Introduction to Forces

1 Initial thoughts and motivation

1.1 Where are we now?

2 Questions

2.1 Check your understanding

2.2 Trying out the waters

1. A book of mass M is positioned against a vertical wall. The coefficient of friction between the book and the wall is μ. You wish to keep the book from falling by pushing on it with a force F applied at an angle θ with respect to the horizontal ($-\pi/2 < \theta < \pi/2$), as shown in Figure 1.

   a) For a given θ, what is the minimum F required?

   b) For what θ is this minimum F the smallest? What is the corresponding minimum F?

   c) What is the limiting value of θ, below which there does not exist an F that keeps the book up?

2.3 Olympiad style questions

1. A bar of mass m is pull up by means of a thread up an inclined plane forming an angle α with the horizontal (see figure 2). The coefficient of friction is equal to k. Find the angle β which the thread must form with the inclined plane for the tension of the thread to be minimum. What is it equal to?

2. What is the minimum force needed to dislodge a block of mass m resting on an inclined plane of slope angle α, if the coefficient of friction is μ? Investigate the cases when a) $\alpha = 0$; b) $0 < \alpha < \arctan \mu$.

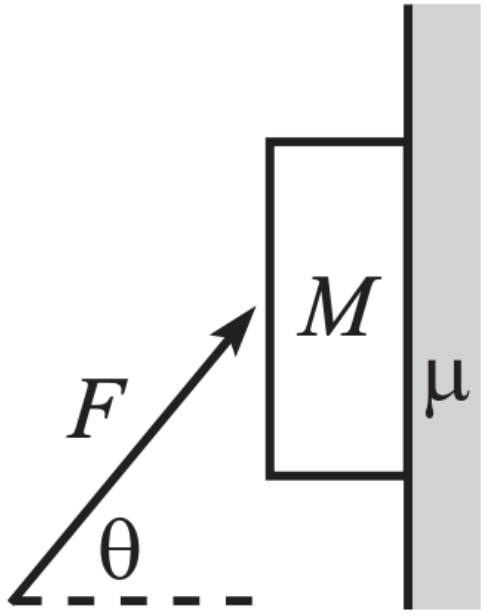

Figure 1: Book on wall

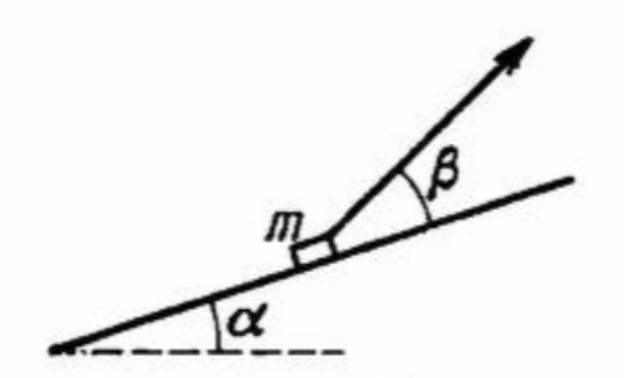

Figure 2: Mass pulled up on incline

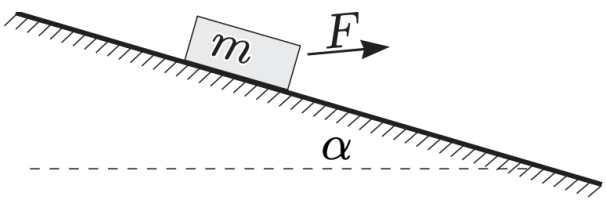

Figure 3: Dislodging block