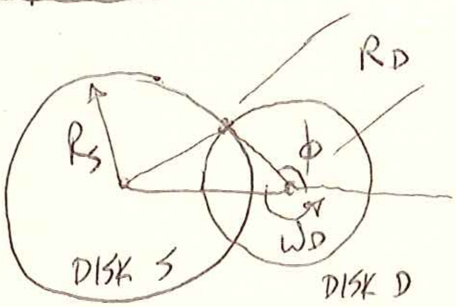
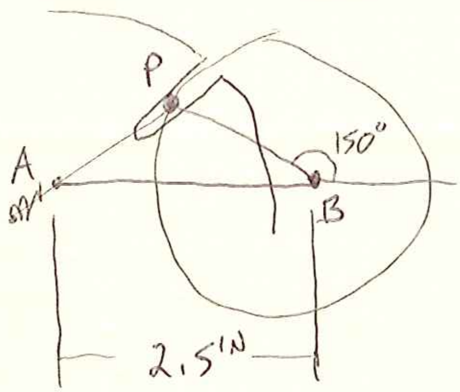
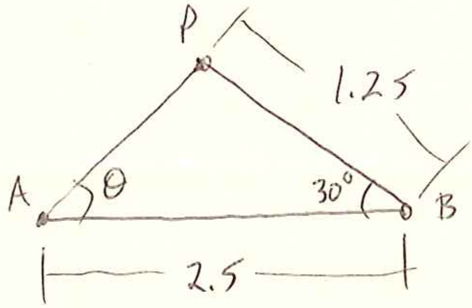
PROB. 15-179



$\omega_D = 8 \frac{RAD}{S}$ ↻, $R_D = 1.25^{IN}$

FIND ω_S, α_S WHEN $\phi = 150°$





$$Y_{P/B} = 1.25 \cdot \sin 30° = 0.625^{IN}$$

$$X_{P/B} = 1.25 \cdot \cos 30° = 1.082^{IN}$$

$$Y_{P/A} = 0.625^{IN}, \quad X_{P/A} = 2.5 - 1.082 = 1.417^{IN}$$

$$\vec{v}_P = \vec{v}_{P'} + \vec{v}_{P/A}$$

$$\vec{v}_P = \omega_D \hat{k} \times \vec{r}_{P/B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & 8 \\ -1.082 & 0.625 & 0 \end{vmatrix}$$

$$= [0 - (8)(0.625)]\hat{i} - [0 - (8)(-1.082)]\hat{j}$$

$$\vec{v}_P = (-5.0)\hat{i} + (-8.656)\hat{j} \ \frac{IN}{S}$$

$$\theta = \tan^{-1}\left(\frac{0.625}{1.417}\right) = 23.8°$$

$$\vec{v}_{P'} = \omega_S \hat{k} \times \vec{r}_{P'/A}$$

PROB. 15-179 CONT.

$$\vec{v}_{P'} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & \omega_s \\ 1.417 & 0.625 & 0 \end{vmatrix}$$

$$= [0-(\omega_s)(0.625)]\hat{i} - [0-(\omega_s)(1.417)]\hat{j}$$

$$\vec{v}_{P'} = (-0.625\,\omega_s)\hat{i} + (1.417\,\omega_s)\hat{j} \ \frac{\text{IN}}{\text{S}}$$

$$\vec{v}_{P/A} = (-v_{PA} \cdot \cos 23.8°)\hat{i} + (-v_{PA} \cdot \sin 23.8°)\hat{j}$$

$$\vec{v}_{P/A} = (-0.9149\,v_{PA})\hat{i} + (-0.4035\,v_{PA})\hat{j}$$

$$(-5.0)\hat{i} + (-8.656)\hat{j} = (-0.625\,\omega_s)\hat{i} + (1.417\,\omega_s)\hat{j}$$

$$+ (-0.9149\,v_{PA})\hat{i} + (-0.4035\,v_{PA})\hat{j}$$

X-DIRECTION: $-5 = -0.625\,\omega_s - 0.9149\,v_{PA}$

$$\omega_s = 8 - 1.464\,v_{PA}$$

Y-DIRECTION: $-8.656 = 1.417\,\omega_s - 0.4035\,v_{PA}$

$$v_{PA} = 8.071 \ \frac{\text{IN}}{\text{S}}, \quad \boxed{\omega_s = -3.816 \ \frac{\text{RAD}}{\text{S}} \circlearrowright}$$

$$\vec{v}_{P/A} = [-0.9149(8.071)]\hat{i} + [-0.4035(8.071)]\hat{j}$$

$$\vec{v}_{P/A} = (-7.384)\hat{i} + (-3.257)\hat{j} \ \frac{\text{IN}}{\text{S}}$$

PROB. 15 - 179 CONT.

$$\vec{a}_P = \vec{a}_{P'} + \vec{a}_{P/A} + \vec{a}_C$$

$$\vec{a}_P = \cancel{\alpha_B}^{\,0} \hat{k} \times \vec{r}_{P/B} - \omega_B^2 \vec{r}_{P/B} = -(8)^2[(-1.082)\hat{i} + (0.625)\hat{j}]$$

$$\vec{a}_P = (69.25)\hat{i} + (-40)\hat{j} \ \frac{\text{IN}}{s^2}$$

$$\vec{a}_{P'} = \alpha_s \hat{k} \times \vec{r}_{P'/A} - \omega_s^2 \vec{r}_{P'/A}$$

$$\alpha_s \hat{k} \times \vec{r}_{P'/A} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & \alpha_s \\ 1.417 & 0.625 & 0 \end{vmatrix}$$

$$= [0 - (\alpha_s)(0.625)]\hat{i} - [0 - (\alpha_s)(1.417)]\hat{j}$$

$$= (-0.625\,\alpha_s)\hat{i} + (1.417\,\alpha_s)\hat{j} \ \frac{\text{IN}}{s^2}$$

$$-\omega_s^2 \vec{r}_{P'/A} = -(-3.816)^2[(1.417)\hat{i} + (0.625)\hat{j}]$$

$$= (-20.63)\hat{i} + (-9.101)\hat{j} \ \frac{\text{IN}}{s^2}$$

$$\vec{a}_{P'} = (-0.625\,\alpha_s)\hat{i} + (1.417\,\alpha_s)\hat{j} + (-20.63)\hat{i} + (-9.101)\hat{j}$$

$$\vec{a}_{P'} = (-0.625\,\alpha_s - 20.63)\hat{i} + (1.417\,\alpha_s - 9.101)\hat{j} \ \frac{\text{IN}}{s^2}$$

$$\vec{a}_{P/A} = (-a_{PA} \cdot \cos 23.8^\circ)\hat{i} + (-a_{PA} \cdot \sin 23.8^\circ)\hat{j}$$

$$\vec{a}_{P/A} = (-0.9145\,a_{PA})\hat{i} + (-0.4035\,a_{PA})\hat{j} \ \frac{\text{IN}}{s^2}$$

PROB. 15-179 CONT.

$$\vec{a}_c = 2\omega_s \hat{k} \times \vec{v}_{P/A}$$

$$\vec{a}_c = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & 2(-3.816) \\ -7.384 & -3.257 & 0 \end{vmatrix}$$

$$= [0 - 2(-3.816)(-3.257)]\hat{i} - [0 - (2)(-3.816)(-7.384)]\hat{j}$$

$$\vec{a}_c = (-24.86)\hat{i} + (56.35)\hat{j} \ \frac{\text{in}}{\text{s}^2}$$

$$(69.25)\hat{i} + (-40)\hat{j} = (-0.625\alpha_s - 20.63)\hat{i}$$

$$+ (1.417\alpha_s - 9.101)\hat{j} + (-0.9145\,a_{PA})\hat{i} + (-0.4035\,a_{PA})\hat{j}$$

$$+ (-24.86)\hat{i} + (56.35)\hat{j}$$

X-DIRECTION: $69.25 = -0.625\alpha_s - 20.63 - 0.9145\,a_{PA}$
$- 24.86$

$$\alpha_s = -183.6 - 1.463\,a_{PA}$$

Y-DIRECTION: $-40 = 1.417\alpha_s - 9.101 - 0.4035\,a_{PA} + 56.35$

$$a_{PA} = -69.83 \ \frac{\text{in}}{\text{s}^2}$$

$$\boxed{\alpha_s = -81.43 \ \frac{\text{rad}}{\text{s}^2}}$$

TOPS. 35500