Static applied forces physics problem:

A mass m, attached to a spring with spring constant k, is at rest a distance ℓ_1 from the spring's equilibrium position on the frictionless portion of an incline with angle θ (Figure 1). Draw the free-body diagram for mass, and solve for ℓ_1 in terms of the variables given and Newton's constant, g. Next, the block is pulled distance ℓ_2 down the ramp to the frictional (with coefficient of static friction μ_s) portion of the ramp, where it remains at rest when released (Figure 2). Again, draw the free-body diagram for the mass and solve for ℓ_2 in terms of m, k, θ, μ_s and g.

Figure 1

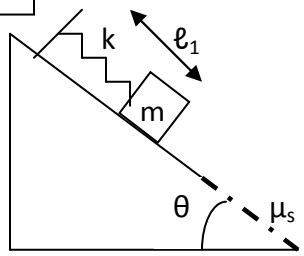
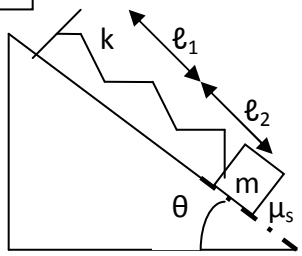


Figure 2



Learning objectives:
Understand how to solve a simple static problem with applied forces. Understand the gravitational force, the normal force, Hooke's law for springs, and static friction.

Concepts necessary for solving the problem:

- Correctly identify the relevant forces acting on the mass, their magnitudes, and their directions: gravitational, spring, normal, and in the second case, static friction.
- Understand how to apply Newton's second law to a static problem. This, of course, also requires an understanding of vectors.
- Pictorially represent these concepts in a free-body diagram.
- Correctly work through the physical relations to arrive at the solution.