

TORQUE (Part 1)

Class XI Rotational Motion

Monday, November 1, 2021

7:55 PM



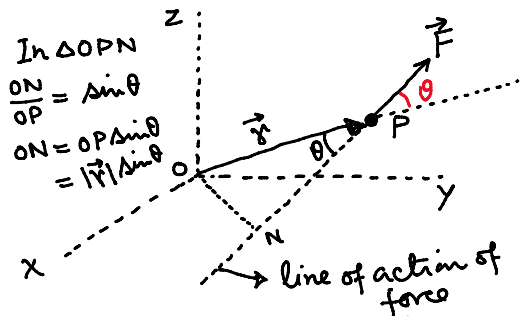
Torque (Moment of a Force):

The rotational effect generated by a force on a body about a point, is measured by the quantity called Torque.

"The rotational effect generated by force in a body about a point is measured by the quantity".

Torque or Moment of a force is a rotational analogue of 'Force' in linear motion.

i.e. Torque plays the same role in rotational motion as Force plays in translational motion. ✓



Moment of force (Torque) at point O

$$\vec{\tau} = \vec{r} \times \vec{F} \quad \text{--- (1)} \quad \left| \begin{array}{l} \vec{A} \times \vec{B} \\ = |\vec{A}| \cdot |\vec{B}| \sin \theta \end{array} \right.$$

$$|\vec{\tau}| = |\vec{r}| \cdot |\vec{F}| \cdot \sin \theta \quad \text{--- (2)}$$

↳ magnitude of Torque

$$|\vec{r}| = OP$$

θ = angle between \vec{r} and \vec{F}

* Torque is a vector quantity, direction is determined by 'Right hand Screw Rule'.

* SI unit of Torque: Nm

* Dimension of Torque: $[M^1 L^2 T^{-2}]$

$$\vec{\tau} = \vec{r} \times \vec{F} \quad \text{--- (3)}$$

$$|\vec{\tau}| = |\vec{r}| \cdot |\vec{F}| \cdot \sin \theta \quad \text{--- (4)}$$

Note 1: (i) if $\theta = 0^\circ$ or $180^\circ \Rightarrow \sin \theta = 0$
by (4) or (2) $|\vec{\tau}| = 0$

(ii) if $\theta = 90^\circ \Rightarrow \sin \theta = 1$ (max).

by Eq (4) $|\vec{\tau}| = |\vec{r}| \cdot |\vec{F}| = |\vec{\tau}|_{\text{max}}$

So, Torque generated by a force is max. when it acts \perp to the position vector of point of application of force.

