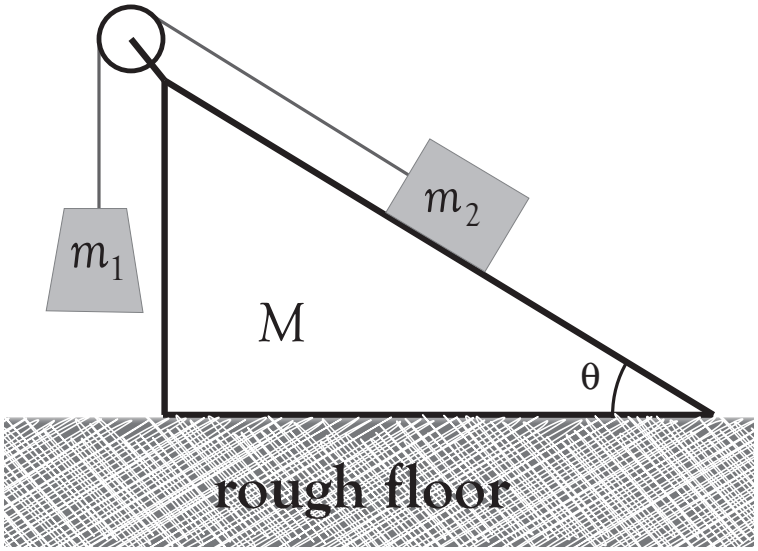
QP36

Problem 1 (4 points) - Incline Slipping

An incline of mass M rests on a floor with a coefficient of static friction μ. A mass m_1 is suspended by a massless string that passes over a frictionless pulley of negligible mass, attached to the upper corner of the incline. The other end of the string is attached to a mass m_2 that slides without friction on the surface of the incline. The plane of the incline meets the horizontal at an angle θ, as shown in the figure.



Assume that the mass m_1 will move downward with respect to the pulley, and that the string can neither stretch nor break.

(a) (2 points) For the case of very large μ, use Newton's laws to determine the tension T of the string and the acceleration a of the masses. Express your answers in terms of M, m_1, m_2, θ, and the gravitational acceleration g.

For the rest of this problem, you may express your answers in terms of the string tension T.

(b) (1 point) Draw a free-body diagram for the incline.
Hint: In order to determine the direction of the frictional force, think first of which way the incline would move in the frictionless case.

(c) (1 point) Find the smallest μ for which the incline will remain at rest. You don't need to simplify your answer.