

Motion

Motion

A body is said to be in **motion** if it changes its position with respect to a reference point over time.

Example

- A car moving on a road is in motion.

Rest

A body is said to be at **rest** if it does not change its position with respect to its surroundings.

Example:

- A book lying on a table is at rest.

Reference Point

A **reference point** is a fixed point used to describe the position of an object.

Example:

A tree can be used as a reference point to observe the motion of a car.

Types of Motion

1. Linear Motion

When an object moves in a **straight line**, it is called linear motion.

Examples:

- A car moving on a straight road
- A stone falling vertically

2. Circular Motion

When an object moves in a **circular path around a fixed point**, it is called circular motion.

Examples:

- Blades of a fan
- A merry-go-round

3. Oscillatory Motion

When an object moves **to and fro about a fixed point**, it is called oscillatory motion.

Example:

- A pendulum of a clock

Distance

Distance is the **total length of the path travelled** by an object.

- It is a **scalar quantity** (only magnitude).

Example:

If a person walks 10 m forward and 5 m backward, distance = 15 m.

Displacement

Displacement is the **shortest distance between initial and final position in a specific direction**.

- It is a **vector quantity** (magnitude + direction).

Example:

- If a person walks 10 m forward and 5 m backward, displacement = 5 m forward.

Uniform Motion

A body is said to be in **uniform motion** if it covers **equal distances in equal intervals of time**.

Example:

- A train moving at constant speed of 60 km/h.

Non-uniform Motion

A body is said to be in **non-uniform motion** if it covers **unequal distances in equal intervals of time**.

Examples:

- A car moving in traffic

- A freely falling stone

Speed

Speed is the **distance travelled per unit time**.

- Formula: Speed = Distance / Time
- Unit: m/s

Example:

- If a car travels 100 m in 10 s, speed = 10 m/s.

Types of Speed

1. Uniform Speed

When an object covers equal distances in equal time intervals.

Example:

- A bus moving at constant speed.

2. Non-uniform Speed

When speed keeps changing.

Example:

A car in city traffic.

3. Instantaneous Speed

Speed at a particular moment of time.

Example:

- Speed shown by a speedometer at a given instant.

4. Average Speed

Total distance travelled divided by total time taken.

Example:

- If a car travels 100 km in 2 hours, average speed = 50 km/h.

Conversion of Units

- 1 km/h = $\frac{5}{18}$ m/s

- $1 \text{ m/s} = 18/5 \text{ km/h}$

Velocity

Velocity is the **speed in a given direction**.

- It is a **vector quantity**
- Unit: m/s

Example:

- A car moving at 20 m/s towards north.

Average Velocity

Total displacement divided by total time.

Example:

- If displacement is 100 m in 10 s, velocity = 10 m/s.

Acceleration

Acceleration is the **rate of change of velocity per unit time**.

- Formula:
 - Acceleration = $(v - u) / t$
- Unit: m/s^2

Example:

If velocity increases from 10 m/s to 20 m/s in 5 s, acceleration = 2 m/s^2 .

Types of Acceleration

1. Uniform Acceleration

Equal change in velocity in equal time intervals.

Example:

- A freely falling object.

2. Non-uniform Acceleration

Unequal change in velocity.

Example:

- A moving bus in traffic.

3. Positive Acceleration

Velocity increases with time.

Example:

- A car speeding up.

4. Negative Acceleration (Retardation)

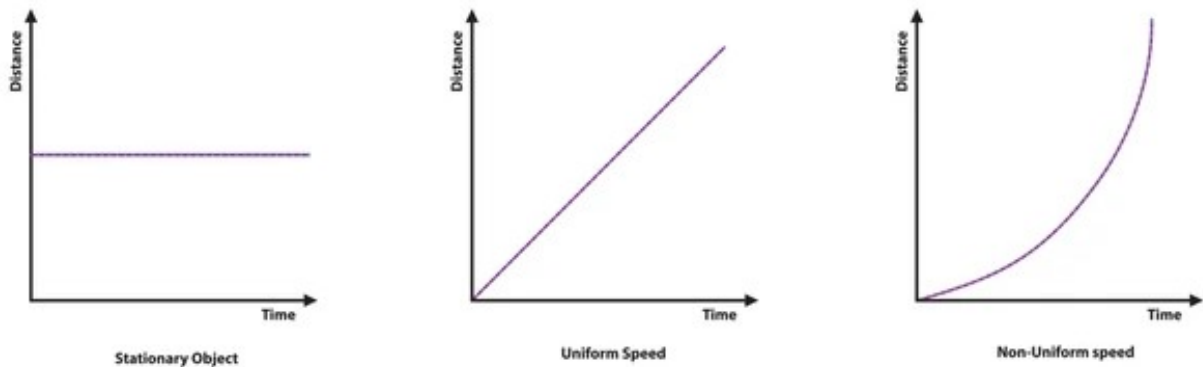
Velocity decreases with time.

Example:

- A car slowing down.

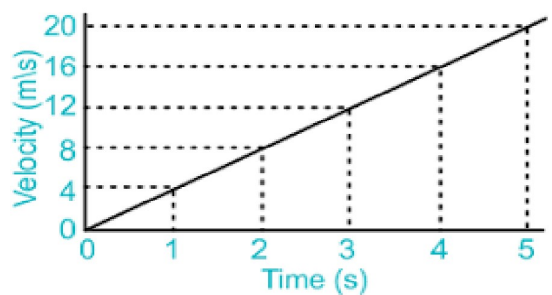
Graphs of Motion

Distance-Time Graph



Shows how distance changes with time

Velocity-Time Graph



Shows how distance changes with time

Equations of Motion	• u = initial velocity
For uniformly accelerated motion:	

1) $v = u + at$ 2) $s = ut + \frac{1}{2} at^2$ 3) $v^2 = u^2 + 2as$	<ul style="list-style-type: none">• v = final velocity• s = displacement• a = acceleration• t = time
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Uniform Circular Motion

When an object moves in a circular path with **constant speed**, it is called uniform circular motion.

- Velocity changes due to change in direction

Example:

- A satellite moving around Earth

Time Period

Time taken to complete one full revolution.

Example:

Time taken by a fan blade to complete one rotation.