velocity of the entangled mass after the collision?

⊕ N
↑
⊖ S

$$m_2 \vec{v}_2 = (m_1 + m_2) \vec{v}_f \quad \text{s.s.f.}$$

$$\frac{975 \text{ kg} (22.0 \text{ m/s})}{(1850 \text{ kg} + 975 \text{ kg})} = \boxed{v_f = 7.59 \frac{\text{m}}{\text{s}} \text{ to the north}}$$

2. A 1.0 kg ball traveling at 6.0 m/s collides head-on with a 2.0 kg ball moving in the opposite direction at a speed of 12 m/s. The 1.0 kg ball rebounds at a speed of 14 m/s after the collision. Find the velocity of the second ball. (-12 m/s)

① →

← ② (-14 m/s)

$$m_1 v_1 + m_2 v_2 = m_1 v_1 + m_2 v_2$$

$$\frac{(1.0 \text{ kg})(6.0 \frac{\text{m}}{\text{s}}) + (2.0 \text{ kg})(-12 \frac{\text{m}}{\text{s}}) - [(1.0 \text{ kg})(-14 \frac{\text{m}}{\text{s}})]}{(2.0 \text{ kg})} = \vec{v}_{f2}$$

$$\boxed{\vec{v}_{f2} = -2.0 \frac{\text{m}}{\text{s}}}$$

3. Two dynamics carts at rest are pushed apart by a compressed spring. The 1.5 kg cart moves off with a speed of 0.27 m/s. What is the velocity of the 4.5 kg cart after the spring is sprung?

$$0 \frac{\text{kg m}}{\text{s}} = m_1 v_1 + m_2 v_2$$

$$v_{f2} = -\left(\frac{m_1 v_1}{m_2}\right)$$

$$\boxed{v_{f2} = -0.09 \frac{\text{m}}{\text{s}}}$$

4. A 0.105 kg hockey puck moving at 48 m/s is caught by a 75 kg goalie at rest. With what speed does the goalie slide on the ice?

$$m_1 \vec{v}_1 = (m_1 + m_2) \vec{v}_f$$

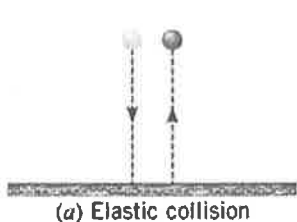
$$\boxed{v_f = 0.067 \frac{\text{m}}{\text{s}}}$$

$$\frac{(0.105 \text{ kg})(48 \frac{\text{m}}{\text{s}})}{(0.105 \text{ kg} + 75 \text{ kg})} = 0.067 \frac{\text{m}}{\text{s}}$$

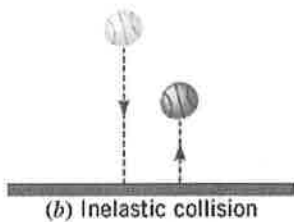
Elastic and Inelastic Collisions

Elastic collision: A collision in which total kinetic ^{energy} is conserved.

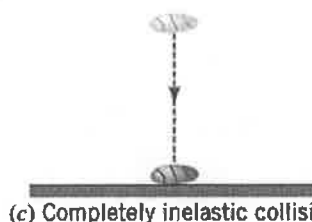
Inelastic collision: A collision in which total kinetic energy is not conserved.



(a) Elastic collision



(b) Inelastic collision (partially)



(c) Completely inelastic collision

Where does some of the mechanical energy go in an inelastic collision?

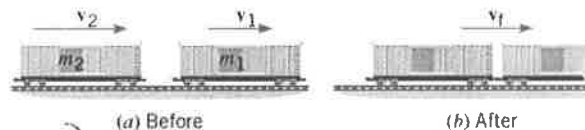
energy of deformation, thermal energy, sound energy (internal)

1. Find the final velocity of the two train cars after they latch together. Car 1 has a mass of 65,000 kg and moves at a velocity of 0.80 m/s. Car 2, with a mass of 92,000 kg, has a velocity of 1.3 m/s.

$$m_1 \vec{v}_1 + m_2 \vec{v}_2 = (m_1 + m_2) \vec{v}_f$$

$$\frac{(65,000 \text{ kg})(0.80 \text{ m/s}) + (92,000 \text{ kg})(1.3 \text{ m/s})}{(65,000 \text{ kg} + 92,000 \text{ kg})} = \vec{v}_{f_{1+2}}$$

$$\boxed{\vec{v}_{f_{1+2}} = 1.1 \frac{\text{m}}{\text{s}}}$$



(a) Before

(b) After



2. Is this collision elastic or inelastic? Justify your answer.

elastic: $KE_i = KE_f$

inelastic: $KE_i \neq KE_f$

$$KE_i = \frac{1}{2} m_1 \vec{v}_{1i}^2 + \frac{1}{2} m_2 \vec{v}_{2i}^2 = \boxed{9.9 \times 10^4 \text{ J}}$$

$$KE_f = \frac{1}{2} m_T \vec{v}_{f_{1+2}}^2 = \boxed{9.4 \times 10^4 \text{ J}}$$

$$KE_f < KE_i$$

inelastic