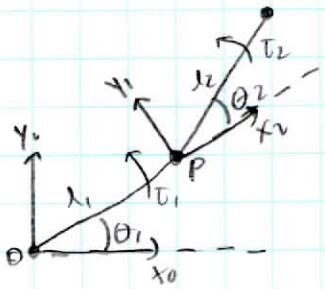
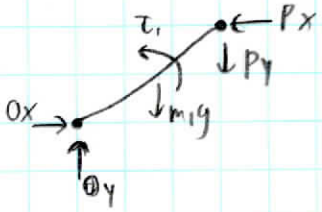
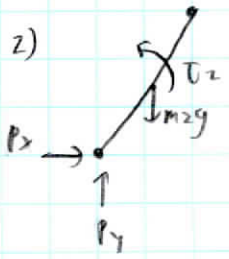


- Separate each link into a FBD

1)



2)



(1)

$$\Sigma F_y = m a_{y1} = O_y - m_1 g - P_y$$

$$\Sigma F_x = m a_{x1} = P_x - O_x$$

$$\Sigma M_O = I_1 \alpha_1 = \tau_1 - m_1 g \frac{l_1}{2} \cos(\theta_1) - P_y l_1 \cos(\theta_1) + P_x l_1 \sin(\theta_1)$$

(2) $\Sigma F_y = m_2 a_{y2} = P_y - m_2 g$

$\Sigma F_x = m_2 a_{x2} = P_x$

$\Sigma M_P = I_2 \alpha_2 = \tau_2 - m_2 g \frac{l_2}{2} \cos(\theta_2)$

$a_y = \ddot{y}$, $a_x = \ddot{x}$, $\alpha = \ddot{\theta}$

small angle approximation

$\cos(\theta) \approx 1$

$\sin(\theta) \approx \theta$

(1)

$$m_1 \ddot{y}_1 = O_y - m_1 g - P_y \quad , \quad m_1 \ddot{x}_1 = P_x - O_x$$

$$I_1 \ddot{\theta}_1 = \tau_1 + P_x l_1 \theta_1 - m_1 g \frac{l_1}{2} - P_y l_1$$

(2) $m_2 \ddot{y}_2 = P_y - m_2 g$, $m_2 \ddot{y}_2 = P_x$

$$I_2 \ddot{\theta}_2 = \tau_2 - m_2 g \frac{l_2}{2}$$