Consider a simple pendulum of length l at angle θ from the vertical (see illustration). The pendulum is massless, but has a mass m at the end. We assume that we are working on scales at which the force due to gravity is a constant g.

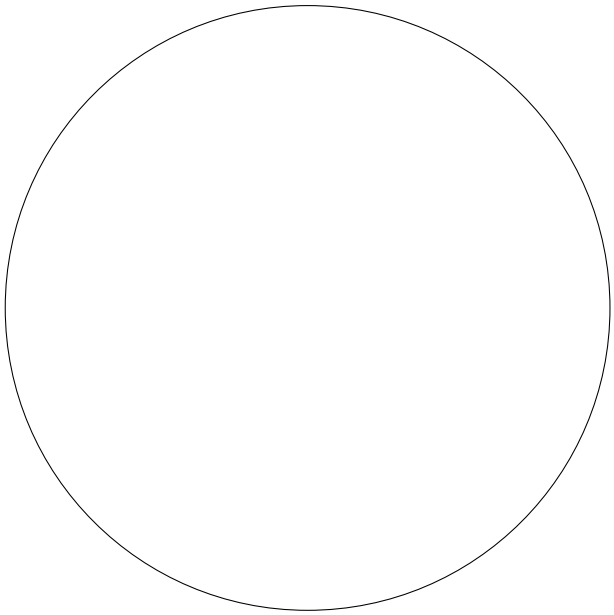

Figure 1: The pendulum apparatus

Theorem 0.1.

$$E_K = \frac{m}{2} l^2 \dot{\theta}^2 \tag{1}$$

$$E_P = l(1 - cos(\theta))mg \tag{2}$$

Equating the two gives us a differential equation for θ

$$\dot{\theta}^2 = \frac{g}{l}(1 - cos(\theta)) \tag{3}$$

$$\dot{\theta} = \sqrt{\frac{g}{l}(1 - cos(\theta))} \tag{4}$$