

Basic Terminologies of Physics

1. Distance & Displacement

- Distance is the path sequence between the starting point and the endpoint. i.e. how much ground an object has covered.
- Distance is a scalar quantity.
- Displacement is the shortest distance between the starting point and the end point. i.e., speed = move + direction.
- Displacement is a vector quantity.
- The displacement is less than the distance, or Same.
- SI: m & CGS: cm

2. Velocity

- The distance traveled by an object in a certain direction over a period of time is called velocity.
- **Velocity = displacement / time**

$$v = \text{Displacement } (d) / \text{Time } (t)$$

- SI: m/s & CGS: cm/s

3. Acceleration

- The change in velocity over a period of time is called acceleration.
- **Acceleration = $v-u / t$ = velocity change / time = final velocity - start velocity / total duration**

$$a = v - u / t$$

- SI: m/s
- If the velocity decreases, then there is a negative acceleration. If the velocity increases, then there is a positive acceleration.

4. Other formulas for motion

a. Speed - Time relationship

$$v = u + at$$

b. Displacement - Time relationship

$$s = ut + \frac{1}{2}at^2$$

c. Displacement - Velocity relationship

$$v^2 = u^2 + 2as$$

5. Inertia

Inertia is the state of resisting a change in the stationary or moving state of an object.

a. Inertia at rest

The inertia of rest is the tendency of a body to resist a change of state of motion from rest by an external force.

Eg.

- When the bus starts suddenly, the passenger falls backwards.
- After moving the branch, the fruit fell from the tree.
- After shaking the satranji, the dust particles remain still, so the satranji becomes clean

b. Inertia due to Motion

The resistance that occurs when the motion of an object is brought to a state of rest is called Inertia due to Motion.

Eg.

- पंख्याचे बटण बंद केले तरी तो फिरत असतो. (काही काळ)
- चालत्या बसमधून उतरणारा प्रवासी पुढच्या दिशेने पडतो
- बस अचानक थांबल्यावर प्रवासी पुढच्या दिशेला झुकला जातो.

c. Inertia due to Direction

The property of an object that resists changing the direction of its motion is called inertia of direction.

Eg.

- When the vehicle is moving, the mud blows upwards.
- While sharpening the knife, sparks are seen flying from the tangent of the sharpening wheel.

6. Newton's laws of motion

a. The first law - the law of inertia

When no external force acts on the main object, then the object in the state of rest remains in the state of rest, while the object in the state of motion remains in the state of motion, this is called the law of inertia.

b. The second law - the law of force

The acceleration of an object depends on the mass of the object and the amount of force applied.

$$force = mass \times acceleration$$

Eg.

- Hitting the ball with the bat.
- Flight of 'Agni' Missiles

c. The third law - Action & Reaction

Whenever one object exerts a force on a second object, the second object exerts an equal and opposite force on the first.

The rate of change of momentum is proportional to the force applied. Also, the change of momentum is in the direction of the force.

$$\text{momentum } (p) = \text{mass } (m) \times \text{speed } (v)$$

Eg.

- In the game of cricket, a player withdraws his hand when caught.
 - a. Because of his arm and the speed of the ball - as their duration increased. This reduces the momentum of the ball and reduces the impact on the hand.
- In the high jump arena, the player falls on a thick layer of sand.
- The motion of a jet engine produces thrust.

7. Newton's law of gravity

Wherever any two objects in the world are, there is a force at work between them, called the force of gravity.

- The force of gravity is proportional to the product of the masses of both objects.

$$f \propto m_1 m_2$$

- And it is inversely proportional to the square of the distance between two objects.

$$f \propto \frac{1}{r^2}$$

Hence,

$$f = G \frac{m_1 m_2}{r^2}$$

Where, $G = 6.67 \times 10^{-11} \text{ Nm}^2/\text{Kg}^2$

8. Acceleration due to gravity

The change in velocity is called acceleration. As an object descends from a height to the ground, its force changes due to the force of gravity and acceleration is created. That acceleration is called gravitational acceleration.

- The value of 'g' is highest on the pole because the distance is less from the center of earth. 9.83 m/s^2
- The value of 'g' is lowest at the equator because the distance is greater. 9.78 m/s^2
- Normally it's taken as 9.8 m/s^2
- The value of 'g' increases as it reaches the surface of the earth from a height and decreases as it goes down (from the ground).
- The value of 'g' decreases as it moves from the surface to the center of the earth, as the mass of the earth is assumed to be less.
- The mass at the center of the earth is considered zero, so $g = 0$

9. Thrust

- The force applied perpendicular to the surface of an object is called thrust.
- The effect of thrust depends on the area.

10. Pressure

- Thrust is the pressure applied to a specific surface area.

$$\text{pressure} = \text{thrust} / \text{area}$$

- SI: N/m^2 or *Pascal*

a. Pressure of Gases (atmospheric pressure)

- The force exerted by the weight of air on a given surface is the atmospheric pressure.
- Atmospheric pressure depends on the altitude above sea level.
- As the altitude increases, the air becomes thinner, so the atmospheric pressure decreases.
- Atmospheric pressure at sea level $10^5 N/m^2$ or *Pascal*

b. Pressure of Liquid

- The pressure of the liquid is the same in all directions on all the sides inside the pot.
- It does not depend on the size of the pot.
- The pressure of the fluid depends on the height of the mass. It also depends on the density of the substance.
 - ◆ The higher the height or depth of the fluid, the higher the pressure of the fluid.
 - ◆ The higher the density of the liquid, the higher the pressure of the liquid.

c. Pressure of fluid

- The pressure of the fluid is the same on all sides.
- When an object sinks in a liquid, it exerts a force on the object.
- This force is perpendicular.
- When an object is submerged in water, the weight of the object decreases due to buoyant force.

11. Archimedes' principle

- When an object sinks in a fluid — the upward buoyant force exerted on a body immersed in a fluid is equal to the weight of the fluid displaced by the body.
- This principle is used for the construction of submarines as well as ships.

12. Inconsistent behavior of water

- Normally, any substance expands when its temperature is raised, while a substance shrinks when its temperature is reduced. But this does not happen with water.
- When the water temperature is raised from $0^\circ C$ to $4^\circ C$, the water contracts instead of circulating, and if the temperature decreases from $4^\circ C$ to $0^\circ C$, the water contracts instead of shrinking. This property is called inconsistent behavior of water.