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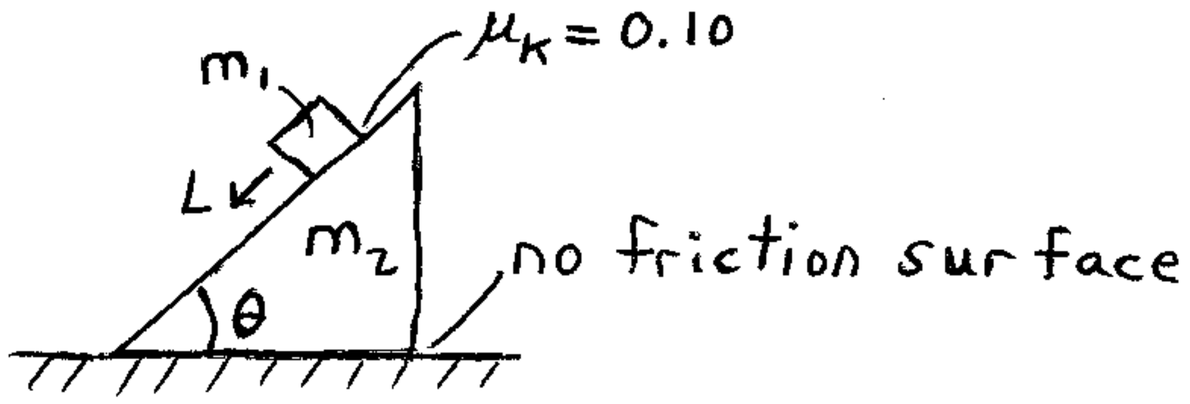
This is a problem involving systems of particles.



In the system shown, a mass m_1 slides a distance L down an incline of mass m_2. How far does the incline slide along the surface, and in what direction?

Solution:

Choose a point (any point) as a reference point from which to measure the horizontal location of the center of mass of the system. So pick a point somewhere to the left of the incline, and choose the rightward direction as positive. Then the location of the center of mass of the system, before and after the mass slides, stays constant.

Before: $\longrightarrow +$

$$R_{cm_1} = \frac{r_1 m_1 + r_2 m_2}{m_1 + m_2}$$

horizontal location of system center of mass

After:

$$R_{cm_2} = \frac{(r_1 - L\cos\theta + S)m_1 + (r_2 + S)m_2}{m_1 + m_2}$$

$\sum F_{ext} = 0$, for system, in horizontal direction

where r_1 is the distance from the reference point to the center of mass of the block, and r_2 is the distance from the reference point to the center of mass of the incline.

S is the sliding distance of incline.

$$R_{cm_1} = R_{cm_2}$$

$$\Rightarrow \quad r_1 m_1 + r_2 m_2 = (r_1 - L\cos\theta + S)m_1 + (r_2 + S)m_2$$

$$\Rightarrow \quad 0 = (-L\cos\theta + S)m_1 + S m_2$$

$$\Rightarrow \quad S = \frac{m_1 L\cos\theta}{m_1 + m_2} \longrightarrow \text{(answer)}$$

Note that μ_K (kinetic friction) has <u>no</u> effect on the answer.