Physic² 121: Fundament°ls of Phy²ics I

September 29, 2006

Example Problem

- **Chapter 2, Prob. 44**
  - It is possible to shoot an arrow at a speed as high as 100 m/s.
    - A) If friction is neglected, how high would an arrow launched at this speed rise if shot straight up?
    - B) How long would the arrow be in the air?

Forces of Friction

- When an object is in motion on a surface or through a viscous medium, there will be a resistance to the motion
  - This is due to the interactions between the object and its environment
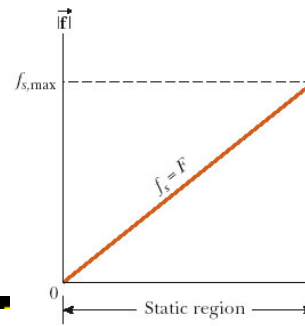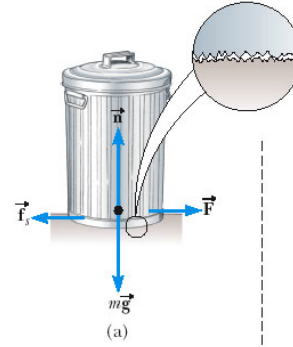- This is resistance is called **friction**

More About Friction

- Friction is proportional to the normal force
- The force of static friction is generally greater than the force of kinetic friction (define these terms in next slides)
- The coefficient of friction (μ) depends on the surfaces in contact
- The direction of the frictional force is opposite the direction of motion
- The coefficients of friction are nearly independent of the area of contact

Static Friction, f_s

- Static friction acts to keep the object from moving
- If F increases, so does f_s
- If F decreases, so does f_s
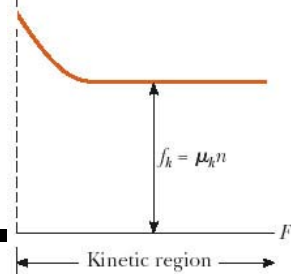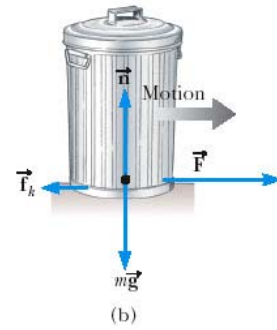- $f_s \leq \mu_s \, n$

STATIC → NOT MOVING

(a)

$\vec{|f|}$

$f_{s,max}$

$f_s = F$

0

Static region

Kinetic Friction, f_k

- The force of kinetic friction acts when the object is in motion
- $f_k = \mu_k n$
  - Variations of the coefficient with speed will be ignored

KINETIC → MOVING

- See Figure 4.19 in book
- The values of μ_s and μ_k depend on surface
- μ_k is generally less than μ_s
- The direction of the friction force is opposite to direction of motion (kinetic) or impending motion (static)
- The coefficients of friction are nearly independent of the area of contact

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$\vec{n}$ Motion

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

$m\vec{g}$

(b)

$f_k = \mu_k n$

F

Kinetic region

What does friction do:

1. Friction always slows things down
2. Friction always speeds things up
3. Friction can do both

33% 33% 33%

Friction always slows... Friction always spee.. Friction can do both

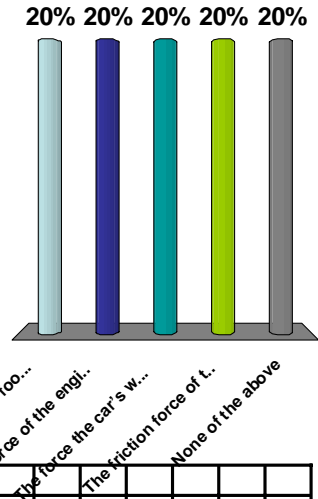| 1	2	3	4	5																			

When you start your car, what force causes it to speed up?

1. The force of your foot on the gas pedal
2. The force of the engine turning
3. The force the car's wheels exert on the ground
4. The friction force of the ground on the car's wheels
5. None of the above

20% 20% 20% 20% 20%

The force of your foo... | The force of the engi... | The force the car's w... | The friction force of t... | None of the above

1	2	3	4	5															