

Tarzan ($m = 85.0 \text{ kg}$) tries to cross a river by swinging from a vine. The vine is 10.0 m long, and his speed at the bottom of the swing (as he just clears the water) will be 8.00 m/s . Tarzan doesn't know that the vine has a breaking strength of 1000 N . Does he make it safely across the river?

As Tarzan swings, he moves on a circular path of radius equal to the length of vine which is 10.0 m and his speed will be maximum at the bottom of the swing.

When a body is moving on a circular path it is having acceleration towards the center of the circular path called centripetal acceleration and its magnitude is given by V^2/R where v is the speed and R is the radius of the circular path.

The tension in the vine has to balance the weight of the Tarzan and also to provide the required centripetal force hence writing the equation of motion we have

$$T - mg = \frac{mv^2}{R}$$

Or
$$T = mg + \frac{mv^2}{R} = 85.0 * 9.8 + \frac{85.0 * 8.0^2}{10.0} = 833.0 + 544.0 = 1377 \text{ N}$$

Hence the maximum tension in the vine during the swing 1377 N is more than the tension can be supported by it and hence the vine will break in between and Tarzan will not be able to cross the river.

