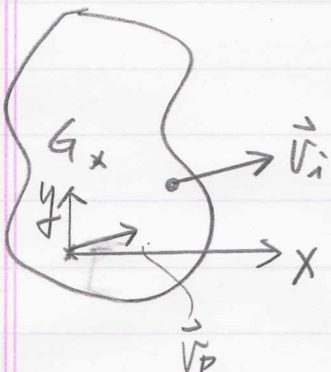
Kinetic Energy

Definition: $\boxed{T = \frac{1}{2}\int_m dm \cdot v_i^2} \geq 0$

For $\vec{v}_i = \vec{v}_p + \vec{v}_{i/p} = \left[(v_p)_x - \omega y\right]\vec{i} + \left[(v_p)_y + \omega x\right]\vec{j}$

$$\Rightarrow T = \underline{\frac{1}{2}\int_m dm \cdot v_p^2} - (v_p)_x \cdot \omega \cdot \underbrace{\int_m y\, dm}_{= \bar{y} \cdot m}$$

$$+ (v_p)_y \cdot \omega \cdot \underbrace{\int_m x\, dm}_{= \bar{x}\, m} + \frac{1}{2}\omega^2 \underbrace{\int_m r^2 dm}_{I_p}$$



When $P = G$, $\bar{x} = 0$, $\bar{y} = 0$

$$\Rightarrow \boxed{T = \frac{1}{2} m v_G^2 + \frac{1}{2} I_G \cdot \omega^2}$$

* Translation-only @ G : $T = \frac{1}{2} m v_G^2$

Rotation-only @ G : $T = \frac{1}{2} I_G \omega^2$

Rotation-only @ O : $T = \frac{1}{2}(I_G + m r_G^2)\omega^2 = \frac{1}{2} I_O \omega^2$

General plane motion @G : $T = \frac{1}{2} m v_G^2 + \frac{1}{2} I_G \cdot \omega^2$

or @O : $T = \frac{1}{2} m v_O^2 + \frac{1}{2} I_O \cdot \omega^2$

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The Work of a Force

$$U_F = \int \vec{F} \cdot d\vec{r} = \int_s F \cdot \cos\theta \cdot ds$$

When $F = F_c = \text{constant}, \Rightarrow U_{F_c} = (F_c \cdot \cos\theta)\, s$

The Work of a Couple Moment

$$U_M = \int_{\theta_1}^{\theta_2} M \, d\theta$$

When $M = M_c = \text{constant}, \Rightarrow U_{M_c} = M_c (\theta_2 - \theta_1)$

Principle of Work and Energy

$$T_1 + \Sigma U_{1-2} = T_2$$