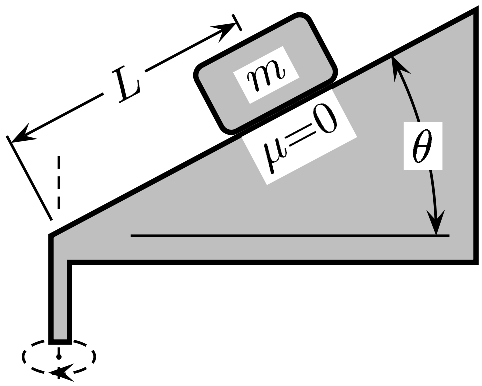
A child's toy consists of a wedge with an angle θ. The wedge is spinning at a constant speed by rotating a rod that is firmly attached to one end. On the wedge, the block can freely slide along the slope. The wedge has enough traction so that the block will not slide along the tangential direction due to the rotation. When the wedge has an angular velocity ω, the equilibrium position occurs at L.



As ω increase, what is the corresponding new equilibrium Length L'?

A) $L' > L$.

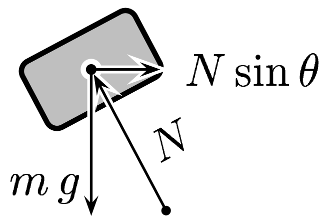
B) $L' = L$.

C) $L' < L$.

Explanation: At equilibrium the normal force N satisfies the relations

$$\sum F_y : \quad N \cos\theta - m\, g = 0 \qquad \text{and} \tag{1}$$

$$\sum F_x : \quad N \sin\theta = m\, a_c = m\, \frac{v^2}{r} = m\, \omega^2\, r = m\, \omega^2\, L \cos\theta\,. \tag{2}$$



Equation 1 implies that N is independent of ω.

Equation 2 gives $N \tan\theta = m\, \omega^2\, L$.

So as ω increases, the new equilibrium length along the ramp must decrease in order to arrive at the same N value, consequently equilibrium is reached at $L' < L$.

Answer **C**.

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