Newton's 1st Law of Motion:

A body will continue in its **state of rest** or move **at constant speed in a straight line** unless an **external resultant force** acts on it. If there is a **resultant force** acting on a body, it will **change its state of motion.**

Inertia: is defined as the resistance to ma change in the state of motion of an object.

Mass: is a property that determines the object's inertia.

Newton's 2nd Law of Motion:

The **rate of change of linear momentum** of a body is **directly proportional** to the **resultant force** acting on it and its direction is in the **same direction as this resultant force.**

$$F \propto \frac{dp}{dt}$$

Thus, the **force acting on an object** is defined as the **rate of change of momentum of an object.**

When mass of a body is constant, N2L reduces to

$$Resultant\ Force = ma$$

Where the direction of the resultant Force is in the **SAME direction** as the body's acceleration or direction of **the change in momentum** of the body.

Newton's 3rd Law of Motion:

If **body A** exerts a force on **body B**, then body B will exert an **equal and opposite force** on body A.

Forces act in pairs, called action-reaction pairs. Force can always be expressed as an interaction between 2 bodies in the form "Force exerted by A on B".

Action-Reaction Pair

- They act on different bodies.
- The forces are of the same nature.
- They are equal in magnitude and opposite in direction.

Linear Momentum:

of a body is defined as the product of its mass and its velocity. It is a **vector quantity.**

$$p = mv$$

Impulse: is the product of the average force acting on an object and time interval over which the force is applied.

$$J = F\Delta t$$

- Area under the F-t graph gives the impulse.
- Impulse is a **vector quantity.**

Momentum-Impulse relation:

$$Change\ in\ momentum = Impulse$$

$$p_f - p_i = \int_{t1}^{t2} F\ dt$$

Principle of Conservation of Linear Momentum:

States that the **total momentum of a system is a constant** when **no net external force acts on it.**

Types of Collisions (2-bodies)	Total linear momentum before and after collision	Total kinetic energy before & after collision
(Perfectly) Elastic	Conserved	Conserved
	Relative speed of approach = Relative speed of separation	
Inelastic	Conserved	NOT Conserved
Perfectly Inelastic	Two bodies **coalesce** (stick together) after the collision. That is, the two bodies have the **same velocity after collision**.	

Weight and Weightlessness

Weight of an object is defined as the gravitational force acting on the object.

"Weightlessness" refers to apparent weightlessness and does not mean no gravitational force. It means **no contact force** acting on an object. A body experiences apparent weightlessness when the **resultant force acting on it is only its weight, or it is undergoing free fall.**