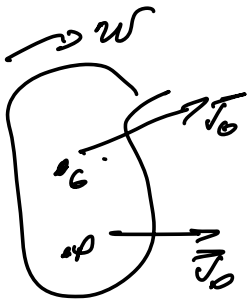
Theory Review: Rigid Body Work Energy

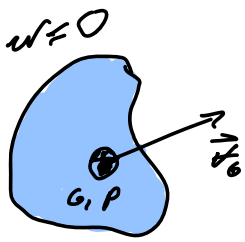
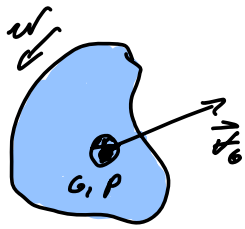
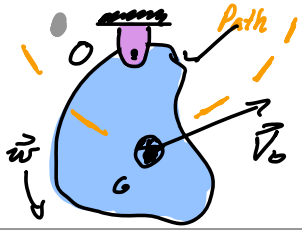
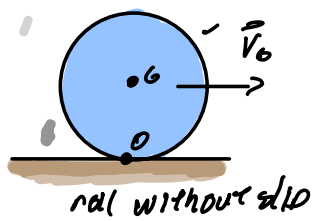
$$\boxed{T_1 + V_1 + \sum U_{1-2}^{NC} = T_2 + V_2}$$



Focus on Kinetic Energy of a Rigid Body

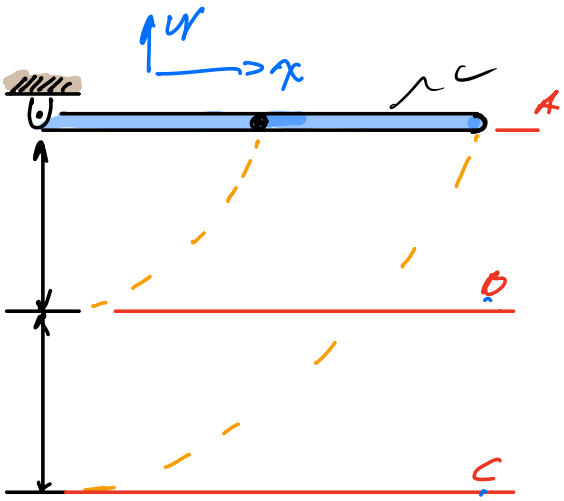
$T = \frac{1}{2} m v_P^2 + \frac{1}{2} I_P \omega^2 + m \vec{v}_P \cdot (\vec{\omega} \times \vec{r}_{G/P})$ ~ Nasty

is valid if you use the velocity of an arbitrary point P.

Point P	Situation	Kinetic Energy
P		$V_G = V_P$ $T = \frac{1}{2} m V_G^2$ same as particle
P = G		$T = \frac{1}{2} m V_G^2 + \frac{1}{2} I_G \omega^2$ works for all cases
P = O above a point w/zero velocity	 	$T = \frac{1}{2} I_O \omega^2$ $I_O = I_G + m \lvert \vec{r}_{G/O} \rvert^2$

Potential Energy due to Gravity

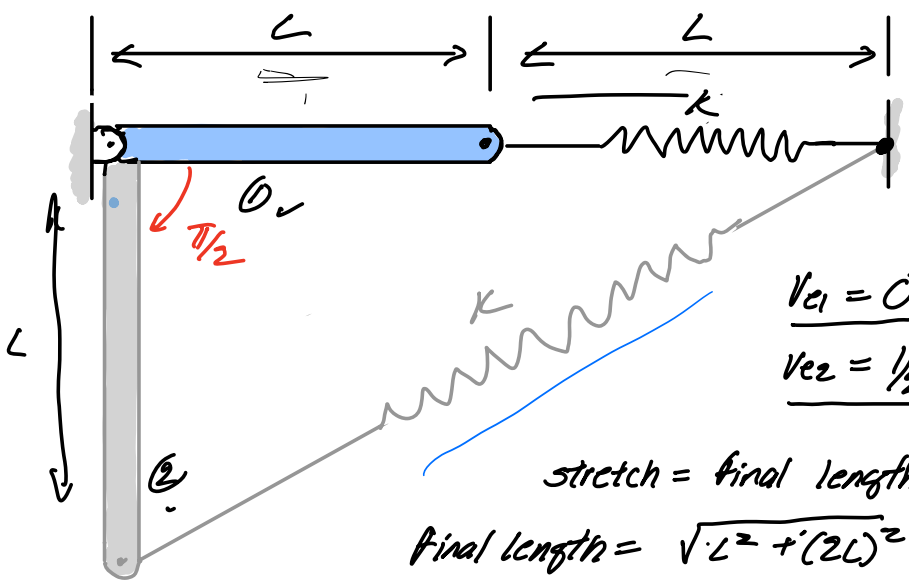
- only the center of gravity matter
- position of datum arbitrary



datum	V_1	V_2	$V_1 - V_2$
A	0	$-mgL/2$	$mgL/2$
B	$mgL/2$	0	$mgL/2$
C	mgL	$mgL/2$	$mgL/2$

Potential Energy due to Spring

Same as particles depend on displacement of attachment point



$V_{e1} = 0$

$V_{e2} = \frac{1}{2} k (\text{stretch})^2$

stretch = final length - unstretched length

final length $= \sqrt{L^2 + (2L)^2} = \sqrt{5}\,L$

unstretched length $= L$

$V_{e2} = \frac{1}{2} k L^2 (\sqrt{5} - 1)^2$