Chapter – 08 MOTION

Motion :- Motion means movement. The motion of an object is observed when its position changes continuously wuth rerspect to some stationary object.

Distance :- The distance travelled by an object is the length of actual path travelled by the object during the motion.

Displacement :- The displacement of an object is a sortest distance between the initial and final position of the object.

Uniform Motion And Non-uniform Motion :- As the object covers equal distances in equal intervals of time, it is said to be in uniform motion. The time interval in this motion should be small.

An object will be in a non-uniform motion if it travels unequal distances in equal intervals of time.

Speed :- Speed of a body is defined as the distance travelled by the body in unit time. Sped is a scalar quantity.

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

Velocity :- Velocity of a body is the distance travelled in unit time in a given direction. Velocity is a vector quantity. The unit of velocity is m/sec.

$$\text{Velocity} = \frac{\text{Distance travelled in a given direction}}{\text{Time taken}}$$

Acceleration :- The rate of change of velocity of the body with time is called acceleration. Acceleration is a vector quantity. The unit of acceleration is m/s^2.

$$a = \frac{v - u}{t}$$

v = final velocity

u = initial velocity

t = time

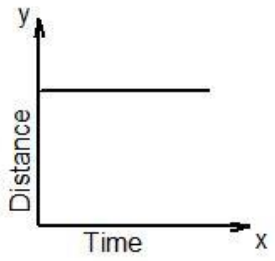
Uniform and non-uniform acceleration :- If an object travels in a straight line and its velocity increases or decreases by equal amounts in equal intervals of time, then the acceleration of the object is said to be uniform. The motion of a freely falling body is an example of uniformly accelerated motion.

When an object can travel with non-uniform acceleration if its velocity changes at a non-uniform rate. For example, if a car travelling along a straight road increases its speed by unequal amounts in equal intervals of time, then the car is said to be moving with non-uniform acceleration.

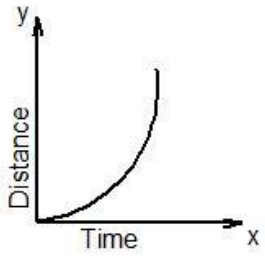
Graphical representation of motion :- Graphs provide a convenient method to present basic information about a variety of events.

DISTANCE–TIME GRAPHS :- The change in the position of an object with time can be represented on the distance-time graph adopting a convenient scale of choice. In this graph, time is taken along the *x*–axis and distance is taken along the *y*-axis. Distance-time graphs can be employed under various conditions where objects move with uniform speed, non-uniform speed, remain at rest etc.

1. **When the body is in uniform motion :-** When an object travels equal distances in equal intervals of time, it moves with uniform speed. This shows that the distance travelled by the object is directly proportional to time taken. Thus, for uniform speed, a graph of distance travelled against time is a straight line, We can use the distance-time graph to determine the speed of an object.

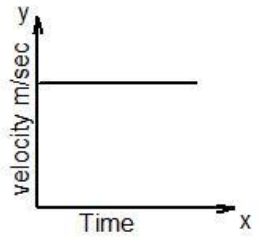


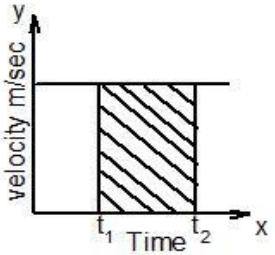
2. **When the body is in non-uniform motion :-** When an object travels unequal distaces in equal intervals of time. It means it moves with non-uniform speed. So in this condition the graph obtained will be curve shaped.



VELOCITY-TIME GRAPHS :- The variation in velocity with time for an object moving in a straight line can be represented by a velocity-time graph. In this graph, time is represented along the *x*-axis and the velocity is represented along the *y*-axis.

1. **When the object is moving with uniform velocity :-** If the object moves at uniform velocity , the height of velocity-time graph will not change with time. It will be a straight line parallel to the x-axis.





The product velocity and time give displacement of an object moving with uniform velocity. The area enclosed by velocity-time graph will be equal to the magnitude of the displacement.

First equation of motion is –
As acceleration is –

$$a = \frac{v - u}{t}$$

$$a \times t = v - u$$

$$\text{or} \quad u + at = v$$

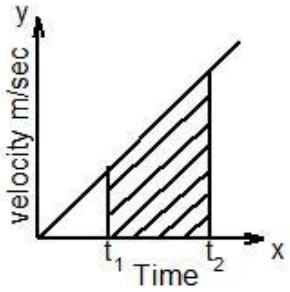
$$\text{or} \quad \boxed{v = u + at}$$

v = final velocity

u = initial velocity

t = time

2. **When the object is moving with uniform acceleration :-** When the body moves with uniform acceleration then the body has equal changes in velocity in equal intervals of time. So for uniformly accelerated motion the velocity-time graph is straight line

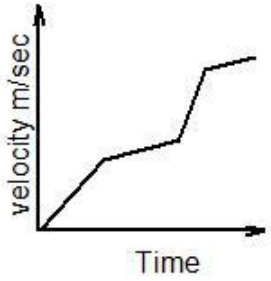


Second equation of motion –

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

S = Displacement

3. **When the object is moving with non-uniform acceleration :-** When an object movbes with non-uniform acceleration then velocity-time graph may have any shape.

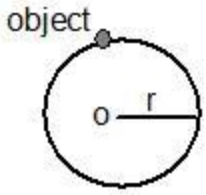


Third equation of motion –

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

Uniform circular motion :- When an object moves along the circumference of a circular path then this type of motion is known as circular motion.
Ex. When an athlete runs along the circumference of a circular path .

When an object moves in a circular path with uniform speed, its motion is called uniform circular motion.
If the radius of the circle is r then the circumference will be $2\pi r$. If the object takes t second to complete one round of the circular path then the velocity v is given by –



$$\text{Velocity} = \frac{\text{Circumference}}{\text{Time}}$$

$$v = \frac{2\pi r}{t}$$