Problem 3

Write down everything given, assumptions, and desired values.

Given: θ=25o vi=vf=0 Δx = 0 mass is not given but we’ll see that it’s not important

Assumptions: acceleration is due to gravity but this is also not important

Desired: μs ( The problem asks for coefficient of kinetic friction μk (friction while moving) but since the block never moves we would need to know the coefficient of static friction (friction while at rest))

While it may at first be tempting to use the energy work theorem but since the object is not moving there is no change in velocity, height, or distance traveled along a surface. So KE, GPE, Eint are constant and are no help. Also, the kinematic equations are equally useless. We need to think in terms of forces.

y

Let’s make a picture

x

25o

Because there is no acceleration the equation $\sum\_{}^{}F=ma$ becomes $\sum\_{}^{}F=m\left(0\right)=0$

Because of this our net forces have to balance out.

Normal force

Let’s make another picture and include all forces involved

y

Frictional force

mg

x

25o

Instead of having our axes be in terms of x and y let’s make them parallel to and perpendicular to the surface. Let’s also split up our mg along these axes.

Perpendicular to surface

Parallel to surface

mg cos(25o)

mg sin(25o)

mg

25o

Frictional force

Normal force

So the normal force must balance with mg cos(25o).Normal force = mg cos(25o). Frictional force is balancing mg sin(25o) so Frictional force = mg sin(25o). But by definition Frictional force is calculated as μs times the normal force so it is also equal to μs mg cos(25o).

Our equation is therefore Frictional force = mg sin(25o) = μs cos(25o)

So μs mg cos(25o) = mg sin(25o), by rearranging terms we have μs =( mg sin(25o))/( mg cos(25o))

Our m and g cancel out so we have μs = (sin(25o))/(cos(25o)) = tan(25o) = .466