Standard Friction Model Notes

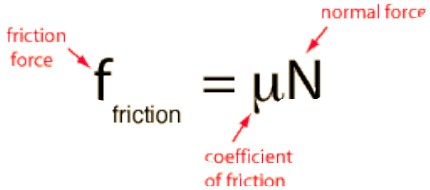
Friction, as related here, is resistance to the relative motion of two solid objects. A somewhat standard model is presented that is used in physics classes to work physics problems. It is unusual to begin a discussion about any topic with a disclaimer about the model, but friction is a very complex phenomenon and numerous exceptions to the standard model can be found. However, this simple model does give adequate answers for many problems and often points the way to a complete understanding of the particular situation representing the exception.

Working Equation:

In the standard model for friction between surfaces, there are certain inherent assumptions:

- The frictional force is independent of area of contact.
- The frictional force is independent of the velocity of motion.
- The frictional force is proportional to the normal force.

Frictional resistance to the relative motion of two solid objects is usually proportional to the force which presses the surfaces together as well as the roughness of the surfaces. Since it is the force perpendicular or "normal" to the surfaces which affects the frictional resistance, this force is typically called the "normal force" and designated by N.
The frictional resistance force may then be written:



The amount of force required to move an object starting from rest is usually greater than the force required to keep it moving at constant velocity once it is started. Therefore, two coefficients of friction are usually quoted for a given pair of surfaces, a coefficient of static friction and a coefficient of kinetic friction. It should be clear the friction force is a **vector** and has magnitude and direction. The equation above gives magnitude, and the direction is parallel to the direction of motion along the surface and **oppositely directed**.

Thus, in any physics problem, the rubbing surfaces must be given or the coefficients of static and/or kinetic friction must be given. Tables of coefficients exist for different surface combinations.

Emphasizing Concepts:

1. The coefficients of friction are constants depending upon the two surface types.
2. The frictional force is independent of contact area. Notice that the contact area does not appear in the equation above.
3. The frictional force is independent of the velocity of motion.
4. The frictional force is proportional to the normal force.

Examples Where This Model Does Not Work Well:

The following URL gives exceptions to the assumptions used in developing the standard model. Explore when time permits.
http://hyperphysics.phy-astr.gsu.edu/hbase/frict3.html#ass