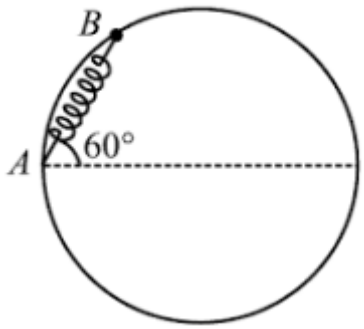
Answer on Question #64345-Physics-Mechanics-Relativity

A bead of mass m is attached to one end of a spring of natural length $\sqrt{3}\,R$ and spring constant $k = \frac{(\sqrt{3}+1)mg}{R}$. The other end of the spring is fixed at point A on a smooth fixed vertical ring of radius R as shown in the figure. What is the normal reaction at B just after the bead is released?

Solution



$$x = 2R\cos 60 = 2R\frac{1}{2} = R.$$

$$l - x = \sqrt{3}\,R - R = \left(\sqrt{3} - 1\right)R$$

The spring force is

$$F_s = k(l - x) = \frac{\left(\sqrt{3} + 1\right)mg}{R}\left(\sqrt{3} - 1\right)R = 2mg.$$

The weight is

$$W = mg.$$

The projection of spring force on the normal is

$$-2mg\cos 60 = 2mg\frac{1}{2} = -mg.$$

The projection of weight on the normal is

$$mg\sin 60 = mg\frac{\sqrt{3}}{2}.$$

The sum of all forces in the normal direction must be zero:

$$N - mg + mg\frac{\sqrt{3}}{2} = 0$$

$$N = \left(1 - \frac{\sqrt{3}}{2}\right)mg.$$

Answer: $\boldsymbol{\left(1 - \frac{\sqrt{3}}{2}\right)mg}$.