RADIANT 2026

Physics

Motion In One Dimension

Lecture - 05

By - Akash Shravan Sir

Topics *to be covered*

1. Acceleration-time graph

2) Graphical Analysis

Recap *of previous lecture*

1. Displacement-time graph
2. Velocity-time graph

$$\text{Slope} = \frac{\Delta y}{\Delta x}$$

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

$\frac{\Delta s}{\Delta t}$ = Velocity

100%.

Slope

(i) acc

(ii) Displacement

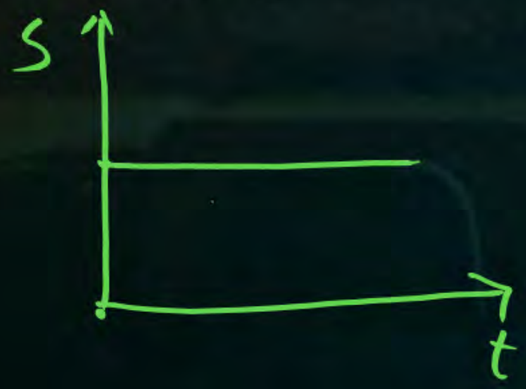
(iii) Velocity

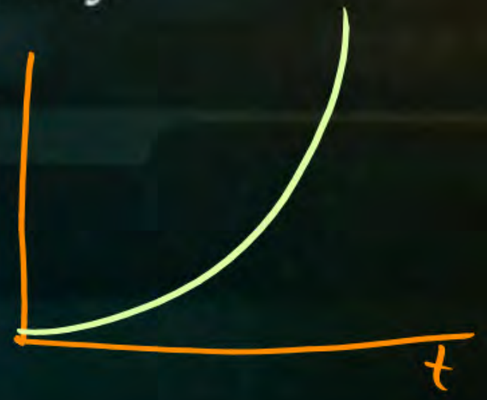
Displacement-Time Graph

(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.





Displacement-Time Graph

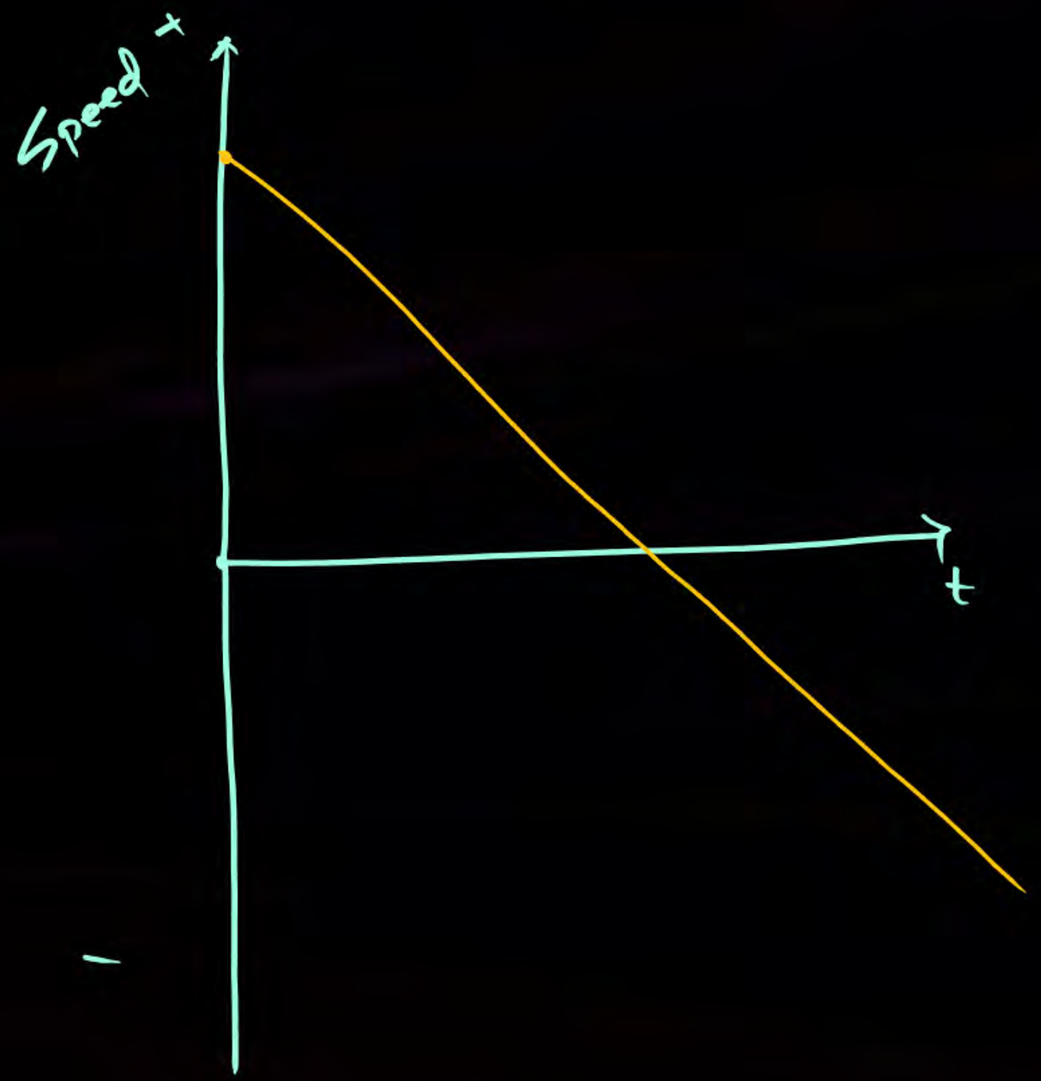
(d) In the displacement-time graph, the slope of the straight line (or the tangent to the curve at an instant) gives the velocity of the object at that instant.

(e) If the slope is positive, it represents the motion away from the origin (or reference point).

(f) If the slope is negative, it represents the motion towards the origin.

up - yes

down - no



Velocity-Time Graph

- From the velocity-time graph, we can determine displacement of the body in a certain time interval and the acceleration of the body at any instant.

$$\text{Slope} = \frac{\text{change in y axis}}{\text{change in x axis}}$$

$$\text{area} = V \times t$$

area Vt = displacement

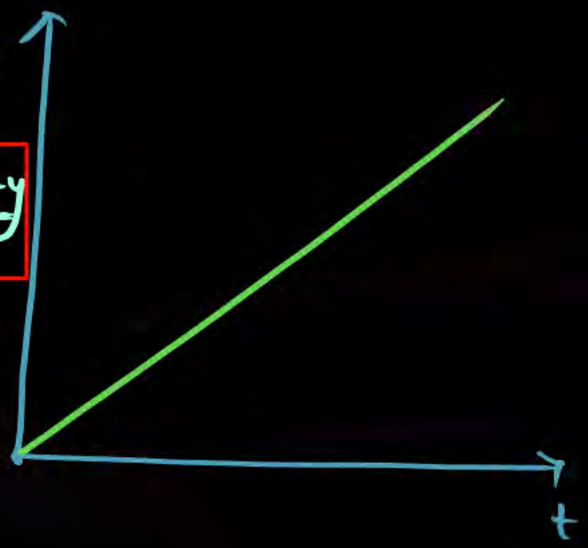
$$\text{acc} = \frac{\text{Change in Velocity}}{\text{time interval}}$$

$V = \frac{S}{t}$ $\boxed{S = V \times t}$

$$\text{acc} = \frac{\text{Change in velocity}}{\text{Change in time}}$$

area $= V \times t$

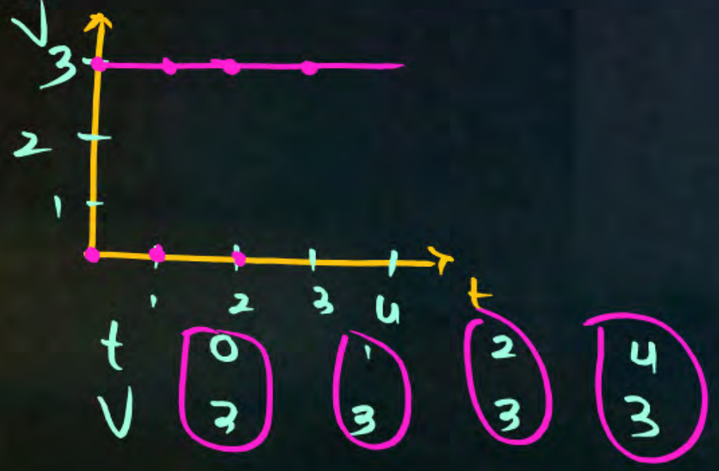
$\boxed{S = V \times t}$

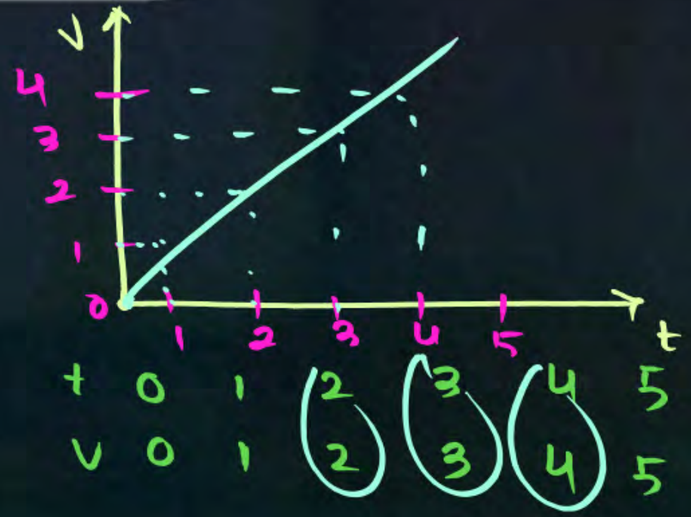


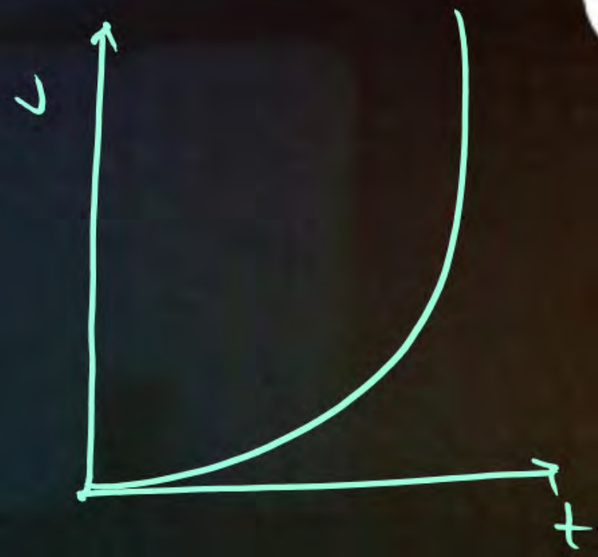
$$\text{Slope} = \frac{\Delta y}{\Delta x}$$

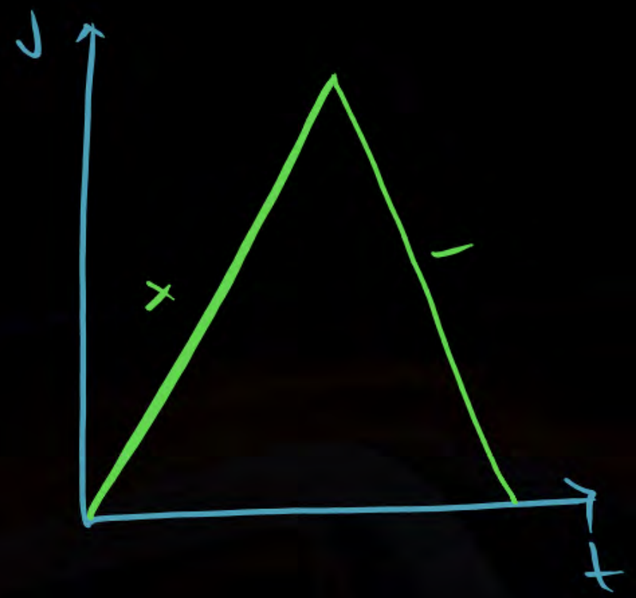
$\text{Area} = x \times y$

Velocity-Time Graph








J
+
−
t

t = 0
v = 2

Conclusions

(a) For motion with a uniform velocity, the velocity-time graph is a straight line parallel to time axis.

(b) If the velocity-time graph is a straight line inclined to the time axis, the motion is with uniform acceleration.

(c) If the velocity-time graph is a curve, the motion is with non-uniform acceleration.

(d) The positive slope means velocity increasing with time i.e., accelerated motion.

(e) The negative slope means velocity decreasing with time i.e., retreated motion and

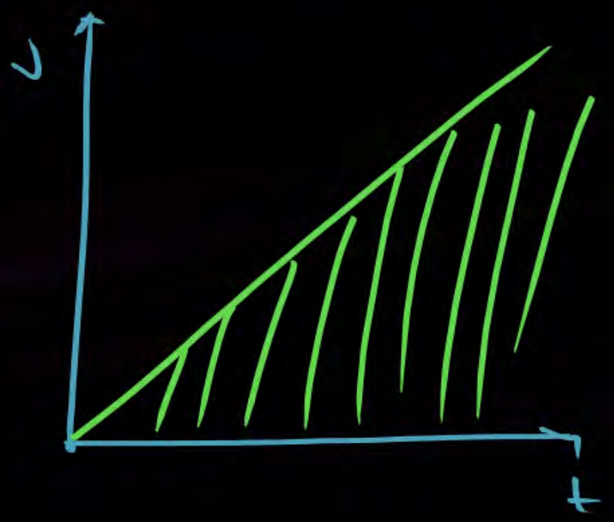
(f) the zero slope implies motion with constant velocity.

A → Velocity

B → Distance

C → Displacement

D → time

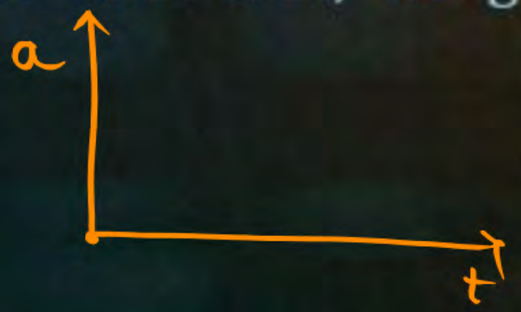


Conclusions

(iv) The area enclosed between the velocity-time sketch and the time axis for a certain time interval gives the displacement in that interval of time. The area above the time axis gives the positive displacement, while the area below the time axis gives the negative displacement.

Acceleration-Time Graph

For linear motion, acceleration × time = change in speed, therefore from the area enclosed between the acceleration-time sketch and the time axis, we get the change in speed of the body for the given time interval.



Acceleration-Time Graph

$a = \frac{\text{change in Velocity}}{\text{time}}$

Change in Velocity = 0

$a = 0$

Case (1):

If the body is stationary or if it is moving with a uniform velocity, the acceleration is zero.

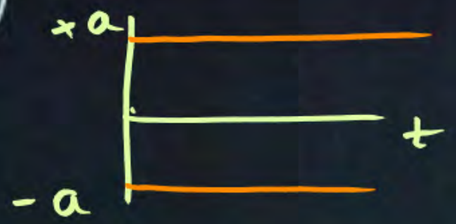
Acceleration-Time Graph

t	0	1	2	3	4	5
v	0	1	2	3	4	5

Case (2):

If the velocity of body in motion increases uniformly with time, the acceleration is constant (i.e., the motion is uniformly.

Acceleration-Time Graph



Case (3):

If the velocity of body decreases at a constant rate, the retardation is constant (i.e., the motion is uniformly retarded). The acceleration- time graph is a straight line parallel to the time axis on the negative acceleration axis. In Figure, the straight line PQ represents the acceleration-time.

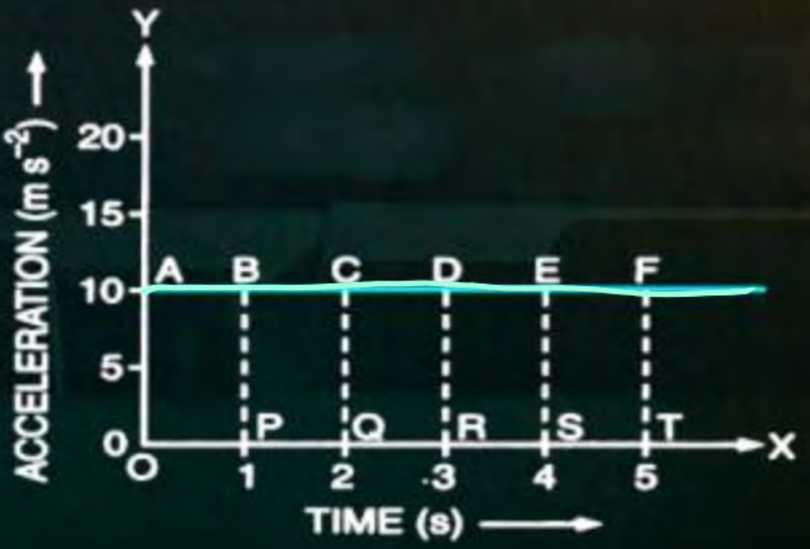
Motion Under Gravity

$g = 9.8\ m/s^2$

A body falling freely under gravity moves with a uniform acceleration of 9.8 m s^{-2} (or nearly 10 m s^{-2}) . For a body moving vertically upwards, there is a uniform retardation of 9.8 m s^{-2} Thus motion under gravity is an example of uniformly accelerated or uniformly retarded motion.

Motion Under Gravity

In Figure, straight line AF represents the acceleration-time graph for a body falling freely (or moving) with uniform acceleration equal to $10\ m\ s^{-2}$.



Equation of Motion

(i) $V = u + at$

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

(iii) $V^2 = u^2 + 2as$

$u \rightarrow$ Initial Velocity

$t \rightarrow$ time

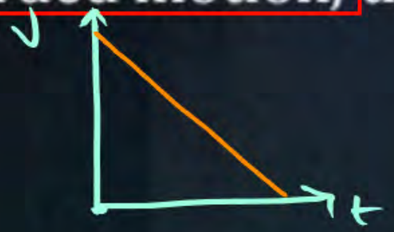
$s \rightarrow$ displacement

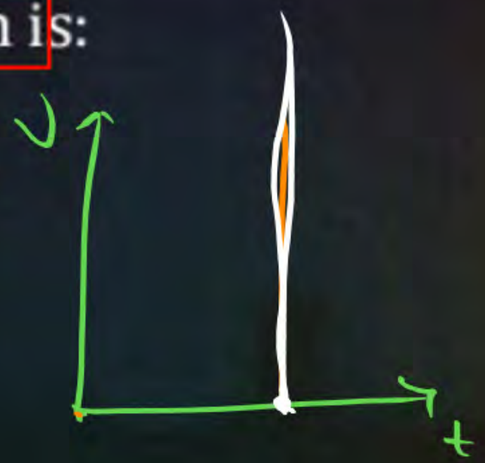
$a \rightarrow$ acceleration

$v \rightarrow$ final Velocity

Question

For a uniformly retarded motion, the velocity-time graph is:





(A) a curve

(B) a straight line parallel to the time axis

(C) a straight line perpendicular to the time axis.

(D) a straight line inclined to the time axis.

Question

For a uniformly retarded motion, the velocity-time graph is:

(A) a curve

(B) a straight line parallel to the time axis

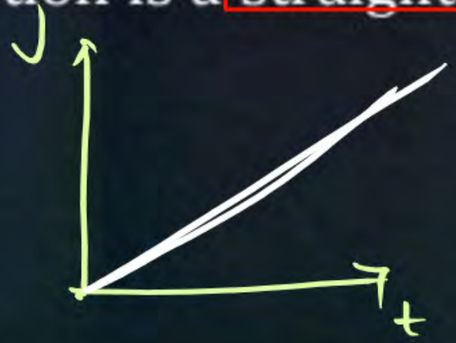
(C) a straight line perpendicular to the time axis.

(D) a straight line inclined to the time axis.

Ans. **(D)** a straight line inclined to the time axis

Question

The velocity-time graph of a body in motion is a straight line inclined to the time axis. The correct statement is:



A velocity is uniform

B acceleration is uniform

C both velocity and acceleration are uniform

D neither velocity nor acceleration is uniform.

Question

The velocity-time graph of a body in motion is a straight line inclined to the time axis. The correct statement is:

(A) velocity is uniform

(B) acceleration is uniform

(C) both velocity and acceleration are uniform

(D) neither velocity nor acceleration is uniform.

Ans. **(B)** acceleration is uniform.


Thank You