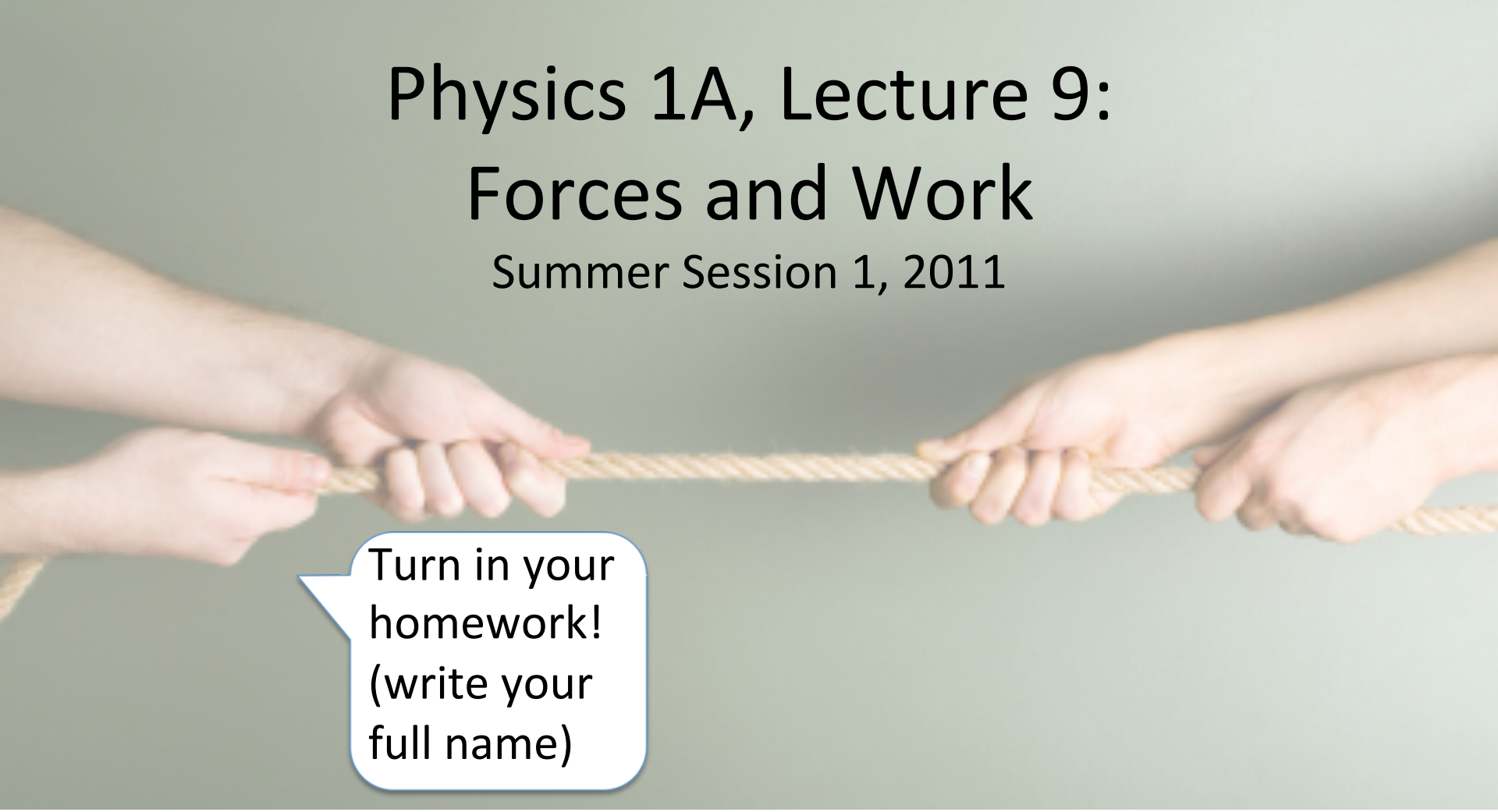
Physics 1A, Lecture 9: Forces and Work

Summer Session 1, 2011



The quiz will commence at 9:33 AM.

Key Questions: (Discuss with neighbors before quiz)

1) Is work a vector or a scalar?

2) Ignoring friction, which requires more work, climbing vertically up a ladder or walking up a ramp to the same height?

3) What is the difference between positive and negative work?

Reading Quiz #7-1

- Is work a vector or a scalar?

A) vector

B) scalar

Reading Quiz #7-2

- Ignoring friction, which requires more work, climbing vertically up a ladder or walking up a ramp to the same height?

A) Climbing a ladder

B) Walking up a ramp

C) They are the same

D) It depends on if you are speeding up or slowing down

Reading Quiz #7-2

- What is the difference between positive and negative work?

A) If the force is in the same direction as the displacement, the work is positive

B) If the force is in the opposite direction of the displacement, the work is positive

C) If the force is the cause of the displacement, that means the work is negative

D) If the force is perpendicular to the displacement, the work is negative

Announcements

- Homework #3 due by 1pm
- Office hours:
  - Me in Mayer 5623 at noon
  - Evan in Mayer 2702 from 2-4pm
  - Problem session in Peterson 104 from 5-6pm
- Pick up old homework from me

My recommendations for studying

- Make sure you understand homework problems
- Review clicker questions, reading quizzes and lecture slides
- Check out equation sheet ahead of time (posted in Announcements page)

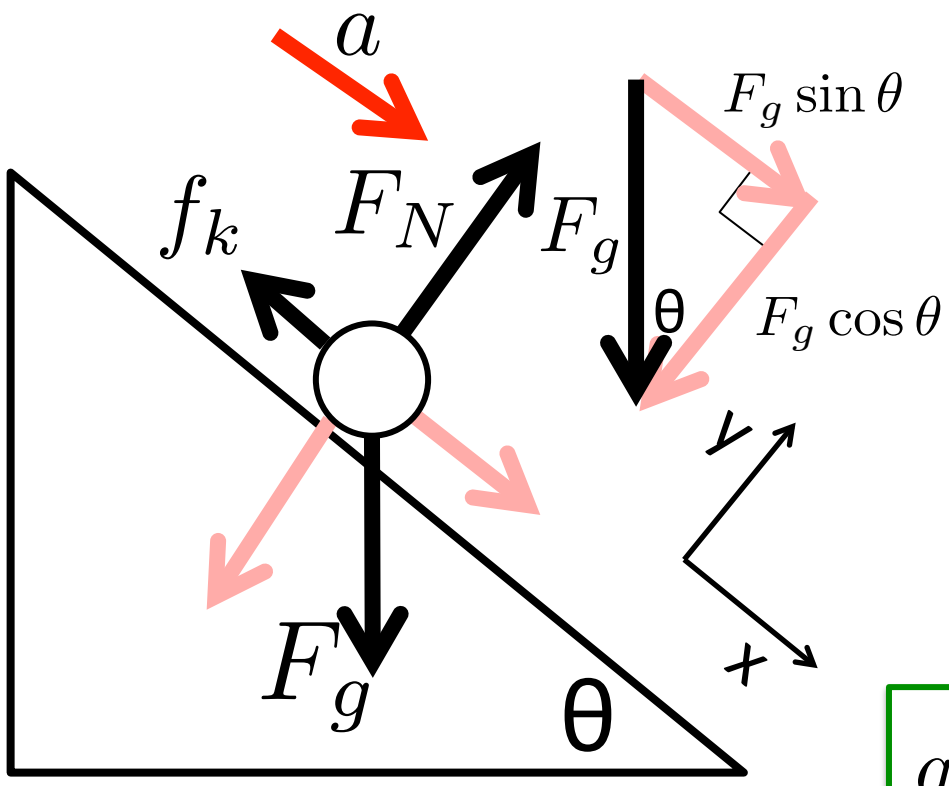
Anonymous poll

- What subject are you most worried about for tomorrow's Quiz?

A) Newton's Laws
B) Friction
C) Figuring out free body diagrams
D) Breaking up vectors into components
E) Everything

Practice drawing FBDs

- A box slides down a ramp with friction. Find acceleration down the ramp in terms of m and μ.



$$\sum F_y = 0$$

$$F_N = F_g \cos\theta$$

$$f_k = \mu_k F_N$$

$$f_k = \mu_k mg \cos\theta$$

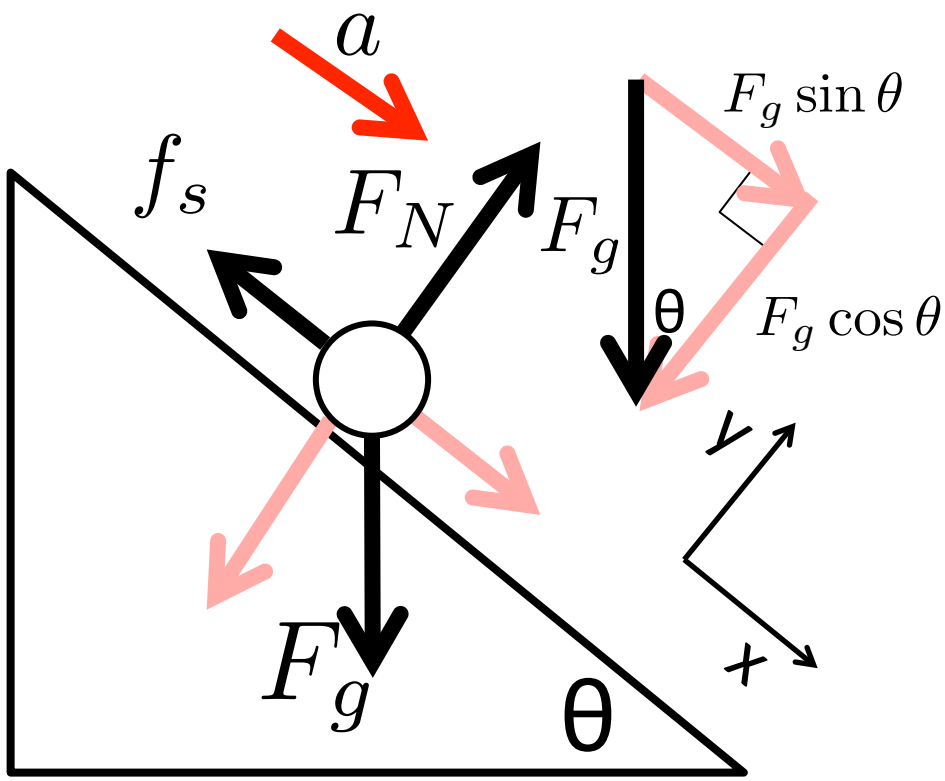
$$\sum F_x = ma_x$$

$$mg \sin\theta - f_k = ma_x$$

$$a_x = g \sin\theta - \mu_k g \cos\theta$$

Practice drawing FBDs

If the coeff. of static friction is μ_s
what is the maximum θ of the ramp
so there is no slipping?

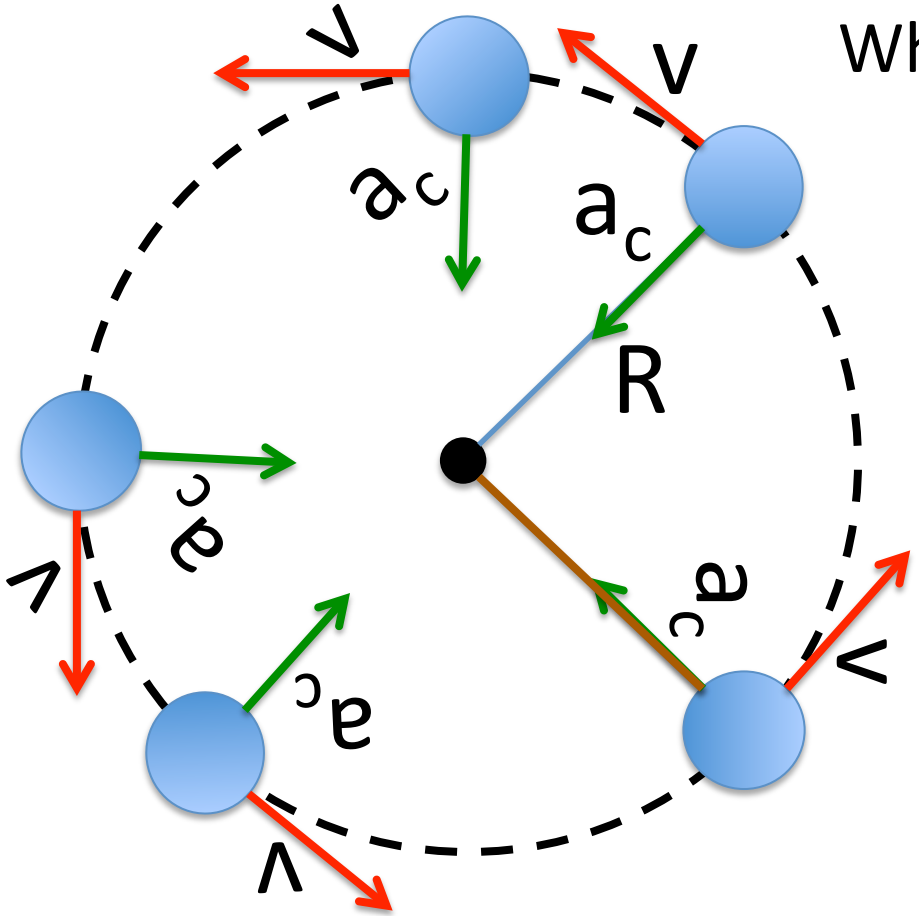


$$\sum F_y = 0$$

$$\sum F_x = 0$$

$$f_s = \mu_s F_N$$

Uniform circular motion



What is the tension in the rope?

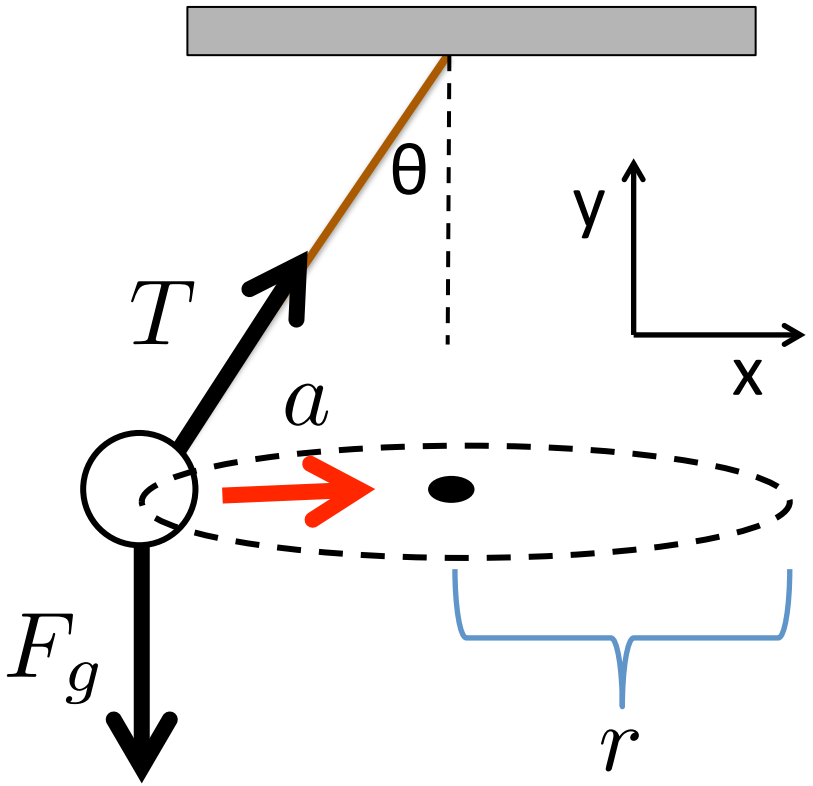
$$\sum F_{radial} = ma_{radial}$$

$$T = m\frac{v^2}{r}$$

$$a_c = \frac{v^2}{r}$$

Force in circular motion

- Forces on a tether ball:

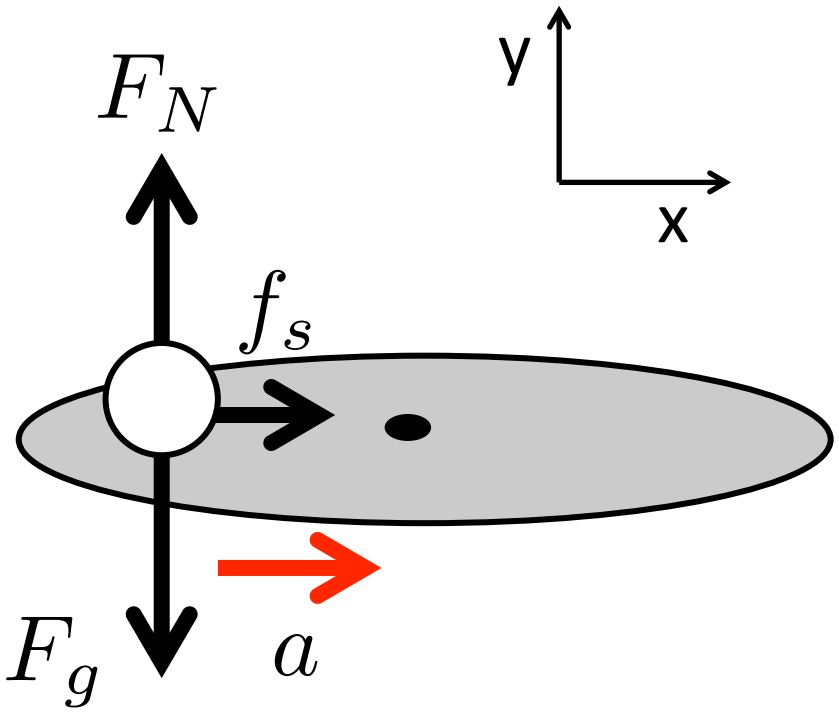


$$T_y - mg = 0$$

$$T_x = ma_x$$

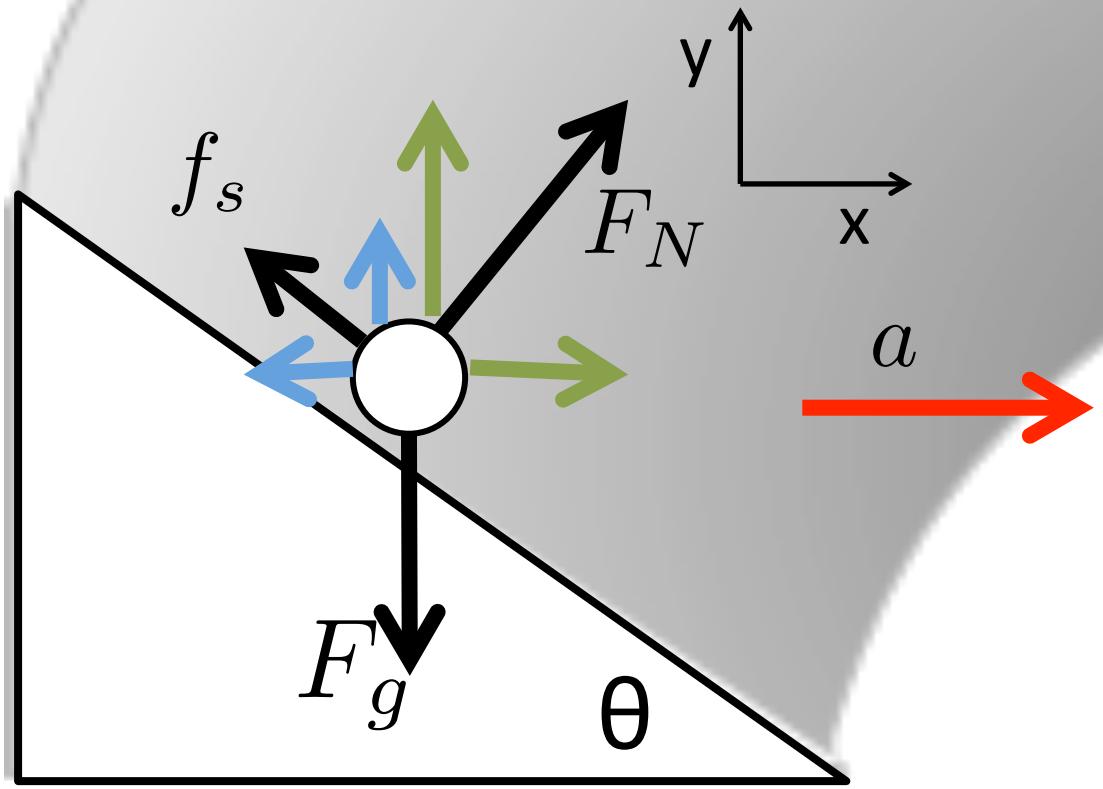
Force in circular motion

- Ant on a record:



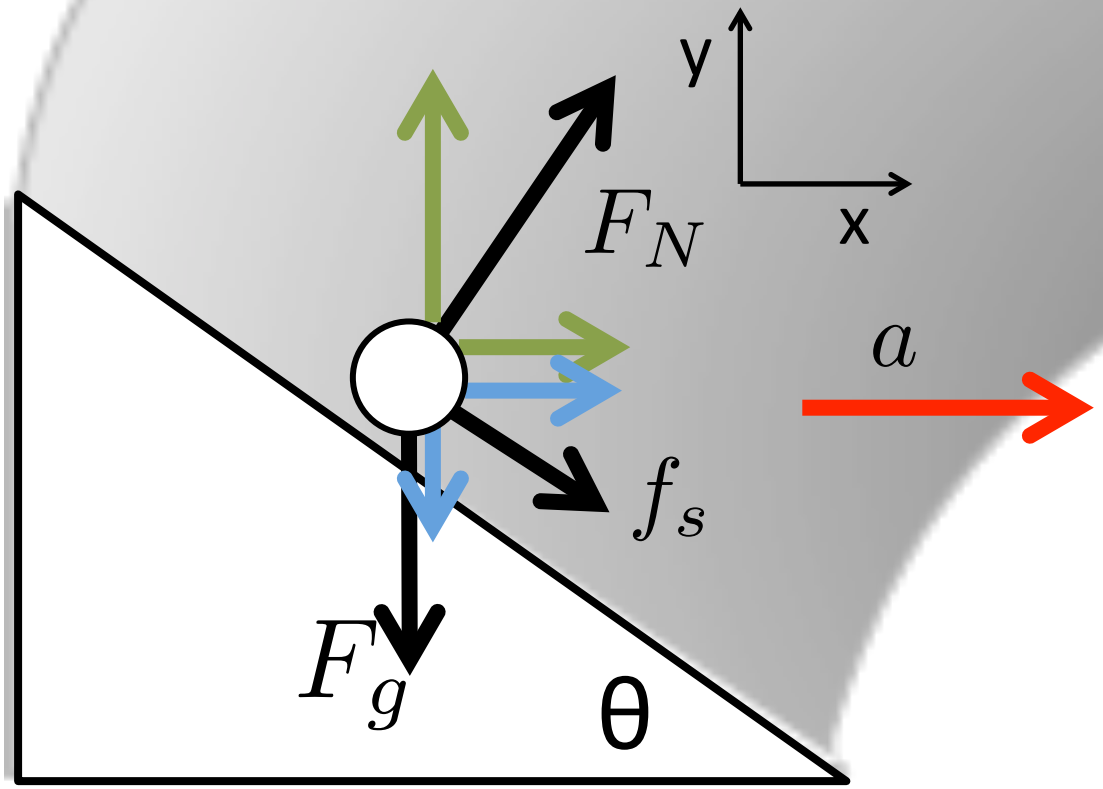
Practice drawing FBDs

Going around a banked curve, go at a speed so that you are almost sliding up the ramp:



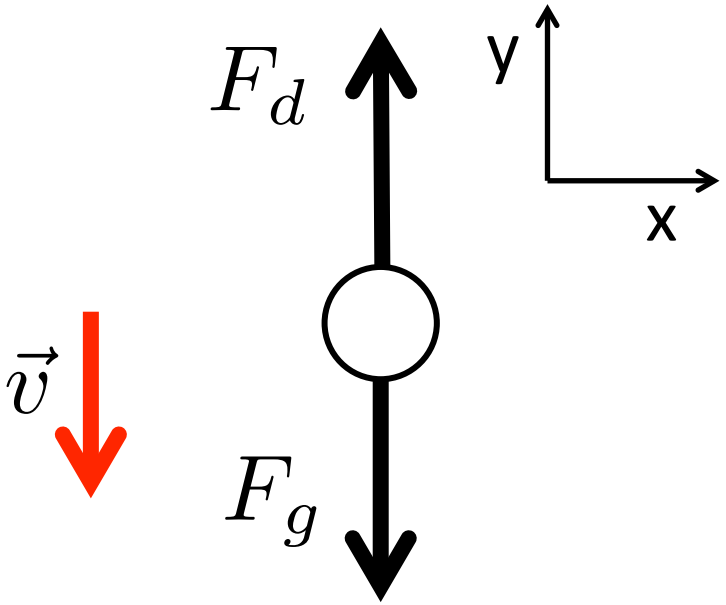
Practice drawing FBDs

Going around a banked curve, go at a speed so that you are almost sliding down the ramp:



Drag force and terminal velocity

- Object in free fall in presence of air resistance:



$$\vec{F}_d = -b\vec{v}$$

- Reach an equilibrium:

$$\sum F_y = F_d - F_g = 0$$

$$bv - mg = 0$$

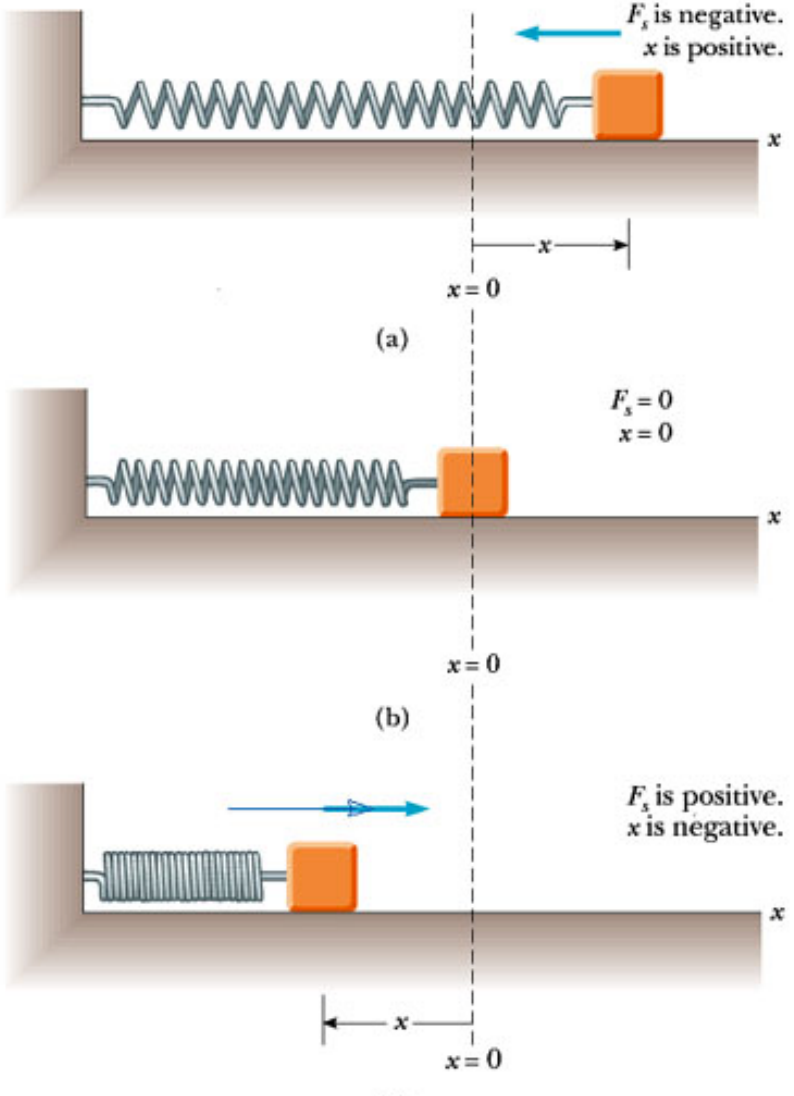
$$v_T = \frac{mg}{b}$$

- This velocity will not change

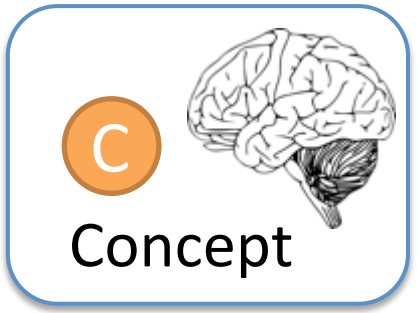
Spring Force

C

Concept



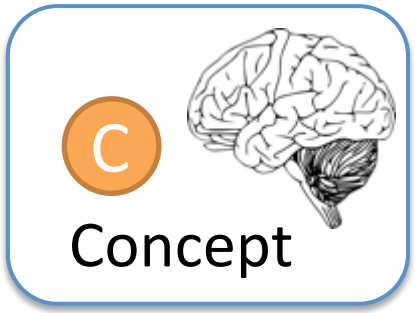
Energy / Money analogy



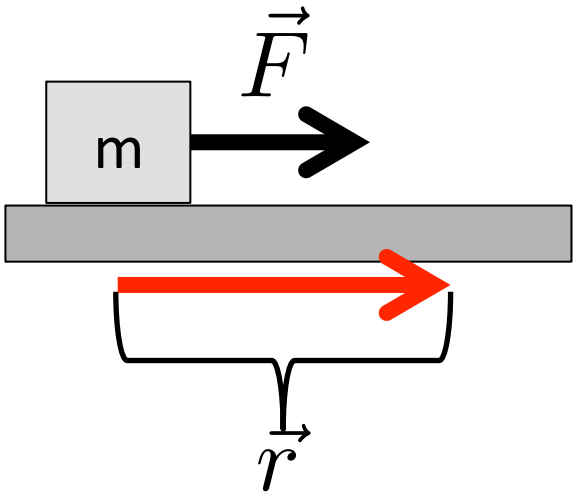
Types of Energy	Types of Money
• Kinetic Energy	• Cash
• Potential Energy	• Money in bank account
• Work	• A paycheck or bill

Math review:
Scalar product of two vectors

Work by a constant force

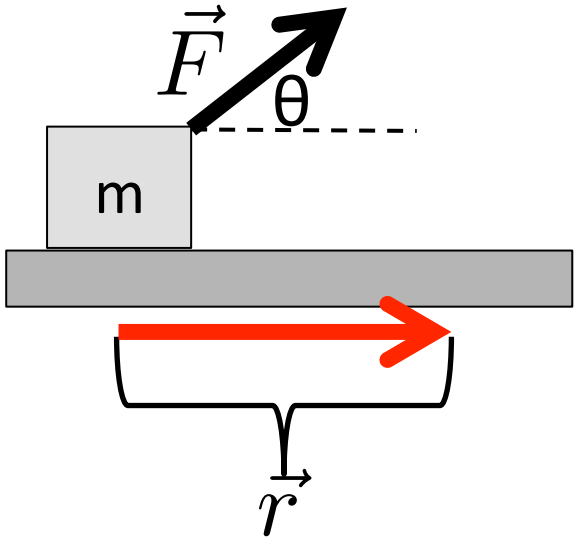


Force in direction of displacement:



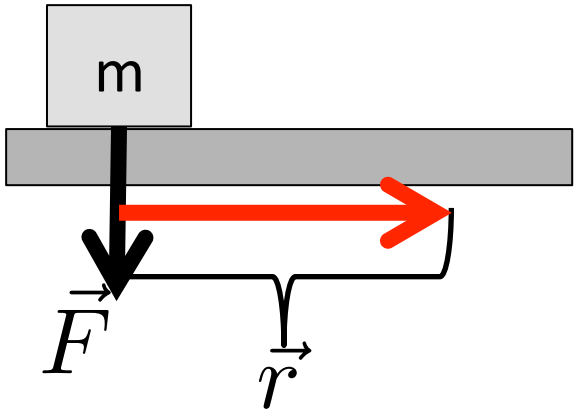
$$W = \vec{F} \cdot \vec{r}$$
$$W = |F| \cdot |r|$$

Force at an angle:



$$W = \vec{F} \cdot \vec{r}$$
$$W = |F| \cdot |r| \cos\theta$$

Force perpendicular to displacement:



$$W = \vec{F} \cdot \vec{r}$$
$$W = 0$$

Homework

- Turn in Homework #3 by 1pm in office hours
- Quiz #2 will be tomorrow
- Monday's reading assignment and Homework #4 will be posted as soon as I finish them
- Quiz #2 grades (and hopefully the other grades) should be posted by Friday.