Angular Velocity | Angular Acceleration

Angular velocity is the velocity of a body moving in a circular path.

When a body rotates in a circle then its motion is angular motion and its displacement is angular displacement. The rate of change of angular displacement is called angular velocity. The rate of change of angular velocity is called angular acceleration.

Topic Related Video:

Angular acceleration

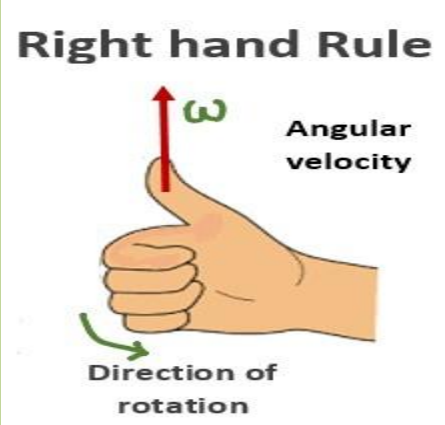
What is angular velocity?

Angular velocity can also be defined as Angular displacement per unit time is called angular velocity."

It is denoted by ω (omega) and is a vector quantity.

How do we find the direction of Angular Velocity?

Its direction is determined by the Right-Hand rule which is along the axis of rotation.



If we curl the finger in the direction of angular displacement then the thumb will give the direction of angular Velocity.

What is the Unit of Angular Velocity?

In the SI system, it is measured in rad/sec.

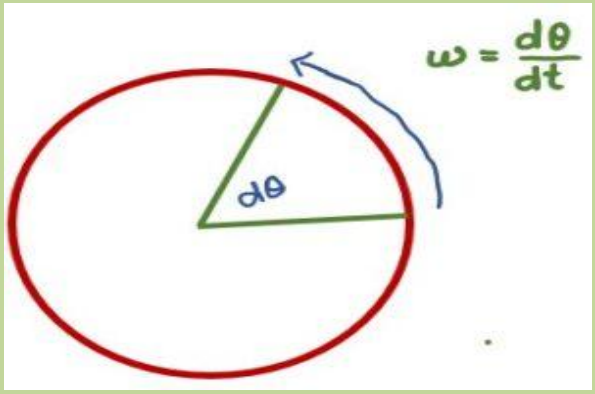
Sometimes it is also measured in deg/sec, rev/sec, or rev/min.

What is the Dimension of Angular Velocity?

The dimension of angular velocity is **[T^1]**.

Average Angular Velocity:

"It is the ratio of the total change in angular displacement to total time taken."



if Δθ is the change in angular displacement during the time interval Δt, the average angular velocity " ω_{av}" during this interval is given by

$$\omega_{av} = \Delta\theta / \Delta t$$

Instantaneous Angular Velocity:

"The angular velocity of an object at a particular instant of time is called instantaneous angular velocity."

"The limit of the ratio Δθ/ Δt as Δt approaches zero is called instantaneous velocity.

$$\omega_{ins} = \lim_{\Delta t \to 0} \Delta\theta/\Delta t$$

What is Angular Acceleration?

The rate of change of angular velocity is called angular acceleration.

A change in angular velocity per unit time is called angular acceleration.

It is denoted by α and is a vector quantity.

How do we find the direction of angular acceleration?

Its direction is determined by the hand rule which is along the axis of rotation.

If we curl the finger in the direction of rotation then the thumb will be in the direction of angular acceleration.

What is the Unit Angular Acceleration?

In S.I. units, it is measured in rad /sec. Other units are deg/sec^2

What is the Dimension Angular Acceleration?

It has a dimension of $[T^2]$.

Average angular acceleration:

It is the ratio of the total change in angular velocity to the total time taken.

If ω_i and ω_f are the values of the instantaneous velocity of the rotating body at instants t_i and t_f.

Then average angular acceleration is given by

$$\alpha_{av} = \omega_f - \omega_i / t_f - t_i$$

Instantaneous Angular Acceleration:

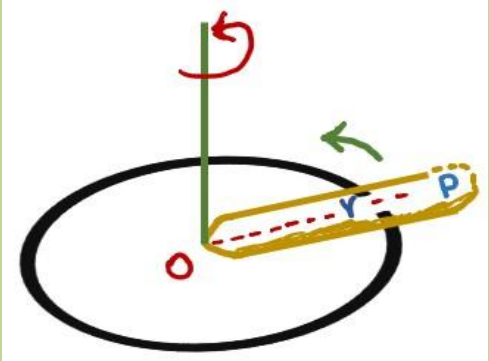
"The angular acceleration of an object at a particular instant is called Instantaneous angular acceleration."

The limit of the ratio $\Delta\omega/\Delta t$ as Δt approaches zero is called instantaneous angular acceleration.

$$\alpha_{ins} = \lim_{\Delta t \to 0} \Delta\omega/\Delta t$$

What is Rotational motion?

Consider a point P on a rigid body. Line OP is the perpendicular drawn from P on the axis of rotation O. It is called a reference line.



As the body rotates, the line OP also rotates with it with the same angular velocity and angular acceleration.

Thus the rotation of a rigid can be described by the rotation of the reference line OP.

In the future, while dealing with the rotational motion of a rigid body, we will replace it with its reference line OP.