kinetic friction force

The kinetic friction force is the frictional force exerted by a surface on a *sliding* object.
Direction of the kinetic friction force on an object = parallel to the surface, and opposite to the direction that the object is sliding
Magnitude of the kinetic friction force = $f_k = \mu_k n$ Notice that there is a special formula for the magnitude of the kinetic friction force.

maximum static friction force

The maximum static friction is the friction force that would be exerted by a surface if the object were just on the *verge* of sliding.
To find the direction of the maximum static friction force on an object: 1. Ask, in what direction are we imagining the object to be on the verge of sliding? 2. The direction of the max $\vec{f}_s$ is opposite to the direction determined in step 1.
magnitude of the *maximum* static friction force = max $f_s = \mu_s n$ Note: there is a special formula for the magnitude of the *maximum* static friction force.

coefficients of friction

μ_k = coefficient of kinetic friction, μ_s = coefficient of static friction
μ_s is used only for finding the *maximum* static friction
μ_k and μ_s have no units. Typically, $0 \leq \mu_k < 1$ and $0 \leq \mu_s < 1$.
μ_k and μ_s both measure how "rough" the surface and object are. (Loosely speaking.)

static friction force
when we do *not* assume that static friction is at its maximum

The static friction force is the frictional force exerted by a surface on an object that is not sliding.
To find the direction of the static friction force on an object: 1. Ask, in what direction would the object slide if there were no friction? 2. The direction of the $\vec{f}_s$ is opposite to the direction determined in step 1.
magnitude of static friction = f_s When we do not assume that static friction is at its maximum, there is *no special formula* for the magnitude of the static friction. The "purpose" of static friction is to prevent the object from sliding along a surface. Therefore, the magnitude of the static friction will be *whatever it takes* to prevent the object from sliding, as determined from the Newton's Second Law equations.
Consider an object that, initially, is not sliding. If the f_s required to prevent sliding > max f_s, then the object will slide. If required $f_s \leq$ max f_s, then the object will not slide.

HOW TO SOLVE DIFFERENT TYPES OF PROBLEMS INVOLVING FRICTION

Problems involving an object that you know is sliding

1. Use the Newton's Second Law framework.
2. Use the special formula for f_k in your Force Table: $f_k = \mu_k n$

Maximum or *minimum* problems involving whether an object will slide

1. Use the Newton's Second Law framework. Assume that the object is just on the *verge* of sliding—i.e., assume: that static friction is at its *maximum*, and that the object does *not* slide.
2. Use the special formula for max f_s in your Force Table: max $f_s = \mu_s n$
3. To determine a_x or a_y, assume that the object does *not* slide.

Problems that ask you to *determine* whether the object will slide

1. Assume that the object does *not* slide, and use the Newton's Second Law framework to determine the f_s that would be required to prevent sliding. In this step, we do not assume that f_s is at its maximum. Therefore, in this step, we do not use a special formula for f_s. Instead, in your Force Table, just represent the magnitude of the static friction by the symbol "f_s". To determine a_x or a_y, assume that the object does *not* slide.
2. Use the special formula to determine max f_s.: max $f_s = \mu_s n$ To find the n you need for the special formula, use the Newton's Second Law framework from step 1.
3. To determine whether static friction will be able to rise high enough to prevent the object from sliding, compare the required f_s from step 1 with the max f_s from step 2. If required $f_s \leq$ max f_s, then the object will not slide. If required $f_s >$ max f_s, then the object will slide.