Answer on Question#56937 - Physics – Mechanics | Relativity

A bob of mass m attached with a string of length l tied to a point on ceiling is released from a position when its string is horizontal. At the bottom most point of its motion, an identical mass m gently stuck to it. Find the angle from the vertical to which it rises.

Solution:

Applying the law of conservation to the initial moment and the moment right before the collision with the second bob, we obtain:

$$\frac{mv^2}{2} = mgl,$$

Where v – is the speed of the first bob right before the collision.

Therefore

$$v = \sqrt{2gl}$$

Since the collision is inelastic, then according to the law of conservation of momentum the new speed v' of the system is

$$v' = \frac{mv}{2m} = \frac{1}{2}\sqrt{2gl} = \sqrt{\frac{gl}{2}}$$

According to the law of conservation of energy the final elevation of the system is given by

$$h = \frac{v'^2}{2g} = \frac{gl/2}{2g} = \frac{l}{4}$$

Thus two bobs at moment of maximum elevation are $l - h = \frac{3}{4}l$ below the ceiling.

The required angle is given by

$$\theta = \operatorname{acos}\frac{l-h}{l} = \operatorname{acos}\frac{3}{4} \approx 41.41°$$

Answer: $\operatorname{acos}\frac{3}{4} \approx 41.41°$.

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