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} ≥ 0 (equals only and if u^2 ≥ 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 = a\ddot{\theta}
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 initially 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

$\cos \theta_1 = (2ga-u^2)/2ga$

$\cos \theta_2 = (2ga-u^2)/3ga$

$\cos \theta_1 < \cos \theta_2$

$\theta_1 > \theta_2$

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. $u^2 = 5ga$

$\cos \theta_1 = (2ga-u^2)/2ga < 0$

$\cos \theta_2 = (2ga-u^2)/3ga < 0,$

Therefore, $\cos \theta_2 = \cos \pi$

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.