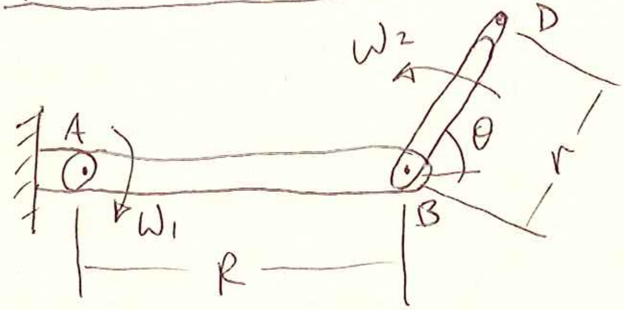
PROB. 15-170

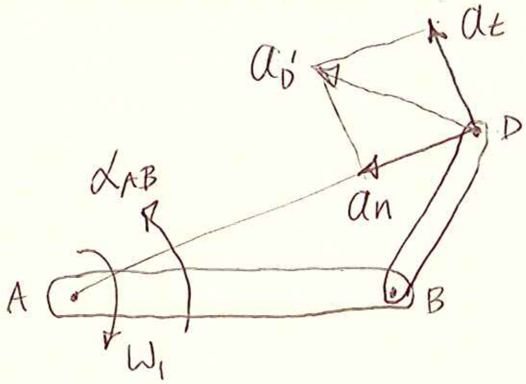


$\omega_{AB} = \omega_1$

$\omega_{BD} = \omega_2$

SHOW THAT a_D PASSES THROUGH A FOR $\omega_2 = 2\omega_1$

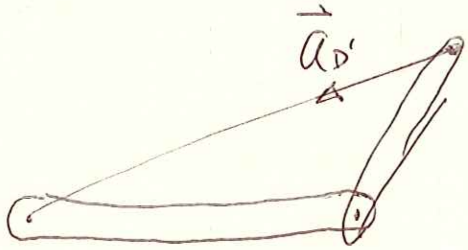
$$\vec{a}_D = \vec{a}_{D'} + \vec{a}_{D/AB} + \vec{a}_c$$



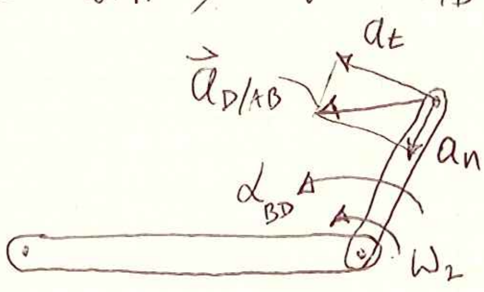
$$a_{D'} = \cancelto{0}{\vec{a}_A} + \cancelto{0}{\alpha_{AB}}\hat{k} \times \vec{r}_{D'/A} - \omega_1^2\,\vec{r}_{D'/A}$$

$$\vec{r}_{D'/A} = (R + r\cos\theta)\hat{i} + (r\sin\theta)\hat{j}$$

$$\vec{a}_{D'} = -\omega_1^2\left[(R + r\cos\theta)\hat{i} + (r\sin\theta)\hat{j}\right]$$



$$\vec{a}_{D/AB} = \cancelto{0}{\alpha_{BD}}\hat{k} \times \vec{r}_{D/B} - \omega_2^2\,\vec{r}_{D/B}$$

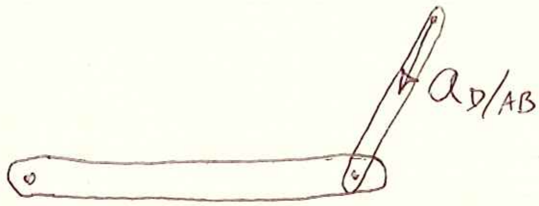


$$\vec{a}_{D/AB} = -\omega_2^2\left[(r\cos\theta)\hat{i} + (r\sin\theta)\hat{j}\right]$$

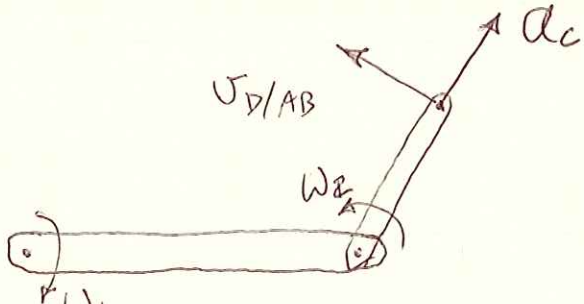
$$\vec{a}_{D/AB} = -r(2\omega_1)^2\left[(\cos\theta)\hat{i} + (\sin\theta)\hat{j}\right]$$

$$\vec{a}_{D/AB} = -4r\omega_1^2\left[(\cos\theta)\hat{i} + (\sin\theta)\hat{j}\right]$$

PROB. 15-170 CONT.



$$\vec{a}_c = 2\omega_1 \hat{k} \times \vec{v}_{D/AB}$$



$$\vec{v}_{D/AB} = \omega_2 \hat{k} \times \vec{r}_{D/B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & \omega_2 \\ r\cos\theta & r\sin\theta & 0 \end{vmatrix}$$

$$= [0 - (\omega_2)(r\sin\theta)]\hat{i} - [0 - (\omega_2)(r\cos\theta)]\hat{j}$$

$$= (-r\omega_2\sin\theta)\hat{i} + (r\omega_2\cos\theta)\hat{j}$$

$$= [-r(2\omega_1)\sin\theta]\hat{i} + [r(2\omega_1)\cos\theta]\hat{j}$$

$$\vec{v}_{D/AB} = (-2r\omega_1\sin\theta)\hat{i} + (2r\omega_1\cos\theta)\hat{j}$$

$$\vec{a}_c = 2\omega_1 \hat{k} \times \vec{v}_{D/AB} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & (-2\omega_1) \\ -2r\omega_1\sin\theta & 2r\omega_1\cos\theta & 0 \end{vmatrix}$$

$$= [0 - (-2\omega_1)(2r\omega_1\cos\theta)]\hat{i} - [0 - (-2\omega_1)(-2r\omega_1\sin\theta)]\hat{j}$$

PROB. 15-170 CONT.

$$\vec{a}_C = (4r\omega_1^2 \cos\theta)\hat{i} + (4r\omega_1^2 \sin\theta)\hat{j}$$

$$\vec{a}_C = 4r\omega_1^2 \left[(\cos\theta)\hat{i} + (\sin\theta)\right]\hat{j}$$

$$\vec{a}_D = -\omega_1^2\left[(R + r\cos\theta)\hat{i} + (r\sin\theta)\hat{j}\right]$$

$$-4r\omega_1^2\left[(\cos\theta)\hat{i} + (\sin\theta)\hat{j}\right]$$

$$+4r\omega_1^2\left[(\cos\theta)\hat{i} + (\sin\theta)\hat{j}\right]$$

$$\vec{a}_D = -\omega_1^2\left[(R + r\cos\theta)\hat{i} + (r\sin\theta)\hat{j}\right]$$

$\vec{a}_D = -\omega_1^2\,\vec{r}_{D/A}$ PASSES THROUGH POINT D