

General Application of the Equation of Motion

$$\sum F_x = m \cdot (a_G)_x$$

$$\sum F_y = m \cdot (a_G)_y$$

$$\sum M_G = I_G \cdot \alpha \quad \text{or} \quad \sum M_P = \sum (M_k)_P$$

Equations of Motion : Translation

$$\text{Rectilinear translation: } \begin{cases} \sum F_x = m \cdot (a_G)_x \\ \sum F_y = m \cdot (a_G)_y \\ \sum M_G = 0 \end{cases}$$

$$\text{Curvilinear translation: } \begin{cases} \sum F_n = m \cdot (a_G)_n \\ \sum F_t = m \cdot (a_G)_t \\ \sum M_G = 0 \end{cases}$$

Equations of Motion : Rotation about a Fixed Axis

$$\begin{cases} \sum F_n = m \cdot (a_G)_n = m \omega^2 r_G \\ \sum F_t = m \cdot (a_G)_t = m \alpha r_G \\ \sum M_G = I_G \cdot \alpha \quad (\because I_P = I_G + m d^2, \text{ we also have} \\ \sum M_P = I_P \cdot \alpha) \end{cases}$$