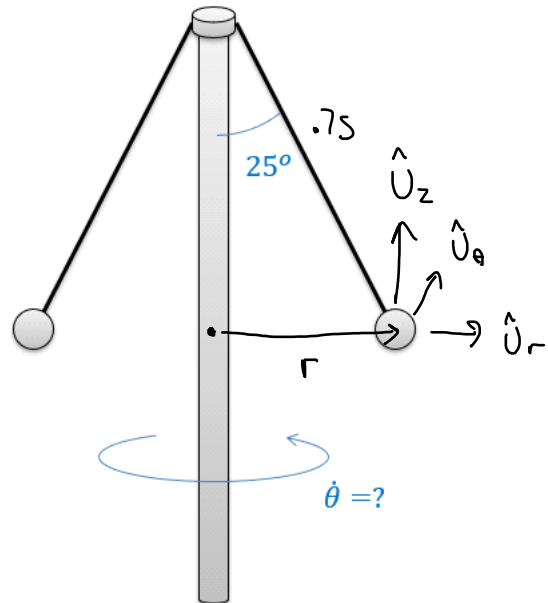


## Problem 1

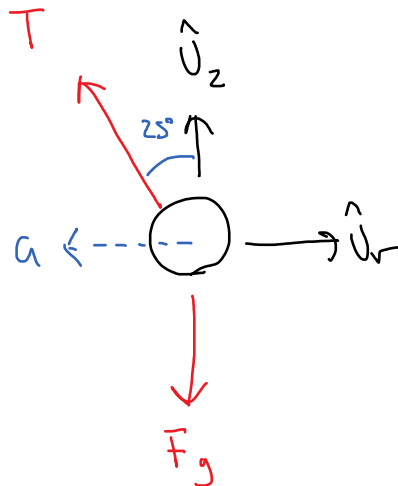
# Kinetics with Polar Coordinates

## Worked Example

- A device consists of two  $\frac{1}{2}$  kg masses tethered to a central shaft. The tethers are each .75 meters long and each tether currently makes 25 degree angle with the central shaft. Assume the central shaft is spinning at a constant rate.
  - What is the rate at which the shaft is spinning?
  - If we want it to spin at exactly 100 rpm, what should the angle of the tethers be?



5



$$\sum F_z = T \cos(25) - (.5)(9.81) = 0$$

$$T = 5.41 \text{ N}$$

$$\sum F_r = -T \sin(25) = m \left( \ddot{r} - r \dot{\theta}^2 \right)$$

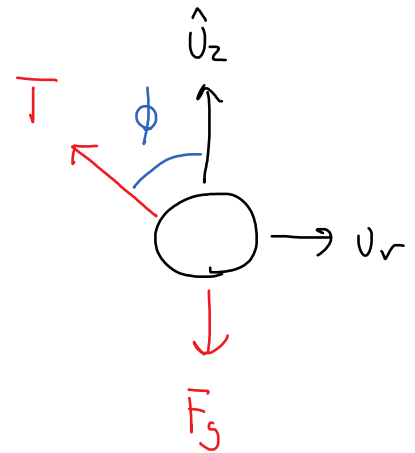
$$r = .75 \sin(25)$$

$$\dot{\theta} = \sqrt{\frac{(5.41) \sin(25)}{(.5) (.75 \sin(25))}} = 3.80 \text{ rad/s}$$

$$100 \text{ rpm} \rightarrow 10.472 \text{ rad/s}$$

$$a_r = \cancel{\ddot{r}} - r \ddot{\theta} = -82.25 \sin \phi$$

$\uparrow$   
 $.75 \sin \phi$



$$\sum F_z = T \cos(\phi) - (.5)(9.81) = 0$$

$$T = \frac{4.905}{\cos(\phi)}$$

$$\sum F_r = -T \sin(\phi) = m(-82.25 \sin \phi)$$

$$\frac{4.905}{\cos \phi} = (.5)(82.25)$$

$$\cos \phi = .119$$

$$\boxed{\phi = 83.15^\circ}$$