Flipping Physics Lecture Notes:

Analyzing Water in a Bucket Revolving in a Vertical Circle

Example: What is the minimum angular speed necessary to keep water in a vertically revolving bucket? The rope radius is 0.77 m.

$$\sum F_{in} = F_g + F_T = ma_c \Rightarrow mg + 0 = mr\omega^2 \Rightarrow g = r\omega^2$$

At the "minimum angular speed necessary to keep water in a vertically revolving bucket" the tension in the rope is reduced to zero. At this angular speed the centripetal force is just the force of gravity.

$$\Rightarrow \omega^2 = \frac{g}{r} \Rightarrow \omega = \sqrt{\frac{g}{r}} = \sqrt{\frac{9.81}{0.77}} = 3.5694 \approx \boxed{3.6\frac{rad}{s}}$$