Physics questions?
Outline

(1) HW

(2) Announce

(3) Friction and Newton's Laws in 2-D
   ▪ “Non-obvious” single forces

(4) Circular Motion

(5) Chandeliers
Friction is temporary bonding

Friction results from these regions where surfaces adhere.

\[ f_k = \mu_k n \]
\[ f_s \leq \mu_s n \]
Problem 4.45 – “A bat crashes into a subway train”
Announcements

Grade update – see next slides.

If you number is in bold – you missed a quiz or more.

The people who have started the homework are the people who have 'A's

Clicker tubs are now available. You can leave clickers if you label with a
Getting Help

Workman Room 110 – Grad. student help (see yellow cards for schedule)

Fidel student center, 2nd floor,
Advising resource center – 6-8 pm
Tuesday (and Wednesday 6-8 pm)

Clicker tubs are now available. You can leave clickers if you label with a number – or not.

Missing persons - Steven Asher and Gael Tawatieu-Yota – please come see me.
Consider a lawnmower of weight $w$ which can slide across a horizontal surface with a coefficient of friction $\mu$. In this problem the lawnmower is pushed using a massless handle, which makes an angle $\theta$ with the horizontal. Assume that $F_h$, the force exerted by the handle, is parallel to the handle.

Take the positive $x$ direction to be to the right and the positive $y$ direction to be upward.

Express the required force in terms of given quantities:

$$F_h = \mu w \cos \theta \sqrt{\theta}$$

Part A

Find the magnitude, $F_h$, of the force required to slide the lawnmower.

Part B

This part will be visited later.
\( \theta = 30^\circ, \ T = 1000 \text{ N}, \ m = 200 \text{ kg}, \ \mu_k = 0.1, \ a = ? \)

\( \theta = 30^\circ, \ T = 1000 \text{ N}, \ m = 200 \text{ kg}, \ \mu_s = ?, \ a = 0 \)
Tires are as important as engine for a drag racer.
Uniform circular motion
An object moves at a constant speed in a clockwise direction around a circular track. The geometrical center of the track is at point $O$. When the object is at point $P$, which arrow shows the direction of the object’s acceleration vector?

A. arrow #1 (directly away from $O$)
B. arrow #2 (perpendicular to track)
C. arrow #3 (in direction of motion)
D. arrow #4 (directly toward point $O$)
You are driving your car (mass \( m \)) at a constant speed \( v \) around a flat, unbanked curve of radius \( R \).

Which of the following forces should be included in a free-body diagram for the car?

A. an outward centrifugal force of magnitude \( \frac{mv^2}{R} \)
B. an inward centripetal force of magnitude \( \frac{mv^2}{R} \)
C. the force of the car’s acceleration
D. two of the above
E. none of the above
You are driving your car (mass \( m \)) at a constant speed \( v \) around a banked curve of radius \( R \) and bank angle \( \beta \) (measured from the horizontal).

Which of the following forces *should* be included in a free-body diagram for the car?

A. a normal force that points vertically upward

B. a normal force that points at an angle \( \beta \) from the vertical

C. a normal force that points at an angle \( \beta \) from the horizontal

D. an outward centrifugal force of magnitude \( mv^2/R \)

E. more than one of the above
Figure 5.29

The diagram shows a 10 kg block suspended from a cable that forms a 45° angle with the vertical.
For a 20 kg pack, what is tension in each rope?

If yield strength of rope is 2000 N, how hard must bear pull to get sardines?
A car engine is suspended from a chain linked at $O$ to two other chains. Which of the following forces *should* be included in the free-body diagram for the engine?

A. tension $T_1$
B. tension $T_2$
C. tension $T_3$
D. two of the above
E. all of $T_1$, $T_2$, and $T_3$
Science teachers ride the vomit comet

http://www.youtube.com/watch?v=iCAzo-wTxiU&NR=1
Astronauts in orbit are weightless because:

-a- gravity ends at the edge of Earth's atmosphere.

-b- they are too far from the center of Earth for gravity to affect them much.

-c- they are closer to the moon which mostly balances Earth's pull.

-d- they aren't weightless, they're just falling.

-e- there are good special effects on that “space set” in Arizona that NASA has been using for years.