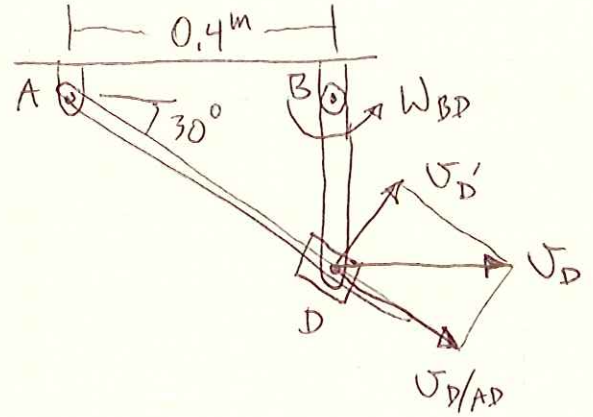
PROB. 15-175



$\omega_{BD} = 6 \frac{RAD}{s}$ ↻

FIND ω_A AND α_A

$\vec{v}_D = \vec{v}_{D'} + \vec{v}_{D/AD}$

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

$y_D = 0.4 \cdot \tan 30^\circ = 0.2309\ m$

$\vec{r}_{D/B} = (-0.2309)\hat{j}\ m$

$$\vec{v}_D = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & 6 \\ 0 & -0.2309 & 0 \end{vmatrix} = [0-(6)(-0.2309)]\hat{i}$$

$\vec{v}_D = (1.386)\hat{i}\ \frac{m}{s}$

$$\vec{v}_{D'} = \omega_A \hat{k} \times \vec{r}_{D'/A} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & \omega_A \\ 0.4 & -0.2309 & 0 \end{vmatrix}$$

$= [0-(\omega_A)(-0.2309)]\hat{i} - [0-(\omega_A)(0.4)]\hat{j}$

$\vec{v}_{D'} = (0.2309\,\omega_A)\hat{i} + (0.4\omega_A)\hat{j}\ \frac{m}{s}$

$\vec{v}_{D/AD} = (v_{DAD} \cdot \cos 30^\circ)\hat{i} + (-v_{DAD} \cdot \sin 30^\circ)\hat{j}$

$\vec{v}_{D/AD} = (0.866\,v_{DAD})\hat{i} + (-0.5\,v_{DAD})\hat{j}\ \frac{m}{s}$

PROB. 15-175 CONT.

$$(1.386)\hat{i} = (0.2309\,W_A)\hat{i} + (0.4\,W_A)\hat{j} + (0.866\,v_{DAD})\hat{i} + (-0.5\,v_{DAD})\hat{j}$$

X-DIRECTION: $1.386 = 0.2309\,W_A + 0.866\,v_{DAD}$

$W_A = 6.0 - 3.75\,v_{DAD}$

Y-DIRECTION: $0 = 0.4\,W_A - 0.5\,v_{DAD}$

$0 = 0.4(6.0 - 3.75\,v_{DAD}) - 0.5\,v_{DAD}$

$2\,v_{DAD} = 2.4 \Rightarrow v_{DAD} = 1.2 \frac{m}{s}$

$W_A = 6.0 - 3.75(1.2)$ $\boxed{= 1.5 \frac{RAD}{s} \circlearrowleft}$

$\vec{v}_{D/AD} = [0.866(1.2)]\hat{i} + [-0.5(1.2)]\hat{j}$

$\vec{v}_{D/AD} = (1.039)\hat{i} + (-0.6)\hat{j} \frac{m}{s}$

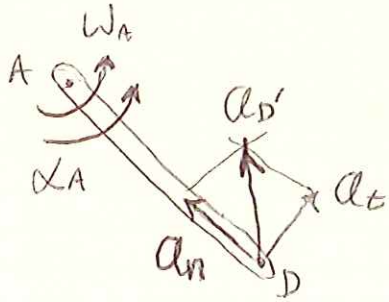
$\vec{a}_D = \vec{a}_{D'} + \vec{a}_{D/AD} + \vec{a}_C$

$\vec{a}_D = \cancel{\alpha_{BD}}^{0}\hat{k} \times \vec{r}_{D/B} - \omega_{BD}^2 \vec{r}_{D/B} = -(6)^2(-0.2309)\hat{j}$

$\vec{a}_D = (8.312)\hat{j} \frac{m}{s^2}$

$\vec{a}_{D'} = \alpha_A \hat{k} \times \vec{r}_{D'/A} - \omega_A^2 \vec{r}_{D'/A}$

$$\alpha_A \hat{k} \times \vec{r}_{D'/A} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & \alpha_A \\ 0.4 & -0.2309 & 0 \end{vmatrix}$$



PROB. 15-175 CONT.

$$= [0 - (\alpha_A)(-0.2309)]\hat{i} - [0 - (\alpha_A)(0.4)]\hat{j}$$

$$= (0.2309\alpha_A)\hat{i} + (0.4\alpha_A)\hat{j} \ \frac{m}{s^2}$$

$$-\omega_A^2 \vec{r}_{D'/A} = -(1.5)^2[(0.4)\hat{i} + (-0.2309)\hat{j}]$$

$$= (-0.9)\hat{i} + (0.5195)\hat{j} \ \frac{m}{s^2}$$

$$\vec{a}_{D'} = (0.2309\alpha_A - 0.9)\hat{i} + (0.4\alpha_A + 0.5195)\hat{j} \ \frac{m}{s^2}$$

$$\vec{a}_{D/AD} = (0.866\, a_{DAD})\hat{i} + (-0.5\, a_{DAD})\hat{j} \ \frac{m}{s^2}$$

$$\vec{a}_c = 2\omega_A \hat{k} \times \vec{v}_{D/AD} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & 2(1.5) \\ 1.039 & -0.6 & 0 \end{vmatrix}$$

$$\vec{a}_c = [0 - (3)(-0.6)]\hat{i} - [0 - (3)(1.039)]\hat{j}$$

$$\vec{a}_c = (1.8)\hat{i} + (3.117)\hat{j} \ \frac{m}{s^2}$$

$$(8.312)\hat{j} = (0.2309\alpha_A)\hat{i} + (0.4\alpha_A)\hat{j} + (-0.9)\hat{i}$$

$$+ (0.5195)\hat{j} + (0.866\, a_{DAD})\hat{i} + (-0.5 \cdot a_{DAD})\hat{j}$$

$$+ (1.8)\hat{i} + (3.117)\hat{j}$$

X-DIRECTION: $0 = 0.2309\alpha_A - 0.9 + 0.866\, a_{DAD} + 1.8$

$$\alpha_A = -3.898 - 3.750\, a_{DAD}$$

PROB. 15-175 CONT.

Y-DIRECTION: $8.312 = 0.4\alpha_A + 0.5195 - 0.5 a_{DAD} + 3.117$

$4.675 = 0.4(-3.898 - 3.750 \cdot a_{DAD}) - 0.5 a_{DAD}$

$6.234 = -2 a_{DAD} \Rightarrow a_{DAD} = -3.117 \frac{m}{s^2}$

$\alpha_A = -3.898 - 3.75(-3.117) = 7.791 \frac{\cancel{kg}}{\cancel{kg}} \frac{RAD}{s^2}$ ↺