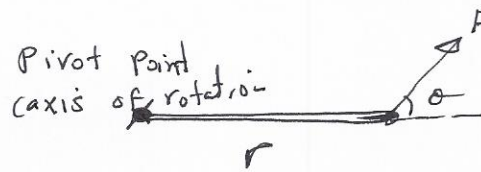


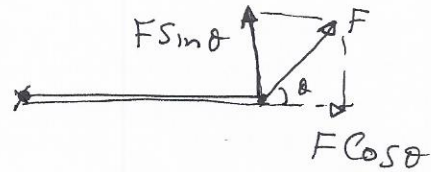
Torque = τ = Rotational Force

Cross
 $\uparrow$
 $\tau = r \times F = r F \sin \theta$



τ : tau

Resolve F in 2-Components



$$\tau = r F \sin \theta$$

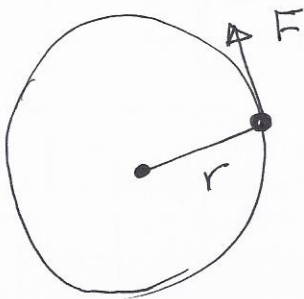
let's call $F \sin \theta = F_{\perp}$ $\leftarrow$ Perpendicular

$$\tau = r F_{\perp}$$

The other component $F \cos \theta$ doesnot exert any torque

Therefore torque is the product of r and F

when they are perpendicular. r the distance between the pivot point and the force is called moment arm



$$\tau = r F_{\perp} = (4 \text{ m})(1 \text{ N}) = 4 \text{ N.m}$$

$$F = m a$$

$$\tau = r m a = m r a \quad a = r \alpha$$

$$\tau = m r (r \alpha) = m r^2 \alpha$$

$I = m r^2$ is called moment of inertia or rotational inertia

$$\boxed{\tau = I \alpha}$$

Compare

$$F = ma$$

$$\tau = I\alpha$$

$$\left\{ \begin{array}{l} m: \text{mass is the measurement of} \\ \text{inertia in linear motion} \\ a: \text{linear acceleration} \end{array} \right.$$

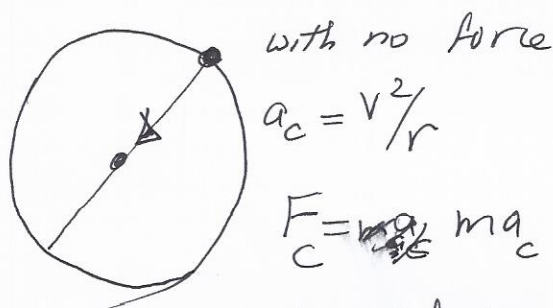
$$\left\{ \begin{array}{l} I: \text{rotational inertia, is the} \\ \text{inertia in rotational motion} \\ \alpha: \text{is angular acceleration} \end{array} \right.$$

$$\tau = r F_{\perp} \Rightarrow I\alpha$$

Applying Force F at distance r from the axis of rotation caused the object to rotate with angular acceleration α .

We can say as $F = ma$ is the Newton's second law in linear motion, $\tau = I\alpha$ is the Newton's second law in rotational motion.

$$a = r\alpha \quad v = r\omega$$



$$F_c = m a_c$$

Centripetal force

is always towards the center.

