Announcements

- WebWork 7 due tonight!
- WebWorK 8 due on Friday
- I'm working on getting my grade reporting system up and running so you can know where you stand currently in the class
- Polling: `rembold-class.ddns.net`

Review Question

A $10\,\mathrm{g}$ sheet of paper is blown horizontally against a vertical brick wall by a $\langle 5, 0, 0 \rangle \mathrm{N}$ breeze. The coefficient of static friction between paper and brick is *roughly* (friction pun!) $\mu_s = 0.75$. Will the paper slide down the wall? You can assume you are on the surface of Earth.

A. Yes. Yes the paper will slide.

B. Nope! That paper is staying put.

C. Jokes on you! That paper is moving *up* the wall.

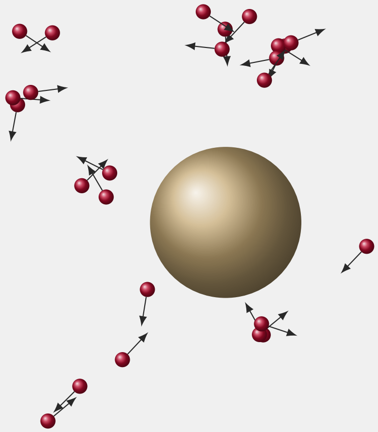
D. It is impossible to determine this without knowing the normal force of the wall on the paper.

Upcoming:

Fluid Contact Forces

Bouncy Forces

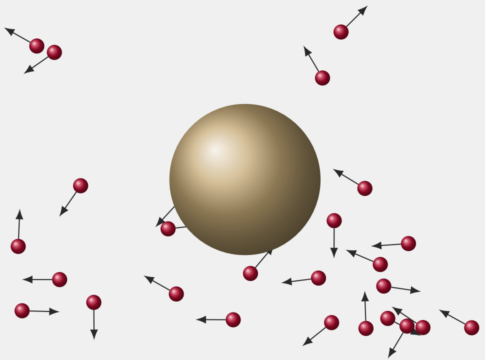
- Contact Forces can take different forms
- Approximated solids with springs because of crystal-like structure
- Fluids (including gases) operate in a more free fashion
- Apply a contact force by bombarding a surface
  - Atoms/Molecules bounce back $\Rightarrow$ change in momentum



Under Pressure dum-dum-dum-da-da-dum-dum

- Total force applied depends on the area being struck by the atoms
- Define pressure as
$$P = \frac{F}{A}$$
where A is the area being bombarded
- Standard unit is a $\mathrm{N/m^2}$ or a Pascal (Pa)
- Can determine force due to pressure by multiplying the pressure by the area

You Buoy Me Up



- In practice, gravity pushes more things towards the bottom
- More atoms $\Rightarrow$ more bombardments $\Rightarrow$ more pressure $\Rightarrow$ greater force
- Bottom of object feels a greater force due to pressure than top
- Gives a net push upwards, called the buoyant force
- Magnitude of buoyant force equals the *weight* (mg or $\rho V g$) of the displaced fluid

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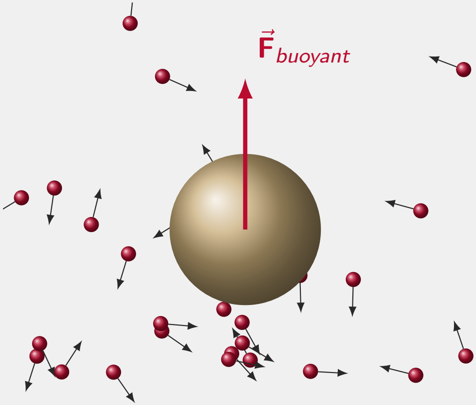

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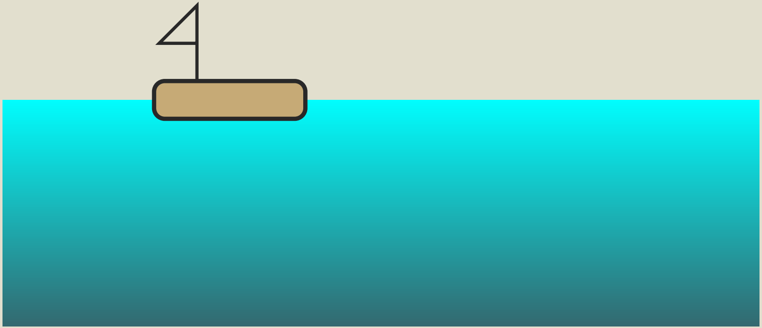
I'm on a BOAT

Suppose we have the (somewhat boring) rectangular boat below. The boat has a total mass of 800 kg and has a 2 m by 1 m bottom cross-section and sidewalls 50 cm high. Assuming we place the boat in water with a density of $1000\,\mathrm{kg/m^3}$, will the boat stay dry or fill with water?

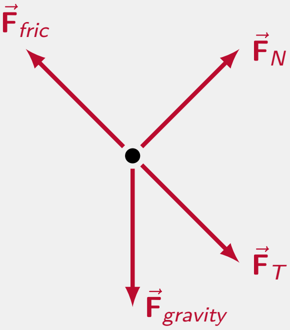


Upcoming:

From Motion: Forces

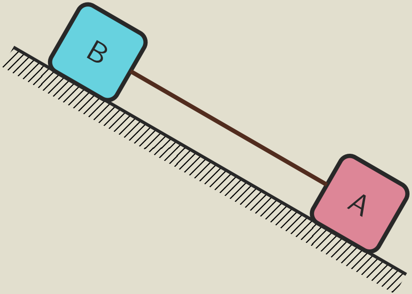
Do (or do not) Underestimate FBDs

- Free body diagrams are going to be even more important to us going forwards
- Basic Steps:
  - Identify all objects in surroundings acting via a long-range force (gravity or electrically)
  - Identify all objects in surroundings acting via contact forces (tension, normal, friction, buoyancy, etc)
  - Draw your FBD, labeling all forces
- Remember that *you* choose the system, and FBD's on different systems will look different!



A Matter of Perspective

Consider two masses attached via a rope sliding down an incline. Draw FBD's for mass A, mass B, and a system consisting of both mass A and B. Assume they are on the surface of Earth and that the incline is rough.



Upcoming:

Constant Motion

Constant Considerations

- Motion is constant when:
  - Direction is unchanging
  - Velocity is unchanging
- As such, in this situation $\Delta\vec{\mathbf{p}} = 0$, or, put in our new formulation:

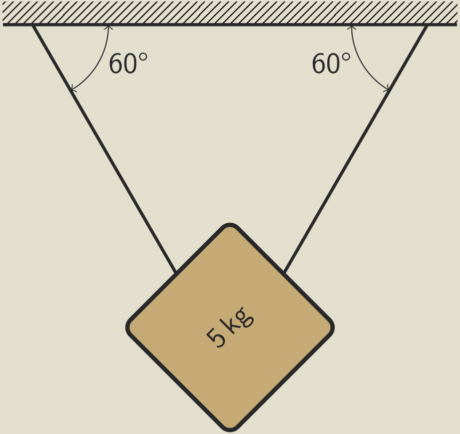
$$\frac{\mathrm{d}\vec{\mathbf{p}}}{\mathrm{d}t} = 0$$

- Thus we will be starting from situations where

$$\vec{\mathbf{F}}_{net} = \vec{\mathbf{0}} = \langle 0, 0, 0 \rangle$$

- This sort of analysis is also called *statics*
- Time for a lot of examples!

Suppose the block below is hanging from two separate strings that form interior angles of 60° with the ceiling. What is the tension in each string?



Practice Time!

Two sleds connected via a rope are sliding down a 20° incline at a constant rate. The lower sled (m=10 kg) is very slippery and experiences no frictional force, while the upper sled (m=40 kg) has a non-zero but unknown coefficient of kinetic friction.

- What is the tension in the rope?
- If the rope measures 1 mm in diameter and 2 m long, how much does it stretch? You can assume the rope is made of hemp with a Young's Modulus of 35 GPa.
- What is the coefficient of kinetic friction between the upper sled and the snow? You can take the rope to have negligible mass.