Skill 23: Frictional Force

Friction is a force that always opposes the motion of an object. It is a "resistive force" similar to air resistance, but friction acts between solid surfaces. In Skill 22, friction was determined as part of a F_{net} equation. You can also figure out the size of a frictional force if you know characteristics about the objects that are interacting. **The only factors which influence the frictional force are the magnitude of the normal force and the value of coefficient of friction (kinetic or static).** The equation to determine friction is:

$$F_f=\mu F_N$$

For coefficient of friction, μ, and Normal Force, F_N, keep in mind the following:

Coefficients of Friction are listed on reference table or will be given in problem

Approximate Coefficients of Friction

	Kinetic	Static
Rubber on concrete (dry)	0.68	0.90
Rubber on concrete (wet)	0.58	
Rubber on asphalt (dry)	0.67	0.85
Rubber on asphalt (wet)	0.53	
Rubber on ice	0.15	
Waxed ski on snow	0.05	0.14
Wood on wood	0.30	0.42
Steel on steel	0.57	0.74
Copper on steel	0.36	0.53
Teflon on Teflon	0.04	

The coefficient of kinetic (moving) friction is always greater than for static friction. Even if the number isn't provided.

The coefficient of kinetic or static friction has no units since it is a ratio of two forces. $\mu = \frac{F_f}{F_N}$

Normal Force is equal to Weight (F_g) for objects on a level surface with no other vertical forces.

$$F_N=F_g=mg$$

Normal Force is equal to the perpendicular component of weight for an object on an inclined plane.

$$F_N=F_g\perp=F_g\cos\Theta$$

Note: The contact surface area of an object does not change the magnitude of the normal force. Therefore, if the surface types are the same, the frictional force is the same.

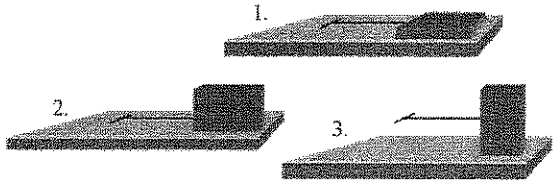

Fig. 1: Leonardo da Vinci used this experiment arrangement to show that friction is independent of the size of the surfaces making contact.

Examples: What is the frictional force required to keep a 5kg wooden box moving across a level wooden surface?

Givens and Knowns:
m=5kg
$F_N=F_g=mg=$ (Since $\Theta=0$)
$(5kg)(9.81m/s^2)=49.05N$
$\mu = 0.30$
(Kinetic because it asks about "keep moving")

Equation and Substitution:
$F_f=\mu F_N = 0.30\ (49.05N)$

Solution:
$= 14.7\ N$