

Acceleration

- **Definition:** Acceleration is the rate of change of velocity in a certain time. It is the vector quantity.
- Acceleration is not the same as velocity or speed
- **Formula:**

$$\text{Acceleration} = (\text{final velocity}) - (\text{initial velocity}) / \text{time}$$

$$\text{Acceleration} = (V_f - V_i) / t$$

$$\text{Acceleration} = \text{Change in velocity} / \text{time}$$

$$A = \Delta V / t$$

Where

- a is the acceleration in m.s^{-2}
- v_f is the final velocity in m.s^{-1}
- v_i is the initial velocity in m.s^{-1}
- t is the time interval in s
- Δv is the small change in the velocity in m.s^{-1}

Deceleration:

- If the object is slow down the change in velocity is negative
- Other word deceleration is **Reduction of velocity** which showed by **Negative sign.**

Acceleration

Moving Car



EXAMPLE

A car is travelling along a road, when it collides with a tree and comes to a stop. Estimate the deceleration of the car.

Solution:

- First give a sensible speed of car Normally speed of car is 25 m/s approximately
- Car come to stop in 1 sec approximately
- Put these value in acceleration equation

$$A = \Delta v / t$$

$$A = (-25) / 1 \text{ (Negative sign show deceleration as asked in question)}$$

$$A = -25 \text{ m/s}^2$$

So the deceleration of car is 25 m/s²

Uniform Acceleration Means a Constant Acceleration

- Constant acceleration also called uniform acceleration
- Due to gravity acceleration is uniform for free fall object, which is approximately 9.8m/s²
- Formula :

$$v^2 - u^2 = 2as$$



i **Q:** A van travelling at 23 m/s starts decelerating uniformly at 2.0 m/s as it heads towards a built-up area 112 m away, what will its speed be when it reaches the built-up area?

Solution:

$$V^2 = u^2 + 2as$$

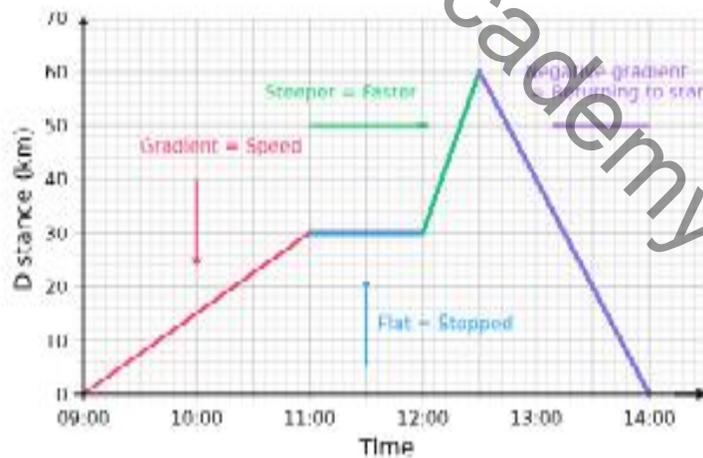
$$V^2 = (23)^2 + (2 \times -2.0 \times 112)$$

$$V^2 = \sqrt{81}$$

$$V = 9\text{m/s}$$

Distance Time Graph:

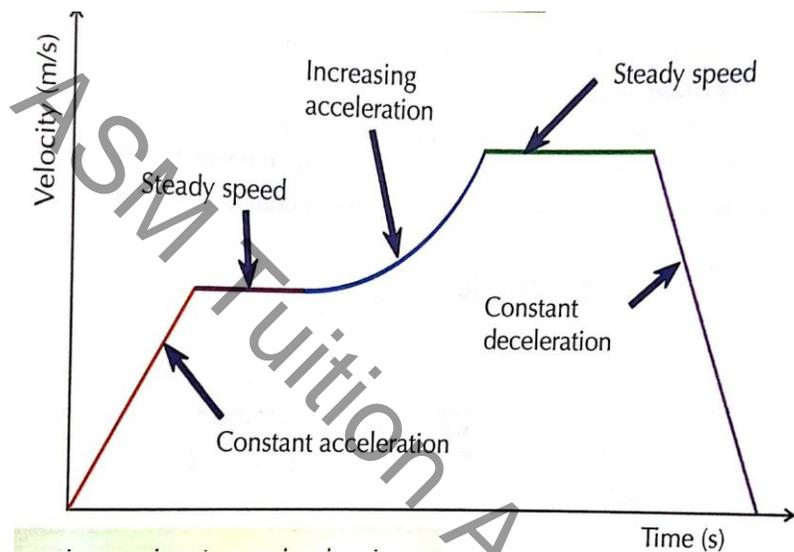
If the object move in a straight line, its distance travelled can be plotted as **Distance Time Graph**



- 1- **Gradient = speed** (The steeper the graph, the faster the object is going.)
- 2- **Flat sections** shows object is stationary- it's stopped
- 3- **Straight uphill** line section showed it is travelling at a steady speed.

- 4- **Curves** represent acceleration or deceleration
- 5- A **curve move upward** means the object's speeding up (increasing gradient).
- 6- **Negative gradient or straight line move downward** means it's slowing down (decreasing gradient).

Velocity-Time Graph



- 1- **Gradient= acceleration so**
Acceleration = change in velocity/time
- 2- **Flat Section** showed fast speed
- 3- **Line move upward** showed increase in acceleration
- 4- **Downward section** showed deceleration
- 5- **Area under any section of graph = distance travelled in time intervals**