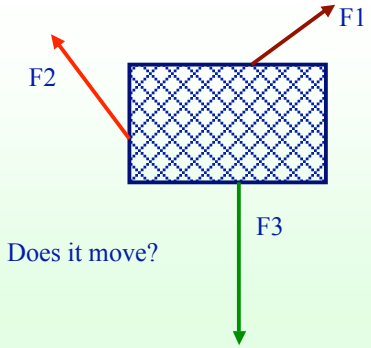
- Sit anywhere at tables 1–8 but arrange yourselves in groups of 3 for today's experiment.
- Last Lecture
  - Force as a vector
  - Static equilibrium $\sum \vec{F} = 0$
  - Addition and subtraction on vectors
- Today
  - Examples, examples, examples…
  - Experiment # 1: Static equilibrium
- Important Concepts
  - Force is a vector, both magnitude and direction matter
  - Vectors: Think with arrows, calculate with components

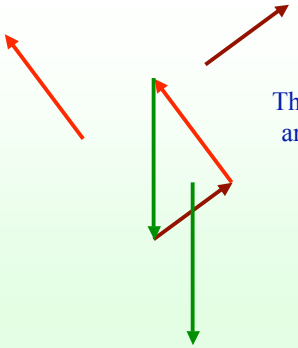
- Problem Solving Tool: Setting up
  - Make a careful drawing
  - Think carefully about all of the forces
  - Chose an axis, put it on your drawing
  - Think carefully about the angles
- Problem Solving Tool: Component checklist
  - Loop through vectors:
    - Is there a component?
    - Is there an angle factor
    - Is it sine or cosine?
    - Is it positive or negative?

Basic idea behind components

- Want to do a quantitative calculation with vectors
- Need to convert multi-dimensional object to numbers, add or subtract or multiply the numbers, and then generate the multi-dimensional answer
- Write each vector as a sum of smaller sub-vectors, all of which point in the same direction.

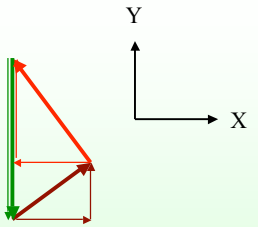


Does it move?

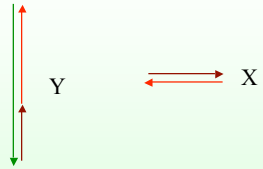


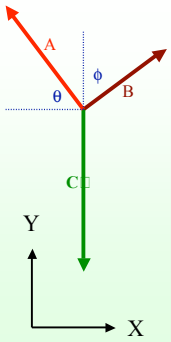
Think with arrows…

Calculate with components - version 1



Calculate with components - version 1





I: Given C, θ and ϕ=90°-θ
Find A,B

II: Given A, C, θ
Find B, ϕ

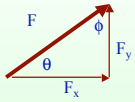
III: Given A, B, C
Find θ, ϕ

$$\sum F_x = -A\cos(\theta) + B\sin(\phi) = 0$$
$$\sum F_y = A\sin(\theta) + B\cos(\phi) - C = 0$$

Summary - I

- Different ways of writing vectors are related by:

$$F_x = F\cos(\theta) = F\sin(\phi)$$
$$F_y = F\sin(\theta) = F\cos(\phi)$$
$$F = \sqrt{F_x^2 + F_y^2} \qquad \tan(\theta) = F_y / F_x$$
$$\tan(\phi) = F_x / F_y$$



- Unit vector notation: $\vec{F} = F_x\hat{x} + F_y\hat{y}$ or $\vec{F} = F_x\hat{i} + F_y\hat{j}$

Summary - II

- Practice the component checklist and the guidelines for setting up static equilibrium problems. Don't try to remember special cases, each problem is different!
- The units of force are Newtons.
- Force of gravity on an object of mass M near the surface of the Earth is M*g* where: $g = 9.81\,N/kg$
- Some forces (for example, the normal force) will rarely be given but, instead, will usually be found using sums of forces.

Experiment Advice - I

- Make sure that the Force sensor is plugged into the 750 interface, the interface is plugged into the USB on the side of the monitor, and that the interface is turned on.
- One member of the group should log onto the computer to download the LabVIEW program to run the experiment.
- Don't forget to use a section of L10 and decide around your table who will be groups A, B, and C.

Experiment Advice - II

- Try to be as careful as possible about your measurements of the two distances.
- Check regularly that the weight hanger is in the middle of the string. It tends to move away from the center as you loosen the string.
- Notice that there are questions on both sides of the answer sheet.
- Each group should list all names on a single answer sheet turned in at the end.