EQILIBRIUM OF RIGID BODIES

EQUILIBRIUM: A rigid body is said to be in mechanical equilibrium, if both its linear momentum and angular momentum are not changing with time, or equivalently, the body has neither linear acceleration nor angular acceleration.

If $\vec{a}_{cm}=0$ and $\vec{\alpha}=0$

→ Mechanical Equilibrium

For Translational Motion

$\Sigma \vec{F} = M\vec{a}_{cm}$ — (1)

↳ mass of body

For Rotational Motion

$\Sigma \vec{\tau} = I\vec{\alpha}$ — (2)

↳ MI

1. Translational Equilibrium: $\vec{a}_{cm}=0$

by Eq (1) $\Sigma \vec{F} = 0$ — (3)

Either $\vec{V}_{cm}=0$ or $\vec{V}_{cm}=$ const

$\vec{V}_{cm}=0$ → Static Equilibrium

$\vec{V}_{cm}=$ const → Dynamic Equilibrium

In terms of components

$\Sigma F_x = 0$, $\Sigma F_y = 0$ and $\Sigma F_z = 0$ — (4)

↳ algebric sum of x-component of all the forces.