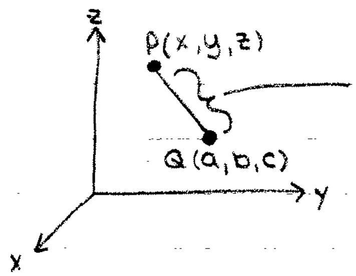
hatie was just summoned for jury duty 9/23

<u>Outline:</u>

- 3D Stuff
- Vectors

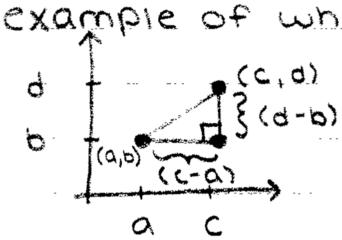
<u>Announcements:</u>

- HW: M 9/14, W 9/16, Th 9/17
- Exam coming up



$$|PQ| = \sqrt{(x-a)^2+(y-b)^2+(z-c)^2}$$

example of why true in the plane:

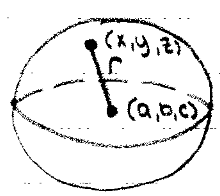


$$\sqrt{(d-b)^2+(c-a)^2}$$

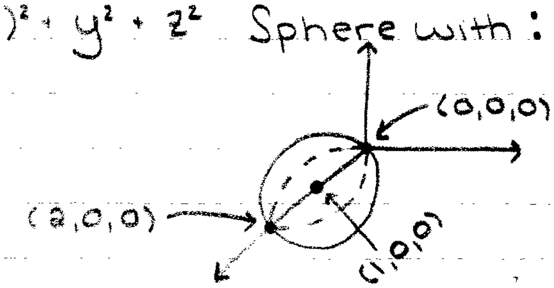
<u>Sphere:</u> The set of all points an equal distance away from a given point

$$r = \sqrt{(x-a)^2+(y-b)^2+(z-c)^2} \longrightarrow r^2 = (x-a)^2+(b-y)^2+(z-c)^2$$

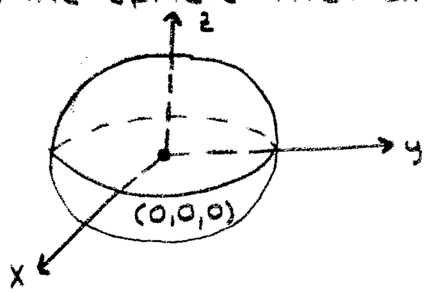
equation for a sphere of radius r with center (a,b,c)



$1 = (x-1)^2 + y^2 + z^2$ Sphere with: radius = 1 center (1,0,0)

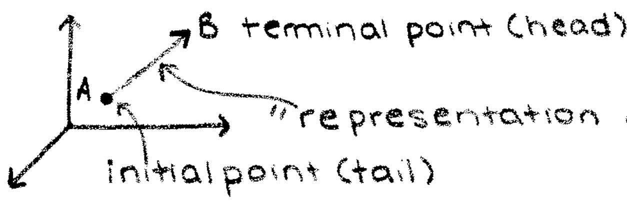


"advice": draw the sphere first and then the axes



Vectors

A vector is magnitude & a direction



"representation of the vector from A to B"
($\overrightarrow{AB}$) Or
"the displacement vector
from A to B"

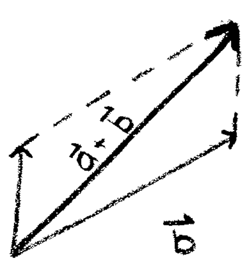
Two vectors $\overrightarrow{CD}$ and $\overrightarrow{AB}$ are equal if they point in the same direction & have the same length.

C $\longrightarrow$ D
SAME
A $\longrightarrow$ B

(Almost) always we draw vectors in a plane

Vector Addition

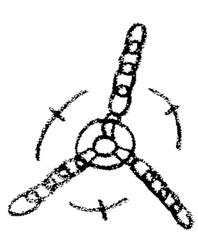
Parallelogram with sides $\vec{a}$ & $\vec{b}$



Parallelogram
Rule
For Sums

new notation $\vec{a}$
(in book **a**)

Example:

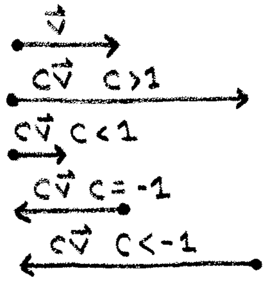


all the same length chains
if 3 people pull with the same
force, the ring goes no where

Another way to think of vector sums:

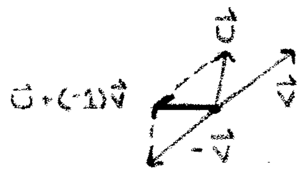
Triangle Rule For Sums

<u>"Scalar" multiplication</u> (Scalar means "number")
(c is the scalar)

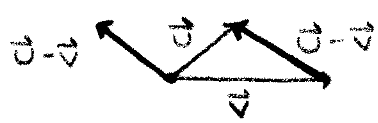


the vector $c\vec{v}$ points in the same or opposite direction as $\vec{v}$ and its length is $|c| \cdot$ length $\vec{v}$

$\vec{u} - \vec{v} \underbrace{:=}_{\text{"is defined to be"}} \vec{u} + (-1)\vec{v}$



or $\vec{u}-\vec{v}$ is the vector from the head of $\vec{v}$ to the head of $\vec{u}$

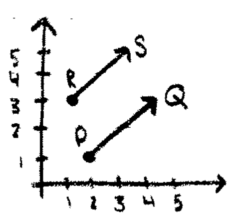


<u>Vectors using components</u>

$\vec{a} = \langle a_1, a_2, a_3 \rangle$ $\vec{b} = \langle b_1, b_2, b_3 \rangle$

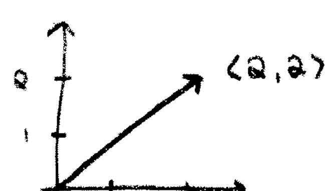
(2d-vectors $\vec{a} = \langle a_1, a_2 \rangle$ & $b = \langle b_1, b_2 \rangle$)

Example in the plane:



$\overrightarrow{PQ} = \langle 4-2, 3-1 \rangle = \langle 2,2 \rangle$

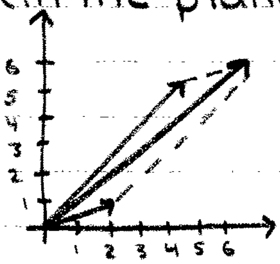
$\overrightarrow{RS} = \langle 3-1, 5-3 \rangle = \langle 2,2 \rangle$



When we use components our vectors are based at the origin

$\vec{a} + \vec{b} = \langle a_1 + b_1, a_2 + b_2, a_3 + b_3 \rangle$

Example (in the plane):



$\langle 2,1 \rangle + \langle 4,5 \rangle = \langle 6,6 \rangle$

length of a vector $\vec{v} = \langle v_1, v_2, v_3 \rangle$
is $|\vec{v}| = \sqrt{v_1^2 + v_2^2 + v_3^2}$

$c\vec{v} = \langle cv_1, cv_2, cv_3 \rangle$

$\vec{a} - \vec{b} = \langle a_1 - b_1, a_2 - b_2, a_3 - b_3 \rangle$

Example:

$\vec{a} = \langle 1,0,3 \rangle \quad \vec{b} = \langle -2,-1,7 \rangle$

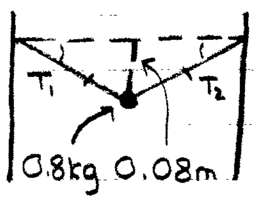
$$2\vec{a} + 3\vec{b} = 2\langle 1,0,3 \rangle + 3\langle -2,-1,7 \rangle$$
$$= \langle 2,0,6 \rangle + \langle -6,-3,21 \rangle$$
$$= \langle -4,-3,27 \rangle$$

$|\vec{a}| = \sqrt{1^2 + 0^2 + 3^2} = \sqrt{10}$

Exercise: Find the big box of laws/rules for vectors (chapter 13.2) and know how to use them

Example Problem Chapter 13.2 #33

A clothesline is tied between two poles, 8m apart. The line is quite taut and has negligible sag. When a wet shirt with a mass of 0.8kg is hung at the middle of the line, the midpoint is pulled down 8cm. Find the tension in each half of the clothesline.



$0.8\,kg \times 9.8\,m/s^2 = 7.84\,N$

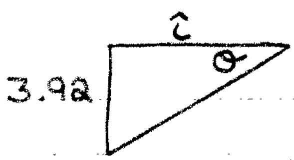
$T_1\hat{j} + T_2\hat{j} = 7.84\,\hat{j}$ and $T_1\hat{j} = T_2\hat{j}$

$\therefore\ 2T\hat{j} = 7.84\hat{j}$

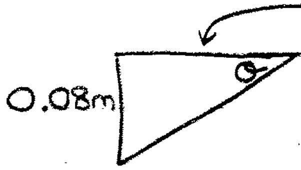
$T\hat{j} = 3.94\hat{j}$

$T_1\hat{i} + T_2\hat{i} = 0$

$\therefore\ T_2\hat{i} = -T_1\hat{i}$



$\tan\theta = \dfrac{3.92}{\hat{i}}$



4m (length of clothesline ÷ 2)

$\tan\theta = \dfrac{0.08\,m}{4\,m} = \dfrac{3.92}{\hat{i}}$

$0.08\hat{i} = 3.92(4)$

$\hat{i} = 196$ for T_2

$T_1\hat{i} = -T_2\hat{i} = 196$

$$\boxed{\begin{aligned} T_1 &= -196\hat{i} + 3.92\hat{j} \\ T_2 &= 196\hat{i} + 3.92\hat{j} \end{aligned}}$$