Laws of Motion

1. Force

- **Definition**: A push or pull on an object that can cause it to change its velocity (accelerate). It is a vector quantity, meaning it has both magnitude and direction.
- **Formula**: $F = ma$ (Force = Mass × Acceleration)

2. Inertia

- **Definition**: The tendency of an object to resist any change in its state of motion or rest. It is directly related to the mass of the object.

3. Newton's First Law of Motion (Law of Inertia)

- **Definition**: An object at rest stays at rest, and an object in motion stays in motion with the same speed and in the same direction unless acted upon by an unbalanced external force.

4. Newton's Second Law of Motion

- **Definition**: The rate of change of momentum of an object is directly proportional to the applied force and takes place in the direction of the force.
- **Formula**: $F = \frac{dp}{dt}$ or $F = ma$

5. Momentum

- **Definition**: The product of an object's mass and its velocity. It is a vector quantity.
- **Formula**: $p = mv$

6. Newton's Third Law of Motion

- **Definition**: For every action, there is an equal and opposite reaction. This means that forces always come in pairs.

7. Conservation of Momentum

- **Definition**: The total momentum of a closed system remains constant if no external forces are acting on it.

8. Friction

- **Definition**: A force that opposes the relative motion or tendency of such motion of two surfaces in contact.
- **Types**:
  - **Static Friction**: The friction that exists between a stationary object and the surface on which it rests.
  - **Kinetic Friction**: The friction between moving surfaces.
  - **Rolling Friction**: The frictional force that occurs when an object rolls over a surface.

9. Free Body Diagram (FBD)

- **Definition**: A graphical illustration used to visualize the forces acting on a single object. It helps in analyzing the effects of these forces.

10. Centripetal Force

- **Definition**: A force that acts on an object moving in a circular path and is directed toward the center around which the object is moving.
- **Formula**: $F_c = \frac{mv^2}{r}$ (where m is mass, v is velocity, and r is the radius of the circular path)

11. Tension

- **Definition**: The force transmitted through a string, rope, cable, or any other flexible connector when it is pulled tight by forces acting from opposite ends.

12. Gravitational Force

- **Definition**: The force of attraction between two masses. The force with which a massive body (like Earth) attracts another body toward itself.

13. Normal Force

- **Definition**: The perpendicular force exerted by a surface on an object in contact with it. It is equal and opposite to the force applied by the object on the surface.

14. Equilibrium

- **Definition**: A state in which all the forces acting on an object are balanced, resulting in no acceleration of the object.