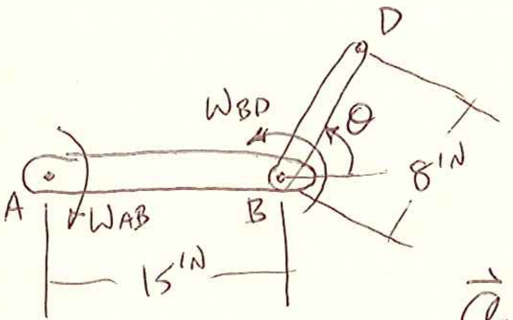
PROB. 15-171



$\omega_{AB} = 5\ \frac{RAD}{S}$ $\circlearrowright$, $\omega_{BD} = 3\ \frac{RAD}{S}$ $\circlearrowleft$

$\theta = 60°$, FIND a_D

$$\vec{a}_D = \vec{a}_{D'} + \vec{a}_{D/AB} + \vec{a}_c$$

$$\vec{a}_{D'} = \cancel{\vec{a}_A}^{0} + \cancel{\alpha_{AB}}^{0}\,\hat{k} \times \vec{r}_{D'/A} - \omega_{AB}^2\,\vec{r}_{D'/A}$$

$$\vec{r}_{D'/A} = (15 + 8\cos 60°)\hat{i} + (8\sin 60°)\hat{j} = (19)\hat{i} + (6.928)\hat{j} \text{ IN}$$

$$\vec{a}_{D'} = -(-5)^2\left[(19)\hat{i} + (6.928)\hat{j}\right]$$

$$\vec{a}_{D'} = (-475)\hat{i} + (-173.2)\hat{j}\ \frac{IN}{S^2}$$

$$\vec{a}_{D/AB} = \cancel{\alpha_{BD}}^{0}\,\hat{k} \times \vec{r}_{D/B} - \omega_{BD}^2\,\vec{r}_{D/B}$$

$$\vec{r}_{D/B} = (8\cos 60°)\hat{i} + (8\sin 60°)\hat{j} = (4)\hat{i} + (6.928)\hat{j} \text{ IN}$$

$$\vec{a}_{D/AB} = -(3)^2\left[(4)\hat{i} + (6.928)\hat{j}\right]$$

$$\vec{a}_{D/AB} = (-36)\hat{i} + (-62.35)\hat{j}\ \frac{IN}{S^2}$$

$$\vec{a}_c = 2\omega_{AB}\hat{k} \times \vec{v}_{D/AB}$$

$$\vec{v}_{D/AB} = \omega_{BD}\hat{k} \times \vec{r}_{D/B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & 3 \\ 4 & 6.928 & 0 \end{vmatrix}$$

$$= [0 - (3)(6.928)]\hat{i} - [0 - (3)(4)]\hat{j}$$

$$\vec{v}_{D/AB} = (-20.78)\hat{i} + (12)\hat{j}\ \frac{IN}{S}$$

PROB. 15-171 CONT.

$$\vec{a}_C = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & -10 \\ -20.78 & 12 & 0 \end{vmatrix}$$

$$= [0-(-10)(12)]\hat{i} - [0-(-10)(-20.78)]\hat{j}$$

$$\vec{a}_C = (120)\hat{i} + (207.8)\hat{j} \ \frac{\text{IN}}{\text{S}^2}$$

$$\vec{a}_D = (-475)\hat{i} + (-173.2)\hat{j} + (-36)\hat{i} + (-62.35)\hat{j}$$

$$+ (120)\hat{i} + (207.8)\hat{j}$$

$$\vec{a}_D = (-391)\hat{i} + (-27.75)\hat{j}, \ \theta = \tan^{-1}\left(\frac{27.75}{391}\right) = 4.059°$$

$$\boxed{\vec{a}_D = 392 \ \frac{\text{IN}}{\text{S}^2} \ 4.059°}$$