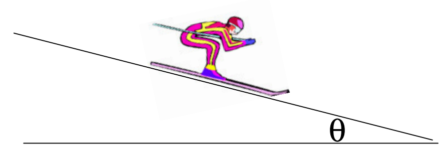
Announcements

1. **Exam 1**
   a. Covers Ch. 2,3
   b. Available in Testing center starting on Friday, Sept. 28 (opening time), up to Monday, Oct. 1 at 4:00 pm.
      i. Mon 4 pm to closing has a late fee.
   c. Sample Exam 1 is posted on the web site and Sample Exam 1 Solutions also.
      i. Don't look at the solutions until you've *worked* the sample exam...or you won't find out where you are weak.
      → It's easy to fool yourself!
   d. The exam is timed, 3 hours max.
      i. Will likely be done by 2 hours; Should probably plan on at least 1.5 hours
2. **Exam Review on Thurs**
   a. Exam is computer graded—we'll go over how to record answers in the review session on Thurs.
   b. The "reading quiz" questions will be taken from reading questions from past lectures.

Inclined planes
(another of the "simple machines")

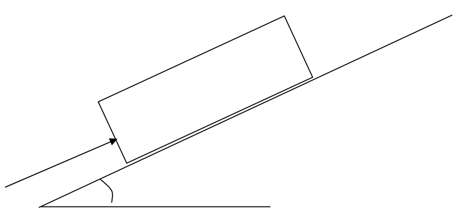
A skiier is on a hill with no friction. What is her acceleration?



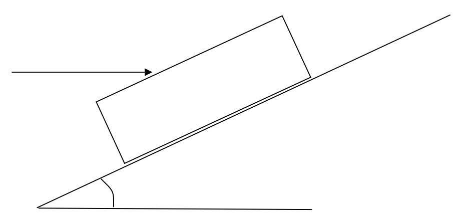
Concept first:
What force is it that accelerates her?
Motion parallel and perpendicular to the slope
What is the acceleration?
Two extremes:
level ground
infinite slope

a for any angle:

Worked Problem:
You push with a force of 200 N on a 25 kg frictionless ice block which is on a hill sloping 30° above the horizontal. What is the acceleration of the block?

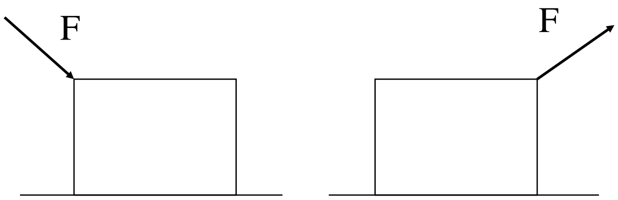


Same setup:
If you push with the same force, but horizontally what will the acceleration be?
(hint: qualitatively, will it be more, less or the same)



Kinetic and static friction

Q4. For the same magnitude of F, is one easier to get moving?



a. left is easier
b. right is easier
c. same

Static Friction:

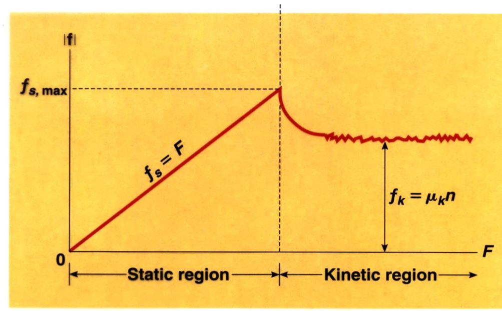
Grows with sideways force, to a point….

at slipping pt: $F_f \propto N$ $\boxed{F_f = \mu N}$

Demo: Friction blocks

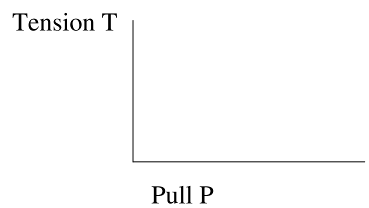
Kinetic "aka Moving" Friction

Demo: adjustable ramp



Compare with the forces in breaking a rope:

Tension vs. pull force in rope tied to a wall



Friction, Summary:

Static: $F_f\,(\text{max}) = \mu_S N$

Kinetic: $F_f = \mu_K N$

TABLE 4.2

Coefficients of Friction[a]

	μ_s	μ_k
Steel on steel	0.74	0.57
Aluminum on steel	0.61	0.47
Copper on steel	0.53	0.36
Rubber on concrete	1.0	0.8
Wood on wood	0.25–0.5	0.2
Glass on glass	0.94	0.4
Waxed wood on wet snow	0.14	0.1
Waxed wood on dry snow	—	0.04
Metal on metal (lubricated)	0.15	0.06
Ice on ice	0.1	0.03
Teflon on Teflon	0.04	0.04
Synovial joints in humans	0.01	0.003

[a]All values are approximate.

Worked Problem

Mary pulls a box of books with mass 25 kg to the right with a rope.

$\mu_s = 0.5 \quad \mu_k = 0.3 \quad g = 10\ \text{m/s}^2$

a. First she pulls horizontally on the box with a force of 40 N. The box doesn't move. What is the frictional force of the floor on the box?

b) What minimum force will she have to exert to get it moving?

Q5. If she pulls with force 175 N, what will the acceleration be after it starts moving?

a. 1 m/s^2 c. 4 m/s^2
b. 2 m/s^2 d. 6 m/s^2 e. > 6 m/s^2

Worked Problem

If Mary instead pulls the 25 kg box with force 180 N at an angle of 60° above the horizontal, what will the acceleration be?

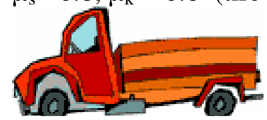
FBD:

Strategy:

- y-direction stuff:
  - i.
  - ii.
  - iii.
- x-direction stuff:
  - i.
  - ii.

N2 for y: N2 for x:

A 5000 kg truck has four tires with $\mu_s = 0.8$, $\mu_k = 0.6$ (tire to road friction)



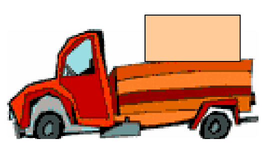
What is the maximum stopping ***deceleration***?

What is the maximum stopping ***deceleration* if the wheels are locked**?

What do anti-lock brakes do?

Worked Problem

In the back of the open truck is a large box of mass 300 kg with $\mu_s = 0.4$, $\mu_k = 0.3$

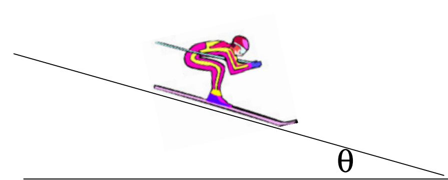


What is maximum acceleration the driver can give the truck if the box is not to slide out?

Friction on slopes

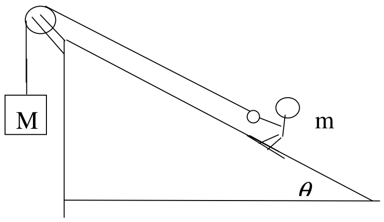
Q6. For the same skis and snow, as the slope angle **increases**, the ski-snow **frictional force**

a. increases
b. decreases
c. stays the same



Problem: If the kinetic coefficient of friction is μ, find the frictional force f.

You invent a new olympic sport called pulley ski jumping. If the kinetic coefficient of friction is μ, what is the acceleration?



“x” direction

“y” direction

Q7. Did you discuss at least half of the discussion quiz questions today with a neighbor?

a. Yes b. No