

<p><u>Support</u> Hinges that prevents translation in the same direction does NOT produce couple moment, but force in that direction.</p>		<p><u>Friction</u> $F_s = \mu_s$ (impending motion), $F_k = \mu_k N$. Use moment equilibrium to determine point of normal force.</p>
<p><u>Tangential Coord.</u></p> $\rho = \frac{\left[1 + \left(\frac{dx}{dy}\right)^2\right]^{\frac{3}{2}}}{\frac{d^2y}{dx^2}}$ $\vec{v} = v\vec{u}_t$ $\dot{\theta} = \frac{v}{\rho}$ $\vec{a} = \dot{v}\vec{u}_t + v\dot{\vec{u}}_t$ $= \dot{v}\vec{u}_t + \frac{v^2}{\rho}\vec{u}_n$	<p><u>Cylindrical Coord.</u> Polar but with an additional axis, z.</p> $\vec{u}_z = \vec{u}_\theta \times \vec{u}_r$	<p><u>Linear Momentum and Impulse</u></p> $\vec{L} = m\vec{v}$ $\vec{I} = \int_{t_1}^{t_2} \vec{F}(t) dt$ $m\vec{v}_1 + \sum \int_{t_1}^{t_2} \vec{F} dt = m\vec{v}_2$ <p>Can be conserved.</p>
	<p><u>Vector Components</u></p> $\vec{v}_\parallel = (\vec{v} \cdot \hat{u})\hat{u} \quad \vec{v}_\perp = \vec{v} - \vec{v}_\parallel$ $\vec{v}_1 \cdot \vec{v}_2 = v_1 v_2 \cos(\theta) \quad \vec{v}_1 \times \vec{v}_2 = v_1 v_2 \sin(\theta) \vec{n} \text{ (right-hand)}$	
<p><u>Tangential-Polar</u> Let ψ be the angle between \vec{r} and \vec{u}_t, η be the angle between the tangential and the polar axis.</p> $\tan(\psi) = \frac{r\dot{\theta}}{\dot{r}} = \frac{r}{\frac{dr}{d\theta}}$ $\eta = 90^\circ - \psi$ $\vec{u}_r = \vec{u}_n \cos(\eta)$		<p><u>Polar Coord.</u></p> $\vec{v} = \dot{\vec{r}}$ $= v_r \vec{u}_r + v_\theta \vec{u}_\theta$ $= \dot{r} \vec{u}_r + r \dot{\theta} \vec{u}_\theta$ $\vec{a} = (\ddot{r} - r\dot{\theta}^2) \vec{u}_r + (r\ddot{\theta} + 2\dot{r}\dot{\theta}) \vec{u}_\theta$
<p><u>Energetics</u></p> $U_{\text{const}} = F \cos(\theta)(b - a)$ $U_{\text{var}} = \int_a^b F \cos(\theta) ds$ $U_{\text{spring}} = \frac{1}{2}k(s_b^2 - s_a^2)$ $T = \frac{1}{2}mv^2$ $V_g = Wh = mgh$ $V_s = +\frac{1}{2}ks^2$ <p>Can be conserved.</p> $T_1 + V_1 = T_2 + V_2$		<p><u>SI-Imperial</u></p> <p>Constants:</p> $g = 9.81 \text{ m s}^{-2} = 32.2 \text{ m s}^{-2}$ <p>Units:</p> <p>mass : kg, $\text{s}^2 \text{ ft}^{-1}$</p> <p>force : kg m s^{-2},</p>
<p><u>Moment</u></p> $\vec{M} = \vec{r} \times \vec{F}$ $M = rF \sin(\theta) = Fd$ <p>Vector moments of the same point add up like forces.</p> <p>Couple moments can move to anywhere. To move a force, add a pair of force on the target point, then make a couple moment.</p>	<p><u>Reduction to a Wrench</u></p> <ol style="list-style-type: none"> 1. Get a resultant force; 2. get a resultant moment to a point; 3. split the moment into parallel and perpendicular components to the force; 4. remove the perpendicular components by moving the force ($M = Fd$); 5. move the parallel moment to the force. 	