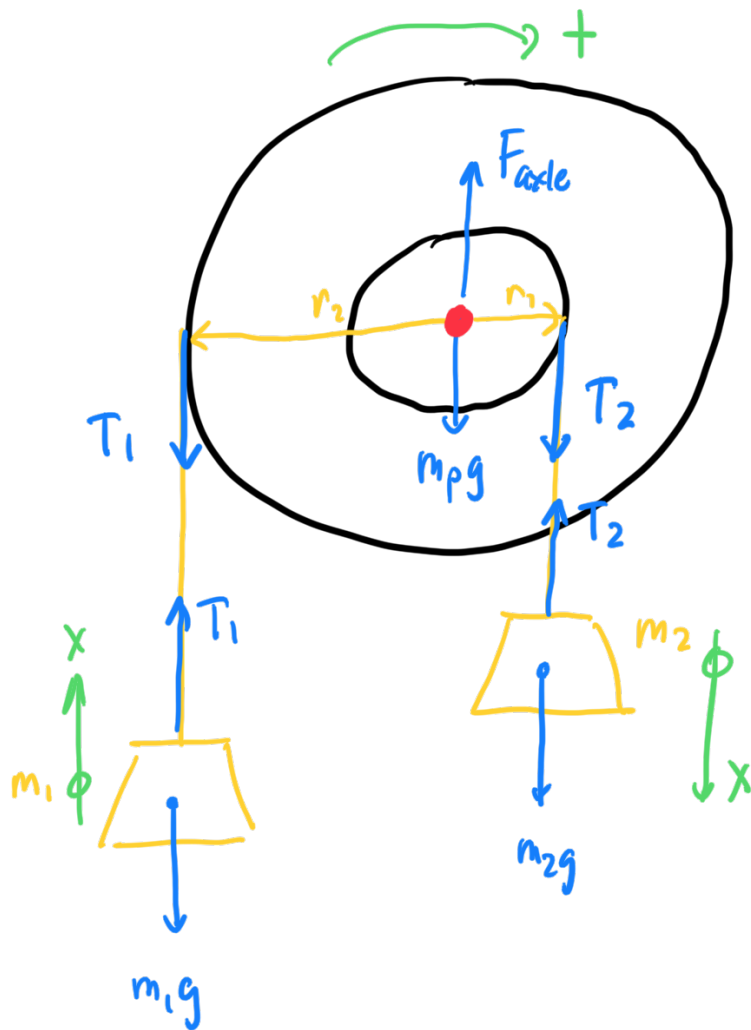


Assignment 7 - Question 9



$$m_1: \quad T_1 - m_1 g = m_1 a_{1x}$$

$$m_2: \quad m_2 g - T_2 = m_2 a_{2x}$$

$$..: \quad T r_2 - T_1 r_1 = I \alpha$$

pulling:

12.4

Relationships between a_{1x} , a_{2x} , and α :

$$\begin{aligned} a_{1x} &= r_1 \alpha \\ a_{2x} &= r_2 \alpha \end{aligned}$$

$$\begin{aligned} \textcircled{1} \quad T_1 - m_1 g &= m_1 r_1 \alpha \end{aligned}$$

$$\textcircled{2} \quad m_2 g - T_2 = m_2 r_2 \alpha$$

$$\textcircled{3} \quad T_2 r_2 - T_1 r_1 = I \alpha$$

multiply equation $\textcircled{1}$ by r_1 , and multiply equation $\textcircled{2}$ by r_2 :

$$\textcircled{1} \quad T_1 r_1 - m_1 r_1 g = m_1 r_1^2 \alpha$$

$$\textcircled{2} \quad m_2 r_2 g - T_2 r_2 = m_2 r_2^2 \alpha$$

$$\textcircled{3} \quad T_2 r_2 - T_1 r_1 = I \alpha$$

Add all three equations together:

$$m_2 r_2 g - m_1 r_1 g = (m_1 v_1^2 + m_2 v_2^2 + I) \times \alpha$$

$$\alpha = \frac{m_2 r_2 g - m_1 r_1 g}{(m_1 r_1^2 + m_2 r_2^2 + I)}$$

For my problem, I had:

$$m_1 = 1.0 \text{ kg}$$

$$m_2 = 2.2 \text{ kg}$$

$$r_1 = 0.53 \text{ m}$$

$$r_2 = 0.20 \text{ m}$$

$$I = 2.1 \text{ kg} \cdot \text{m}^2$$

$$g = 9.80 \text{ m/s}^2$$

$$\alpha = \frac{(2.2)(.2)(9.8) - (1.0)(.53)(9.8)}{((1.0)(.53)^2 + (2.2)(.20)^2 + 2.1)}$$

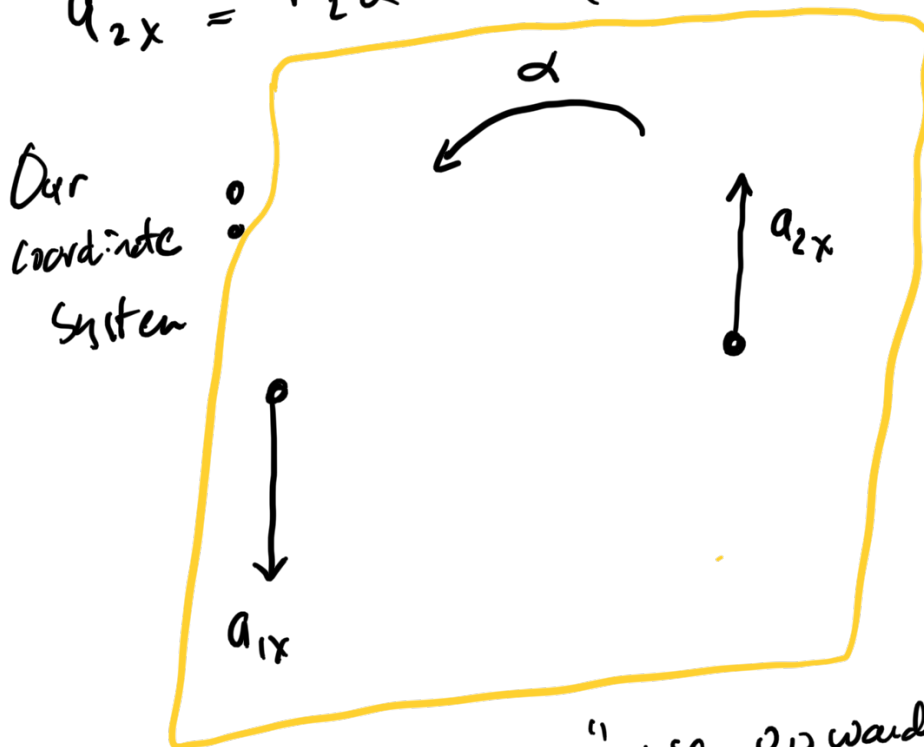
= 0.8820

$$= \frac{-0.0000}{2.4689}$$

$$\alpha = -0.357 \text{ rad/s}^2$$

$$a_{1x} = r_1 \alpha = (0.53)(-0.357) = -0.189 \text{ m/s}^2$$

$$a_{2x} = r_2 \alpha = (.20)(-0.357) = -0.0714 \text{ m/s}^2$$



WebAssign says "use upwards as the positive direction". So, in their coordinate system \rightarrow

$$a_{1x} = -0.189 \text{ m/s}^2 \quad (\text{down})$$

$$\ddot{a}_{2x} = + 0.0714 \text{ m/s}^2 \quad \text{up}$$