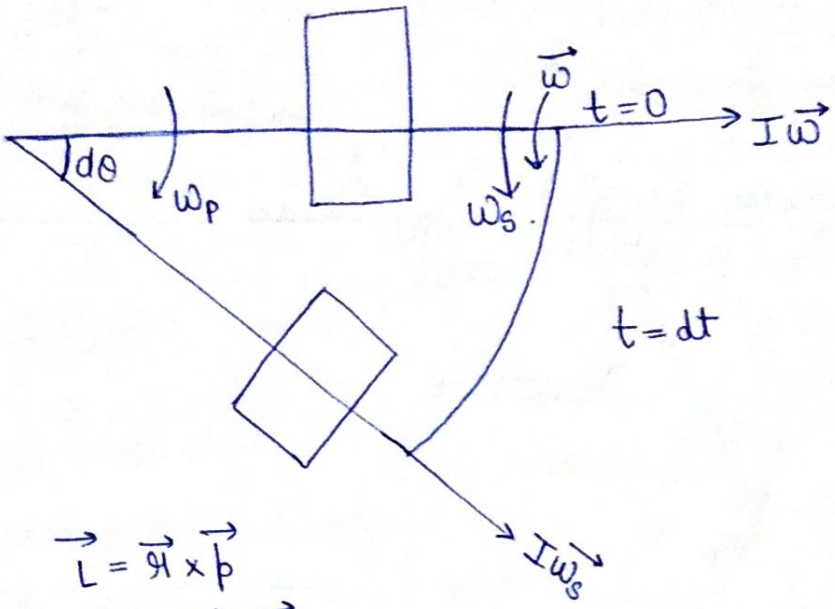
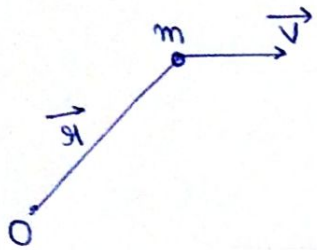
# GYROSCOPE

A rotar is mounted on a shaft.

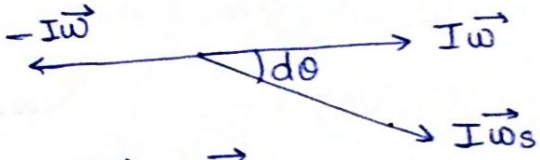



$\vec{L} = m\vec{r} \times \vec{v}$




$\vec{L} = \vec{r} \times \vec{p}$

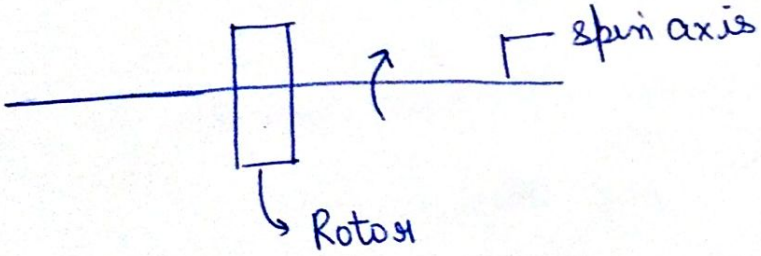
$\vec{L} = m\vec{r} \times \vec{v}$

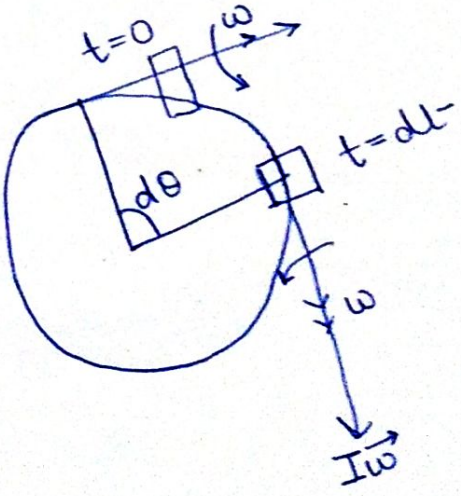



$$\text{Gyroscopic couple} = \frac{I\vec{\omega} - I\vec{\omega}_s}{\Delta t}$$

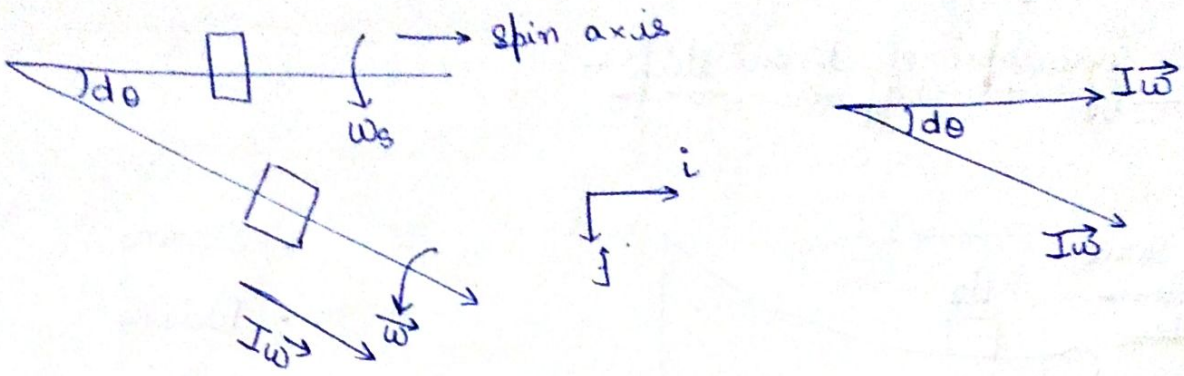
$$\text{Gyroscopic couple} = (G) = I \cdot \omega_s \cdot \omega_p$$

## Derivation of gyroscope couple-




$$\vec{T} = \frac{d\vec{L}}{dt} = \lim_{\Delta t \to 0} \frac{\vec{L}_f - \vec{L}_i}{t_f - t_i}$$




$$\vec{L_i} = I\omega\hat{i}$$

$$\vec{L_f} = I\omega\cos d\theta\,\hat{i} + I\omega_s \sin d\theta\,\hat{j}$$

$$\vec{L_f} - \vec{L_i} = I\omega(\cos d\theta - 1)\hat{i} + I\omega_s \sin d\theta\,\hat{j}$$

$$\frac{\vec{L_f} - \vec{L_i}}{dt} = 0\hat{i} + I\omega_s \frac{d\theta}{dt}\hat{j}$$

$$\vec{\tau} = I\vec{\omega_p} \times \vec{\omega_s}$$

$$G_1 = -\vec{\tau} = I.\vec{\omega_s} \times \vec{\omega_p}$$

→ Solve problems on gyroscopic couple of ship & aeroplane