



# Friction

Vikasana – Bridge Course 2012



# Friction makes it possible:

- To walk
- Use wheeled vehicles
- Sit
- Hold books



**Friction is a force that occurs when 2 surfaces oppose each other.**



**Rub your hands together to  
produce friction.**



# Types of friction

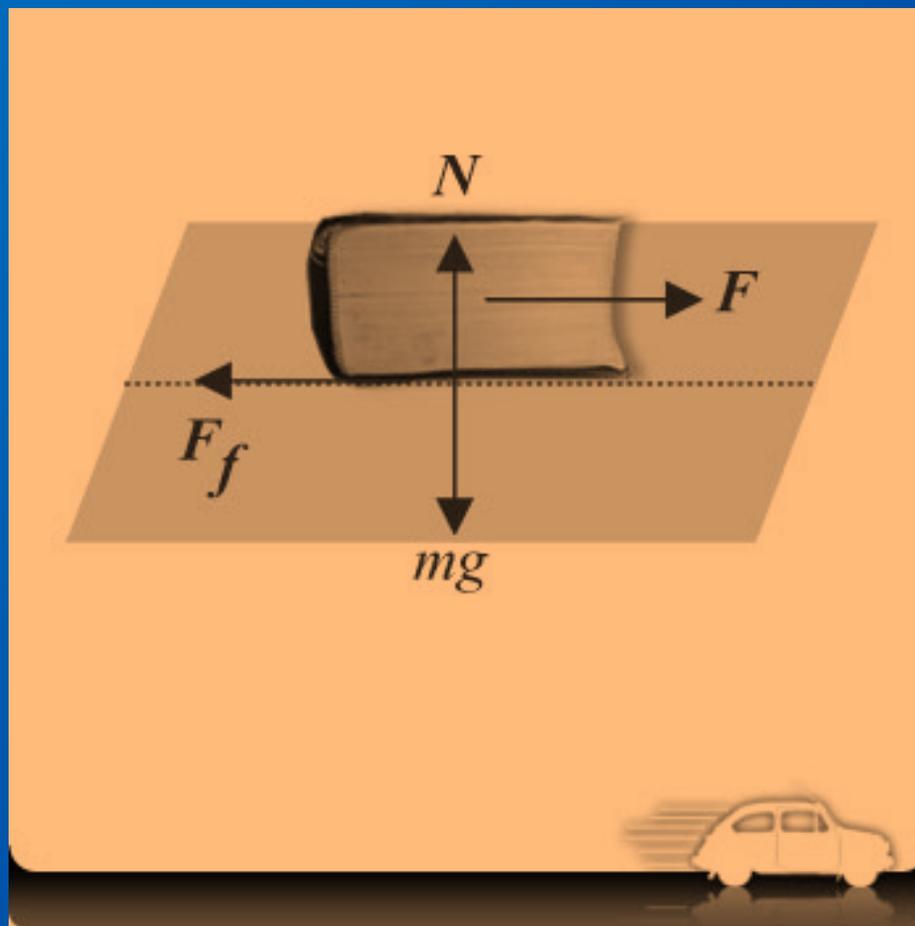
- Static
- Sliding
- Rolling
- Fluid

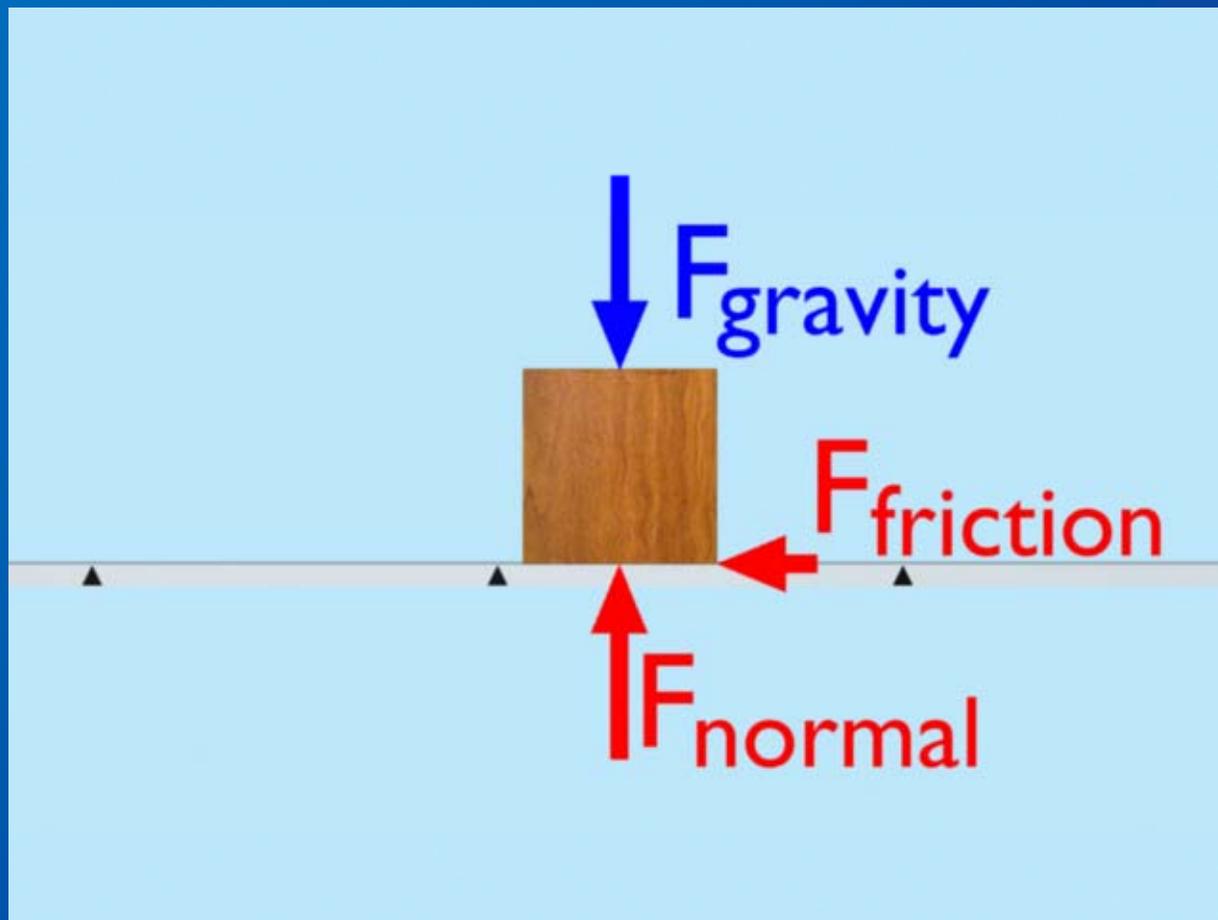


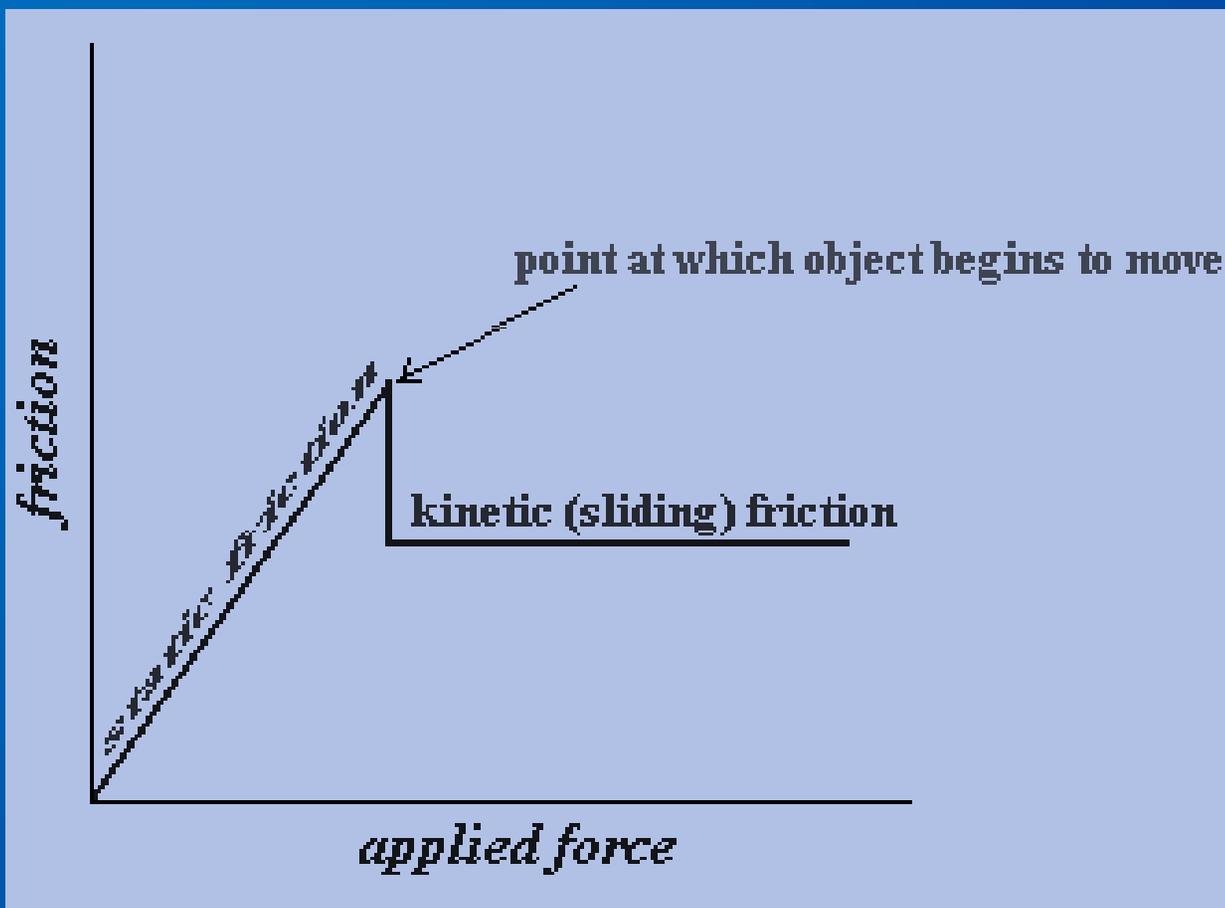
# Static

**Friction that acts on something that is not moving**

- Piano is held in place by static friction
- Static friction keeps you in your seat
- No heat or wear is generated

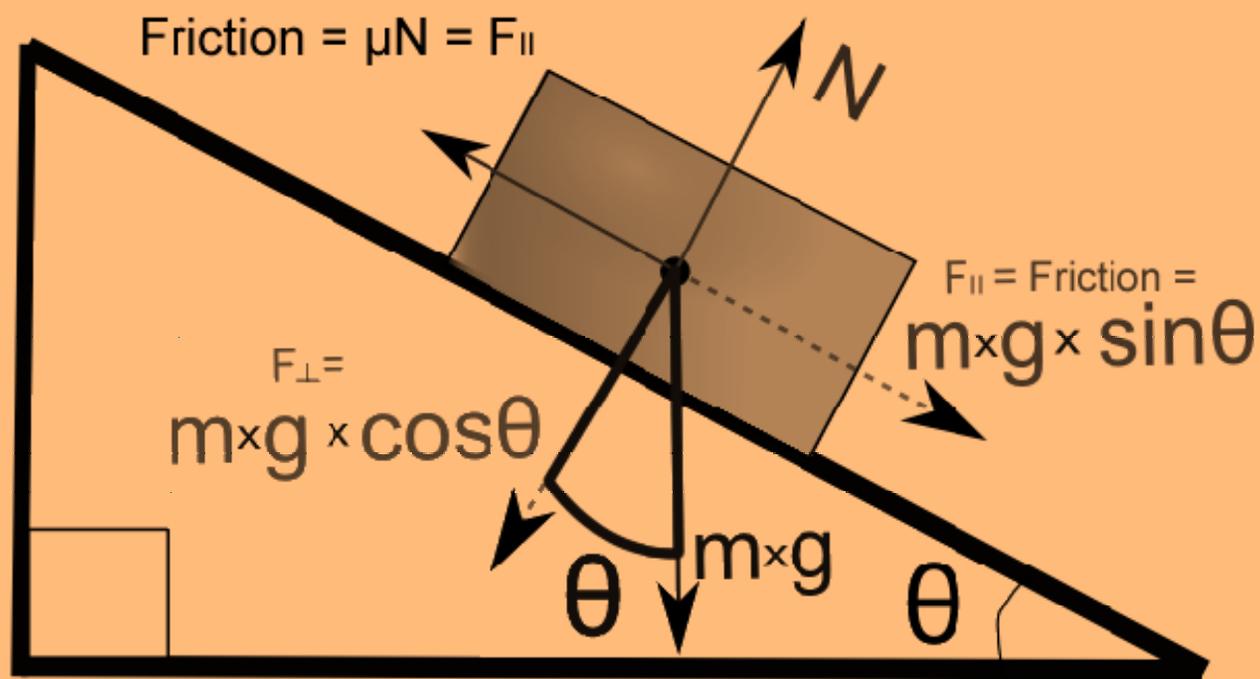








$\theta$  = FRICTION ANGLE





# Sliding

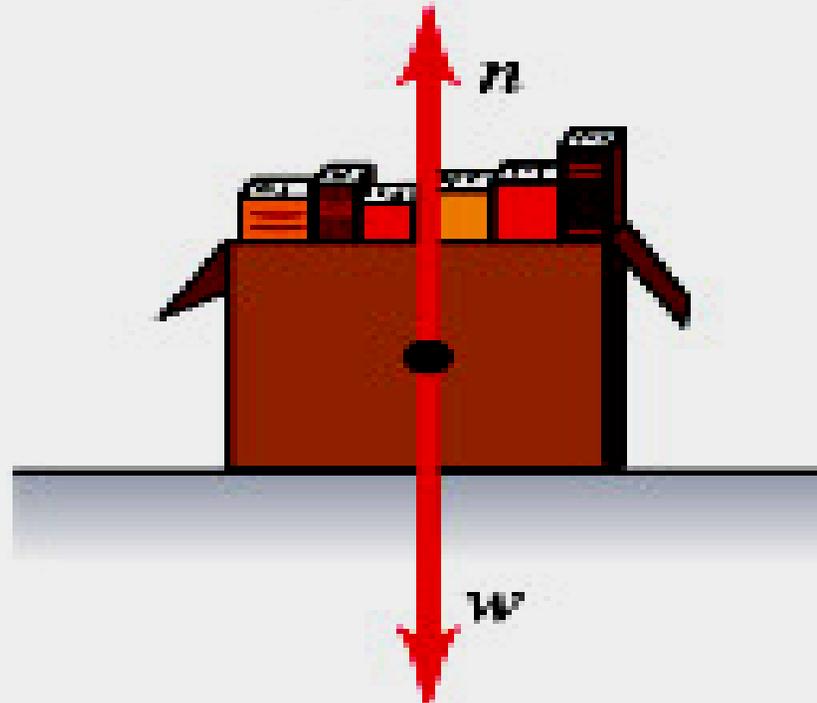
Force resulting when pushing or pulling an object over a surface.

- Moving —pushing a box across the floor
- Heat and wear can result



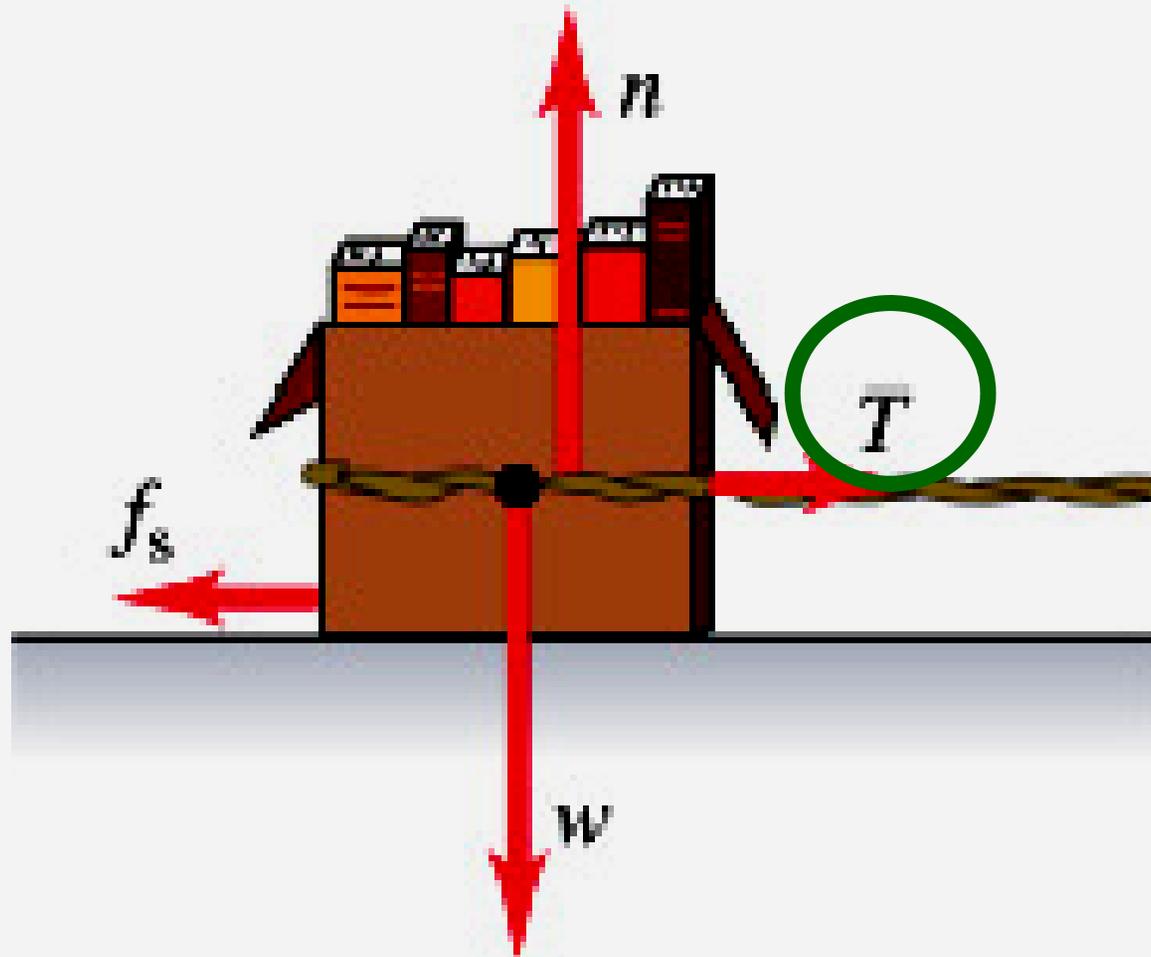
No applied force,  
box at rest

$$f_s = 0$$



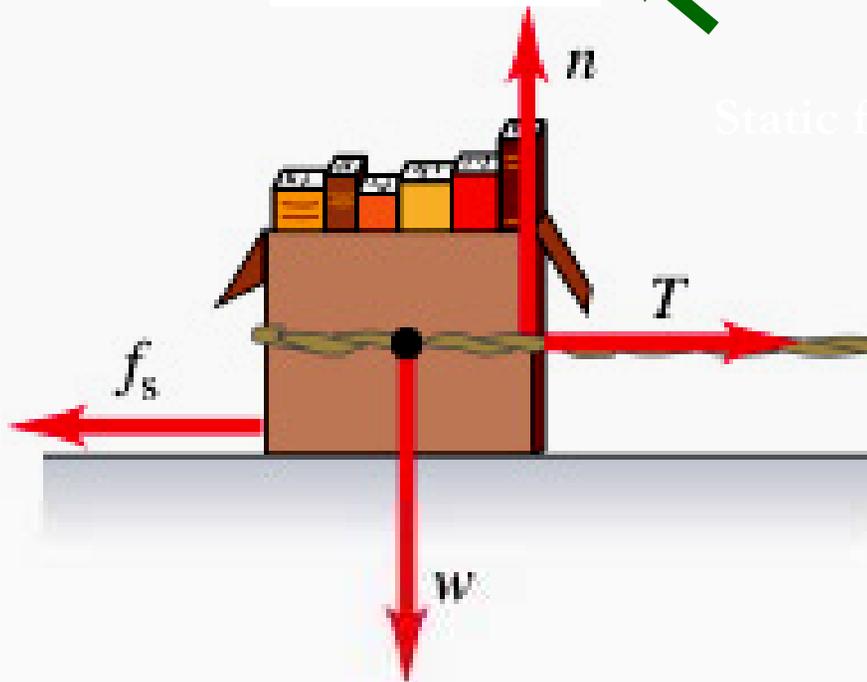
Weak applied force,  
box remains at rest

$$f_s < \mu_s N$$



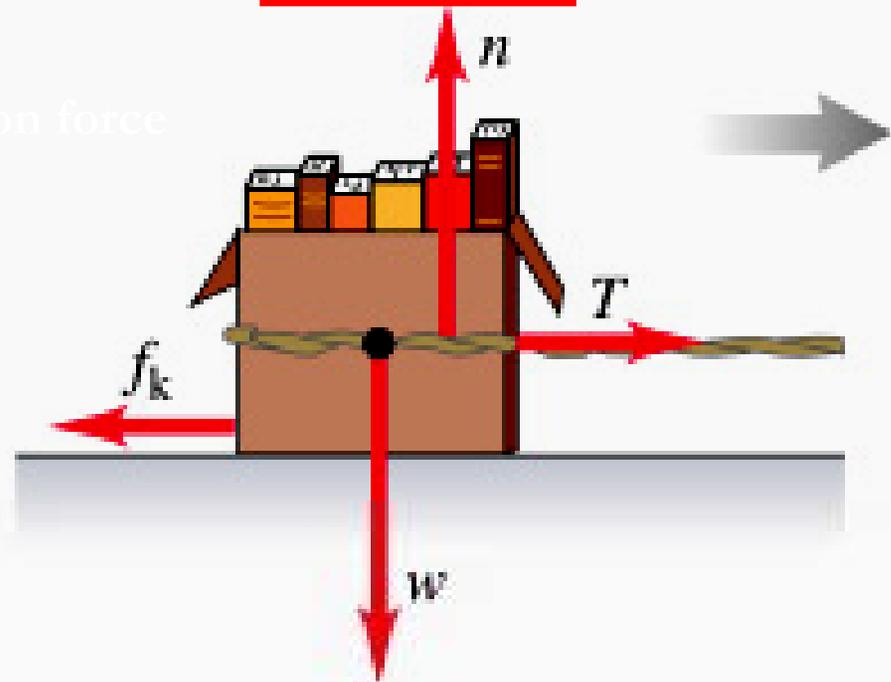
Stronger applied force,  
box just about to slide

$$f_s = \mu_s n$$



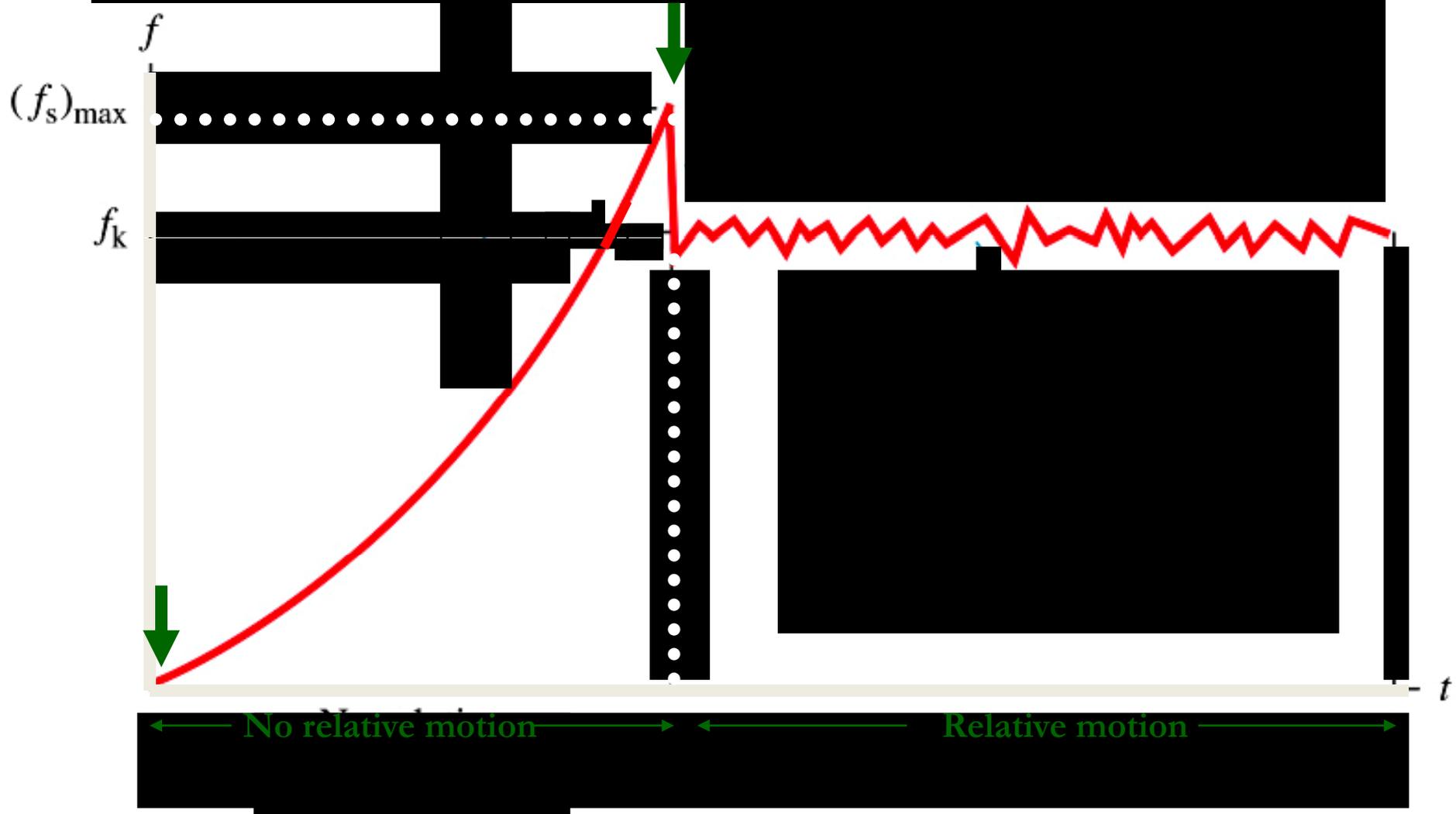
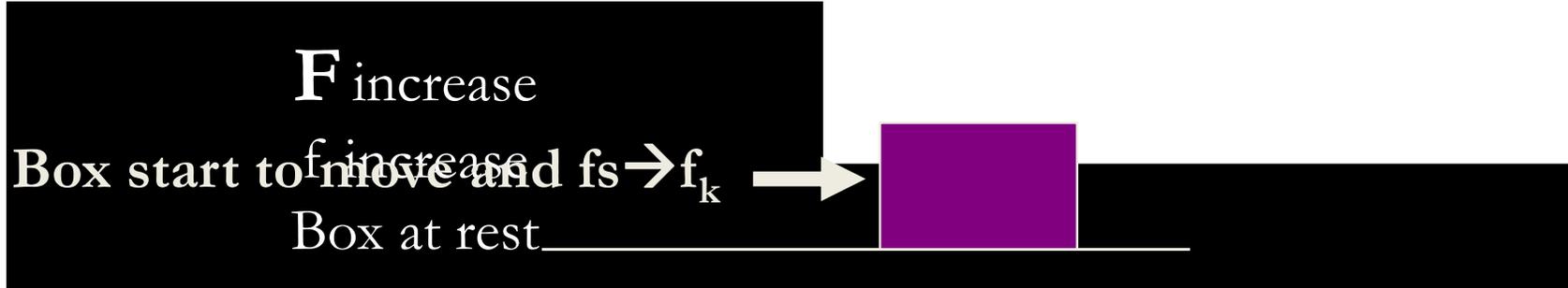
Box sliding at  
constant speed

$$f_k = \mu_k n$$



Kinetic friction force

Static friction force





# Rolling

- Contact is reduced because of rollers or wheels or ball bearings.
- Skate boards have ball bearings in the wheels.
- A cart has wheels.
- Less heat and wear will result.



# Fluid friction

- Resistance from a “liquid” or air.
- Stirring a thick batter
- Walking through water
- Olympic bike riders



# Mu

is the coefficient of friction.

This depends on the two surfaces involved.



## Typical values of $\mu$ :

- Wood on wood 0.25-0.5(no units)
- Glass on glass 0.9-1.0
- Steel on steel 0.6
- Steel on steel with oil 0.09
- Rubber on dry pavement 1.0
- Ski on snow 0.04
- Teflon on teflon 0.04



## Assignment:

- Name 2 sports where friction is helpful and needed. Explain
- Name 2 sports where friction is reduced for better performance. Explain



# Reducing friction

- A smooth surface does demonstrate as much friction as a rough surface.
- A lubricant can be used to reduce friction.



# Advantages and disadvantages Friction