4.1 – Force
Newton's 1st Law of Motion

Go through 4.2 etc and alter the x an y components info: Subtract angle of incline from 90 degrees!

As the years drug on, Skywalker began to find Obi-Wan increasingly annoying.

Force

A push or pull on objects, measured in newtons (N).

Contact Force:– objects touch each other to move.
Ex: Tension, Friction, Normal (prevents objects from moving through each other), Applied force (a push), Torque (twisting), etc.

For perspective, gravity gives this 100 g mass a force of 1 N.

Field Force
Long rangeforce.
Ex: Gravity, Electrostatic, Magnetic, Nuclear (holds atoms together)


We all need a personal force field!

Net Force

Vector sum of all forces.
(This is why we spent so much time decomposing and adding vectors.)


Net force = all these guys!

If forces balance each other, $F_{net} = 0$.

If forces are unbalanced, the object accelerates.

F + F + F + F = 4 F

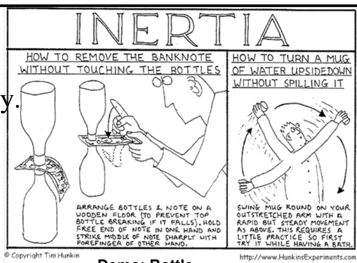
F_2

If 4 F = F_2 , F_{net} = 0 and there's no movement.

Inertia

An object's tendencyto resist changing velocity.

Mass is a quantitative measure of inertia: the more mass something has, the more inertia it has.



Demo: Bottle doesn't move!

Demo: Swinging can of water.

Newton's First Law (The Couch Potato Law)

A system with no net force has constant velocity:

"An object in motion stays in motion; an object at rest stays at rest, unless acted upon by an external force."

If $F_{net} = 0$, an object remains at constant velocity.


Ironic Couch Potato

Tension Rabbit Hole!

Let's Talk Tension!

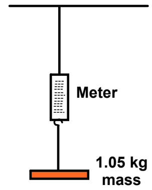
Tension is a pulling force, propagatingthrough a medium such as a rope, cable, stick, etc.

Can anyone think of an example of tension that occurs in a liquid?

Surface tension in water allows objects denser than water to float. (Paper clip Demo) Surface tension is a product of intermolecular attraction between water molecules. It takes a certain amount of energy to disrupt these forces, and if an object is light enough, or has a large surface area (force is distributed more), then it will "float".

1. Single Meter Physics Democracy!

What will the meter read, when this 1.05 kg mass hangs from it?

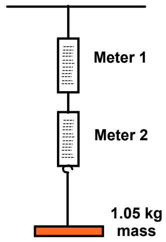


About 0.0 N	About 1.0 N	About 10.0 N

Answer: About 10 N.
$F = mg$: $F = 1.05\text{ kg} \times 9.81\text{ m/s}^2 = 10.3\text{ N}$

2. Serial Physics Democracy!

What will the meters read in this configuration?

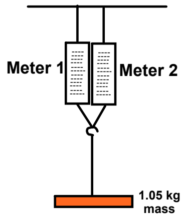


Meter 1: About 0 N Meter 2: About 0 N	
Meter 1: About 0 N Meter 2: About 10 N	
Meter 1: About 10 N Meter 2: About 0 N	
Meter 1: About 5 N Meter 2: About 5 N	
Meter 1: About 10 N Meter 2: About 10 N	

Answer: Both read 10 N.
The force of tension propagates through the entire system undiminished.

3. Parallel Physics Democracy!

What will the meters read in this configuration? Explain your vote.



Meter 1: About 0 N Meter 2: About 0 N	
Meter 1: About 5 N Meter 2: About 5 N	
Meter 1: About 10 N Meter 2: About 10 N	
The meters will be very different from each other.	

Answer: Both read about 5 N.
The force of tension is shared equally between multiple connections.

Tension Through Solids

Tension propagates uniformly through solids, at any point along the line, the amount of force is the same.

In many-stranded systems, tension divides evenly amongst all branches. Block and tackle systems use this to lift heavy loads.

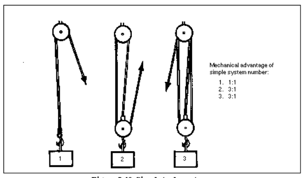


Figure 3-18. Simple tacle systems

Tension gives rise to a measurable tensile strength of a material, a property reported in N/m^2. The larger cross section of a material you have, the more force it takes to rip it apart.

Homework

Preview 4.2

4.1 Problems in your Booklet
Due: Next Class