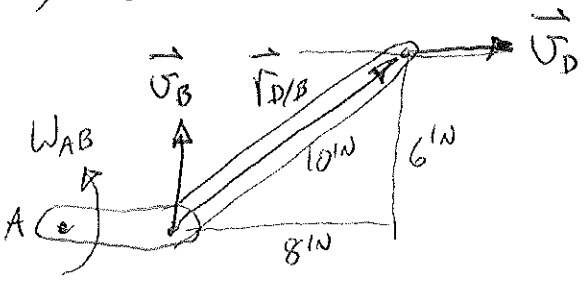
PROB. 15-55

$\omega_{AB} = \left(160 \frac{REV}{MIN}\right)\left(\frac{MIN}{60\,s}\right)\left(\frac{2\pi}{REV}\right) = 16.75 \frac{RAD}{SEC}$ CCW

FIND ω_{BD} AND v_D FOR:

a) $\theta = 0$



$v_B = r_{AB}\omega_{AB}$

$\vec{v}_D = \vec{v}_B + \vec{v}_{D/B}$

$= \vec{v}_B + (\omega_{BD})\hat{k} \times \vec{r}_{D/B}$

$\vec{r}_{D/B} = (8)\hat{i} + (6)\hat{j}$ IN

$$(\omega_{BD})\hat{k} \times \vec{r}_{D/B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & \omega_{BD} \\ 8 & 6 & 0 \end{vmatrix}$$

$= [0 - (\omega_{BD})(6)]\hat{i} - [0 - (\omega_{BD})(8)]\hat{j}$

$= (-6\omega_{BD})\hat{i} + (8\omega_{BD})\hat{j}$

$(v_{DX})\hat{i} = (r_{AB}\omega_{AB})\hat{j} + (-6\omega_{BD})\hat{i} + (8\omega_{BD})\hat{j}$

Y-DIRECTION:

$0 = r_{AB}\omega_{AB} + 8\omega_{BD}$

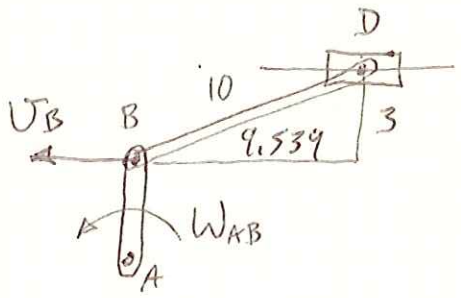
$\omega_{BD} = -\left(\frac{3}{8}\right)\left(16.75 \frac{RAD}{SEC}\right) = \left(-6.281 \frac{RAD}{SEC}\right)\left(\frac{60}{2\pi}\right) = \boxed{-60.0 \text{ RPM } \circlearrowleft}$

X-DIRECTION:

$v_{DX} = -6\omega_{BD} = -6\left(-6.281 \frac{RAD}{SEC}\right) = \boxed{37.69 \frac{IN}{SEC}}$

PROB. 15-55 CONT.

b) $\theta = 90°$



$$\vec{v}_B = \vec{r}_{AB} \omega_{AB}$$

$$\vec{v}_D = \vec{v}_B + \vec{v}_{D/B} = \vec{v}_B + (\omega_{BD})\hat{k} \times \vec{r}_{D/B}$$

$$(\omega_{BD})\hat{k} \times \vec{r}_{D/B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & \omega_{BD} \\ 9.539 & 3 & 0 \end{vmatrix}$$

$$= [0 - (\omega_{BD})(3)]\hat{i} - [0 - (\omega_{BD})(9.539)]\hat{j}$$

$$= (-3\omega_{BD})\hat{i} + (9.539\,\omega_{BD})\hat{j}$$

$$(v_{DX})\hat{i} = (-r_{AB}\omega_{AB})\hat{i} + (-3\omega_{BD})\hat{i} + (9.539\,\omega_{BD})\hat{j}$$

Y-DIRECTION:

$$0 = 9.539\,\omega_{BD} \Rightarrow \omega_{BD} = 0$$

X-DIRECTION:

$$v_{DX} = -(3^{IN})(16.75\ \tfrac{RAD}{SEC}) = -50.25\ \tfrac{IN}{SEC} \leftarrow$$