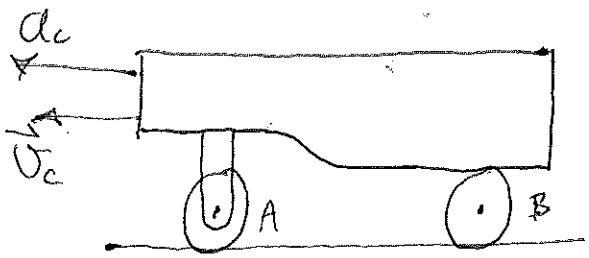
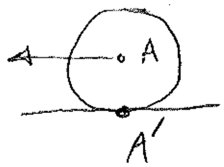
PROB. 15-112

$D = 0.05\ m, \quad a_c = 2.4\ \frac{m}{s^2} \leftarrow, \quad v_c = 1.5\ \frac{m}{s} \leftarrow$



a) FIND α_A AND α_B

CASTER



$\vec{a}_A = \vec{a}_c = (-2.4)\hat{i}\ \frac{m}{s^2}$

$\vec{v}_A = \vec{v}_c = (-1.5)\hat{i}\ \frac{m}{s}$

$v_{A'} = 0, \quad (a_{A'})_x = 0$ NO SLIPPING

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

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

$$\omega\hat{k} \times \vec{r}_{A'/A} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & \omega \\ 0 & -0.025 & 0 \end{vmatrix} = [0 - (\omega)(-0.025)]\,\hat{i}$$

$$= (0.025\omega)\,\hat{i}\ \frac{m}{s^2}$$

$$0 = (-1.5)\hat{i} + (0.025\omega)\hat{i} \Rightarrow \omega = 60\ \frac{RAD}{s}$$

$$\alpha\hat{k} \times \vec{r}_{A'/A} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & \alpha \\ 0 & -0.025 & 0 \end{vmatrix} = [0 - (\alpha)(-0.025)]\,\hat{i}$$

$$= (0.025\alpha)\,\hat{i}\ \frac{m}{s^2}$$

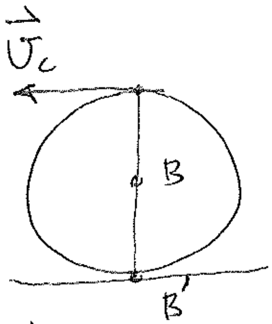
PROB. 15-112 CONT.

$$\vec{a}_{A'} = (-2.4)\hat{i} + (0.025\alpha)\hat{i} - (60)^2(-0.025)\hat{j}$$

$$\vec{a}_{A'} = (0.025\alpha - 2.4)\hat{i} + (90)\hat{j} \ \frac{m}{s^2}$$

$$(a_{A'x}) = 0 \ ; \ 0.025\alpha - 2.4 = 0 \Rightarrow \boxed{\alpha = 96 \ \frac{\text{RAD}}{s^2}}$$

CYLINDER



$\vec{v}_c = (-1.5)\hat{i} \ \frac{m}{s}$, $\vec{v}_{B'} = 0$

$(a_{B'x}) = 0$ NO SLIPPING

$(a_{By}) = 0$ NO Y-DIRECTION ACCELERATION

$$\vec{v}_{B'} = \vec{v}_c + \omega\hat{k} \times \vec{r}_{B'/c}$$

$$\omega\hat{k} \times \vec{r}_{B'/c} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & \omega \\ 0 & -0.05 & 0 \end{vmatrix} = [0 - (\omega)(-0.05)]\hat{i}$$

$$= (0.05\omega)\hat{i}$$

$$0 = (-1.5)\hat{i} + (0.05\omega)\hat{i} \Rightarrow \omega = 30 \ \frac{\text{RAD}}{s}$$

$$\vec{a}_{B'} = \vec{a}_c + \alpha\hat{k} \times \vec{r}_{B'/c} - \omega^2 \vec{r}_{B'/c}$$

$$\vec{a}_{B'} = \cancelto{0}{(a_{B'x})}\hat{i} + (a_{B'y})\hat{j} = (a_{B'y})\hat{j}$$ NO SLIPPING

$$\vec{a}_c = (a_{Cx})\hat{i} + (a_{Cy})\hat{j} = (-2.4)\hat{i} + (a_{Cy})\hat{j}$$

PROB. 15-112 CONT.

$$\alpha\hat{k}\times\vec{r}_{B'/C} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & \alpha \\ 0 & -0.05 & 0 \end{vmatrix} = [0-(\alpha)(-0.05)]\hat{i}$$

$$=(0.05\alpha)\hat{i}$$

$$-\omega^2\vec{r}_{B'/C} = -(30)^2(-0.05)\hat{j} = (45)\hat{j}\ \frac{m}{s^2}$$

$$(a_{B'y})\hat{j} = (-2.4)\hat{i} + (a_{Cy})\hat{j} + (0.05\alpha)\hat{i} + (45)\hat{j}$$

X-DIRECTION: $0 = -2.4 + 0.05\alpha \Rightarrow \boxed{\alpha = 48\ \frac{RAD}{S}}$

Y-DIRECTION: $a_{B'y} = a_{Cy} + 45$

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

$$\vec{a}_B = (a_{Bx})\hat{i} + \cancelto{0}{(a_{By})}\hat{j} = (a_{Bx})\hat{i}$$ NO Y-DIR. ACCEL.

$$\vec{a}_C = (-2.4)\hat{i} + (a_{Cy})\hat{j}$$

$$\alpha\hat{k}\times\vec{r}_{B/C} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & 48 \\ 0 & -0.025 & 0 \end{vmatrix} = [0-(48)(-0.025)]\hat{i}$$

$$=(1.2)\hat{i}\ \frac{m}{s^2}$$

$$-\omega^2\vec{r}_{B/C} = -(30)^2(-0.025)\hat{j} = (22.5)\hat{j}\ \frac{m}{s^2}$$

$$(a_{Bx})\hat{i} = (-2.4)\hat{i} + (a_{Cy})\hat{j} + (-1.2)\hat{i} + (22.5)\hat{j}$$

PROB. 15-112 CONT.

X- DIRECTION: $a_{Bx} = -2.4 + 1.2 = -1.2 \ \frac{m}{s^2}$

$$\boxed{\vec{a}_B = (-1.2)\,\hat{i} \ \frac{m}{s^2}}$$

Y- DIRECTION: $0 = a_{cy} + 22.5$

$a_{cy} = -22.5 \ \frac{m}{s^2}$

$\vec{a}_c = (-2.4)\,\hat{i} + (-22.5)\,\hat{j} \ \frac{m}{s^2}$

$a_{B'y} = a_{cy} + 45 = (-22.5) + 45 = 22.5 \ \frac{m}{s^2}$

$\vec{a}_{B'} = (22.5)\,\hat{j} \ \frac{m}{s^2}$