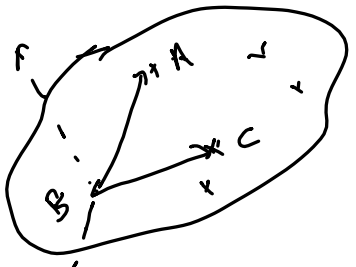
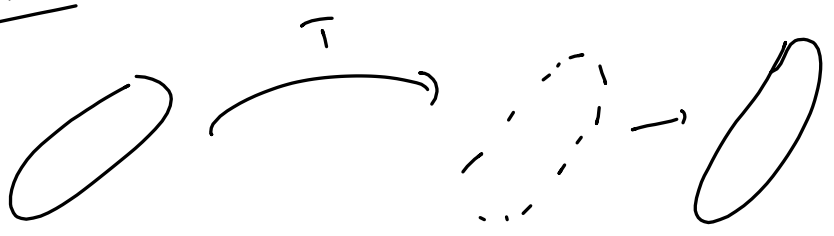


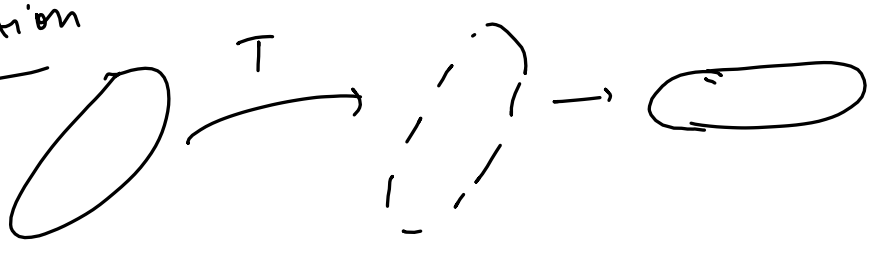
→ 1 point on body & 3 angles

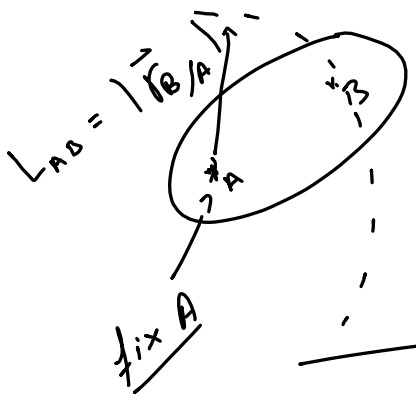
→ 3 non-collinear points on body

Translation

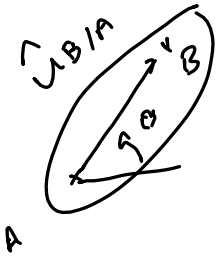


Rotation





Velocity of B is velocity of A plus rotation of B about A with $\omega = \omega_{AB}$

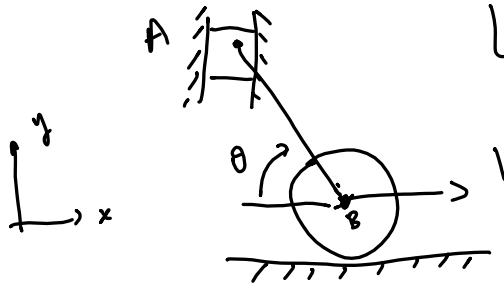


$$\vec{V}_B = \vec{V}_A + \vec{V}_{B/A}$$

$$\vec{V}_{B/A} = \cancel{|\vec{r}_{B/A}|}^{\,0}\,\hat{u}_{B/A} + \vec{\omega}_{AB} \times \vec{r}_{B/A}$$

$$= \vec{\omega}_{AB} \times \vec{r}_{B/A}$$

$$\vec{V}_B = \vec{V}_A + \vec{\omega}_{AB} \times \vec{r}_{B/A}$$



$L_{AB} = 40$ in

$V_A = ?$

$V_B = 7$ ft/s

$\omega_{AB} = ?$

$\theta = 72^\circ$

$$\vec{V}_A = \vec{V}_B + \vec{V}_{A/B}$$

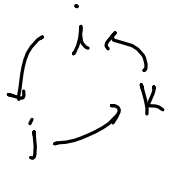
$$= \vec{V}_B + \vec{\omega}_{AB} \times \vec{r}_{A/B}$$

$$\vec{V}_A = V_A \hat{j}, \quad \vec{V}_B = V_B \hat{i}, \quad \vec{\omega}_{AB} = \omega_{AB} \hat{k}$$

$$\vec{r}_{A/B} = -L_{AB}\cos\theta\,\hat{i} + L_{AB}\sin\theta\,\hat{j}$$

$$\vec{V}_A = \vec{V}_B + \vec{\omega}_{AB} \times \vec{r}_{A/B}$$

$$V_A \hat{j} = V_B \hat{i} + \omega_{AB} \hat{k} \times (-L_{AB}\cos\theta\,\hat{i} + L_{AB}\sin\theta\,\hat{j})$$



$$V_A \hat{j} = V_B \hat{i} - \omega_{AB} L_{AB}\cos\theta\,\hat{j} - \omega_{AB} L_{AB}\sin\theta\,\hat{i}$$

$$V_A \hat{j} = (V_B - \omega_{AB} L \sin\theta)\,\hat{i} - \omega_{AB} L_{AB}\cos\theta\,\hat{j}$$

$$0\hat{i} + V_A\hat{j} = (V_B - \omega_{AB} L_{AB} \sin\theta)\,\hat{i} - \omega_{AB} L_{AB} \cos\theta\,\hat{j}$$

$$\Rightarrow V_B - \omega_{AB} L_{AB} \sin\theta = 0 \quad -(1)$$

$$V_A = -\omega_{AB} L_{AB} \cos\theta \quad -(2)$$

from (1), $\omega_{AB} = \dfrac{V_B}{L_{AB} \sin\theta} = \dfrac{7}{\left(\frac{40}{12}\right)\sin(72)}$

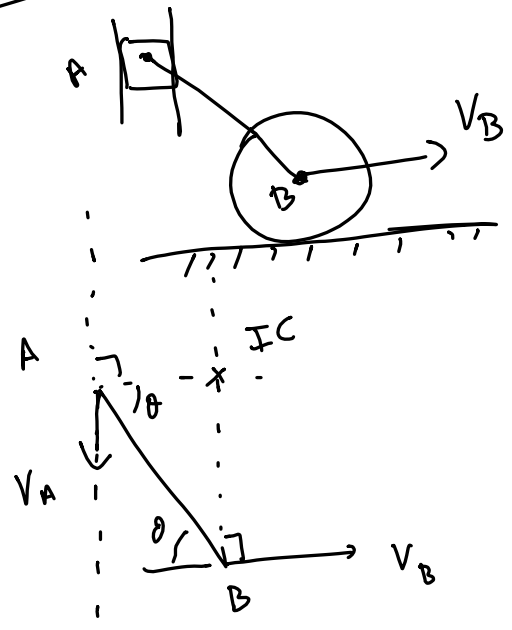
$$\boxed{\omega_{AB} = 2.208 \text{ rad/s}}$$

from (2), $V_A = -\omega_{AB} L_{AB} \cos\theta$

$= -2.208 \times \frac{40}{12} \times \cos(72)$

$$\boxed{V_A = -2.274 \text{ ft/s}}$$

Using IC



$$\omega_{AB} = \frac{V_A}{L_{A,IC}} = \frac{V_B}{L_{B,IC}}$$

$$\omega_{AB} = \frac{V_A}{L_{AB}\cos\theta} = \frac{V_B}{L_{AB}\sin\theta}$$