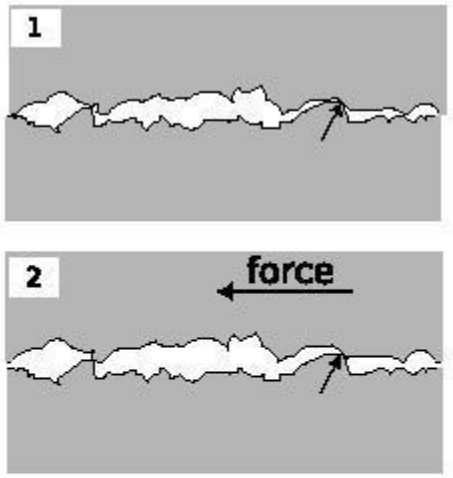
Friction

8.4.1 Describe the nature and properties of frictional forces

Friction is a non conservative force that always acts in the opposite direction of the object it is acting on. A non conservative force removes energy from an object in such a way as to make it impossible for the object to recover the lost energy.



g / A model that correctly explains many properties of friction. The microscopic bumps and holes in two surfaces dig into each other, causing a frictional force.

Gravity is a conservative force. As an object falls it loses potential energy, but that energy is converted into kinetic energy, so the object has no net change in energy.

If an object experiences a frictional force the object loses kinetic energy in the form of heat or sound. The energy lost is distributed to the surroundings and will not “flow back into” the object.

Friction is most often experienced when two objects are in contact and/or sliding relative to each other. For example a rectangular block sliding down a ramp. The displacement of the block is parallel to the surface of the ramp, therefore the frictional force is also parallel to the ramp but in the opposite direction of the displacement.

Friction can be explained as two rough surfaces rubbing together as shown in the picture to the right. No surface is completely smooth, every surface has irregularities that cause friction. Atoms could be thought of as spheres, they do no fit together perfectly, i.e. there are bumps…

Image stolen from "Newtonian Physics" by Benjamin Crowell pg 157

8.4.2 Distinguish between static and dynamic (sliding) friction.

If you push on a heavy object with a small force it will not slide. Friction will prevent the object from sliding. As you slowly increase the force applied to the object, the static frictional force will continue to increase up to a point. At that point the object will start to move and the frictional force will be decreased. The change in the force is sometimes very significant. We describe this situation with the terms static friction and dynamic (sliding or kinetic) friction.

When two surfaces are in contact there is friction. If the surfaces are not moving relative to each other it is a static situation, and we call the friction, static friction. If the two surfaces are moving relative to each other we call the friction, dynamic (sliding or kinetic) friction.

Static friction is always larger than dynamic friction. Which makes sense… Imagine it was the other way around. If you apply a force just barely large enough to overcome static friction, i.e. the object starts to accelerate, the object would then experience an increase in the frictional force (it is now dynamic friction) and the object would stop moving. But once it stops moving static friction takes over and your force is now large enough to make it accelerate… Think about it, it simple wouldn't work or make sense.

8.4.3 Define coefficient of friction

The force of friction can be mathematically described by:

(1)
$$F_{fr} = \mu F_N$$

Where μ is the called the coefficient of friction and N is the normal force between the two surfaces. μ is a function of the two surfaces that are rubbing. You can not have a coefficient of friction for steel, you can only have a coefficient of friction for two surfaces, steel and cement, steel and wood or steel and steel

Since static friction and dynamic friction have different magnitudes therefore they must have different coefficients of friction. We give them slightly different symbols as well:

Static Friction Force

(2)
$Ffr \leq \mu sFN$

Dynamic Friction Force

(3)
$Ffr = \mu kFN$

The two equations above are in the IB formula book.

Since static friction is always larger than kinetic friction we can say $\mu s \geq \mu k$

Source: http://ibphysicsstuff.wikidot.com/friction