

LAW OF MOTION

- **Introduction To Law Of Motion :**

- - Laws of Motion were first introduced by Sir Isaac Newton in 1687. These laws describe the relationship between a body and the forces acting upon it. A body refers to any object, particle, or system of particles.

- **Newton's First Law of Motion :**

- - Also known as the law of inertia. It states that an object at rest will remain at rest, and an object in motion will remain in motion with a constant velocity, unless acted upon by an external force. Inertia is the property of a body to resist any change in its state of rest or motion.

- **Newton's Second Law of Motion :**

- - It states that the rate of change of momentum of an object is directly proportional to the net force applied to it and takes place in the direction in which the force acts.
- The equation for this law is $F = ma$, where F is the net force applied, m is the mass of the object, and a is its acceleration. Momentum is the product of mass and velocity of an object.

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- **Newton's Third Law of Motion :**

- - It states that for every action, there is an equal and opposite reaction. This means that when two objects interact, the force that one object exerts on the other is equal in magnitude and opposite in direction to the force that the second object exerts on the first.

• Inertial and Non-Inertial Frames of Reference :

- - Inertial frames of reference are those in which the first law of motion holds true, and the motion of an object is determined solely by the forces acting upon it. Non-inertial frames of reference are those in which the first law of motion does not hold true, and the motion of an object is affected by other factors such as rotation or acceleration.
- Examples of non-inertial frames of reference include a rotating frame and an accelerating frame.

• Friction :

- - Friction is a force that opposes the relative motion between two surfaces in contact. It can be classified into two types: static friction, which keeps an object at rest, and kinetic friction, which opposes the motion of an object already in motion. The coefficient of friction is a measure of the force of friction between two surfaces.

• Circular Motion :

- - Circular motion is the motion of an object in a circular path. The centripetal force, which always acts towards the center of the circle, is required to maintain the circular motion of an object.
- The equation for centripetal force is $F = mv^2/r$, where m is the mass of the object, v is its velocity, and r is the radius of the circular path. Centrifugal force is a fictitious force that appears to act outward on an object moving in a circular path.

• Conservation Laws :

- The law of conservation of momentum states that the total momentum of a system remains constant if no external forces act on it.
- The law of conservation of energy states that energy cannot be created or destroyed, only transferred or converted from one form to another.
- The principle of conservation of linear momentum and the principle of conservation of angular momentum are both examples of the conservation laws.

• Elastic and Inelastic Collisions :

- In an elastic collision, the total kinetic energy of the system is conserved.
- In an inelastic collision, some of the kinetic energy is lost in the form of heat, sound, or deformation.
- The coefficient of restitution is a measure of the relative velocity of separation of two colliding bodies after a collision, and it is defined as the ratio of the final relative velocity to the initial relative velocity.