Answer on Question #55217-Physics-Mechanics-Kinematics-Dynamics

A ball of mass $m = 50\ g = 0.05\ kg$ tied to the end of a $l = 50\ cm = 0.5\ m$ 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 $g = 10\ ms^{-2}$.

Solution

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,

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

The tension depends on speed of ball v.

You need to know the speed of ball.

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

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