Marwari college Darbhanga

Subject---physics

Class--- I.Sc.first year

Topic--- work, Energy and Power (collision)

By:- Dr. Sony Kumari,

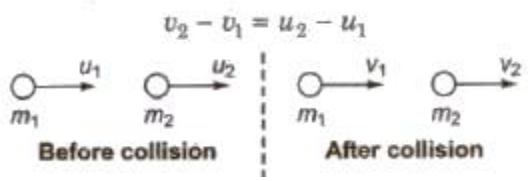
Assistant professor

Marwari college Darbhanga.

Collision

One Dimensional or Head-on Collision
If the initial and final velocities of colliding bodies lie along the same line, then the collision is called one dimensional or head-on collision.

Inelastic One Dimensional Collision
Applying Newton's experimental law, we have



Velocities after collision

$v_1 = (m_1 - m_2)\, u_1 + 2m_2u_2 / (m_1 + m_2)$
and $v_2 = (m_2 - m_1)\, u_2 + 2m_1u_1 / (m_1 + m_2)$
When masses of two colliding bodies are equal, then after the collision, the bodies exchange their velocities.

$v_1 = u_2$ and $v_2 = u_1$

If second body of same mass ($m_1 = m_2$) is at rest, then after collision first body comes to rest and second body starts moving with the
initial velocity of first body.
$v_1 = 0$ and $v_2 = u_1$
If a light body of mass m_1 collides with a very heavy body of mass m_2 at rest, then after collision.
$v_1 = -u_1$ and $v_2 = 0$
It means light body will rebound with its own velocity and heavy body will continue to be at rest.

If a very heavy body of mass m_1 collides with a light body of mass $m_2(m_1 > > m_{21})$ at rest, then after collision
$v_1 = u_1$ and $v_2 = 2u_1$

In Inelastic One Dimensional Collision

Loss of kinetic energy

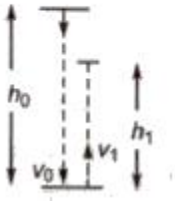
$\Delta E = m_1m_2 / 2(m_1 + m_2) (u_1 - u_2)^2 (1 - e^2)$

In Perfectly Inelastic One Dimensional Collision

Velocity of separation after collision = 0.

Loss of kinetic energy = $m_1m_2 (u_1 - u_2)^2 / 2(m_1 + m_2)$
If a body is dropped from a height h_o and it strikes the ground with velocity v_o and after inelastic collision it rebounds with velocity $v_1$and rises to a height h_1, then

$$e = \frac{v_1}{v_0} = \sqrt{\frac{2gh_1}{2gh_0}} = \sqrt{\frac{h_1}{h_0}}$$



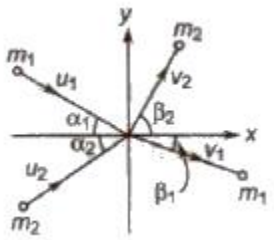
If after n collisions with the ground, the body rebounds with a velocity v_n and rises to a height h_n then
$e^n = v_n / v_o = \sqrt{h^n / h^o}$

Two Dimensional or Oblique Collision

If the initial and final velocities of colliding bodies do not lie along the same line, then the collision is called two dimensional or oblique Collision.

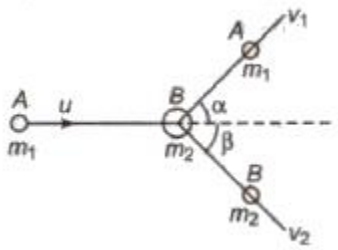
In horizontal direction,

$m_1u_1 \cos \alpha_1 + m_2u_2 \cos \alpha_2 = m_1v_1 \cos \beta_1 + m_2v_2 \cos \beta_2$



In vertical direction.

$m_1u_1 \sin \alpha_1 - m_2u_2 \sin \alpha_2 = m_1u_1 \sin \beta_1 - m_2u_2 \sin \beta_2$
If $m_1 = m_2$ and $\alpha_1 + \alpha_2 = 90°$
then $\beta_1 + \beta_2 = 90°$
If a particle A of mass m_1 moving along z-axis with a speed u makes an elastic collision with another stationary body B of mass m_2



From conservation law of momentum

$m_1u = m_1v_1 \cos \alpha + m_2v_2 \cos \beta$
$0 = m_1v_1 \sin \alpha - m_2v_2 \sin \beta$