RADIANT 2026

Physics

Motion In One Dimension

Lecture - 04

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Topics *to be covered*

1. Displacement-Time Graph
2. Velocity-Time Graph
3. Acceleration-Time Graph

4) Uniform and Non Uniform Motion

Recap *of previous lecture*

1. Speed
2. Velocity
3. Acceleration
4. Numerical

Uniform motion

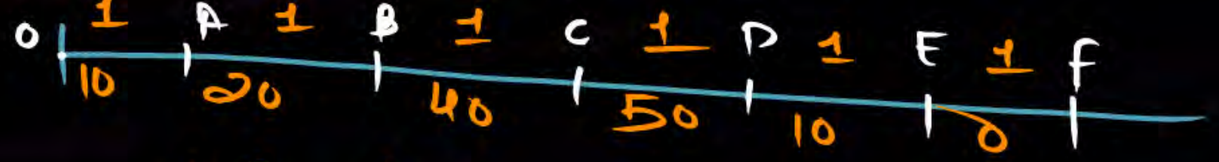
Equal time

Equal distance

] Uniform motion

Speed = constant

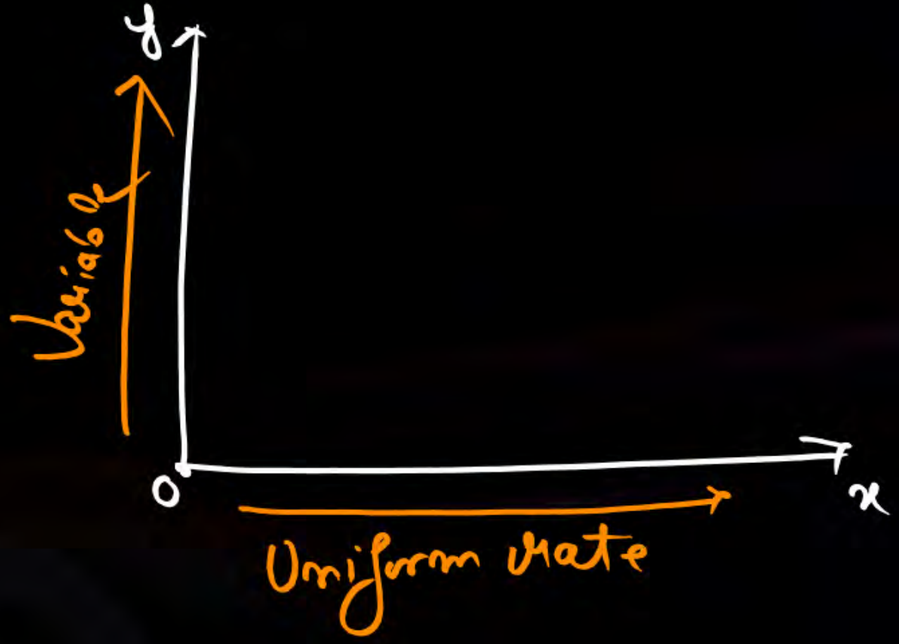
Non-Uniform motion



Equal time

Unequal distance

Non-Uniform Speed



S-t

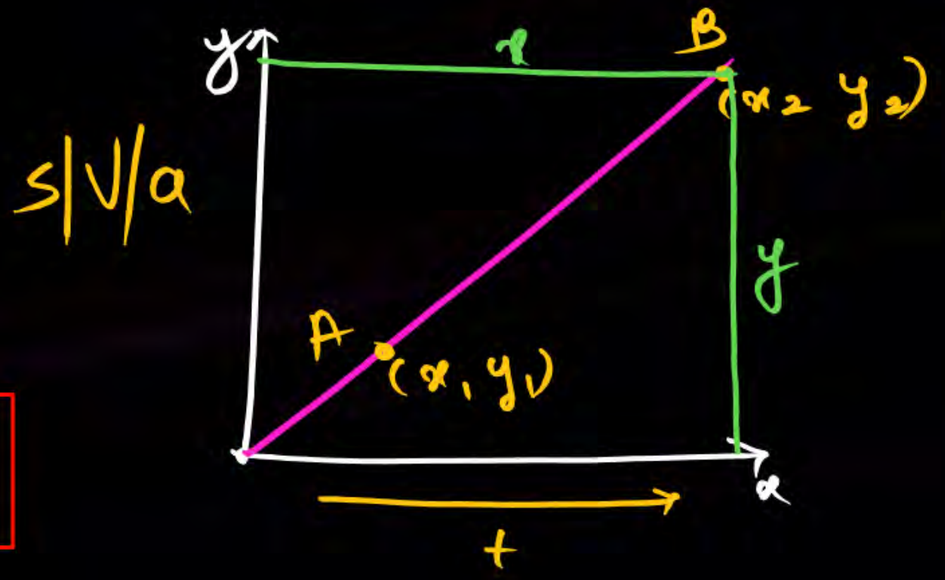
V-t

a-t

$$\text{Slope} = \frac{\text{Change in } y}{\text{Change in } x} = \frac{y_2 - y_1}{x_2 - x_1}$$

$$\text{Slope} = \frac{y_2 - y_1}{x_2 - x_1}$$

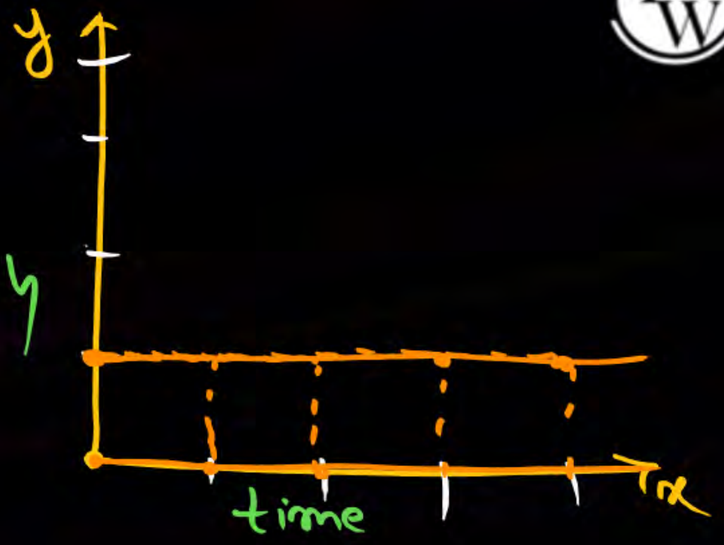
$$\text{Area} = x \times y$$

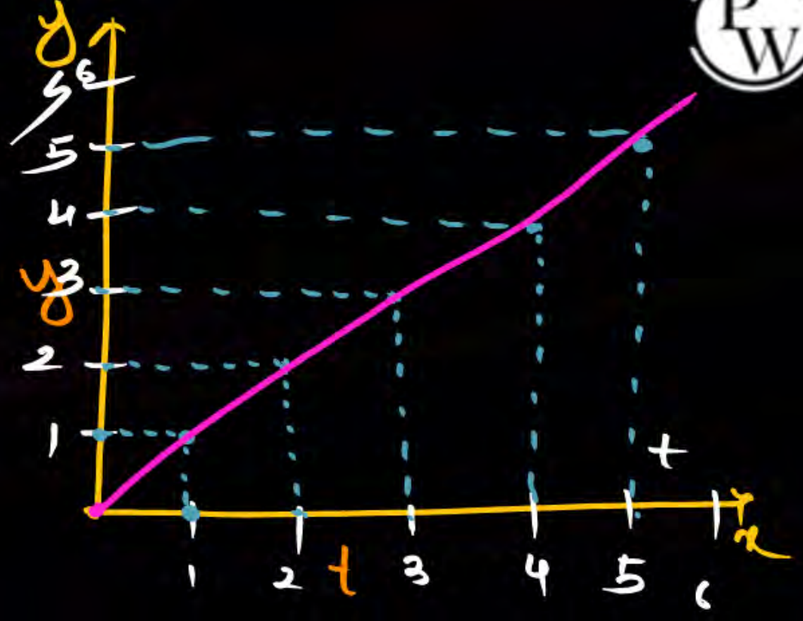


Displacement-Time Graph

- Since, velocity is the ratio of displacement and time, therefore the slope of displacement- time graph gives the velocity. If the slope is positive, it implies that the body is moving away from the starting (or reference) point, but if the slope is negative, the body is returning towards the starting (or reference) point.

(i) S-t





$$\text{Slope} = \frac{\text{Change in } y}{\text{Change in } x}$$

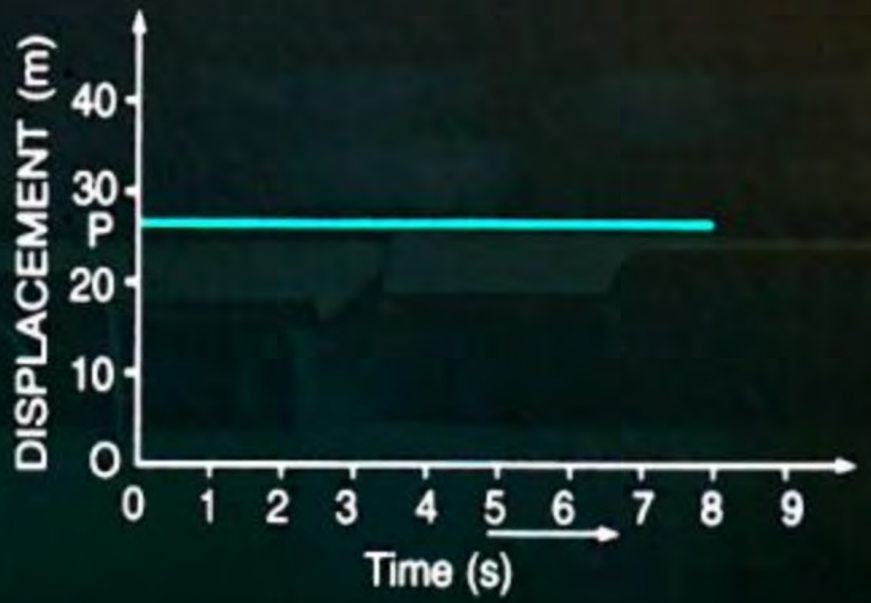
$$\text{Velocity} = \frac{\text{Change in displacement}}{\text{time Interval}}$$

Uniform motion = समान गति

Displacement-Time Graph

Case (1):

If the position of a body does not change with time, the body is said to be stationary.



Displacement-Time Graph

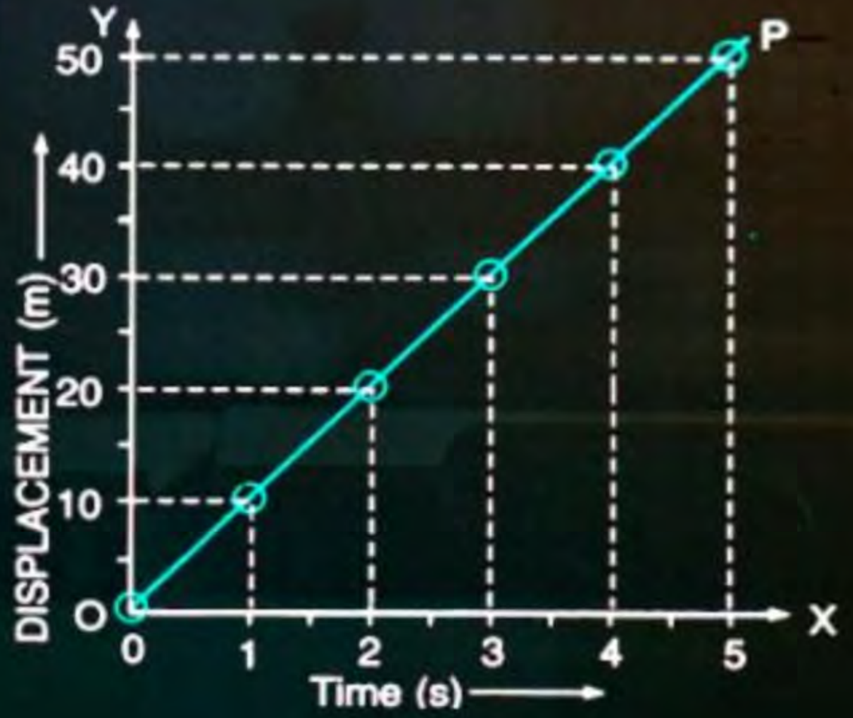
Case (2):

If a body is moving with uniform velocity, its displacement increases by the same amount in each second and so the displacement-time graph is a straight line inclined to the time axis. The velocity of body can be obtained by finding the slope of the straight line.

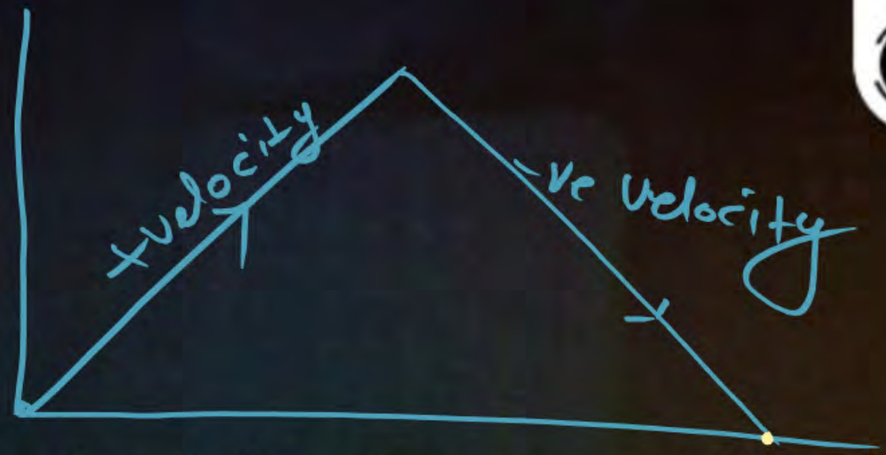
Example:

A car is moving on a straight path in a given direction with a uniform speed. The following table represents its displacement (i.e., distance from the starting point) at different instants.

Time in second (s)	0	1	2	3	4	5
Displacement in metre (m)	0	10	20	30	40	50



Displacement-Time Graph



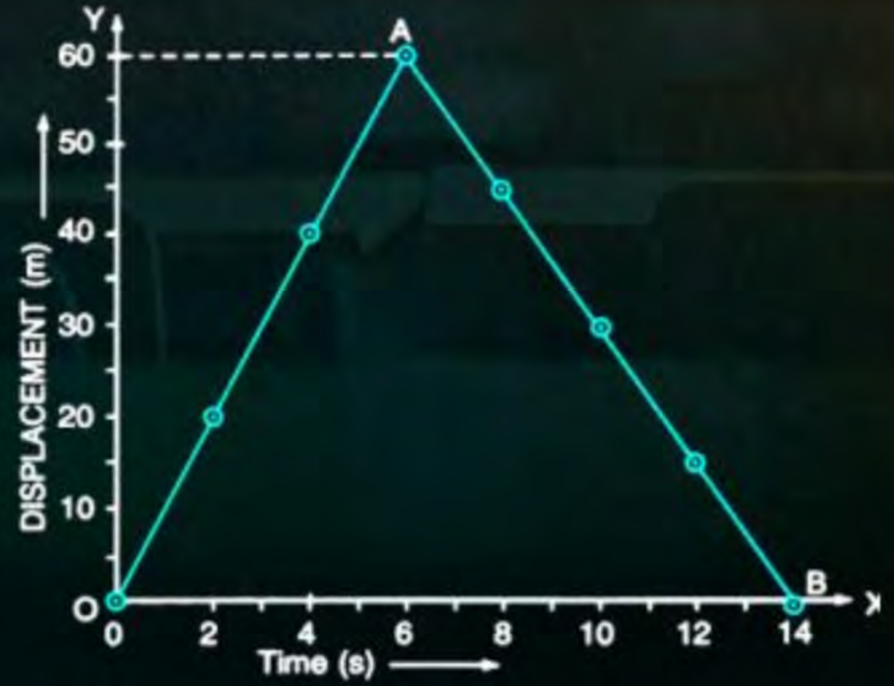
Case (3):

If a body moves with varying speed in a fixed direction i.e., with variable velocity, the displacement-time graph is not a straight line, but it is a curve. The velocity at any instant can then be obtained by finding the slope (or the gradient) of the tangent drawn on the curve at that instant of time.

Example:

Figure represents the displacement-time graph of a ball which while moving on a perfectly smooth floor hits a wall at $t = 6$ s and then comes back along the same line. The displacement (i.e., distance of ball from the starting point) at different instants of time is given in the table below.

Time (in second)	0	2	4	6	8	10	12	14
Displacement (in metre)	0	20	40	60	45	30	15	0



Conclusions

(i) (a) If the displacement-time graph of an object, is a straight line parallel to the time axis, the object is stationary. (b) If the graph is a straight line inclined to the time axis, the motion is with uniform velocity. (c) If the graph is a curve, the motion is with non-uniform velocity.

Conclusions

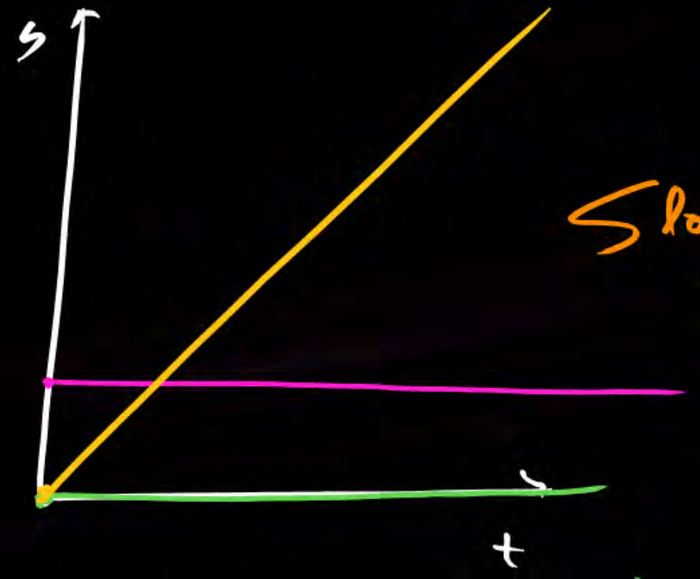
(ii) In the displacement-time graph, the slope of the straight line (or the tangent to the curve at an instant) gives the velocity of the object at that instant. (a) If the slope is positive, it represents the motion away from the origin (or reference point). (b) If the slope is negative, it represents the motion towards the origin.

Conclusions

(iii) Knowing the velocity of the object at different instants from the displacement-time graph, the velocity-time graph can be drawn.

(i) Slope = $\frac{y_2 - y_1}{x_2 - x_1}$

(ii) Area = $x \times y$



Slope = Velocity

Area = वुनह नहीं

0 → origin stay (rest)

→ fixed

→ Uniform motion

→ Non Uniform


Thank You