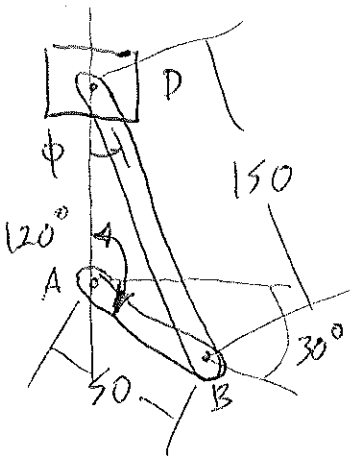
PROB. 15-126



$\omega_{AB} = \left(900 \frac{REV}{MIN}\right)\left(\frac{MIN}{60\,S}\right)\left(\frac{2\pi}{REV}\right) = 94.25 \frac{RAD}{S}$ ↻

$\alpha_{AB} = 0$ FIND a_D

VELOCITY

$\vec{v}_B = \vec{v}_A + \omega_{AB}\hat{k} \times \vec{r}_{B/A}$

$\vec{r}_{B/A} = (0.05 \cdot \cos 30^\circ)\hat{i} + (-0.05 \cdot \sin 30^\circ)\hat{j}$

$\vec{r}_{B/A} = (0.0433)\hat{i} + (-0.025)\hat{j}$ m

$$\vec{v}_B = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & -94.25 \\ 0.0433 & -0.025 & 0 \end{vmatrix}$$

$= [0 - (-94.25)(-0.025)]\hat{i} - [0 - (-94.25)(0.0433)]\hat{j}$

$\vec{v}_B = (-2.356)\hat{i} + (-4.081)\hat{j}$ $\frac{m}{s}$

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

$\sin\phi = \left(\frac{0.0433}{0.15}\right)$ ⇒ $\phi = 16.78^\circ$

$\cos\phi = \frac{y}{0.15}$, $y = 0.15 \cdot \cos 16.78^\circ = 0.1436$ m

$\vec{r}_{D/B} = (-0.0433)\hat{i} + (0.1436)\hat{j}$ m

$$\omega_{BD}\hat{k} \times \vec{r}_{D/B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & \omega_{BD} \\ -0.0433 & 0.1436 & 0 \end{vmatrix}$$

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$$\omega_{BD}\hat{k} \times \vec{r}_{D/B} = [0-(\omega_{BD})(0.1436)]\hat{i} - [0-(\omega_{BD})(-0.0433)]\hat{j}$$

$$= (-0.1436\,\omega_{BD})\hat{i} + (-0.0433\,\omega_{BD})\hat{j}$$

$$\vec{v}_D = (-2.356)\hat{i} + (-4.081)\hat{j} + (-0.1436\,\omega_{BD})\hat{i}$$

$$+ (-0.0433\,\omega_{BD})\hat{j}$$

$$v_{Dx} = 0 = -2.356 - 0.1436\,\omega_{BD} \Rightarrow \omega_{BD} = -16.40 \ \frac{\text{RAD}}{s} \ \text{↻}$$

ACCELERATION

$$\vec{a}_B = \vec{a}_A + \alpha_{AB}\hat{k} \times \vec{r}_{B/A} - \omega_{AB}^2\,\vec{r}_{B/A}$$

$$= -(-94.25)^2[(0.0433)\hat{i} + (-0.025)\hat{j}]$$

$$\vec{a}_B = (-384.6)\hat{i} + (222.1)\hat{j} \ \frac{m}{s^2}$$

$$\vec{a}_D = \vec{a}_B + \alpha_{BD}\hat{k} \times \vec{r}_{D/B} - \omega_{BD}^2\,\vec{r}_{D/B}$$

$$\alpha_{BD}\hat{k} \times \vec{r}_{D/B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & \alpha_{BD} \\ -0.0433 & 0.1436 & 0 \end{vmatrix}$$

$$= [0-(\alpha_{BD})(0.1436)]\hat{i} - [0-(\alpha_{BD})(-0.0433)]\hat{j}$$

$$= (-0.1436\,\alpha_{BD})\hat{i} + (-0.0433\,\alpha_{BD})\hat{j} \ \frac{m}{s^2}$$

$$-\omega_{BD}^2\,\vec{r}_{D/B} = -(-16.4)^2[(-0.0433)\hat{i} + (0.1436)\hat{j}]$$

$$= (11.64)\hat{i} + (-38.62)\hat{j} \ \frac{m}{s^2}$$

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$$\vec{a}_D = (-384.6)\hat{i} + (222.1)\hat{j} + (-0.1436\alpha_{BD})\hat{i} + (-0.0433\alpha_{BD})\hat{j} + (11.64)\hat{i} + (-38.62)\hat{j}$$

$$\vec{a}_D = (-373.0 - 0.1436\alpha_{BD})\hat{i} + (183.5 - 0.0433\alpha_{BD})\hat{j}$$

$$a_{Dx} = 0 = -373 - 0.1436\alpha_{BD} \Rightarrow \alpha_{BD} = -2597 \ \frac{RAD}{s^2}$$

$$\vec{a}_D = [183.5 - 0.0433(-2597)]\hat{j}$$

$$\boxed{\vec{a}_D = (295.9)\hat{j} \ \frac{m}{s^2}}$$