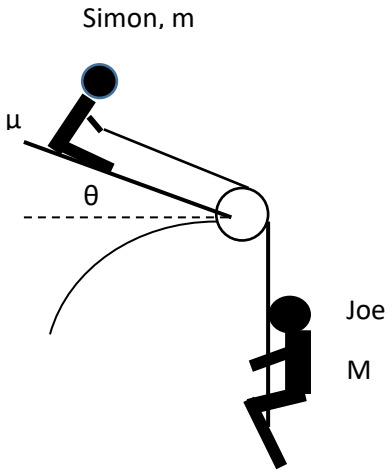
Physics 1135 Homework # 7: Friction

1. A worker is pushing a box of mass *M* up a rough incline by applying a **horizontal** pushing force of constant magnitude *P*. The incline makes an angle θ with respect to the **vertical**, and the coefficient of kinetic friction between the slope and the box is μ. Derive an expression for the acceleration of the box.

2. For reasons hard to explain, you are holding a box of mass 2kg against a rough vertical wall by pushing on it with a force of constant magnitude, directed upward at 30° above the horizontal. The coefficient of static friction between the box and the wall is 0.2. What is the minimum force you must exert in order for the box not to slide down?

3. Two climbers are on a mountain. Simon, of mass *m*, is sitting on a snow covered slope that makes an angle θ with the horizontal. The coefficient of static friction between his body and the snow is μ. He is tied into one end of a massless rope that runs over a frictionless pulley. Joe, of mass *M*, is at the other end of the rope. He has fallen and is hanging motionless below an overhang.
Derive an expression for the maximum value of Joe's mass *M* so that Simon is not pulled down the slope, in terms of relevant system parameters.



4. A block of mass *M* is pushed up a **frictionless incline** which makes an angle θ with respect to the horizontal. The pushing force is parallel to the incline and has a constant magnitude. A small block of mass *m* sits on top of the large block. The coefficient of **static friction between the two blocks** is μ.
Derive an expression for the maximum magnitude *P* of the pushing force for which the small block does not slip on the large block, in terms of relevant system parameters. (Hint: begin with fully labeled free-body diagrams for the small block and for the two blocks combined, respectively.)