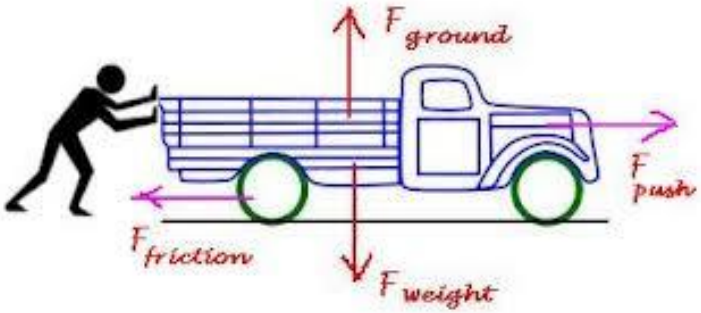
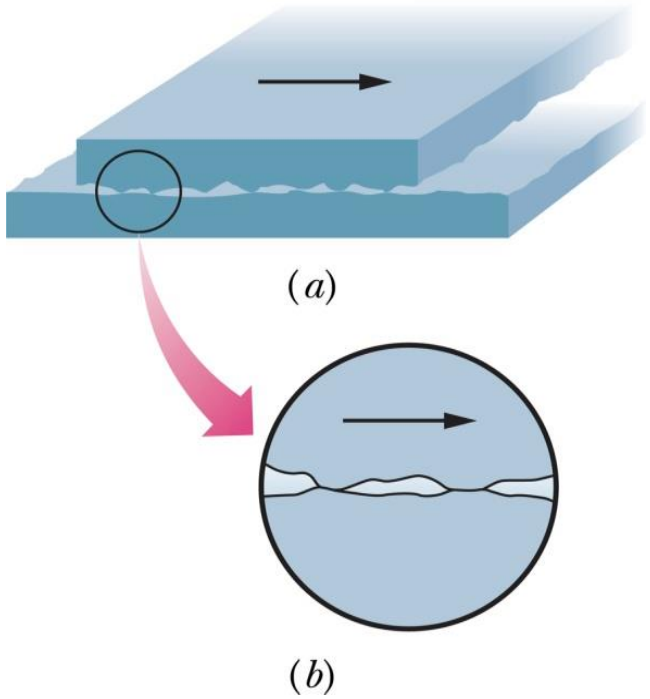


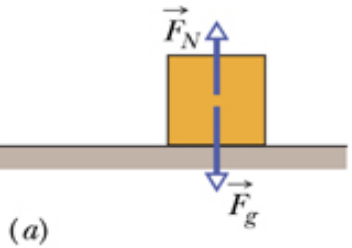
Chapter 6
Force and Motion II

By: Dr. Wajood Diery

6-2 | Friction

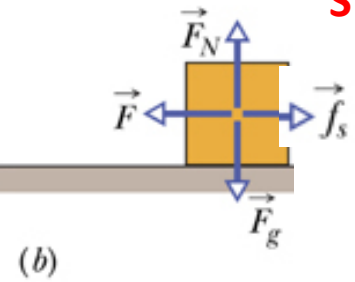
- Definition.
- Is it Bad or good?
- Cause of friction.





No fractional force

Static fractional force

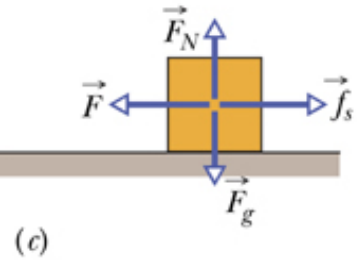


The body does not move

$$F_{net,x} = 0$$

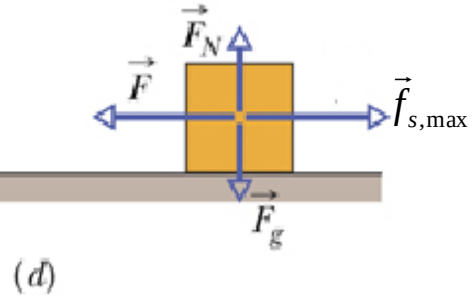
$$f_s - F = 0$$

$$F = f_s$$



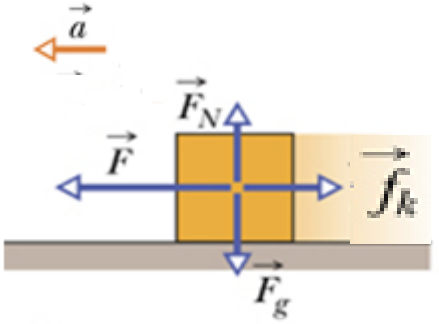
The body does not move

$$F = f_s$$



The body does not move

$$F = f_{s,max}$$

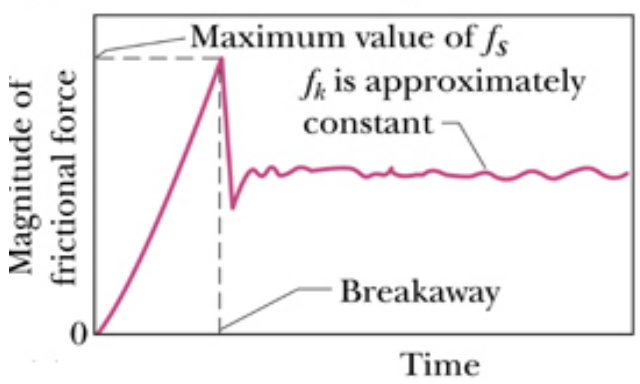


$$\vec{F} \succ \vec{f}_{s,max}$$

*The body starts moving with acceleration

***The kinetic frictional force.**

$$f_k \prec f_{s,max}$$



6-3 | Properties of Friction

Property 1. If the body does not move, then the static frictional force $\vec{f}_s$ and the component of $\vec{F}$ that is parallel to the surface balance each other. They are equal in magnitude, and $\vec{f}_s$ is directed opposite that component of $\vec{F}$.

Property 2. The magnitude of $\vec{f}_s$ has a maximum value $f_{s,\max}$ that is given by

$$f_{s,\max} = \mu_s F_N,$$

where μ_s is the **coefficient of static friction** and F_N is the magnitude of the normal force on the body from the surface.

Property 3. If the body begins to slide along the surface, the magnitude of the frictional force rapidly decreases to a value f_k given by

$$f_k = \mu_k F_N$$

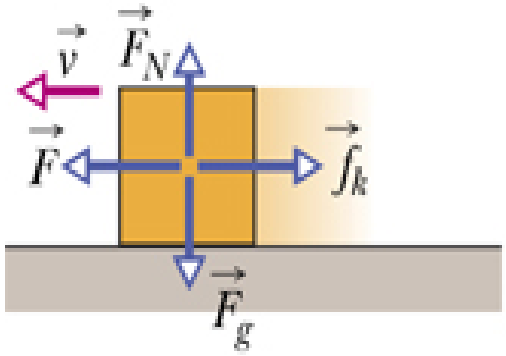
where μ_k is the **coefficient of kinetic friction.**

μ_s : Cofficient of static friction.

μ_k : Cofficient of kinetic friction.

- They are dimensionless.
- Their values must be determined experimentally.
- Their values depend on the properties of the body and the surface.

If the body starts moving with **constant velocity** what is the magnitude of kinetic frictional force?

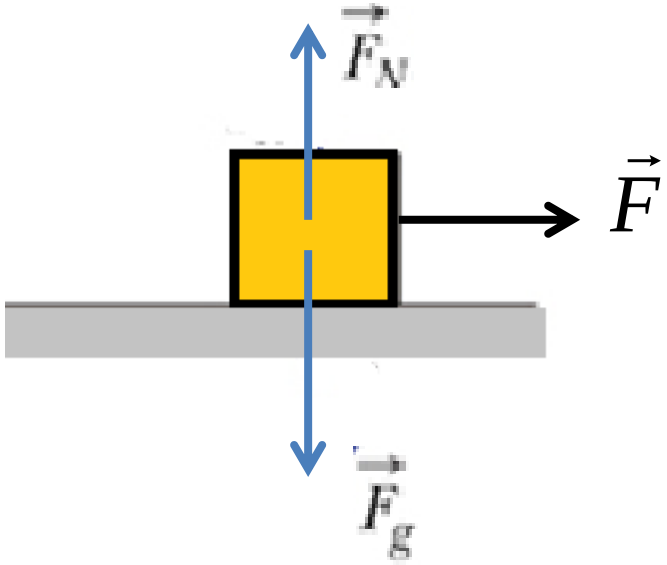


$$F_{net,x} = 0$$

$$-F + f_k = 0$$

$$F = f_k$$

How you can make this block move, given the mass of the block and μ_s ?



$$f_{s,\max} = \mu_s F_N$$

$$F \succ f_{s,\max}$$

$$F_{net,y} = 0$$

$$F_n - F_g = 0$$

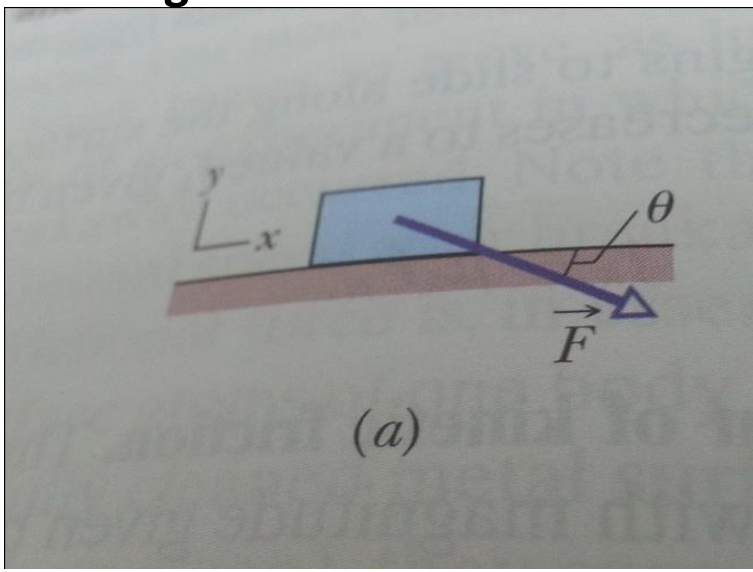
$$f_{s,\max} = \mu_s mg$$

$$F_n = F_g = mg$$

$$F \succ \mu_s m g$$

Sample Problem 6.01 Angled force applied to an initially stationary block

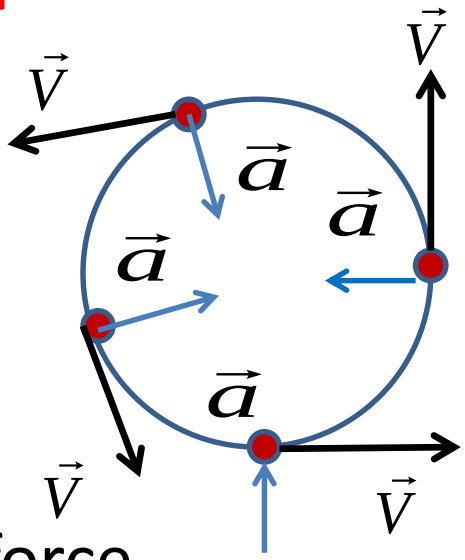
Figure (6-3 a) shows a force of magnitude F = 12 N applied to an 8.00 kg block at a downward angle of θ = 30.0 °. The coefficient of static friction between block and floor is μ_s = 0.700 , the coefficient of kinetic friction is μ_k = 0.400. Does the block begin to slide or does it remain stationary? What is the magnitude of the frictional force on the block?



6-5 | Uniform Circular Motion

A particle is in uniform circular motion if it travels Around a circle or circular arc at **constant speed.**

If we apply Newton's second law to analyze uniform circular motion we conclude that:

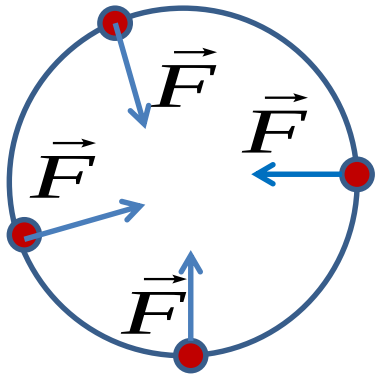


There is an acceleration $\Rightarrow$ there must be a force produced that acceleration.

- magnitude : $F = ma = m\dfrac{v^2}{r}$

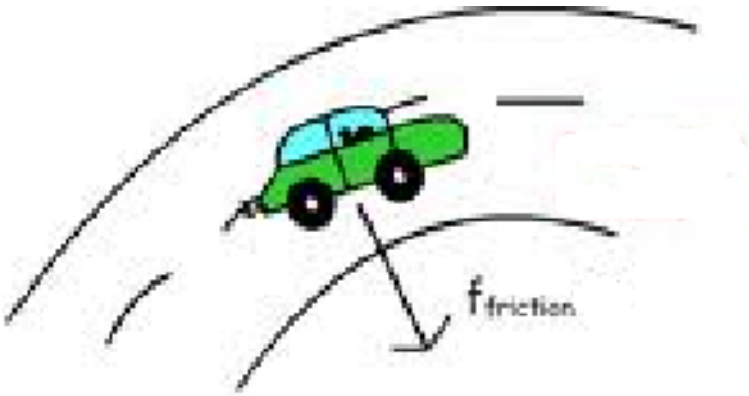
- direction: toward the center.

- It is called **Centripetal Force.**

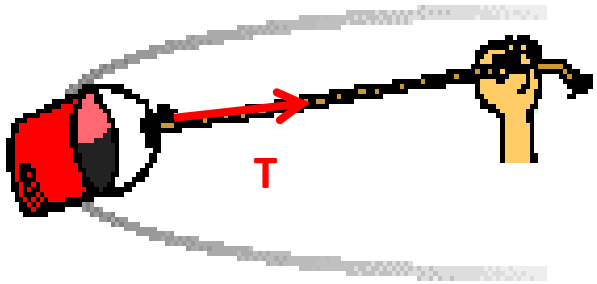


A centripetal force accelerates a body by changing the direction of the body's velocity without changing the body's speed.

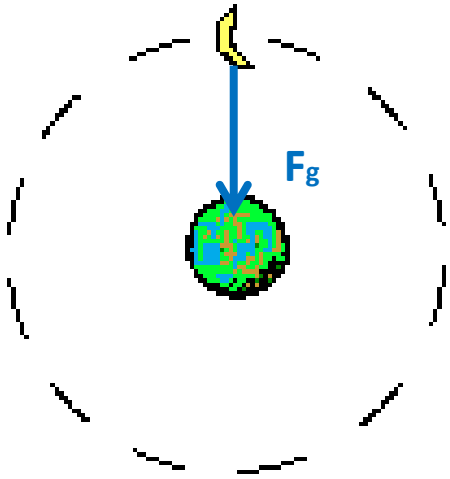
Centripetal force is **not** a new kind of force. It is simply the **net force** that points from the rotating body to the rotation center . Depending on the situation the centripetal force can be friction, tension, or gravity.



Friction Force is the centripetal force



Tension Force is the centripetal force



Gravity Force is the centripetal force

Problem 57p125

A puck of mass m = 1.50 kg slides in a circle of radius r = 25.0 cm on a frictionless table while attached to a hanging cylinder of mass M = 2.50 kg by means of a cord that extends through a hole in the table (Fig. 6-45). What speed keeps the cylinder at rest?

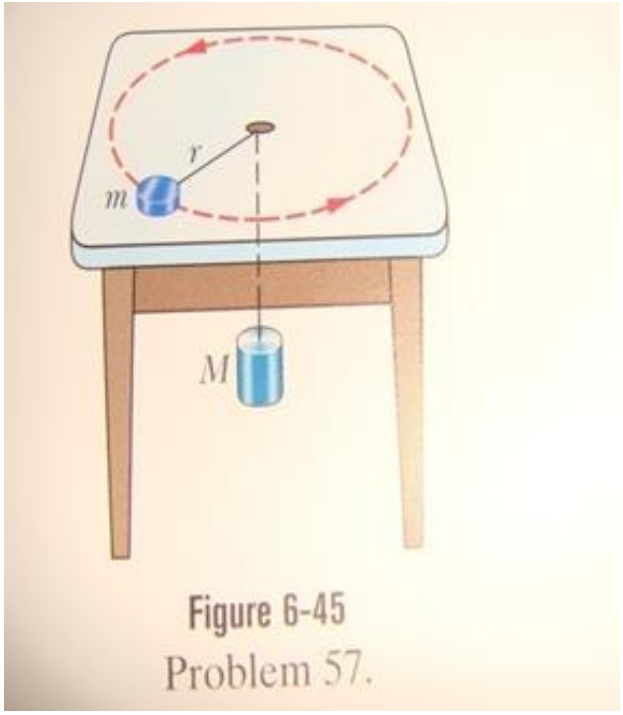


Figure 6-45
Problem 57.

THE END.