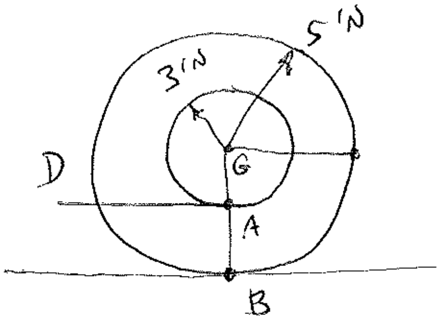
PROB. 15-115



$v_D = 8\ \frac{IN}{s} \leftarrow\ ,\ a_D = 30\ \frac{IN}{s^2} \leftarrow$

FIND $a_A,\ a_B,\ a_C$

VELOCITY

$\vec{v}_B = 0\ ,\ \vec{v}_A = \vec{v}_D = (-8)\hat{i}\ \frac{IN}{s}$

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

$$\omega\hat{k}\times\vec{r}_{B/A} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & \omega \\ 0 & -2 & 0 \end{vmatrix} = [0-(\omega)(-2)]\hat{i} = (2\omega)\hat{i}$$

$$0 = (-8)\hat{i} + (2\omega)\hat{i} \Rightarrow \omega = 4\ \frac{RAD}{s}\ \circlearrowleft$$

ACCELERATION

$$\vec{a}_B = (\cancel{a_{BX}}^{\,0})\hat{i} + (a_{BY})\hat{j} = (a_{BY})\hat{j} \quad \text{NO SLIPPING}$$

$$\vec{a}_A = (-30)\hat{i} + (a_{AY})\hat{j}$$

$$\vec{a}_B = \vec{a}_A + \alpha\hat{k}\times\vec{r}_{B/A} - \omega^2\vec{r}_{B/A}$$

$$\alpha\hat{k}\times\vec{r}_{B/A} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & \alpha \\ 0 & -2 & 0 \end{vmatrix} = (2\alpha)\hat{i}\ \frac{IN}{s^2}$$

$$-\omega^2\vec{r}_{B/A} = -(4)^2(-2)\hat{j} = (32)\hat{j}\ \frac{IN}{s^2}$$

$$(a_{BY})\hat{j} = (-30)\hat{i} + (a_{AY})\hat{j} + (2\alpha)\hat{i} + (32)\hat{j}$$

PROB. 15-115 CONT.

X-DIRECTION: $0 = -30 + 2\alpha \Rightarrow \alpha = 15\ \frac{RAD}{s^2}$

Y-DIRECTION: $a_{BY} = a_{AY} + 32$

$\vec{a}_G = (a_{Gx})\hat{i} + (\cancelto{0}{a_{GY}})\hat{j}$ NO Y-DIR. ACCELERATION

$$\vec{a}_B = \vec{a}_G + \alpha\hat{k} \times \vec{r}_{B/G} - \omega^2 \vec{r}_{B/G}$$

$$\alpha\hat{k} \times \vec{r}_{B/G} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & 15 \\ 0 & -5 & 0 \end{vmatrix} = [0-(15)(-5)]\hat{i} = (75)\hat{i}\ \frac{in}{s^2}$$

$$-\omega^2 \vec{r}_{B/G} = -(4)^2(-5)\hat{j} = (80)\hat{j}\ \frac{in}{s^2}$$

$$(a_{BY})\hat{j} = (a_{Gx})\hat{i} + (75)\hat{i} + (80)\hat{j}$$

X-DIRECTION: $0 = a_{Gx} + 75 \Rightarrow a_{Gx} = -75\ \frac{in}{s^2}$

$\vec{a}_G = (-75)\hat{i}\ \frac{in}{s^2}$

Y-DIRECTION: $a_{BY} = 80$, $\boxed{\vec{a}_B = (80)\hat{j}\ \frac{in}{s^2}}$

$80 = a_{AY} + 32 \Rightarrow a_{AY} = 48$

$\vec{a}_A = (-30)\hat{i} + (48)\hat{j}$, $\theta = \tan^{-1}\left(\frac{48}{30}\right) = 58^\circ$

$\boxed{\vec{a}_A = 56.60\ \frac{in}{s^2}\ \angle 58^\circ}$

$$\vec{a}_C = \vec{a}_G + \alpha\hat{k} \times \vec{r}_{C/G} - \omega^2 \vec{r}_{C/G}$$

$$\alpha\hat{k} \times \vec{r}_{C/G} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & 15 \\ 5 & 0 & 0 \end{vmatrix} = -[0-(15)(5)]\hat{j} = (75)\hat{j}\ \frac{in}{s^2}$$

PROB. 15-115 CONT.

$$-\omega^2 \vec{r}_{C/G} = -(4)^2(5)\hat{i} = (-80)\hat{i} \ \frac{\text{IN}}{s^2}$$

$$\vec{a}_C = (-75)\hat{i} + (75)\hat{j} + (-80)\hat{i}$$

$$\vec{a}_C = (-155)\hat{i} + (75)\hat{j}$$

$$\theta = \text{TAN}^{-1}\left(\frac{75}{155}\right) = 25.82$$

$$\boxed{\vec{a}_C = 172.2 \frac{\text{IN}}{s^2} \ \nwarrow 25.82^\circ}$$