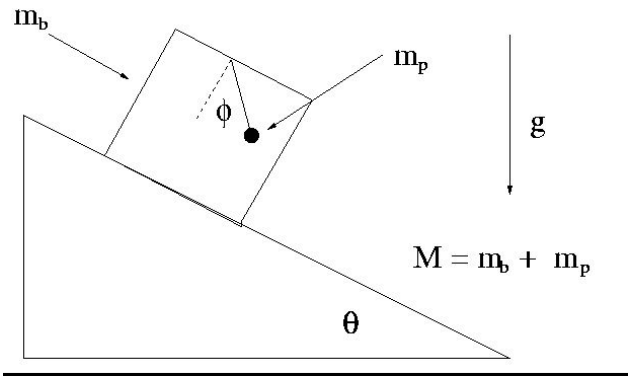
QP5



A hollow box of mass m_b sliding down an inclined plane has a pendulum of mass m_p attached by a massless, inextensible string as shown. Let μ be the coefficient of kinetic friction between the inclined plane and the box.

a) (1 point) Sketch the free body diagram and write down the equations from Newton's second law for the box and pendulum as a single unit, where the total mass is $M = m_b + m_p$.

b) (1 point) Solve for the acceleration a down the plane in terms of g, θ and μ.

c) (1 point) Now move into the accelerating frame of the box. Sketch the free body diagram for the pendulum including any "fictious" forces.

d) (1 point) Find the equilibrium angle ϕ the pendulum makes with the line perpendicular to the top of the box for both the case of no friction ($\mu = 0$) and for the case of friction ($\mu \neq 0$) between the box and the inclined plane.