## Answer on Question #40803, Physics, Mechanics

A ball of mass 50 g tied to the end of a 50 cm inextensible string is whirled around in a vertical circle. Find the tension in the string when the ball is at the top of the circle. Take g=10 m·s$^2$.

**Solution:**

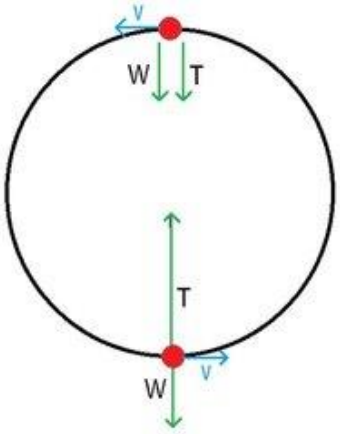
Given:

$m = 50\ \text{g} = 50 \cdot 10^{-3}\text{kg},$

$r = 50\ \text{cm} = 0.5\ \text{m},$

$g = 10\ \text{m/s}^2,$

$T = ?$




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 highest and lowest points

Tension+Weight=CentripetalForce.

Hence,

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

$$T + W = ma$$

Thus,

$$T = ma - W = \frac{mv^2}{r} - mg = m\left(\frac{v^2}{r} - g\right)$$

$$T = m\left(\frac{v^2}{r} - g\right)$$

The tension depends on speed of ball *v*.

You need to know the speed of ball.

If $v = \sqrt{gr}$, then $T = 0$.

If $v > \sqrt{gr}$, then $T > 0$.

**Answer.** $T = m\left(\frac{v^2}{r} - g\right)$.