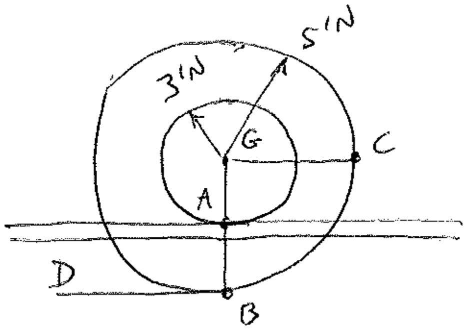
PROB. 15-116



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

FIND a_A, a_B, a_C

VELOCITY

$$\vec{v}_B = \vec{v}_D = (-8)\hat{i} \ \frac{IN}{S}$$

$$\vec{v}_B = \cancel{\vec{v}_A}^{\,0} + \omega\hat{k} \times \vec{r}_{B/A} \qquad \text{NO SLIPPING}$$

$$\vec{v}_B = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & \omega \\ 0 & -2 & 0 \end{vmatrix} = [0 - (\omega)(-2)]\hat{i} = (2\omega)\hat{i} \ \frac{IN}{S}$$

$$(-8) = (2\omega) \Rightarrow \omega = -4 \ \frac{RAD}{S} \circlearrowright$$

ACCELERATION

$$\vec{a}_A = (\cancel{a_{AX}}^{\,0})\hat{i} + (a_{AY})\hat{j} = (a_{AY})\hat{j} \qquad \text{NO SLIPPING}$$

$$\vec{a}_B = (a_{BX})\hat{i} + (a_{BY})\hat{j} = (-30)\hat{i} + (a_{BY})\hat{j}$$

$$\vec{a}_G = (a_{GX})\hat{i} + (\cancel{a_{GY}}^{\,0})\hat{j} = (a_{GX})\hat{i} \qquad \text{NO Y-DIR. ACCEL.}$$

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

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

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

PROB. 15-116 CONT.

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

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

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

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

$$\alpha\hat{k} \times \vec{r}_{A/G} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & -15 \\ 0 & -3 & 0 \end{vmatrix} = [0 - (-15)(-3)]\hat{i} = (-45)\hat{i} \ \frac{IN}{s^2}$$

$$-\omega^2 \vec{r}_{A/G} = -(-4)^2(-3)\hat{j} = (48)\hat{j} \ \frac{IN}{s^2}$$

$$(a_{AY})\hat{j} = (a_{GX})\hat{i} + (-45)\hat{i} + (48)\hat{j}$$

X-DIRECTION: $0 = a_{GX} - 45 \Rightarrow a_{GX} = 45$

$$\vec{a}_G = (45)\hat{i} \ \frac{IN}{s^2}$$

Y-DIRECTION: $a_{AY} = 48$

$$\boxed{\vec{a}_A = (48)\hat{j} \ \frac{IN}{s^2}}$$

$48 = a_{BY} - 32, \quad a_{BY} = 80$

$$\vec{a}_B = (-30)\hat{i} + (80)\hat{j}, \quad \theta = \tan^{-1}\left(\frac{80}{30}\right) = 69.44°$$

$$\boxed{\vec{a}_B = 85.44 \ \frac{IN}{s^2} \quad 69.44°}$$

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

PROB. 15-116 CONT.

$$\alpha\hat{k} \times \vec{r}_{C/B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & -15 \\ 5 & 5 & 0 \end{vmatrix}$$

$$= [0-(-15)(5)]\hat{i} - [0-(-15)(5)]\hat{j} = (75)\hat{i} + (-75)\hat{j} \ \frac{\text{IN}}{\text{S}^2}$$

$$-\omega^2 \vec{r}_{C/B} = -(-4)^2[(5)\hat{i} + (5)\hat{j}] = (-80)\hat{i} + (-80)\hat{j} \ \frac{\text{IN}}{\text{S}^2}$$

$$\vec{a}_C = (-30)\hat{i} + (80)\hat{j} + (75)\hat{i} + (-75)\hat{j} + (-80)\hat{i} + (-80)\hat{j}$$

$$\vec{a}_C = (-35)\hat{i} + (-75)\hat{j}, \quad \theta = \text{TAN}^{-1}\left(\frac{75}{35}\right) = 64.98^\circ$$

$$\boxed{\vec{a}_C = 82.76 \ \frac{\text{IN}}{\text{S}^2} \ \swarrow 64.98^\circ}$$