

Dynamics of a Wedge System

Problem Statement

Consider the mechanical system depicted in the figure below. The system consists of:

- A lower wedge of mass M .
- An upper wedge of mass m .
- An object resting on the upper wedge, also of mass m .

The angle of the inclined surface is $\alpha = 45^\circ$. All surfaces are frictionless, and the acceleration due to gravity is g .

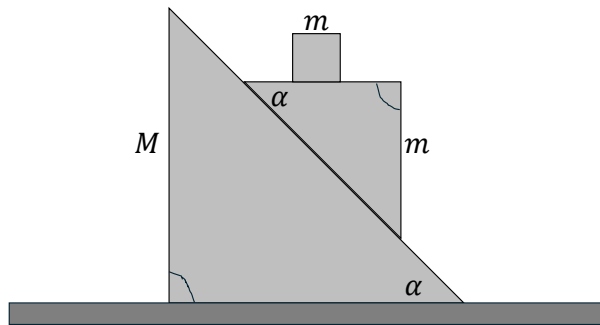


Figure 1: Schematic representation of the wedge system.

Tasks

1. Perform a force analysis for each component of the system. Draw a free-body diagram illustrating all forces acting on the wedges and the object. **(2 points)**

2. Formulate the equations of motion for the system. **(2 points)**
3. Establish the relationship between the accelerations of the masses. Derive the necessary equation(s). *Hint: Consider the geometrical constraints and draw an auxiliary diagram to aid in the motion analysis.* **(3 points)**
4. Solve the system of linear equations to determine the accelerations of the masses in terms of the given parameters. **(3 points)**

Note: You may *alternatively* choose to analyze the problem using an accelerated frame of reference. If so, you can follow the same steps outlined above while considering the appropriate fictitious forces and constraints.

Submission Deadline: March 6, 2025.