Answer on Question #41991, Physics, Other

A 2.3 kg object is whirled in a vertical circle whose radius is 1.2 m. If the time of one revolution is 0.95 s, what is the tension in the string (assume uniform speed) when it is at the bottom?

Solution:

Given:

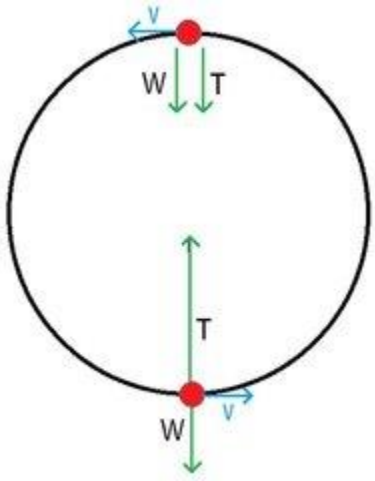
$m = 2.3\ \text{kg},$

$r = 1.2\ \text{m},$

$t = 0.95\ \text{s},$

$g = 9.81\ \text{m/s}^2,$

$T = ?$



If you have a ball on the end of a string and you swing it in a vertical circle the "centripetal force" or the forces causing the acceleration will be a combination of the tension from the string and gravity.

The Tension and Weight are the forces causing the acceleration. The ball is also moving in a circle so at the lowest point

Tension - Weight=CentripetalForce.

Hence,

$$F_{net} = ma = \frac{mv^2}{r} = m\omega^2 r$$

$$T - W = ma$$

Thus,

$$T = ma + W = m\omega^2 r + mg = m(\omega^2 r + g)$$

The angular velocity

$$\omega = \frac{2\pi}{t} = \frac{2 \cdot 3.14159}{0.95} = 6.6139\ \text{rad/s}$$

The tension is

$$T = 2.3\ \cdot (6.6139^2 \cdot 1.2 + 9.81) = 143.3\ \text{N}$$

Answer. $T = 143.3\ \text{N}.$