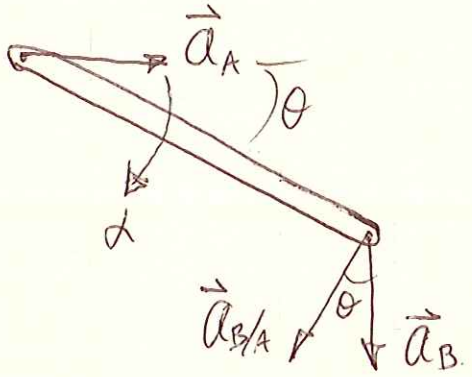
PROB. 16-117

$m = 10^{kg}$, $\theta = 25°$, $L = 1.2^{m}$, FIND α, A_y, B_x

KINEMATICS



$$\vec{a}_B = \vec{a}_A + \vec{a}_{B/A}$$

$$\vec{a}_A = (a_A)\hat{i}, \quad \vec{a}_B = (-a_B)\hat{j}$$

$$\vec{a}_{B/A} = L\alpha\left[(-\sin\theta)\hat{i} + (-\cos\theta)\hat{j}\right]$$

$$(-a_B)\hat{j} = (a_A)\hat{i} + (-L\alpha\sin\theta)\hat{i} + (-L\alpha\cos\theta)\hat{j}$$

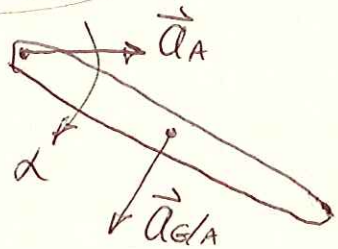
X-DIRECTION:

$$0 = a_A - L\alpha\cdot\sin\theta \Rightarrow \boxed{a_A = L\alpha\sin\theta}$$

Y-DIRECTION:

$$-a_B = -L\alpha\cos\theta \Rightarrow \boxed{a_B = L\alpha\cos\theta}$$

ACCELERATION OF POINT G:



$$\vec{a}_G = \vec{a}_A + \vec{a}_{G/A}$$

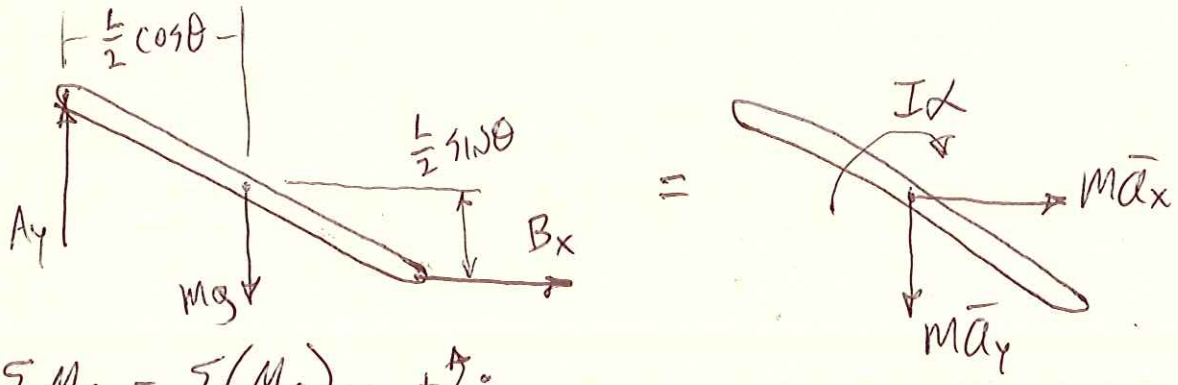
$$\vec{a}_{G/A} = \left(\frac{L}{2}\right)\alpha\left[(-\sin\theta)\hat{i} + (-\cos\theta)\hat{j}\right]$$

$$\vec{a}_G = (L\alpha\sin\theta)\hat{i} + \left(\frac{L}{2}\right)\alpha\left[(-\sin\theta)\hat{i} + (-\cos\theta)\hat{j}\right]$$

$$\boxed{\vec{a}_G = \left(\frac{L}{2}\alpha\sin\theta\right)\hat{i} + \left(-\frac{L}{2}\alpha\cos\theta\right)\hat{j}}$$

PROB. 16-117 CONT.

KINETICS



$\Sigma M_G = \Sigma (M_G)_{EFF}$ $+\circlearrowleft$:

$$-A_y\left(\frac{L}{2}\cos\theta\right) + B_x\left(\frac{L}{2}\sin\theta\right) = -I\alpha = -\frac{1}{12}mL^2\alpha$$

$\Sigma F_x = ma_x$: $\boxed{B_x = m\bar{a}_x = m\left(\frac{L}{2}\right)\alpha\sin\theta}$

$\Sigma F_y = ma_y$: $A_y - mg = -m\bar{a}_y = -m\left(\frac{L}{2}\right)\alpha\cos\theta$

$$\boxed{A_y = mg - m\left(\frac{L}{2}\right)\alpha\cos\theta}$$

$$-\left[mg - m\left(\frac{L}{2}\right)\alpha\cos\theta\right]\left(\frac{L}{2}\cos\theta\right) + \left[m\left(\frac{L}{2}\right)\alpha\sin\theta\right]\left(\frac{L}{2}\sin\theta\right) = -\frac{1}{12}mL^2\alpha$$

$$-g\left(\frac{L}{2}\right)\cos\theta + \left(\frac{L}{2}\right)^2\alpha\cdot\cos^2\theta + \left(\frac{L}{2}\right)^2\alpha\cdot\sin^2\theta = -\frac{L^2}{12}\alpha$$

$$-g\left(\frac{L}{2}\right)\cos\theta + \left(\frac{L^2}{4}\right)\alpha = -\frac{L^2}{12}\alpha$$

$$\left(\frac{L^2}{4}\right)\alpha + \left(\frac{L^2}{12}\right)\alpha = g\left(\frac{L}{2}\right)\cos\theta$$

$$\left(\frac{L^2}{3}\right)\alpha = g\left(\frac{L}{2}\right)\cos\theta$$

PROB. 16-117 CONT.

$$\alpha = \frac{3g\cos\theta}{2L} = \frac{3\left(9.81\ \frac{m}{s^2}\right)\cos 25^\circ}{2(1.2\ m)} = 11.11\ \frac{RAD}{s^2}\ \curvearrowright$$

$$A_y = (10\ kg)\left(9.81\ \frac{m}{s^2}\right) - (10\ kg)\left(\frac{1.2\ m}{2}\right)\left(11.11\ \frac{RAD}{s^2}\right)\cos 25^\circ$$

$$A_y = 37.66\ N\ \uparrow$$

$$B_x = (10\ kg)\left(\frac{1.2\ m}{2}\right)\left(11.11\ \frac{RAD}{s^2}\right)\cdot \sin 25^\circ = 28.17\ N\ \rightarrow$$