Hello!

- Please take out a calculator, your notebook and a pencil.
- In your notes: draw the FBD for a car that is moving at a constant velocity.

This Week:

T: Forces Quiz and begin accelerating systems.

W: Continue accelerating systems.

R: Core Data Collection

F: Core Assessment Quiz

Today

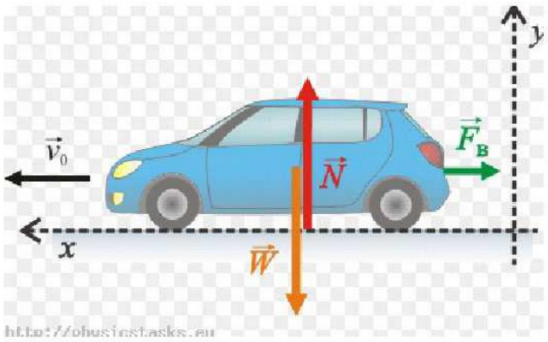
- Determine the forces acting on an object that is accelerating.
- Determine the acceleration of objects with unbalanced forces.

Homework Tonight

- physicsclassroom.com: Newton's Laws. Lesson 3. Sections a-d.

So Far...

- All of our FBDs have been about objects with balanced forces.
- Our FBDs have had equally sized arrows.



Accelerating Objects

- Sum of forces not equal to zero.

F=ma

- Newton's 2nd Law of Motion.
- Force is equal to mass times acceleration.
- Units: Force [Newtons] = mass [kg] x acceleration [meters/seconds^2]

Conceptual Understanding

- Inertia is the resistance to change of velocity.
- The more massive something is, the more force is required to accelerate it.
- The greater the force, the greater the acceleration.

Determining Acceleration

- If we know the net force acting on an object, we can calculate the acceleration.
- Solve for the sum of the forces and use F=ma to solve for the acceleration.

The space shuttle weighed about 2 million kg at launch. If the engines produce 2.96x10^7N of thrust. What is the acceleration of the shuttle?

FBD

$F_{push} = 2.96 \times 10^7 N$

$F_g = 2 \times 10^6 kg \cdot 9.8 \frac{m}{s^2} = 1.96 \times 10^7 N$

A bicycle has a mass of 13.1kg. The rider has a mass of 71.3kg. The rider applies a 9.78N force. With no drag, what is the acceleration of the bike?

$F_N = 827N$

$F_{push} = 9.78N$

$F_g = mg = 84.4kg \cdot 9.8 \frac{m}{s^2}$

$= 827N$

Do Now: Set up the following on a whiteboard.

An 50kg sled is being pushed at a constant velocity of 7m/s. The pushing stops and the sled slows to a stop due to a frictional foce of 30N. What is the acceleration of the sled?

What is the distance that the sled travels after the pushing stops?

Determining Net Force

- If we know the mass of the object (system) and it's acceleration, we can solve for force.
- We can use kinematics to find the acceleration.

Force and Kinematics

- A person is pushed in an office chair and then let go.
- Friction will eventually stop them.
- Draw an FBD for the chair after it is let go.

On a whiteboard, determine how you are going to measure the variables needed to solve for the force of friction.

$\Delta x=1/2(Vi+Vf)t$ & $a=(Vf-Vi)/t$

- How are we going to determine the variables we need to solve for acceleration?
- Take a moment and make a game plan with your lab partner.

Good Morning!

Let's finish up the chair problem from Friday.

Write down all of the variables we need to solve for the force of friction on the chair.

Vi= $8m/5.35 = 1.51\ m/s$

Vf= $0\ m/s$

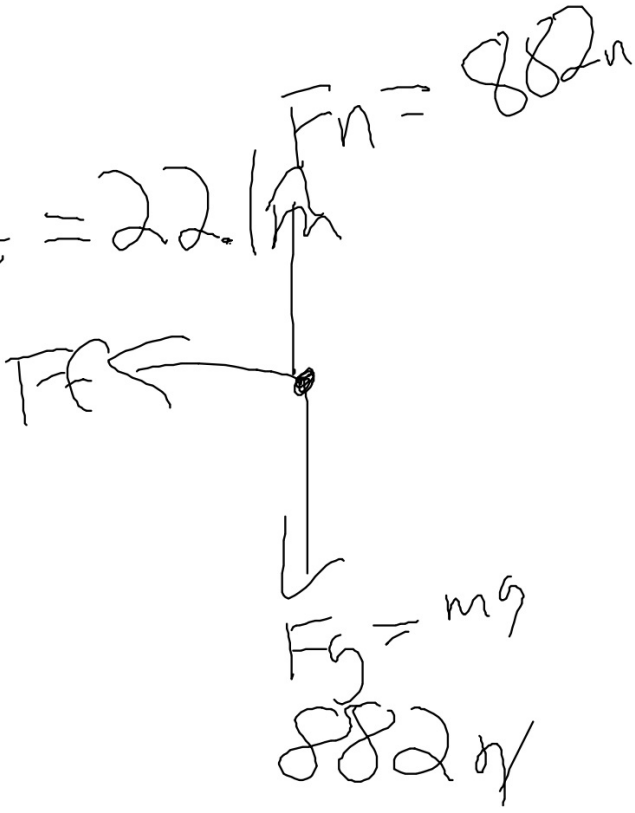
Xf-Xi= $\Delta x = 72.5\ ft = 22.1\ m$

a= $-0.65\ m/s^2$

m= $90\ kg$

Ff= $4.5\ N$

$\mu_K = 0.005$



A crew team rows a 500kg boat with a force of 300N. The drag from the water exerts a force of 150N. What is the acceleration of the boat?

$\Sigma F_x = 150N$ (to the right)

$m = 500kg$

$a = ?$

$\Sigma F_x = F = ma$

$a = \frac{F}{m} = 0.3\ m/s^2$

Would you weigh less in an elevator? - Carol Hedden

Elivator Problems:

Take the difference of the accelerations rather than sum of the forces.

Down is negative.

Use this to solve for the "apparent weight" (really the normal force) acting on the object in the elivator.

A 75 kg person gets into an elevator. When the elevator accelerates ~~upward~~ downward at -2m/s^2, what is the normal force acting on the person?

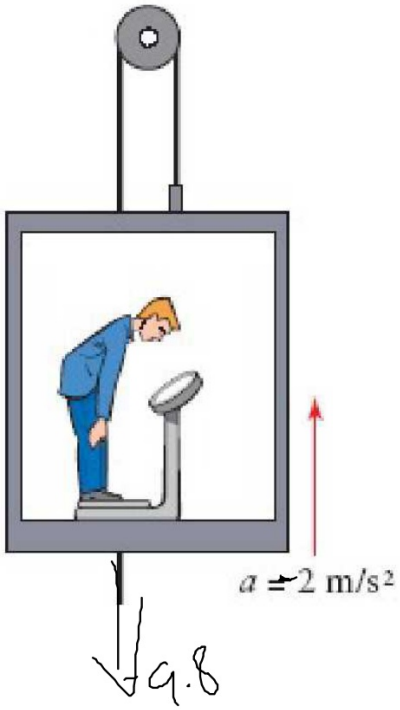
$m = 75\,kg$

$a = -2 - (-9.8) = 7.8$

$a = -9.8 - (-2) = -7.8$

$F_n = m\,a = 75\,kg \cdot 7.8\,m/s^2$

$F_n = 585\,N$



A 1100kg car is going 25m/s. A squirrel runs across the road and the driver slams on the breaks. The car comes to a stop in 1.5 seconds. What is the breaking force of the car.

$V_i = 25\ m/s$

$V_f = 0\ m/s$

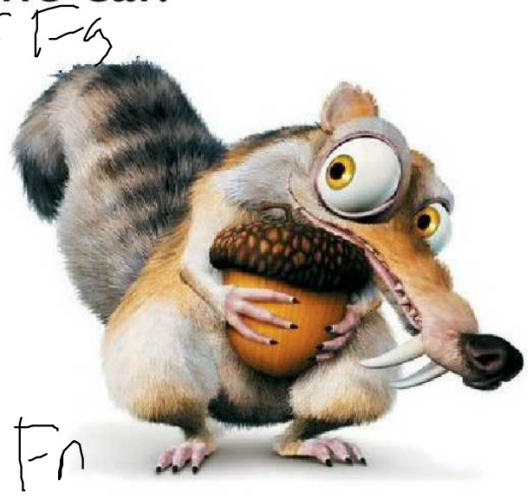
$t = 1.5\ s$

$a = -16.\overline{6}\ m/s^2$

$F = mg = 1100kg \cdot (-16.\overline{6}\ m/s^2)$

$F = -18,333N$

18,333N to the left



Intro to Net force worksheet: on school wires under Newton's Second Law.

Complete this worksheet in your notes alone or with a classmate.

When finished, check your answers with the key that I will be circulating with.

If all are correct, begin looking
over the Quest assignment.

Today:
Forces in multi-body problems.
Determining the force of friction on an incline.

A 3500kg limo is experiencing 600N of air resistance and it goes down the highway. What force does the car have to use to accelerate at 1.3m/s^2?

$m = 3500\,kg$

$a = 1.3\,m/s^2$

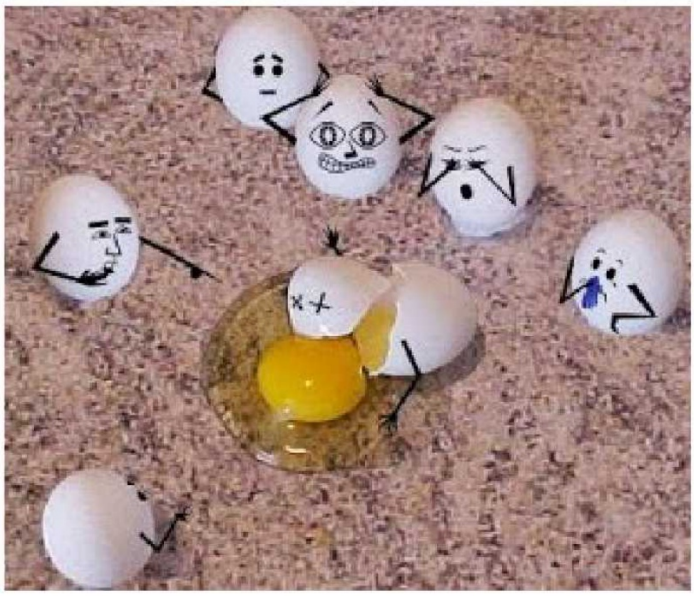
$\Sigma F = m \cdot a = 4550\,N$

$F_F = 600\,N$

$F_{push} = 5150\,N$

Egg Drop: Wednesday

- Read over the handout and begin planning your contraption.
- Review the restrictions.



Good Morning!!

Please take out your notbook, calculator, and a pencil.

Multi-body problems:
Draw an FBD for each object in the problem.
Determine the forces that are acting on each object.
The **key** is to remember that there may only be one force acting on the system.
A force on one object may accelerate two or more things.

A 5kg box is pushed with a force of 30N across a frictionless floor. The box accelerates until in comes into contact with a box weighing 8kg. If the force remains the same, what is the acceleration of both boxes?

$\Sigma F = 30N$

$\Sigma m = 13kg$

$a = \frac{F}{m} \approx 2.31 \, m/s^2$

~~A~~ Force is constant.

Snoopy pulls a 15kg sled with enough force to accelerate it at 1.7m/s^2. Woodstock dedides to hop a ride and hitches he and his sled (4kg) to the back of Snoopy's sled. What is the acceleration of the whole system.

$= 25.5\ N$

$= 15\ kg$

$= 1.7\ m/s^2$

$25.5\ N =$

$19\ kg =$

$1.34\ m/s^2 = \frac{F}{m} =$

A 20 kg block (A) rests on a frictionless table; a cord attached to the block extends horizontally to a pulley at the edge of the table. A 10 kg block (B) hangs at the end of the cord. Assume the pulley to be massless and frictionless.
Clearly draw and label a force diagram for each object.

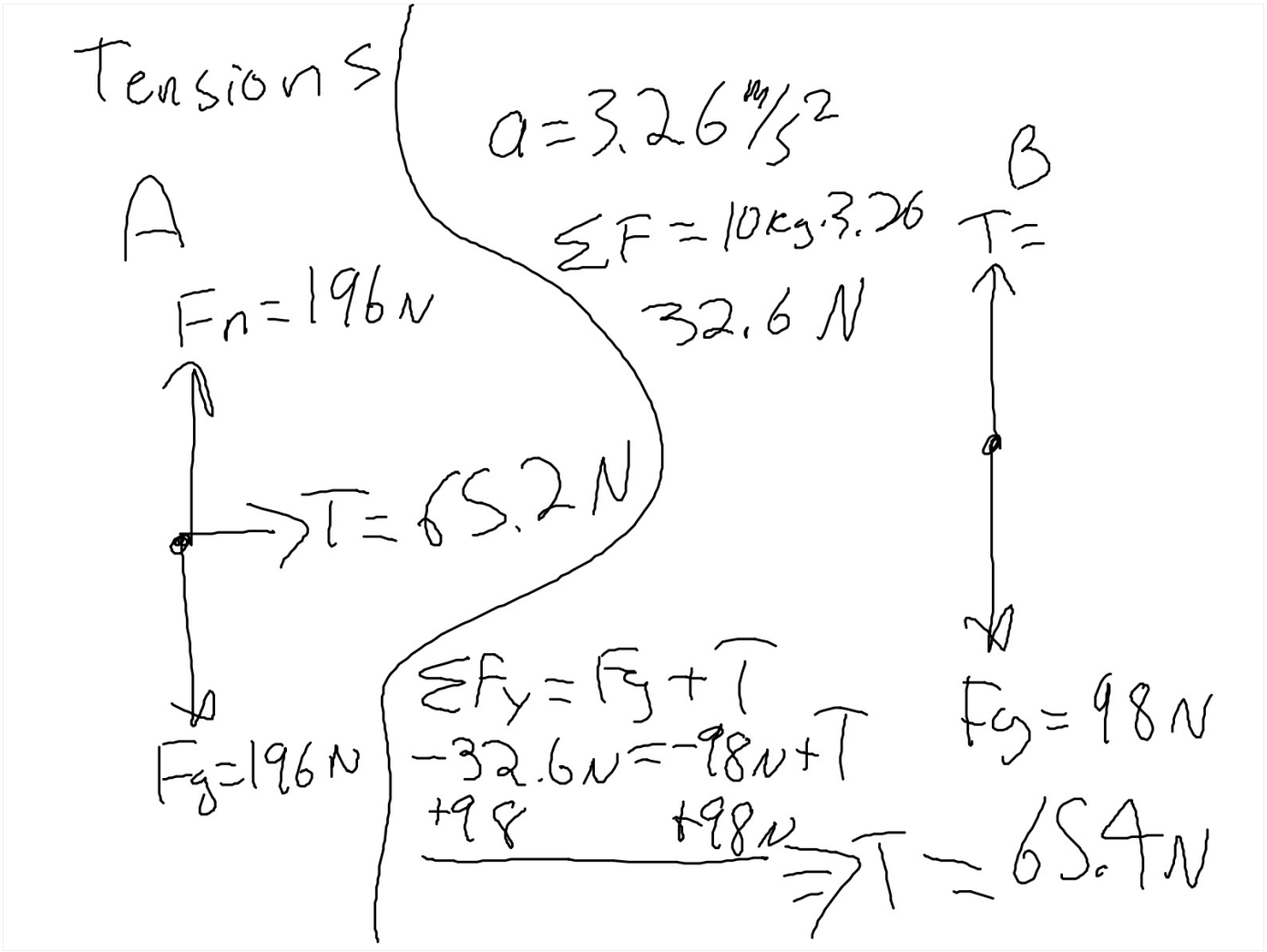
Calculate the acceleration of block A and of block B.

$a = ?$

$F = 98\,N$

$m = 10\,kg + 20\,kg = 30\,kg$

$\frac{F = ma}{m} = \frac{98\,N}{30\,kg} = 3,2\overline{6}\ m/s^2$


Tensions
a = 3.26 m/s²
A
Fn = 196 N
T = 65.2 N
Fg = 196 N
ΣF = 10kg · 3.26
32.6 N
B
T =
Fg = 98 N
ΣFy = Fg + T
−32.6 N = −98 N + T
+98 +98 N
T = 65.4 N

Good Morning!

$m = 24\,kg$

Review Problem: an object sits on an inclined plane that has an angle of 30 degrees from the horizontal. Solve for all forces acting on the block.

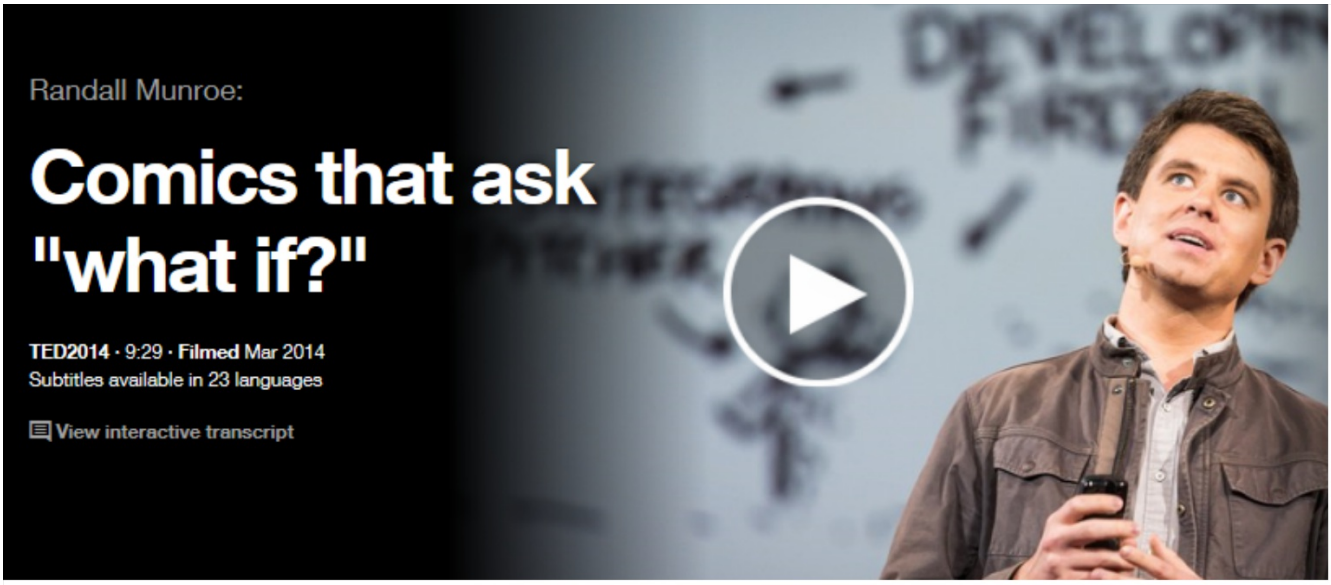
A 10kg object is placed on an inclined plane with an angle of 25 degrees. If the coefficient of kinetic friction is 0.15, what is the acceleration of the object.

$\Sigma F_2 = 0N$

$\Sigma F_1 = F_{g1} + F_f = 41N - 13.2N$

$\Sigma F_1 = 28.8N$

$\frac{F}{m} = \frac{mg}{m} = \frac{28.8N}{10kg} = 2.88 m/s^2$


Randall Munroe:
Comics that ask "what if?"
TED2014 · 9:29 · Filmed Mar 2014
Subtitles available in 23 languages
View interactive transcript

Real-world example:
Calculate the force of friction of an object sliding down a ramp.
We have all of the tools from our offic chair experiment at our disposal.
Watch the demonstration and brainstorm how to determine the force of friction.

Ideas:

$\theta = 52^\circ$

$m = 50\,g$

measure a

- need: $t, \Delta x, v_i = 0$

Measurements:

$m = 50g$

$\theta = 52^{\circ}$

$V_i = 0\ m/s$

$\Delta x = 2m$

$t = ? = 0.95s$

$a = ? = 4.4\ m/s^2$

Calculations:

$\Sigma F = m \cdot a = 0.05kg \cdot 4.4 m/s^2$

$\Sigma F = 0.22N = 0.386N - Ff$

$Ff = 0.386N - 0.22N$

$= 0.166N$

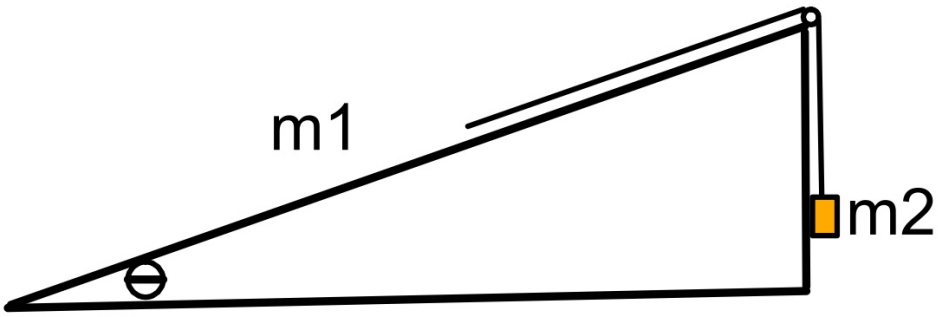
$\mu = \frac{Ff}{Fn} = 0.55$

Begin Review Sheet:

Work alone or with a partner to solve the problems on the worksheet.

I will come around to answer questions and check work with the solutions.

You may work on quest if you would like also. Now due at 9:00 pm.



Assuming no friction, calculate the direction and acceleration of the system.

Last few minutes:
Review the homework for tonight and ask questions if you would like clarification.
Begin brainstorming your egg drop. You may use laptops to research strategies if you wish.