

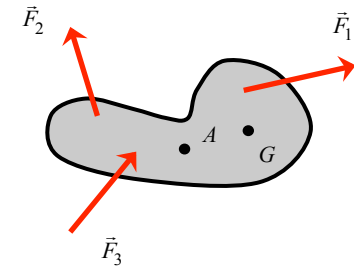
# Summary: Newton/Euler Equations 1

FUNDAMENTAL equations:

$$(1) \quad \sum \vec{F} = m\vec{a}_G$$

$$(2) \quad \sum \vec{M}_A = I_A \vec{\alpha} + m\vec{r}_{G/A} \times \vec{a}_A$$

SAME point "A"!



CRITICAL ISSUES:

- For NEWTON (1):  $G$  must be the center of mass of the body
- For EULER (2):  $A$  is ANY point on the body. The same point "A" must be used across the board in the equation – you cannot mix and match points A.

SIMPLIFICATION: If  $A$  is: EITHER the center of mass  $G$  OR a fixed point (zero acceleration) OR  $\vec{a}_A$  is parallel to  $\vec{r}_{G/A}$ , then the Euler equation (2) reduces to:

$$\sum \vec{M}_A = I_A \vec{\alpha} \quad \leftarrow \text{We will use this form of the equation most of the time}$$

TERMINOLOGY:  $I_A$  is known as the "mass moment of inertia" of the body about point A. The size of  $I_A$  is dependent on the location of A.