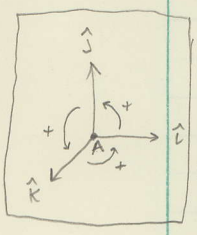
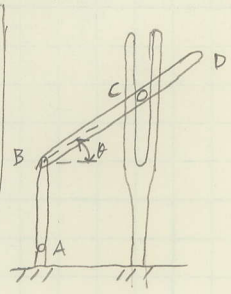
Example Problem Actual Approach

Given: $\vec{v}_{B/A} = 0.6\ \text{m/s}\ \hat{\imath}$, $l_{AB} = 0.12\text{m}$, $l_{BC} = 0.5\text{m}$, $l_{CD} = 0.2\text{m}$, $\theta = 40°$





Find: $\vec{\omega}_{BD}$, $\vec{v}_{D/A}$.

Analysis:

- 1st Get $\vec{r}$'s.

$$\vec{r}_{B\to\{C,D\}} = \{l_{CB}, l_{DB}\}(\cos(\theta)\hat{\imath} + \sin(\theta)\hat{\jmath})$$

- 2nd Get $\vec{v}$'s & $\vec{\omega}$'s.

$$\vec{v}_{B/A} = \vec{\omega}_{BA} \times \vec{r}_{A\to B} = \omega_{AB}(\hat{k}) \times l_{AB}\hat{\jmath} = -\omega_{AB} l_{AB}\hat{\imath} = v_{B/A}\hat{\imath},$$

$$\omega_{AB} = -v_{B/A}/l_{AB} = -5\ \text{rad/s}, \qquad \underline{\vec{\omega}_{AB} = -5\ \text{rad/s}\ \hat{k}.}$$

$$\vec{v}_{C/A} = \vec{v}_{B/A} + \vec{v}_{C/B}.$$

$$\vec{v}_{C/A} = v_{C/A}\hat{\jmath} = v_{B/A}\hat{\imath} + \omega_{BC}\hat{k} \times l_{CB}(\cos(\theta)\hat{\imath} + \sin(\theta)\hat{\jmath})$$

$$v_{C/A}\hat{\jmath} = v_{B/A}\hat{\imath} + \omega_{BC} l_{CB}\cos(\theta)\hat{\jmath} - \omega_{BC} l_{CB}\sin(\theta)\hat{\imath}$$

$$\omega_{BC} = \frac{v_{B/A}}{l_{CB}\sin(\theta)} = 1.867\ \text{rad/s}, \qquad \{\vec{\omega}_{BD} = 1.867\ \text{rad/s}\ \hat{k}\}$$

$$\vec{v}_{D/A} = \vec{v}_{B/D} + \vec{v}_{B/A} = \omega_{BC}\hat{k} \times l_{BD}(\cos(\theta)\hat{\imath} + \sin(\theta)\hat{\jmath}) + v_{B/A}\hat{\imath},$$

$$\vec{v}_{D/A} = (v_{B/A} - l_{BD}\omega_{BC}\sin(\theta))\hat{\imath} + l_{BD}\omega_{BC}\cos(\theta)\hat{\jmath}$$

$$\{\vec{v}_{D/A} = -0.24\hat{\imath} + 1.0\hat{\jmath}\}$$