Friction Problems

1. A 10.0 kg box is sitting on a level floor with a rope attached. Let $\mu_s = 0.40$ and $\mu_k = 0.20$ for the contact between the box and the floor. Find the acceleration of the box and the frictional force if each of the following forces is applied to the rope.
    a. 25 N horizontally, with the block initially at rest.
    b. 50 N horizontally, with the block initially at rest.
    c. 25 N horizontally, with the block initially moving.
    d. 40 N at 30° above the horizontal, with the block initially at rest.
    e. 40 N at 30° below the horizontal, with the block initially at rest.

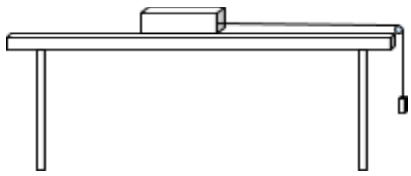
2. The coefficient of static friction between tires and the road is 0.75.
    a. Determine the maximum acceleration the car could have.
    b. With that acceleration, calculate the time it would take to reach 60 mi h^{-1}.

3. The coefficient of static friction between tires and the road is 0.75, while the coefficient of kinetic friction is 0.6 in dry weather. In rainy conditions, the coefficient of kinetic friction drops to 0.4.
    a. Determine the minimum stopping distance for a car traveling at 20 m s^{-1} with antilock brakes in dry conditions.
    b. Determine the minimum stopping distance for a car traveling at 20 m s^{-1} where the brakes lock the tires in dry conditions.
    c. Determine the minimum stopping distance for a car traveling at 20 m s^{-1} where the brakes lock the tires in wet conditions.

4. A 4.0 kg block is placed on a 20° incline. Let $\mu_s = 0.5$ and $\mu_k = 0.3$.
    a. Determine the maximum static frictional force on the block.
    b. If the block is initially at rest, determine if the block slide down the ramp.
    c. If the block is initially sliding down the ramp, calculate the acceleration it would have.

5. A 2.0 kg block is placed on a 40° incline. Let $\mu_s = 0.5$ and $\mu_k = 0.3$.
    a. Determine the minimum force needed to hold the block in place.
    b. Determine the maximum force that can be applied before the block moves up the ramp.

6. A 5.0 kg block is placed on a table and connected to a hanging mass by a massless string over a frictionless pulley. The hanging mass is 2.0 kg.



    a. Calculate the minimum coefficient of static friction between the block and the table needed to hold the system in place.
    b. The coefficient of kinetic friction is 0.2. The blocks are nudged so they are initially moving at 0.1 m s^{-1} If the hanging mass begins 0.4 meters above the ground, calculate the time it takes to reach the ground?