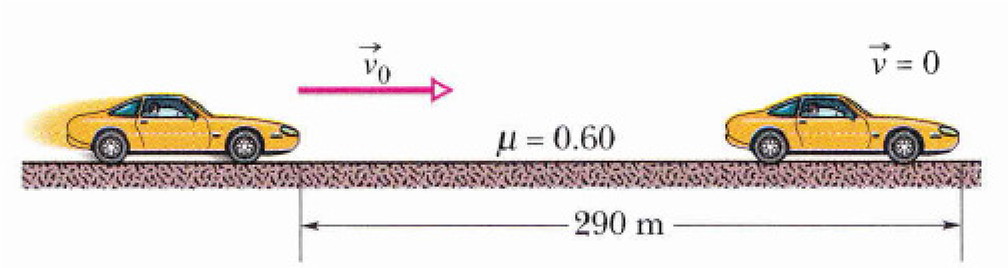
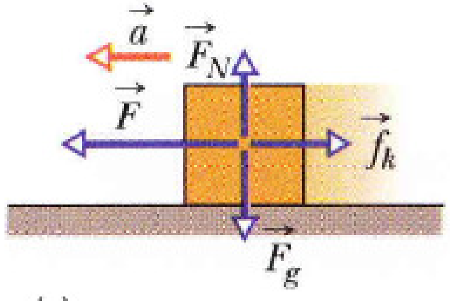
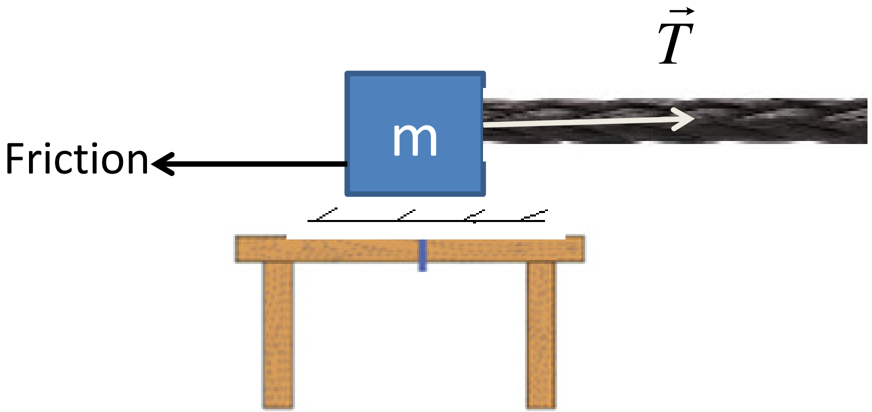




6 Force and Motion—II



6-1 WHAT IS PHYSICS?

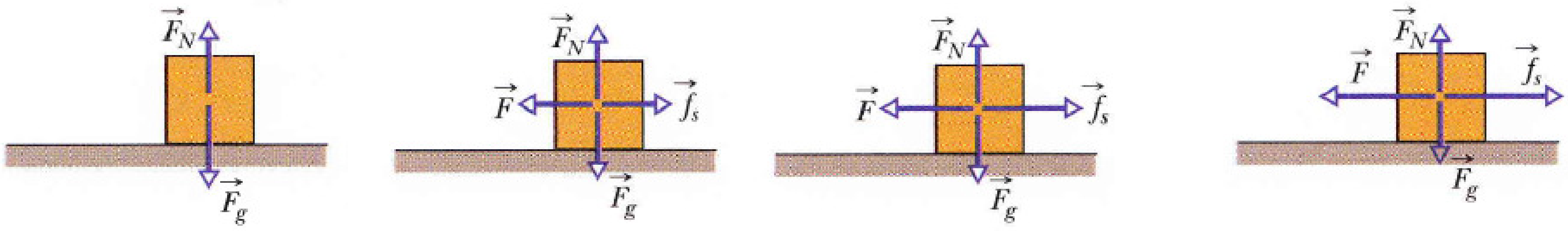
- In this chapter we focus on the physics of:

1- Frictional force.

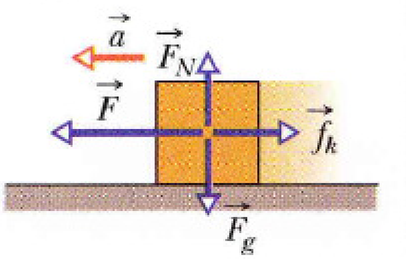
2- Centripetal force.

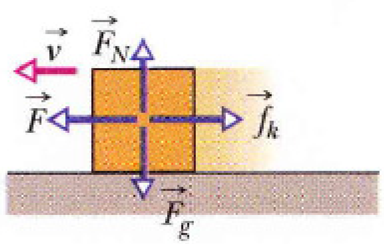
6-2 | Friction

A **frictional force** $\vec{f}$ is the force on a body when the body slides or attempts to slide along a surface. The force is always parallel to the surface and directed so as to oppose the sliding.



No motion, $\vec{f}_s$: is the static friction





Acceleration, $\vec{f}_k$: is the kinetic friction

Constant velocity

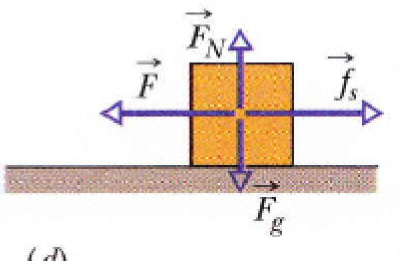
$$\vec{F} = \vec{f}_k$$

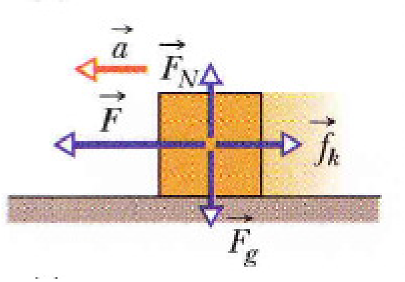
6-3 | Properties of Friction

Frictional force

Static frictional force: $\vec{f}_s$

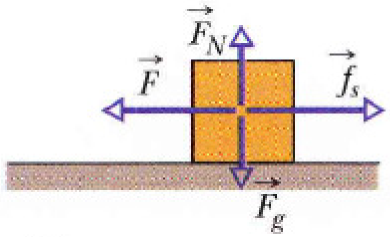
Kinetic frictional force: $\vec{f}_k$





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

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

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

$$\boxed{f_k = \mu_k F_N,}$$

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

Remember:

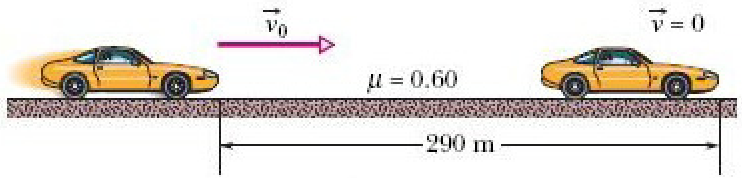
μ_s : Cofficient of static friction.

μ_k : Cofficient of kinetic friction.

- They are dimensionless.

Sample Problem 6-1

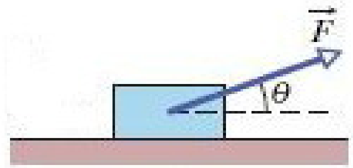
If a car's wheels are "locked" (kept from rolling) durin emergency braking, the car slides along the roac Ripped-off bits of tire and small melted sections of roa form the "skid marks" that reveal that cold-weldin occurred during the slide. The record for the longest skid marks on a public road was reportedly set in 1960 by a Jaguar on the M1 highway in England (Fig. 6-3*a*)—the marks were 290 m long! Assuming that $\mu_k = 0.60$ and the car's acceleration was constant during the braking, how fast was the car going when the wheels became locked?



(*a*)

Sample Problem 6-2

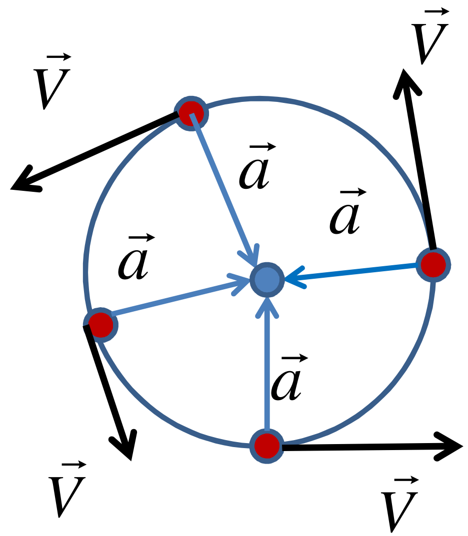
In Fig. 6-4a, a block of mass $m = 3.0$ kg slides along a floor while a force $\vec{F}$ of magnitude 12.0 N is applied to it at an upward angle θ. The coefficient of kinetic friction between the block and the floor is $\mu_k = 0.40$. What is the acceleration of the block?



(a)

6-5 | Uniform Circular Motion

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

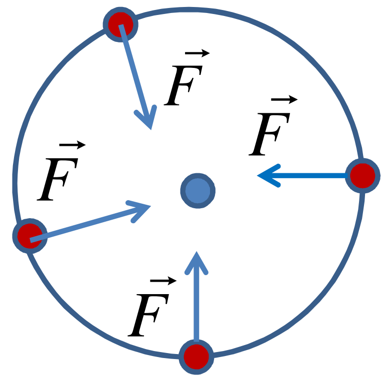


Centripetal acceleration

- magnitude $a = \dfrac{v^2}{r}$

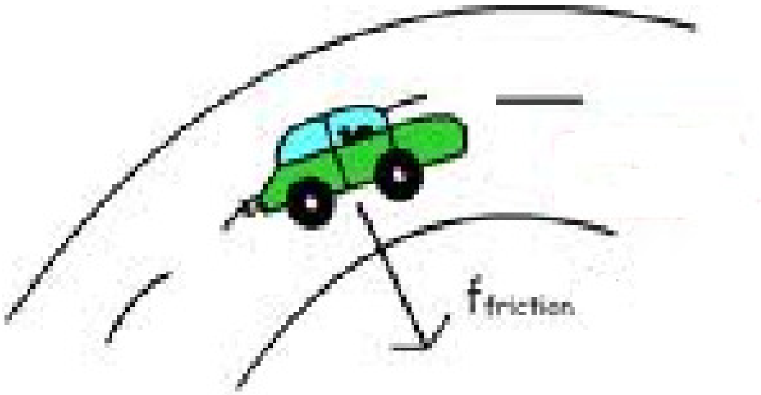
- direction: toward the center.

According to Newton's second law: The cause of the centripetal acceleration is a Force called the centripetal Force

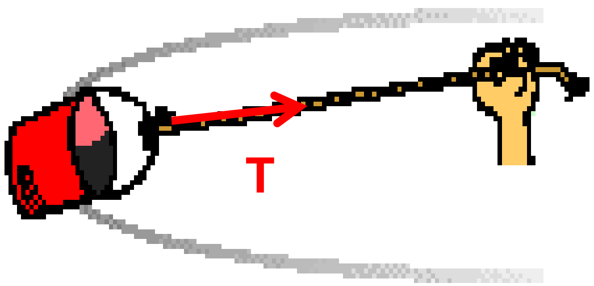


- magnitude: $F = ma = m\dfrac{v^2}{r}$

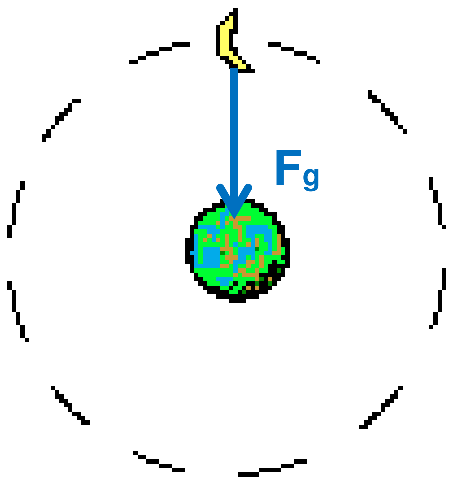
- direction: toward the center.



Friction Force is the centripetal force



Tension Force is the centripetal force



Gravity Force is the centripetal force

Sample Problem 6-6

Igor is a cosmonaut on the International Space Station, in a circular orbit around Earth, at an altitude h of 520 km and with a constant speed v of 7.6 km/s. Igor's mass m is 79 kg.

(a) What is his acceleration?

(b) What force does Earth exert on Igor?