Sliding Block

A rectangular block of width $2b$, length $2a$, and mass M rests on a rough surface which has a coefficient of kinetic friction μ. At some time, the block is given a sharp kick, such that it suddenly attains a horizontal velocity v_0. Under certain circumstances the rear end of the

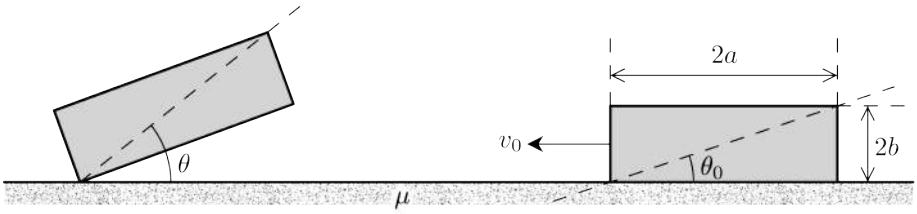

Figure 1: The block, after given its initial velocity.

block will begin to lift and the block will subsequently rotate about its front lower edge, which will remain in contact with the surface.

1. Derive the equation of rotational motion of the block in terms of θ, a, b, μ, and g.

2. Find the physical condition, namely the range of μ, that allows this to happen.

The next question assume this condition is fulfilled, and concerns the subsequent motion of the block.

3. Consider a final state in which the block is at rest in the position shown in Fig. 2, where its center of mass has undergone a total horizontal displacement x. Is such a

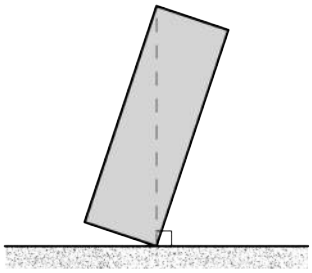

Figure 2: A presumed final position of the sliding block.

position possible? If yes, calculate the initial velocity required to achieve it for the following values: $a = 0.8$ m, $b = 1.0$ m, $\mu = 0.9$, $x = 1.65$ m, $\dot{\theta}_{\max} = 1.27$ s^{-1}.
Note: Knowing a, b and μ the initial velocity can be solved numerically.