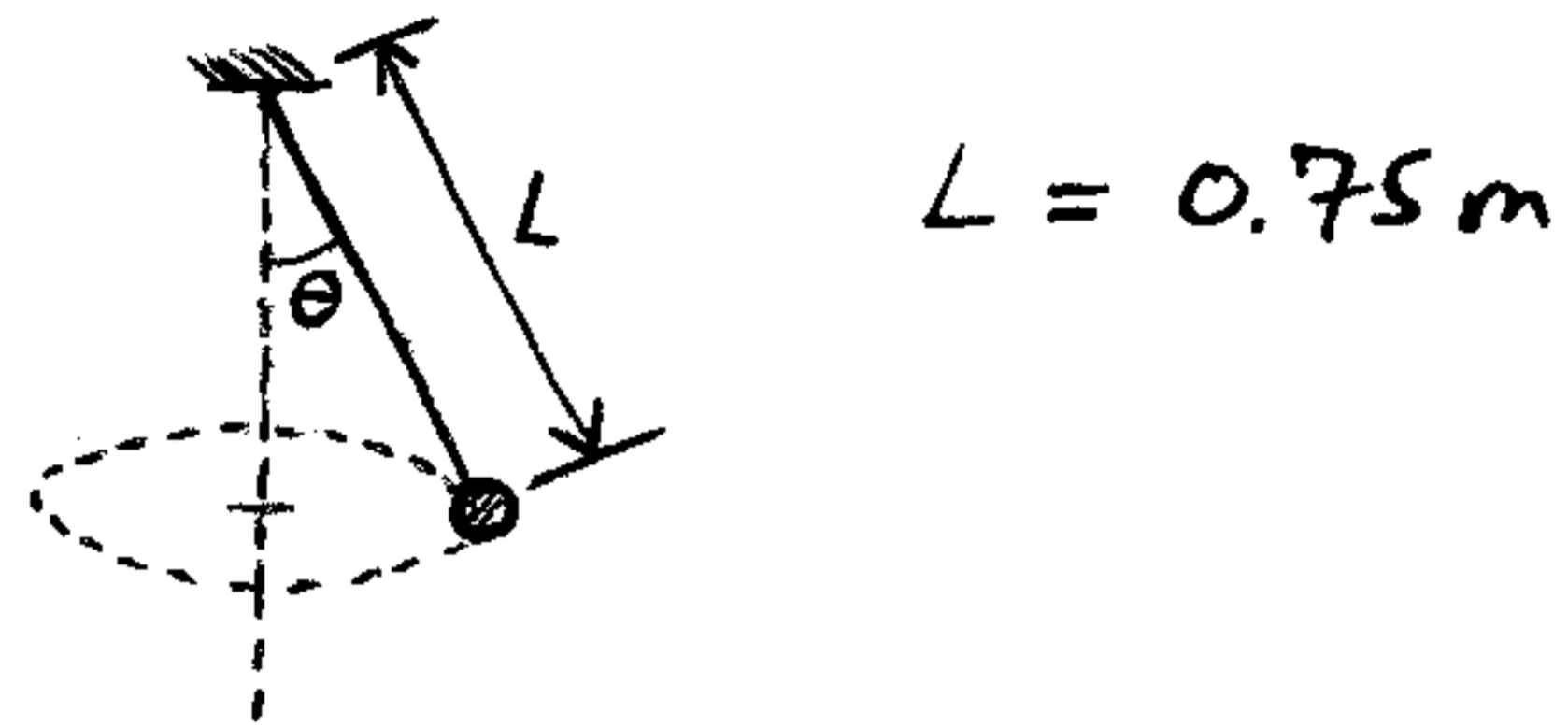
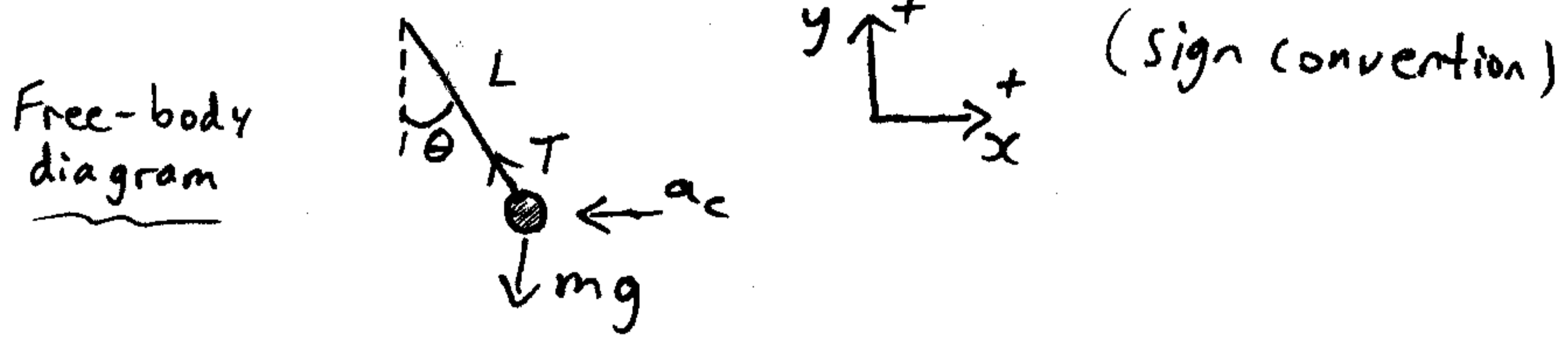


This is a force and motion problem involving uniform circular motion.



A 3 kg ball is attached to a string of length  $L$  and revolves in a horizontal circle, as shown. If the speed of the ball is constant and equal to 2.5 m/s, what is the angle  $\theta$  and the tension in the string?

Solution:



Apply Newton's second law in x-direction:

$$\sum F_x = m a_x \quad , \quad m = 3 \text{ kg}$$

$$\Rightarrow -T \sin \theta = m (-a_c) \quad a_c = \frac{v^2}{R} = \frac{(2.5)^2}{R}$$

$$\Rightarrow -T \sin \theta = 3 \left( \frac{-(2.5)^2}{0.75 \sin \theta} \right) \quad (1) \quad \begin{aligned} R &= L \sin \theta \\ R &= 0.75 \sin \theta \end{aligned}$$

Apply Newton's second law in y-direction:

$$\sum F_y = m a_y, \quad a_y = 0$$

$$\Rightarrow T \cos \theta - mg = m(0)$$

$$\Rightarrow T \cos \theta = 3(9.8) \quad (2)$$

Divide equation (1) by equation (2):

$$\Rightarrow \frac{\sin^2 \theta}{\cos \theta} = 0.85$$

$$\theta = 48.6^\circ \quad (\text{answer})$$

Substitute this in equation (1) or (2)  
and solve for T:

$$T = 44.46 \text{ N} \quad (\text{answer})$$