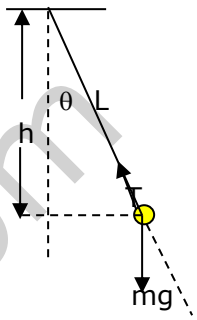
A 1.9 kg ball is attached to the lower end of a length of fishline with a breaking strength of 35 N. The top end of the fishing line is held stationary. The ball is released from rest with the line taut and horizontal. At what angle (measured from the vertical) will the fishline break?

Answer:

As the tension on the string becomes just greater than the breaking strength, it will break. Let this happens at an angle θ to the vertical then (if L is the length of the string)

loss in its height h = L cos θ.

Loss in its Potential energy = mgL cos θ.



If at this point its speed is v, then using conservation of energy

Gain in Kinetic energy = loss in potential energy or

$(1/2)\ mv^2 = mgL \cos\theta$. .....(1)

Now as the ball is moving on a circular path of radius L, a centripetal force is required. This centripetal force is provided by the resultant of tension and the component of mg along radial direction. So writing the force equation

$T - mg \cos\theta = mv^2/L$

Substituting for v^2 from equation (1) we get

$T - mg \cos\theta = 2mg \cos\theta$.

This gives

$\cos\theta = T/(3mg) = 35/(3*1.9*9.8 = 0.627$. and

$\theta = 51.2^0$