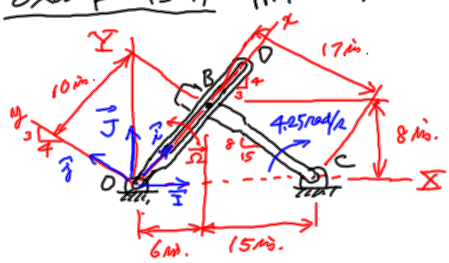
Example 15.19 pp. 700-701



$\vec{\omega}_{OD} = ?$

$\vec{v}_{B/OD} = ?$

Let $Oxyz$ be embedded in the rod OD. Then $\vec{\Omega} = \vec{\omega}_{OD} = \omega_{OD}\vec{k}$

Pin B belongs to rod CB, and slides in the slot of the OD.

$$\vec{v}_B = \vec{v}_{B/C} + \cancel{\vec{v}_C} = \vec{v}_{B/C} = \vec{\omega}_{BC} \times \vec{r}_{B/C}$$

$$\vec{\omega}_{BC} = -4.25\vec{K} \qquad \vec{r}_{B/C} = -15\vec{I} + 8\vec{J}$$

$$\vec{v}_B = -4.25\vec{K} \times (-15\vec{I} + 8\vec{J}) = 34\vec{I} + 63.75\vec{J}$$

$$\vec{v}_B = \vec{v}_{B/Oxyz} + \vec{\Omega} \times \vec{r}_{B/O} + \cancel{\vec{v}_O} \qquad \vec{v}_B = \vec{v}_{B/Oxyz} + \vec{\Omega} \times \vec{r}_{B/O}$$

$$\vec{v}_B = v_{B/OD}\vec{i} + \omega_{OD}\vec{k} \times (10\vec{i}) = v_{B/OD}\vec{i} + 10\omega_{OD}\vec{j}$$

$$= v_{B/OD}\left(\tfrac{1}{5}\right)(3\vec{I} + 4\vec{J}) + \tfrac{2}{10}\omega_{OD}\left(\tfrac{1}{5}\right)(-4\vec{I} + 3\vec{J})$$

$$\vec{v}_B = \left(\tfrac{3}{5}v_{B/OD} - 8\omega_{OD}\right)\vec{I} + \left(\tfrac{4}{5}v_{B/OD} + 6\omega_{OD}\right)\vec{J}$$

$\vec{I}$: $\tfrac{3}{5}v_{B/OD} - 8\omega_{OD} = 34$

$\vec{J}$: $\tfrac{4}{5}v_{B/OD} + 6\omega_{OD} = 63.75$

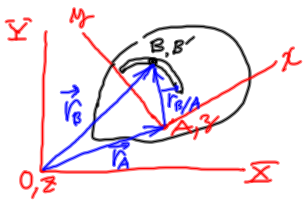
$$\begin{bmatrix} \tfrac{3}{5} & -8 \\ \tfrac{4}{5} & 6 \end{bmatrix}\begin{bmatrix} v_{B/OD} \\ \omega_{OD} \end{bmatrix} = \begin{bmatrix} 34 \\ 63.75 \end{bmatrix}$$

$v_{B/OD} = 71.4 \qquad \omega_{OD} = 1.105$

$\boxed{\vec{\omega}_{OD} = 1.105 \text{ rad/s} \circlearrowleft}$ $\boxed{\vec{v}_{B/OD} = 71.4 \text{ in./s}}$

There will be a quiz on next Thursday, 10/29/09.
A homework collection will be made on 10/29/09 also.

Acceleration of a particle B using a rotating reference frame.



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

$$\dot{\vec{Q}} = (\dot{\vec{Q}})_{OXYZ} \quad \text{V.V.} \cdots \text{I.}$$

$$\boxed{\dot{\vec{Q}} = (\dot{\vec{Q}})_{Axyz} + \vec{\Omega} \times \vec{Q}}$$

$\vec{v}_B$ = time rate of change of the position vector $\vec{r}_B$.

$$\vec{v}_B = \dot{\vec{r}}_B = \dot{\vec{r}}_{B/A} + \dot{\vec{r}}_A = (\dot{\vec{r}}_{B/A})_{Axyz} + \vec{\Omega} \times \vec{r}_{B/A} + \vec{v}_A$$

$\vec{v}_{B/Axyz}$

$$\boxed{\vec{v}_B = \vec{v}_{B/Axyz} + \vec{\Omega} \times \vec{r}_{B/A} + \vec{v}_A}$$

If B' of the slab coincides with B, then

$$\boxed{\vec{v}_{B'} = \vec{\Omega} \times \vec{r}_{B/A} + \vec{v}_A}$$

$$\vec{v}_{B'} = \cancel{\vec{v}_{B'/Axyz}} + \vec{\Omega} \times \vec{r}_{B/A} + \vec{v}_A$$

$$\boxed{\vec{v}_B = \vec{v}_{B/Axyz} + \vec{v}_{B'}}$$

$\vec{a}_B$ = time rate of change of the velocity vector $\vec{v}_B$.

$$\vec{a}_B = \dot{\vec{v}}_B = (\dot{\vec{v}}_{B/Axyz})_{OXYZ} + \dot{\vec{\Omega}} \times \vec{r}_{B/A} + \vec{\Omega} \times \dot{\vec{r}}_{B/A} + \dot{\vec{v}}_A$$

$$= (\dot{\vec{v}}_{B/Axyz})_{Axyz} + \vec{\Omega} \times \vec{v}_{B/Axyz} + \dot{\vec{\Omega}} \times \vec{r}_{B/A} + \vec{\Omega} \times \left[(\dot{\vec{r}}_{B/A})_{Axyz} + \vec{\Omega} \times \vec{r}_{B/A}\right] + \vec{a}_A$$

$$= \vec{a}_{B/Axyz} + \vec{\Omega} \times \vec{v}_{B/Axyz} + \dot{\vec{\Omega}} \times \vec{r}_{B/A} + \vec{\Omega} \times \left[\vec{v}_{B/Axyz} + \vec{\Omega} \times \vec{r}_{B/A}\right] + \vec{a}_A$$

$$\boxed{\vec{a}_B = \vec{a}_{B/Axyz} + \dot{\vec{\Omega}} \times \vec{r}_{B/A} + \vec{\Omega} \times (\vec{\Omega} \times \vec{r}_{B/A}) + 2\vec{\Omega} \times \vec{v}_{B/Axyz} + \vec{a}_A}$$

V.V. ... I.