Circular Motion

The basic requirements for an object to complete a cycle while traveling in circular motion are as follows;

1. $Velocity_{min} > 0$
2. $Tension_{min.} \geq 0$ (equals only and if $u^2 \geq 5ga$, where u= initial velocity, g= gravitational acceleration, a= radius of circle)

- When the rope is considered to be threaded through a ring, the tensions of the rope beside the ring are considered as equal.
- When an object is attached to the rope, the tensions beside the attached objects are not unequal.
- When an object leaves from the circular motion, the tension is supposed as zero.

Let us consider an object going through circular motion;

1. Acceleration along the tangent = aΘ̈
2. Acceleration towards the center = $a\dot{\Theta}^2$

To find the inclination angle of descend, apply as T=0, and to find the velocity while descending, substitute the inclination angle.

The difference of circular motions differing on the initial velocity

1. **$0 < u^2 < 2ga$**

Cos Θ1 = $(2ga-u^2)/2ga$

Cos Θ2= $(2ga-u^2)/3ga$

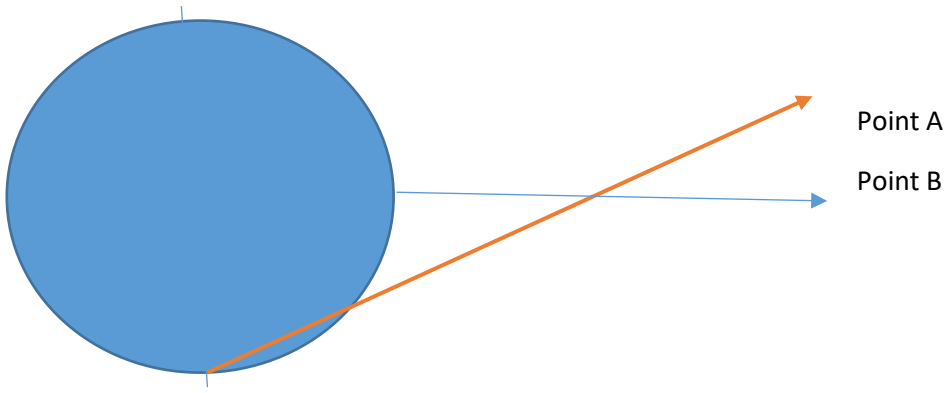
According to the above derivation, the value of Cos Θ1 and Cos Θ2 remains between 0 and 1. Therefore, Θ1 and Θ2 are acute angles.

Hence the velocity becomes initialy zero and the object begins to swing to and fro in acute angles.

2. **$u^2 = 2ga$**

Cos Θ1 = 0, Cos Θ2 = 0.
Therefore, , Θ1 and Θ2 are right angles.

Hence, the object swings to and fro in right angles(swings beside point A in a semi circle)



3. $2ga < u^2 < 5ga$

The object travels in a wider angle and passes point B. The object leaves the circular motion between point C and Point B

$\text{Cos } \Theta 1 = (2ga-u^2)/2ga$

$\text{Cos } \Theta 2= (2ga-u^2)/3ga$

$\text{Cos } \Theta 1 < \text{Cos } \Theta 2$

$\Theta 1 > \Theta 2$

Hence, even though the tension becomes zero, the object will continue to have a velocity, and will leave the circular motion as a projectile.

4. $u^2 = 5ga$

$\text{Cos } \Theta 1 = (2ga-u^2)/2ga < 0$

$\text{Cos } \Theta 2= (2ga-u^2)/3ga < 0,$

Therefore, $\text{Cos } \Theta 2 = \cos \pi$

Hence, the tension becomes zero at the highest point of it's motion, however the object shall still have a velocity and as a result the object will complete it's cycle and journey through circular motion.