1: xyz: Attached to shaft $\overline{OA}$

Find $\vec{\omega}, \vec{\alpha}$ of xyz

$\vec{\omega} = -\omega_1 \hat{I} = -\omega_1 \hat{i}$ at this inst.

$\vec{\alpha} = 0$

Write $\vec{a}_P$ expression. eg

$$\vec{a}_P = \underbrace{\vec{a}_O}_{?} + \vec{\alpha} \times \vec{r}_{P/O} + \vec{\omega} \times \vec{\omega} \times \vec{r}_{P/O} + \underbrace{(\vec{a}_{P/O})_{rel}}_{?} + 2\vec{\omega} \times \underbrace{(\vec{v}_{P/O})_{rel}}_{?}$$

Write $\vec{a}_O$ expression.

cont. of rotation

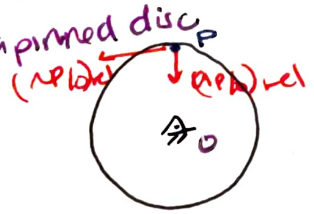
$$\vec{a}_O = \cancel{\vec{a}_A}^{0} + \cancel{\vec{\alpha}_{OA}}^{0} \times \vec{r}_{O/A} + \vec{\omega}_{OA} \times \vec{\omega}_{OA} \times \vec{r}_{O/A}$$

$$= -\omega_1 \hat{I} \times (-\omega_1 \hat{I} \times d\hat{K})$$

$$= -\omega_1^2 d\hat{K} = -\omega_1^2 d\hat{k}$$ at this instant

Find $(\vec{v}_{P/O})_{rel}$ and $(\vec{a}_{P/O})_{rel}$

Like a pinned disc



$$(v_{P/O})_{rel} = \cancel{\vec{v}_O}^{0} + \vec{\omega}_{disk} \times \vec{r}_{P/O} = \omega_2 \hat{k} \times R\hat{j} = -\omega_2 R \hat{i}$$

$$(a_{P/O})_{rel} = \cancel{\vec{a}_O}^{0} + \cancel{\vec{\alpha}_{disk}}^{0} \times \vec{r}_{P/O} + \vec{\omega}_{disk} \times \vec{\omega}_{disk} \times \vec{r}_{P/O} = -\omega_2^2 R \hat{j}$$

Solve for $\vec{a}_P$.

$$\vec{a}_P = -\omega_1^2 d\hat{k} + \overbrace{(-\omega_1 \hat{i}) \times [-\omega_1 \hat{i} \times R\hat{j}]}^{-\omega_1^2 R \hat{j}} - \omega_2^2 R \hat{j} + 2(-\omega_1 \hat{i}) \times (-\omega_2 R \hat{i})$$

$$\vec{a}_P = -(\omega_1^2 R + \omega_2^2 R)\hat{j} - \omega_1^2 d\hat{k}$$

2. xyz Attached to disk

Find $\vec{\omega}, \vec{\alpha}$ of xyz

$\vec{\omega} = -\omega_1 \hat{I} + \omega_2 \hat{k} = -\omega_1 \hat{i} + \omega_2 \hat{k}$ at this inst.

$$\vec{\alpha} = \frac{d}{dt}(\vec{\omega}) = -\cancel{\dot{\omega}_1}^{0} \hat{I} - \omega_1 \cancel{\dot{\hat{I}}}^{0} + \cancel{\dot{\omega}_2}^{0} \hat{k} + \omega_2 \dot{\hat{k}}$$

$\hat{i}$ at the inst.

$$= \omega_2 (\vec{\omega} \times \hat{k}) = \omega_2 [(-\omega_1 \hat{I} + \omega_2 \hat{k}) \times \hat{k}]$$

$$= \omega_2 \omega_1 \hat{j}$$

Write $\vec{a}_P$ expression.

$\vec{a}_P$ = same

Write $\vec{a}_O$ expression.

$\vec{a}_O$ = same

Find $(\vec{v}_{P/O})_{rel}$ and $(\vec{a}_{P/O})_{rel}$

$(\vec{v}_{P/O})_{rel} = 0$

$(\vec{a}_{P/O})_{rel} = 0$

Solve for $\vec{a}_P$.

$$\vec{a}_P = -\omega_1^2 d\hat{k} + (\omega_2 \omega_1 \hat{j} \times R\hat{j}) + (-\omega_1 \hat{i} + \omega_2 \hat{k}) \times [\underbrace{(-\omega_1 \hat{i} + \omega_2 \hat{k}) \times R\hat{j}}_{-\omega_1 R \hat{k} - \omega_2 R \hat{i}}]$$

$$\vec{a}_P = -\omega_1^2 d\hat{k} - \omega_1^2 R\hat{j} - \omega_2^2 R\hat{j}$$

$$= -(\omega_1^2 R + \omega_2^2 R)\hat{j} - \omega_1^2 d\hat{k}$$