Equations

$$\vec{P}^{\text{tot}} = \sum_\alpha m_\alpha \vec{v}_\alpha \qquad \vec{L}^{\text{tot}} = \sum_\alpha \vec{r}_\alpha \times (m_\alpha \vec{v}_\alpha) \qquad \vec{\Gamma}^{\text{tot}} = \sum_\alpha \vec{r}_\alpha \times \vec{F}_\alpha^{\text{tot}}$$

$$\vec{r}_{\text{CM}} = \frac{\sum_\alpha m_\alpha \vec{r}_\alpha}{\sum_\alpha m_\alpha}$$

fixed point stable if $|f'(x_{\text{fix}})| < 1$

$$\vec{L} = \underline{\underline{I}}\,\vec{\omega} \qquad \text{where} \quad I_{xx} = \sum_\alpha m_\alpha (y_\alpha^2 + z_\alpha^2) \quad \text{etc. and } I_{xy} = -\sum_\alpha m_\alpha x_\alpha y_\alpha \quad \text{etc.}$$

for continuous rigid bodies:

$$I_{xx} = \int \rho(\vec{r})\,(y^2 + z^2)\,\mathrm{d}x\,\mathrm{d}y\,\mathrm{d}z \quad \text{etc. and } I_{xy} = -\int \rho(\vec{r}) x\, y\,\mathrm{d}x\,\mathrm{d}y\,\mathrm{d}z \quad \text{etc.}$$

prinicipal moments & eigenvalues: $\underline{\underline{I}}\,\vec{\omega} = \lambda\,\vec{\omega}$

$$S = \int f(x, x', y, y', u)\,\mathrm{d}u \qquad \frac{\partial f}{\partial x} = \frac{\mathrm{d}}{\mathrm{d}u}\frac{\partial f}{\partial x'} \qquad \frac{\partial f}{\partial y} = \frac{\mathrm{d}}{\mathrm{d}u}\frac{\partial f}{\partial y'}$$

$$\mathcal{L} = T - U$$

$$\frac{\mathrm{d}}{\mathrm{d}t}\frac{\partial \mathcal{L}}{\partial \dot{q}_i} = \frac{\partial \mathcal{L}}{\partial q_i}$$

$$p_i = \frac{\partial \mathcal{L}}{\partial \dot{q}_i}$$

$$\mathcal{H} = \sum p_i \dot{q}_i - \mathcal{L} \qquad \text{if natural coord.:} \quad \mathcal{H} = T + U$$

$$\dot{q}_i = \frac{\partial \mathcal{H}}{\partial p_i} \qquad \dot{p}_i = -\frac{\partial \mathcal{H}}{\partial q_i}$$

$$\vec{v} = \omega \times \vec{r} \qquad \left(\frac{\mathrm{d}\vec{Q}}{\mathrm{d}t}\right)_{S_0} = \left(\frac{\mathrm{d}\vec{Q}}{\mathrm{d}t}\right)_S + \vec{\Omega} \times \vec{r}$$

$$\underline{\underline{M}}\ddot{\vec{q}} = -\underline{\underline{K}}\vec{q}$$