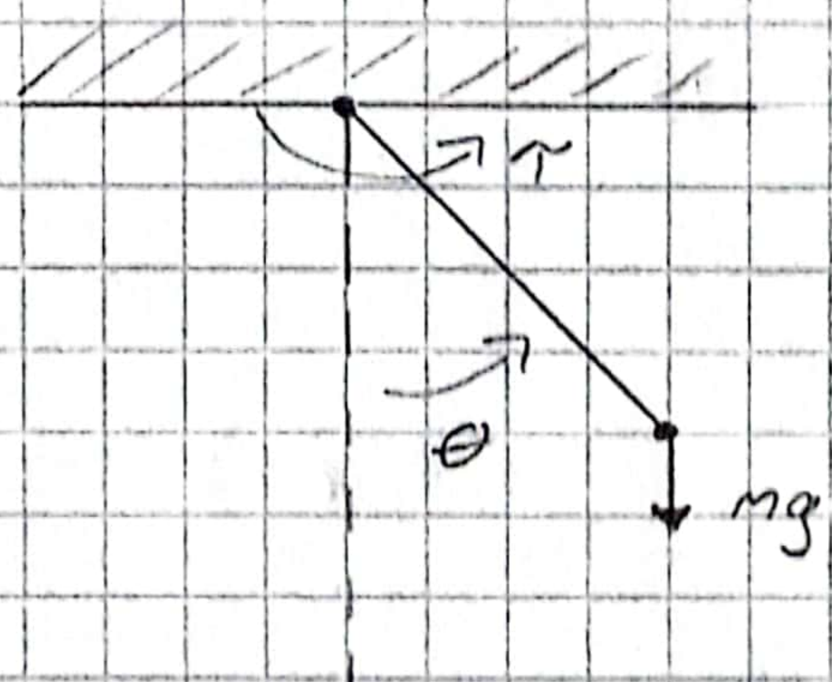
DD MM AA

a)



- Find the state matrix

r The state equation for the mass

$$\tau = mgl\sin(\theta) + I\ddot{\theta}$$

r The moment of inertia about the Pivot is

$$I = ml^2 \rightarrow \tau = mgl\sin(\theta) + ml^2\ddot{\theta}$$

r The state equation

$$\ddot{\theta} = \frac{\tau}{ml^2} - \frac{g}{l}\sin(\theta)$$

r if we coosider the angular motion too small we can affirm

$$\sin(\theta) \simeq \theta \quad if \quad \theta << 1$$

$$\ddot{\theta} = \frac{\tau}{ml^2} - \frac{g}{l}\theta \qquad (1)$$

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✓ The state variable is

$$q_1 = \theta_1 \; ; \quad \dot{q}_1 = \dot{\theta}_1$$

$$\dot{q}_1 = -\frac{g}{l} q_1 + \frac{\tau}{ml^2} \qquad (2)$$

✓ The state matrix is

$$\begin{bmatrix} \dot{q}_1 \end{bmatrix} = \begin{bmatrix} -\frac{g}{l} \end{bmatrix} \begin{bmatrix} q_1 \end{bmatrix} + \begin{bmatrix} \frac{1}{ml^2} \end{bmatrix} \tau$$

$$\begin{bmatrix} \theta \end{bmatrix} = \begin{bmatrix} 1 \end{bmatrix} \begin{bmatrix} q_1 \end{bmatrix}$$