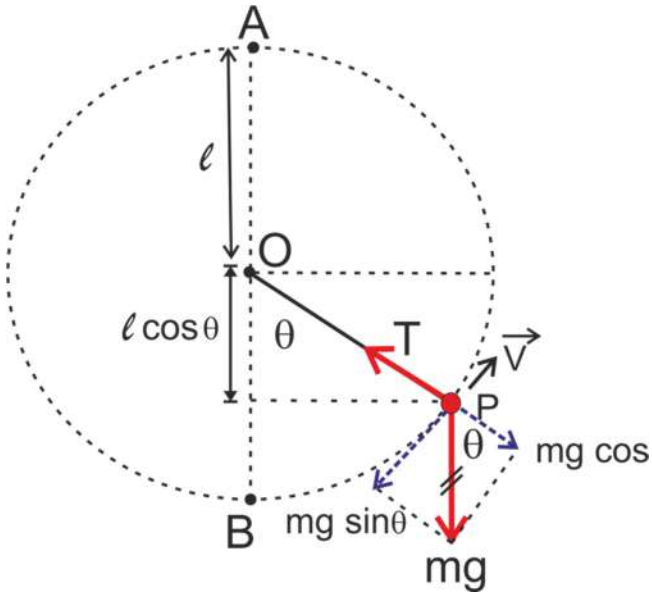
Motion In a Vertical Circle

Let, a particle of mass m is attached to a light and inextensible string. The other end of the string is fixed at O and the particle moves in vertical circle of radius ℓ, which is equal to the length of the string as shown in the fig.



Consider the particle when it is at point P and the string makes as angle θ with vertical. Faces acting on the particle are

T = tension in the string along its length (towards point O)

Mg = weight of the particle vertically downward.

Hence net radial force on the particle is (using formula ma =ΣF along the length of the string)

$$\frac{mv^2}{\ell} = T - mg\cos\theta$$

Where v = speed of the particle at point P

ℓ = radius of the circle

$$\Rightarrow \quad T - mg\cos\theta = \frac{mv^2}{\ell}$$

$$\Rightarrow \quad \boxed{T = \frac{mv^2}{\ell} + mg\cos\theta \quad \text{.....(1)}}$$

Since speed of the particle decreases with height, the tension is maximum at the bottom. So, at the lowest point B where Cos θ = 1