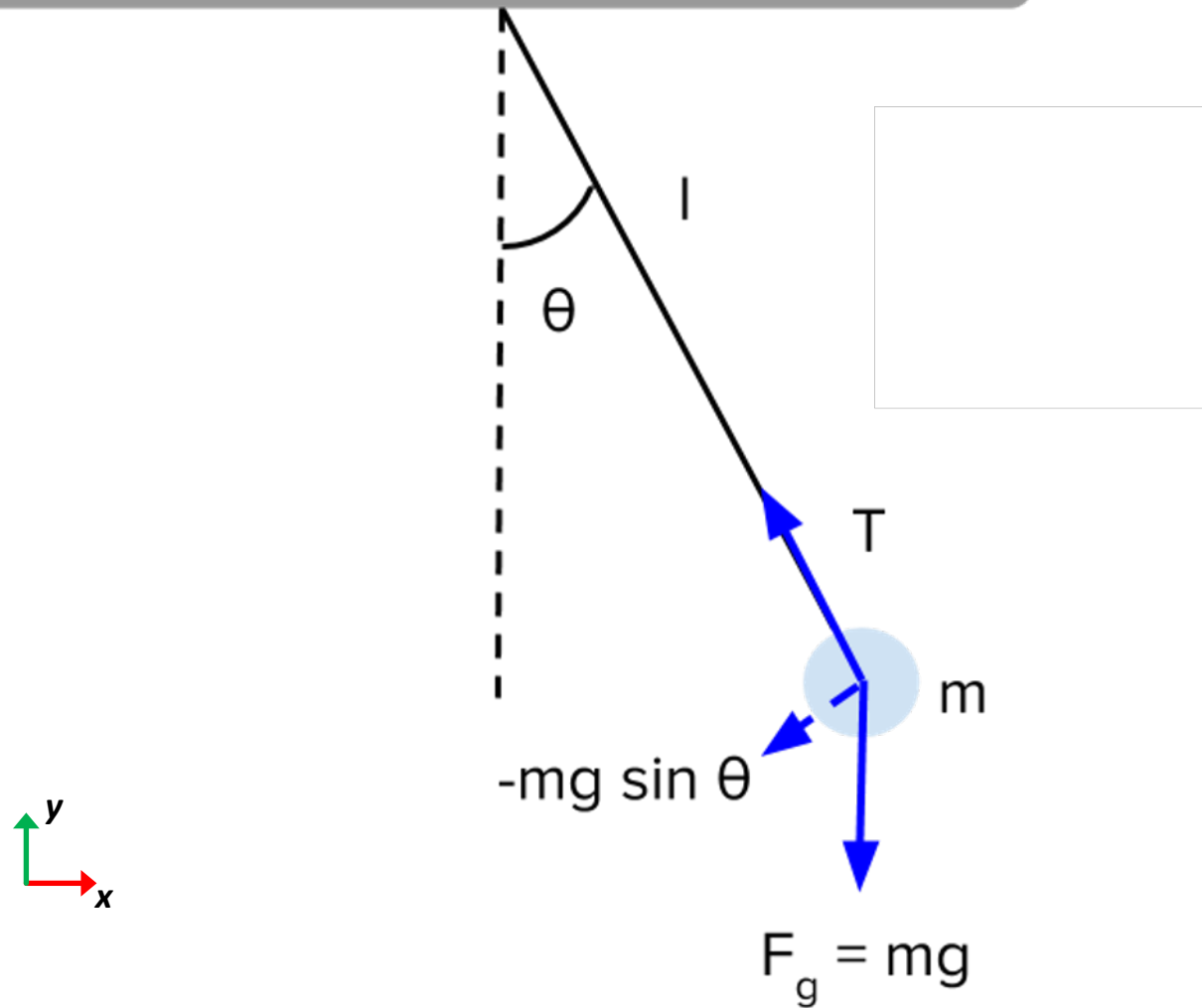


# Pendulum Modeling



$$I\ddot{\theta} \cdot \hat{z} = \vec{r} \times \vec{F}_g + u \cdot \hat{z}$$

$$I\ddot{\theta} \cdot \hat{z} = (-mgl \sin \theta + u) \cdot \hat{z}$$

$$I\ddot{\theta} = -mgl \sin \theta + u$$

$$I = ml^2, \quad u = 0$$

$$\ddot{\theta} = -\frac{g}{l} \sin \theta$$

$$\dot{\mathbf{x}} = \mathbf{f}(\mathbf{x}, t), \quad \begin{cases} x_1 = \theta \\ x_2 = \dot{\theta} \end{cases}$$

$$\dot{\mathbf{x}} = \begin{pmatrix} \dot{x}_1 \\ \dot{x}_2 \end{pmatrix} = \underbrace{\begin{pmatrix} x_2 \\ -\frac{g}{l} \sin x_1 \end{pmatrix}}_{\mathbf{f}(\mathbf{x}, t)}$$