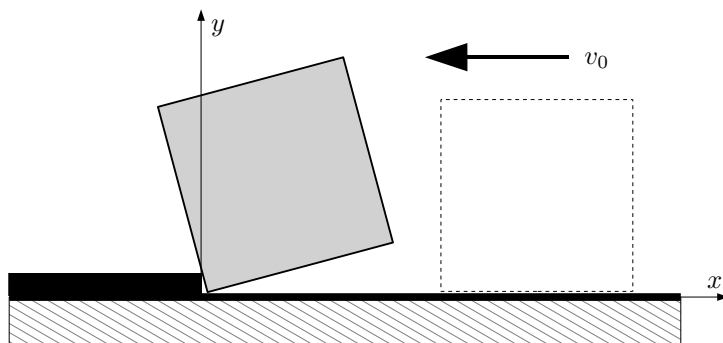


## 1 A Sliding Block Hits a Small Step



A uniform cube with side length  $a$  and mass  $M$  slides on a flat frictionless plane. The cube initially has a speed of  $v_0$  and is initially not spinning. The lower leading edge of the cube aligns with a small step in the plane (along the  $z$ -direction). The lower leading edge of the cube upon hitting the step comes to an abrupt stop as the cube rotates about this edge (at the step), as shown in the figure above.

### 1.1 Moment of Inertia

Find the moment of inertia of the block about an edge of the cube,  $I_e$ .

### 1.2 Angular Speed

Find the angular speed of the cube just after it hits the step,  $\omega_1$ . Answer in terms of  $v_0$  and  $a$ . Hint: Use conservation of angular momentum.

### 1.3 Minimum Speed

Find the minimum initial speed,  $v_{0 \text{ min}}$ , that the cube needs for the cube to roll over the small step. Answer in terms of  $a$  and  $g$  (the acceleration due to gravity).