USEFUL FORMULAS

$n - t$ coordinates: $\vec{v} = v\vec{e}_t$ where $v = \dot{s} = \rho\dot{\beta}$

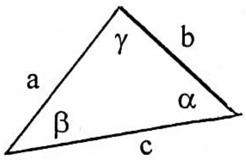
$\vec{a} = a_n\vec{e}_n + a_t\vec{e}_t$ where $a_n = \frac{v^2}{\rho} = \rho\dot{\beta}^2$, $a_t = \dot{v}$ $(vdv = a_t ds)$

Polar coordinates: $\vec{v} = v_r\vec{e}_r + v_\theta\vec{e}_\theta$ where $v_r = \dot{r},\ v_\theta = r\dot{\theta}$

$\vec{a} = a_r\vec{e}_r + a_\theta\vec{e}_\theta$ where $a_r = \ddot{r} - r\dot{\theta}^2,\ a_\theta = 2\dot{r}\dot{\theta} + r\ddot{\theta}$

Relative Velocity: $\vec{v}_A = \vec{v}_B + \vec{\omega} \times \vec{r}$

Relative Acceleration: $\vec{a}_A = \vec{a}_B + \vec{\alpha} \times \vec{r} + \vec{\omega} \times (\vec{\omega} \times \vec{r})$



$$\frac{a}{\sin\alpha} = \frac{b}{\sin\beta} = \frac{c}{\sin\gamma}, \qquad c^2 = a^2 + b^2 - 2ab\cos\gamma$$

Newton's Law: $\sum \vec{F} = m\,\vec{a}_G$ $\sum M_G = I_G\,\alpha$

Work-Energy: $U'_{1-2} = \Delta T + \Delta V_g + \Delta V_e$ $T = \frac{1}{2}mv_G^2 + \frac{1}{2}I_G\omega^2 = \frac{1}{2}I_C\omega^2$

$I_G = \frac{1}{12}mL^2$ (slender rod) , $I_G = \frac{1}{2}mr^2$ (disk) , $I_A = I_G + md^2$