Collision :- Collisions are distinguised according to whether the Kinetic Energy of the system is conserved or not.

⇒ If the K.E of the system is conserved is called elastic collision.

⇒ If the K.E of the System is not conserved is called inelastic collision.

⇒ collisions b/w atomic particles and nuclear particles are elastic

⇒ Collision b/w two large bodies is always inelastic.

Elastic collision :- The total momentum the total energy and total kinetic energy are conserved. the total Mechanical energy is not Conserved into any other energy form.

⇒ The forces involved in the short interaction are Conserved in nature.

⇒ Consider from the above graph. to masses m_1 and m_2 moving with speed u_1 and u_2 the speed other the collision of these masses is v_1 and v_2 the law of Conservation of momentum.

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$$

conservation of kinetic energy.

$$\frac{1}{2}m_1u_1^2 + \frac{1}{2}m_2u_2^2 = \frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2$$

Inelastic collision :-

The object stick to each other or move the same direction. the total kinetic energy in this form of collision is not conserved. but the total momentum and energy are conserved. During this kind of collision, the energy is transformed into other energy forms like heat and light. during the phenomenon the two masses follow the law of Conservation of momentum and move in this same direction with same the speed (v).

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2 \qquad (v_2 = v_1')$$

$$m_1u_1 + m_2u_2 = (m_1 + m_2)\cdot v'$$

$$v = \frac{m_1u_1 + m_2u_2}{m_1 + m_2}$$

The kinetic energy of the masses before the collision is

$$K.E_1 = \frac{1}{2}m_1u_1^2 + \frac{1}{2}m_2u_2^2$$

K.E after the collision is

$$K.E_2 = \frac{1}{2}(m_1 + m_2)v^2$$

But according to the laws of Conservation of energy.

$$\frac{1}{2}m_1u_1^2 + \frac{1}{2}m_2u_2^2 = \frac{1}{2}(m_1+m_2)v^2 + q.$$

a = have the change is energy that results in the production of heat of sound.

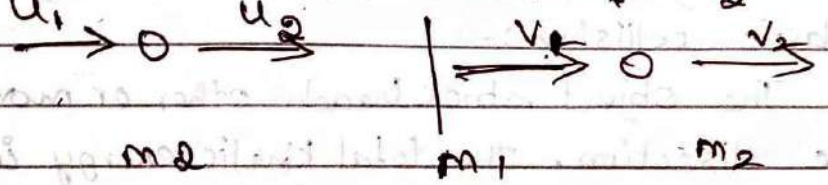
One dimensional collision :- One Dimension Sudden interaction of masses is that collision in which both the initial and final velocities of the masses line in one line. All the variables of motion are contained in single dimension.

Elastic one dimensinal collision :-

The elastic collision the internal kinetic energy is conserved. So Elastic collision can be acheived only with particles like microscopic particles like electron's, Proton's, or neutron.

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$$

$$v_2 - v_1 = u_1 - u_2$$



Before collision After collision.

$$\frac{1}{2}m_1u_1^2 + \frac{1}{2}m_2u_2^2 = \frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2$$

$$\frac{1}{2}(m_1u_1^2 + m_2u_2^2) = \frac{1}{2}(m_1v_1^2 + m_2v_2^2)$$

$$m_1u_1^2 + m_2u_2^2 = m_2(v_2^2 + v_2^2)$$

$$(a^2+b^2) = (a+b)(a-b)$$

$$m(u_1+v_1)(u_1-v_1) = m_2(v_2+u_2)(v_2-u_2)$$

using conservation of momentum equation. ---- (1)

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$$

$$m_1u_1 - m_1v_1 = m_2v_2 - m_2u_2$$

$$m_1(u_1-v_1) = m_2(v_2-u_2) \quad \text{---- (2)}$$

divide equ (1) by equ (2)

$$\frac{m_1(u_1+v_1)(u_1+v_1)}{m_1(u_1-v_1)} = \frac{m_2(u_2+v_2)(v_2-u_2)}{m_2(v_2-u_2)}$$

$$u_1+v_1 = v_2+u_2$$

$$v_1 = v_2+u_2-u_1$$

v_1 in conservation momentum.

$$v_2 = \frac{2m_1u_1 + u_2(m_2 - m_1)}{m_1 + m_2}$$

use v_2 in eqn $v_1 = v_2 - u_2 - u_1$

$$v_1 = \frac{2m_1u_1 + u_2(m_2 - m_1)}{(m_1 + m_2)u_2 - u_1}$$

$$v_1 = \frac{2m_1u_1 + u_2^2(m_2 - m_1) + u_2(m_1 + m_2) - u_1(m_1 + m_2)}{(m_1 + m_2)}$$

finally

$$v_1 = \frac{2m_2u_2 + u_1(m_1 - m_2)}{m_1 + m_2}$$

when masses of both the bodies are equal then generally after collision these masses exchange their velocities.

$$v_1 = u_2 \quad v_2 = u_1$$

collision b/w object of same masses if the second mass is at rest and the first mass collision with it then after collision on the first mass comes to rest and the second mass moves with the speed equal to first mass.

In such case $v_1 = 0 \quad v_2 = u$.

If $m_1 < m_2$ then $v_1 = -u_1 \quad v_2 = 0$

This means that the lighter body will compard back will its own velocity, while the liquid mass will remain state rest.

If $m_1 > m_2$.

Inelastic are dimensinal collision.

The collision masses stick together and moves in the same direction at same speed the momentum is conserved and kinetic energy is changed to different forms of energy for inelastic collision the equation for conservation of momentum is

$$m_1u_1 + m_2u_2 = (m_1 + m_2)v$$

Both the object stick final velocity after the collision. $\frac{m_1u_1 + m_2u_2}{m_1 + m_2}$.

The kinetic energy lost during the phenomenon

$$E, \frac{1}{2} m_1u_2^2 - \frac{1}{2}(m_1 + m_2)v^2$$

collision in two dimensions.

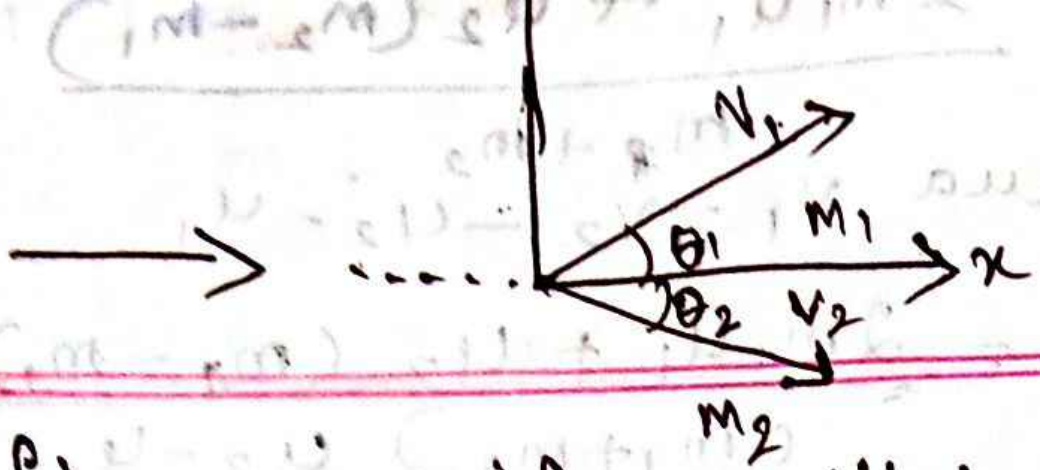


figure signifies collision in 2D, where the masses move in different mass m_1 collision with stationary mass m_2.

The linear momentum is conserved in the 2D interaction of masses. In this case the masses moving in x, y planes. The x' and y' component eqn are,

$$m_1 u_1 = m_1 u_2 \cos\theta_1 \ldots\ldots + m_2 v_2 \cos\theta_2$$

$$0 = m_1 u_2 \sin\theta - m_2 v_2 \sin\theta_2.$$

For spherical objects that have smooth surfaces, the collisions surfaces. the collision touch each other.