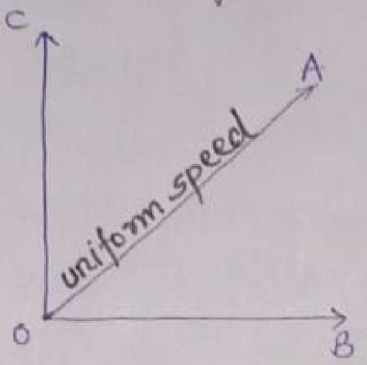
Subject - Physics Chapter - 1 (Motion)

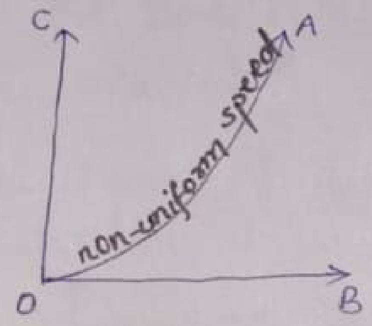
• Graphical representation of motion :-

1. Distance - Time Graph:-

Distance - Time graph shows the speed of the object.

(i) For Uniform Speed:- (ii) For Non-Uniform Speed





"The slope of a distance-time graph = Speed"

(a) The distance time graph of a body moving at uniform speed is always a straight line.

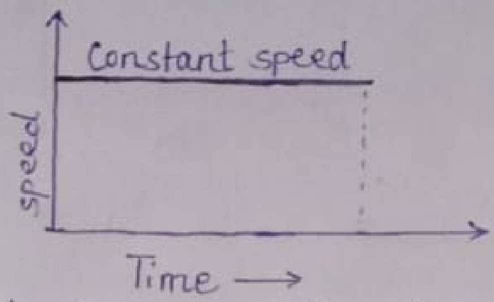
(b) The distance time graph of a body moving at non-uniform speed is always a curve.

(c) The displacement - Time graph of a body represents "velocity".

(d) The speed-time graph is also known as velocity-time graph.

2. Speed-Time Graphs :-

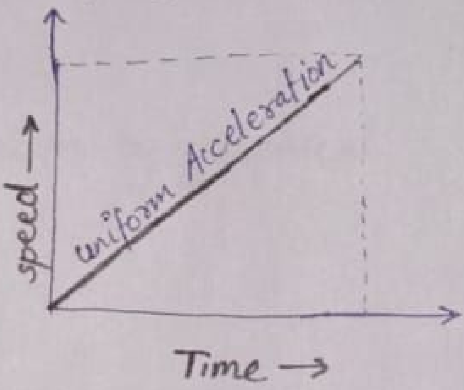
(i) Speed-Time graph when the speed remains constant :-



"— If the speed-time graph of a body is a straight line parallel to the time axis the the speed of body is constant."

(ii) Speed-Time graph when speed Changes at a uniform Rate (Uniform Acceleration) :-

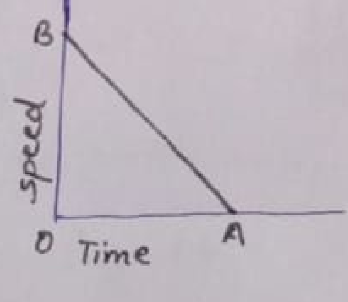
$$\text{Acceleration} = \frac{\text{Change in Speed (Velocity)}}{\text{Time taken}}$$



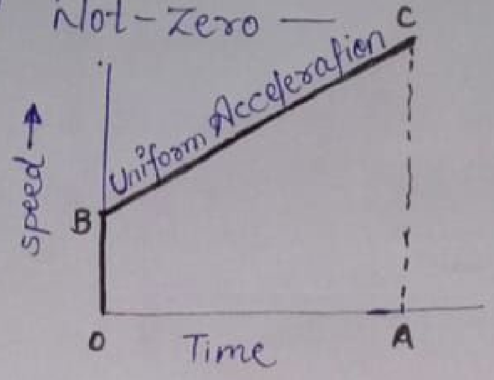
The speed-time graph for a uniformly changing speed will be a straight line.

"— The slope of speed-time graph of a moving body gives its acceleration."

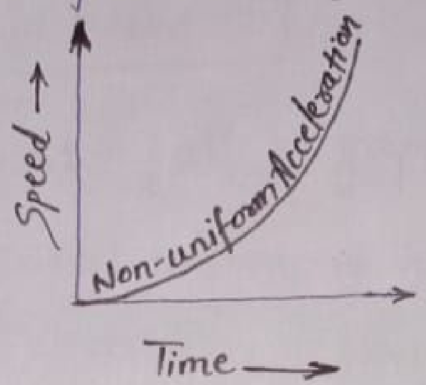
For Retardation :-



speed - time graph when the initial speed of the body is Not - Zero —



(iii) Speed - Time graph when speed changes at a Non-uniform Rate (Non-Uniform Acceleration):—

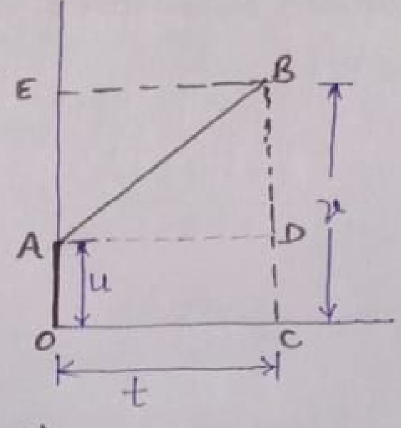


- To derive the equation of motion by graphical method :-

1. To derive $v = u + at$

Let, initial velocity $= u = OA$

Final velocity of body $= v = BC$



From Graph —

$BC = BD + DC$

Therefore,

$v = BD + DC$

Again, $DC = OA$

So, $v = BD + OA$ —— (i)

$\Rightarrow \quad v = BD + u$

Thus,

Acceleration, a = slope of line AB

$$a = \frac{BD}{AD} = \frac{BD}{t}$$

$$\Rightarrow \quad BD = at \quad \text{——— (ii)}$$

putting this value of BD in equation (i)

$$\boxed{v = u + at}$$

2. To derive $s = ut + \frac{1}{2}at^2$ by graphical method :-

Distance travelled = Area of figure OABC

$= Ar(\text{rect. OADC} + \Delta ABD)$

$= OA \times OC + \frac{1}{2} \times AD \times BD$

$= u \times t + \frac{1}{2} \times t \times at \quad (\because BD = at)$

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

3. To derive $v^2 = u^2 + 2as$ by graphycal method :-

Distance travelled = Area of trap. OABC

$$s = \frac{(OA + CB) \times OC}{2} = \frac{(u+v) \times t}{2}$$

$$\Rightarrow \quad 2s = (u+v) \times t \quad [\because v = u + at]$$

So, $\quad 2s = (u + u + at)t = 2ut + at^2 \quad \left[t = \frac{v-u}{a}\right]$

$$\Rightarrow \quad 2s = 2u \times \left(\frac{v-u}{a}\right) + a \times \left(\frac{v-u}{a}\right)^2$$

$$\Rightarrow \quad 2s = \frac{v^2 - u^2}{a} \Rightarrow \boxed{v^2 = u^2 + 2as}$$

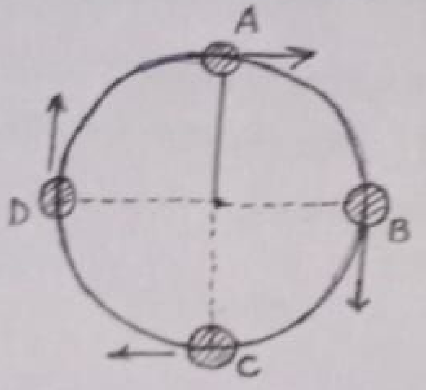
- ## Uniform Circular Motion:-

"When a body moves in a circle, it is called circular motion."

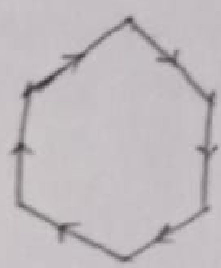
(i) When a body moves along a circular path, then its direction of motion (or direction of speed) keeps changing continuously.

(ii) When the velocity changes (due to continuous change in direction), therefore, the motion along a circular path is said to be accelerated.

(iii) When a body moves in a circular path with uniform speed (constant speed), its motion is called uniform circular motion.



(circular motion)



(Non- Circular motion)

(iv) Accelerated motion:-

"— The motion in a circle with constant speed is an example of accelerated motion."

Examples of uniform circular motion :-

(i) Artificial satellites moves in uniform circular motion around the earth.

⇒ The motion of a satellite around the earth is accelerated.

(ii) The moon moves in uniform circular motion around the earth.

(iii) The earth moves around the sun in uniform circular motion.

(iv) The tip of a seconds' hand of a watch exhibits uniform circular motion on the circular dial of the watch.

(v) An athlete moving on a circular track with constant speed exhibits uniform circular motion.

Question

Que 1. What is the difference between uniform linear motion and uniform circular motion?

Que 2. Show by using the graphical method that

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

Que 3. A bus running at a speed of 18 km/h is stopped in 2.5 Seconds by applying brakes. Calculate the retardation produced.

Que 4. A train starting from rest moves with a uniform acceleration of 0.2 m/sec² for ~~5 Second~~ 5 minutes. Calculate the speed acquired and the distance travelled in this time.

Que 5. A train travelling at 20 m/sec accelerates at 0.5 m/sec² for 30 seconds. How far will it travel in this time?