MOMENTUM AND COLLISION

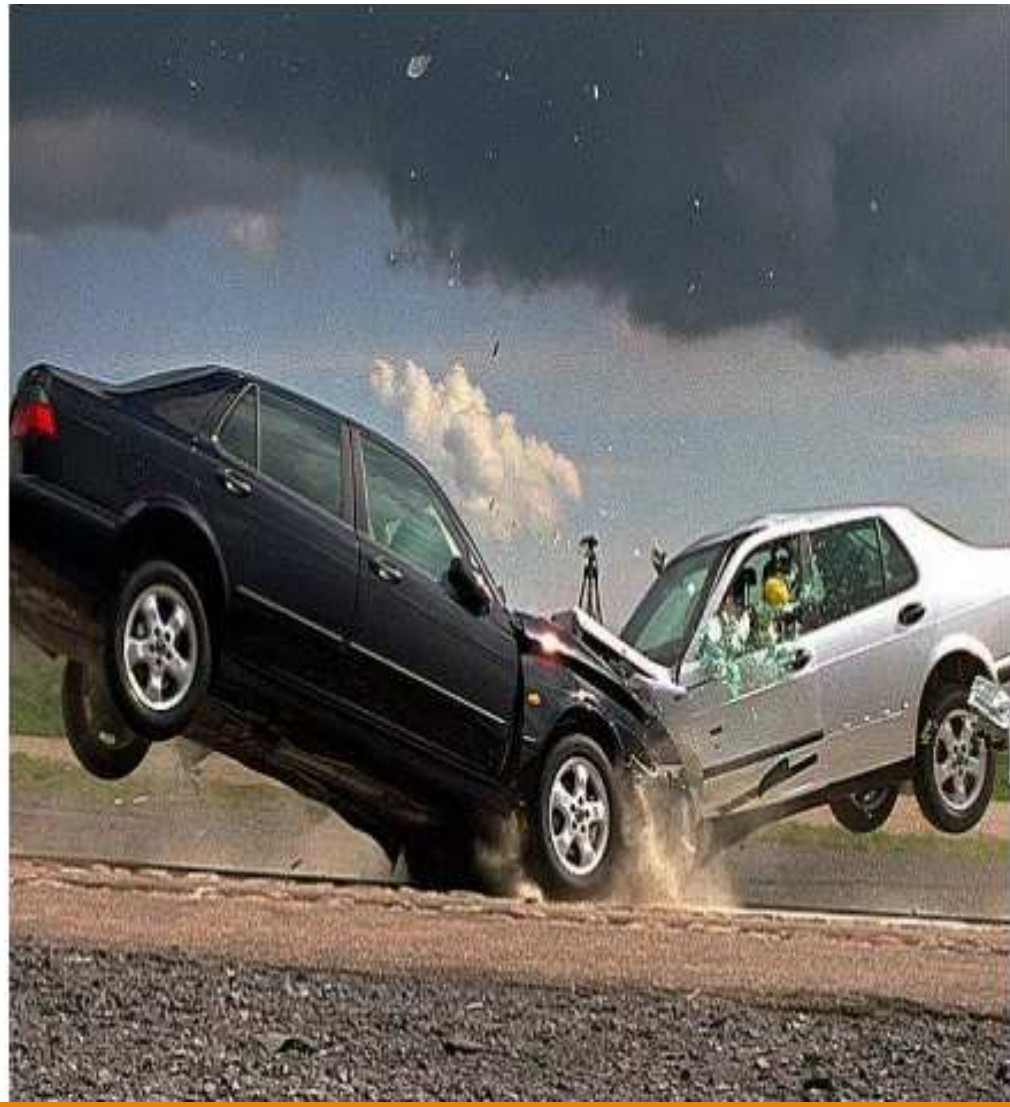
We shall consider the Newton's Second Law of Motion to explain Momentum, Impulse and Collision.

Objectives:

1) What is meant by the momentum of a particle?

2) What is the difference between impulse and momentum?

3) How to solve problems involving momentum and impulse of two bodies?



Review: Newton's Second Law of Motion

Second Law: If a net external force acts on a body, the body accelerates. The direction of acceleration is the same as the direction of the net force. The mass of the body times the acceleration of the body equals the net force vector.

$$\sum \vec{F} = m\vec{a}$$

MOMENTUM

What is Momentum?

Ans: It is a "quantity of motion" that relates the net force F of a body to its mass and velocity.

When a body of mass m in motion changes its initial velocity to final velocity over a period of time t, according to Newton's 2nd Law, the net force is expressed as:

$$\sum \vec{F} = m\vec{a} = m\left(\frac{v-u}{t}\right)$$

Hence **momentum** is defined as the product of the body's mass and its velocity:

$$P = mv$$

The greater the mass and velocity, the greater the momentum.

MOMENTUM

Facts about momentum!

- Momentum is a vector quantity.
- It has the same direction with the direction of the body's velocity.
- The SI unit is kgm/s
- Hence the Newton's second law can be re-written as:

"The net force on a particle is equal to the rate of change of momentum of the particle"

- $\sum \vec{F} = \frac{P_f - P_i}{t} = \frac{dp}{dt}$

IMPULSE

What is Impulse?

Ans: **Impulse** is the change of momentum of an object when the object is acted upon by a force for an interval of time.

When a net force $\sum \vec{F}$ is in contact with the particle for a period of time Δt, another quantity emerges which is closely related to momentum, this is called **impulse.**

Impulse is denoted by J and it is the product of the force and the time-interval.

The impulse-momentum theorem states that: the change in momentum of a particle during a time interval equals the impulse of the net force that acts on the particle during that time interval.

IMPULSE

Facts about impulse!

Impulse is a vector quantity.

It has the same direction with the direction of the net force.

The S.I unit is Ns.

Mathematically, impulse is defined as: $\vec{J} = \sum \vec{F}\,\Delta t$

Work-Problems

Question 1:

A volley ball of mass 0.2kg is moving horizontally to the left with velocity 20m/s. As it hits the wall, it rebounds horizontally to the right with velocity 15m/s.

A) Find the impulse of the volleyball?

B) Find the net force of the ball on the wall if it is in contact with the wall for 0.005s?

Answer: a) 7 Ns

b) 1400 N

COLLISION

A **collision** is the event in which two or more bodies exert forces on each other in about a relatively short time.

There are two types of collision: Elastic Collision and Inelastic Collision.

Elastic Collision: A collision in which kinetic energy is conserved, such that no mechanical energy is lost and the total kinetic energy of the system is the same after the collision as before. There is no physical deformation

Inelastic Collision: It is a collision in which the total kinetic energy after the collision is less than before the collision, hence there is a physical deformation of the system or bodies.

CLASS PROBLEMS

1) A body of mass 8.30kg is kicked with a speed of 16.0m/s at 30.0° above the horizontal. What are the initial horizontal and vertical components of the momentum of this kick?

2) One 95kg runner moves to the right at 2.00m/s while another 110kg runner is moving directly towards him at 1.85m/s.

A) Find the magnitude and direction of the net momentum of these two runners

B) Their total kinetic energy

3) A 0.0450kg golf ball initially at rest is given a speed of 25.0m/s when a club strikes. If the club and ball are in contact for 2*m*s, what average force acts on the ball? Is the effect of the ball's weight during the time of contact significant? Why or why not?

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QUESTION TIME??????????????

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