Trig 8.2

Find ordered pairs that represent vectors
Add, subtract, multiply and divide vectors

vector

resultant

vertical

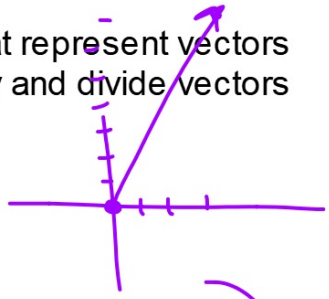
horizontal

component

unit vector

cosine (x adjacent)

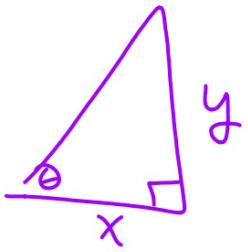
sine (y opposite)



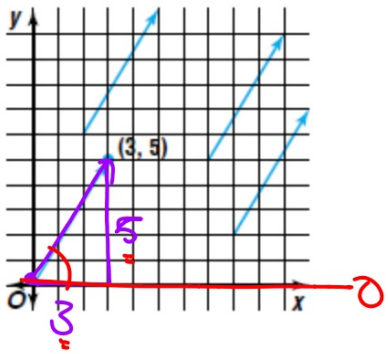
(x, y) $\langle x, y \rangle$

$\langle 3, 7 \rangle$ $\langle\ ,\ \rangle$

i j



Is a geometric method adequate to combine vectors?
Is it precise enough?
Is it user friendly and convenient?



$\langle 3, 5 \rangle$

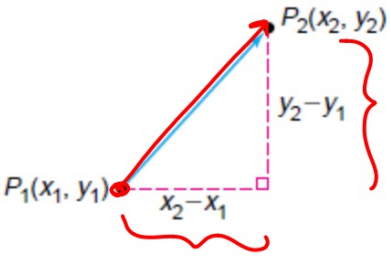
Standard position
magnitude...direction... (same?)

$\sqrt{34}$ 59°

$9 + 25 = h^2$

$\sqrt{34} = h$

$\tan\theta = \frac{5}{3}$



Ordered pairs or vectors?

Some books use < > to represent vectors

<component form> <x,y>

"frackets"

1 Write the ordered pair that represents the vector from $X(-3, 5)$ to $Y(4, -2)$. Then find the magnitude of $\overline{XY}$.

< >

<7, 7>

$7^2+7^2=h^2$

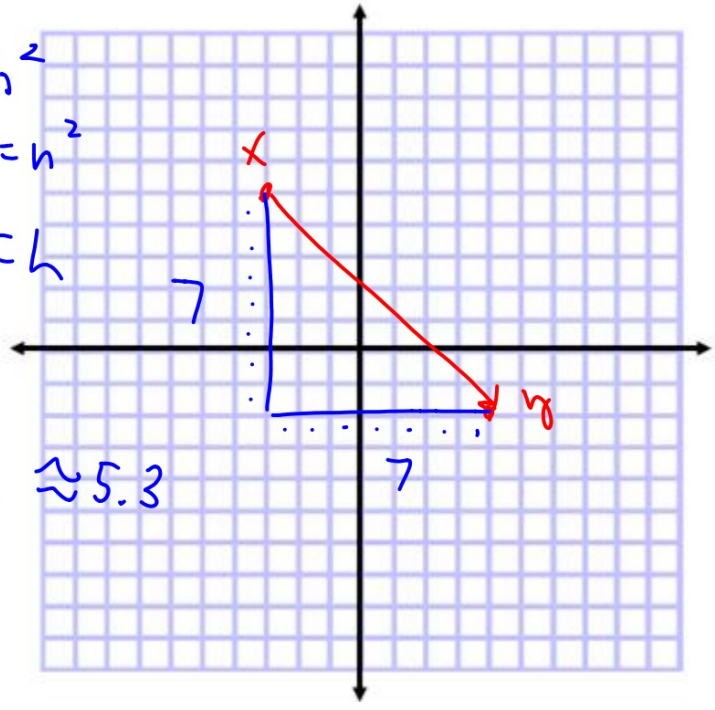
$49+49=h^2$

$\sqrt{98}=h$

$2\sqrt{49}$

$2\cdot 7$

$7\sqrt{2}$ ≈ 5.3

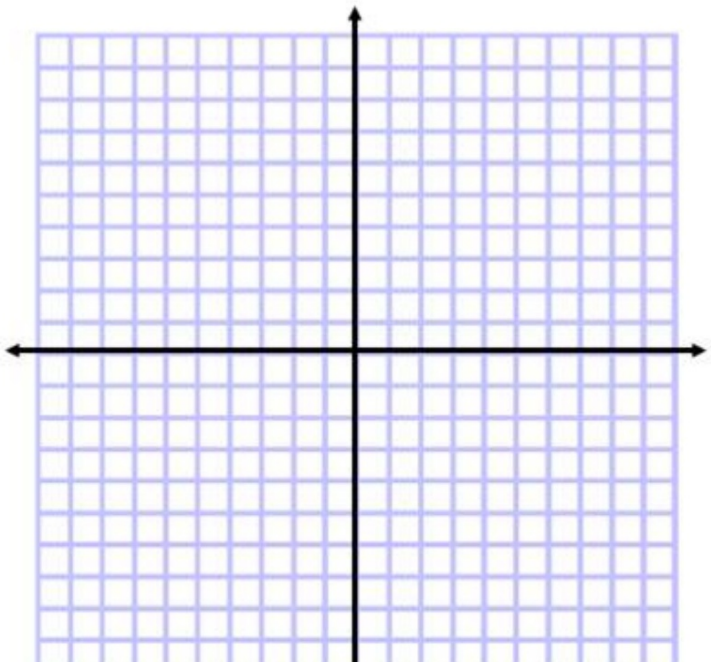


(When it's in component form...)

<x,y >

Write the ordered pair that represents $\overrightarrow{MP}$. Then find the magnitude of $\overrightarrow{MP}$.

4. $M(2, -1), P(-3, 4)$ **5.** $M(5, 6), P(0, 5)$ **6.** $M(-19, 4), P(4, 0)$



Much easier to add & subtract when in component form!
(How can you tell?)

Vector Operations

The following operations are defined for $\vec{a}\ \langle a_1, a_2\rangle$, $\vec{b}\ \langle b_1, b_2\rangle$, and any real number k.

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

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

Scalar multiplication: $k\vec{a} = k\langle a_1, a_2\rangle = \langle ka_1, ka_2\rangle$

Example 2 Let $\vec{m} = \langle 5, -7\rangle$, $\vec{n} = \langle 0, 4\rangle$, and $\vec{p} = \langle -1, 3\rangle$. Find each of the following.

a. $\vec{m} + \vec{p}$

b. $\vec{m} + -\vec{n}$

SMATO

$\langle 5, -7\rangle + \langle -1, 3\rangle$

$\vec{m} + \vec{p} = \langle 4, -4\rangle$

$\vec{m} + -\vec{n}$

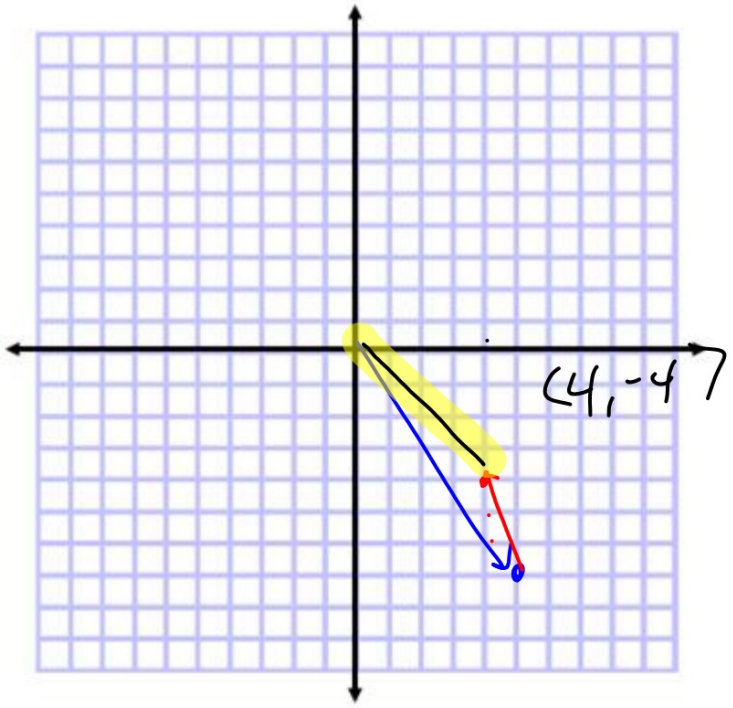
$\langle 5, -7\rangle + \langle 0, -4\rangle$

$\langle 5, -11\rangle$

c. $7\vec{p}$

d. $2\vec{m} + 3\vec{n} - \vec{p}$

$\langle 5, -7 \rangle + \langle -1, 3 \rangle = \langle 4, -4 \rangle$



(Is it already in component form?)

Find an ordered pair to represent $\vec{t}$ in each equation if $\vec{u} = \langle -1, 4 \rangle$ and $\vec{v} = \langle 3, -2 \rangle$.

7. $\vec{t} = \vec{u} + \vec{v}$

8. $\vec{t} = \frac{1}{2}\vec{u} - \vec{v}$

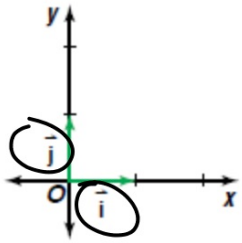
$\vec{u} + \vec{v} =$

$\vec{t} = \frac{1}{2}\langle -1, 4 \rangle + -\langle 3, -2 \rangle$

$= \langle -\frac{1}{2}, 2 \rangle + \langle -3, 2 \rangle$

$= \langle -3.5, 4 \rangle$

A vector that has a magnitude of one unit is called a **unit vector**. A unit vector in the direction of the positive x-axis is represented by $\vec{\mathbf{i}}$, and a unit vector in the direction of the positive y-axis is represented by $\vec{\mathbf{j}}$. So, $\vec{\mathbf{i}} = \langle 1, 0 \rangle$ and $\vec{\mathbf{j}} = \langle 0, 1 \rangle$.



$\langle 5, 7 \rangle$

$5\vec{i} + 7\vec{j}$

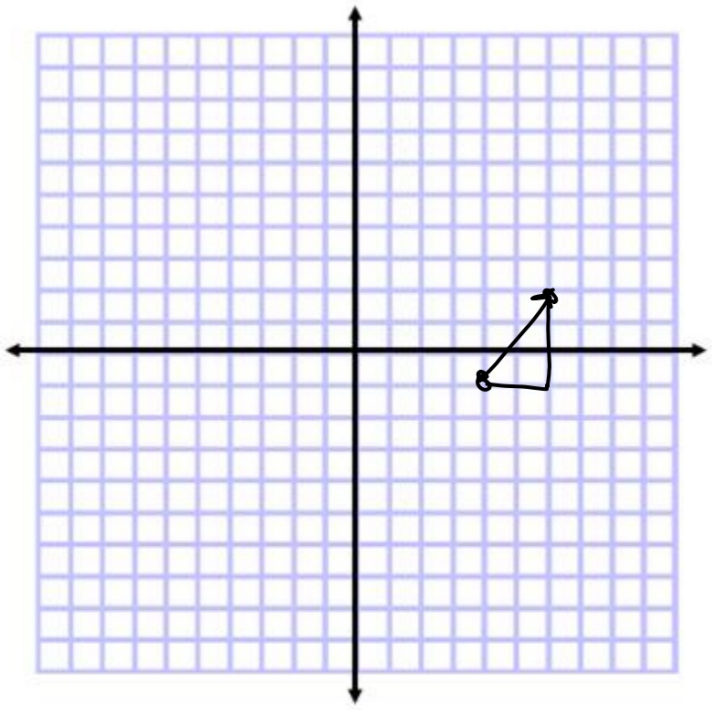
So how do we know whether i represents a unit vector or $\sqrt{-1}$?

Components <x,y> unit vectors i & j

4 Write $\overline{AB}$ as the sum of unit vectors for $A(4, -1)$ and $B(6, 2)$.

$\langle 2, 3 \rangle$ $2\vec{i} + 3\vec{j}$

$2i + 3j$



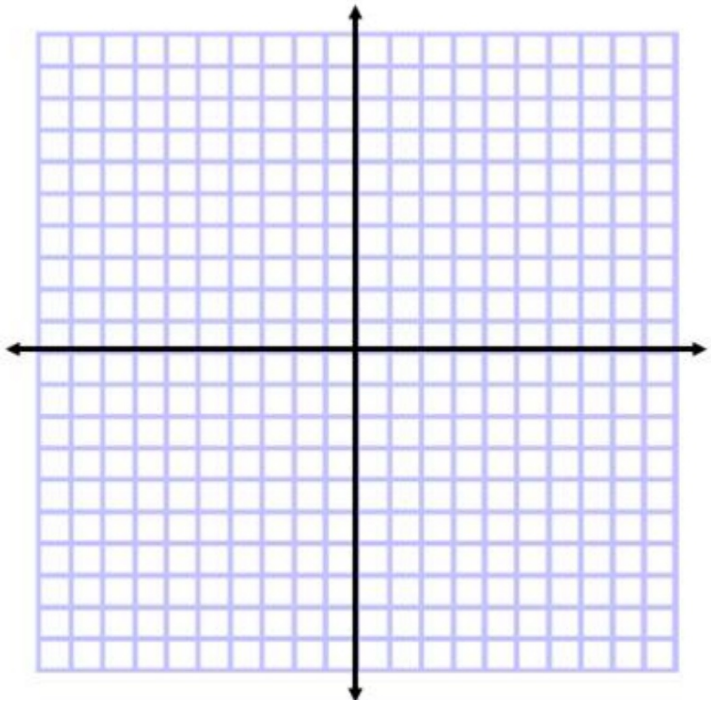
i & j

Find the magnitude of each vector. Then write each vector as the sum of unit vectors.

11. $\langle 8, -6 \rangle$

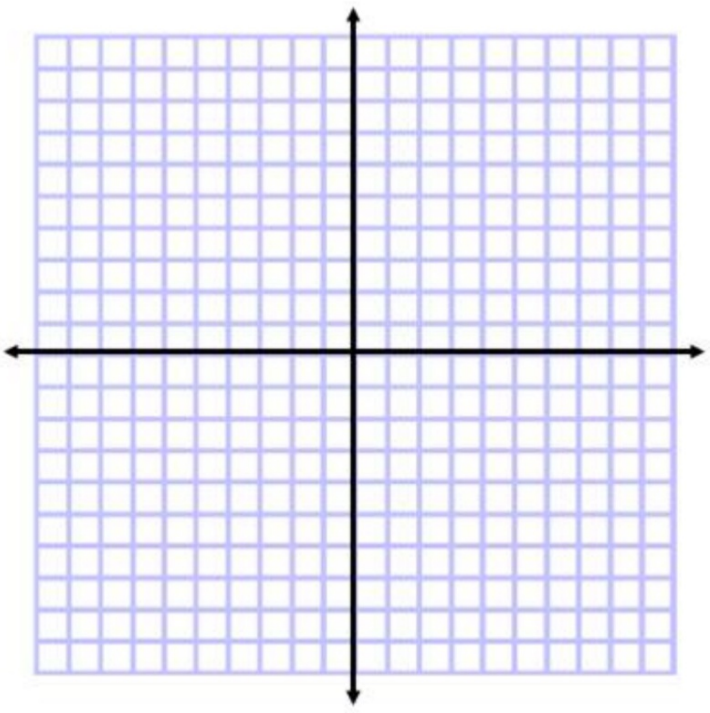
12. $\langle -7, -5 \rangle$

$8\vec{i} - 6\vec{j}$



Find the magnitude of each vector. Then write each vector as the sum of unit vectors.

36. $\langle 3, 4 \rangle$ **37.** $\langle 2, -3 \rangle$ **38.** $\langle -6, -11 \rangle$



Algebraic Vectors

EMERGENCY MEDICINE

Paramedics Paquita Gonzalez and Trevor Howard are moving a person on a stretcher. Ms. Gonzalez is pushing the stretcher with a force of 135 newtons at 58° with the horizontal, while Mr. Howard is pulling the stretcher with a force of 214 newtons at 43° with the horizontal. What is the magnitude of the force exerted on the stretcher? *This problem will be solved in Example 3.*

- components
- combine
- magnitude

G <71.6, 114.5>

G 135N 58°

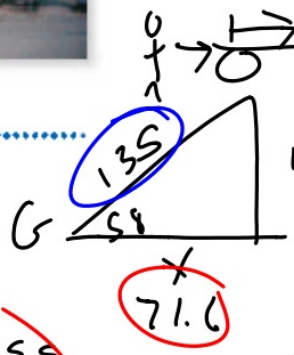
M 214N 43°

<156.5, 145.9>

$\cos 43 = \frac{x}{214}$

$\sin 43 = \frac{y}{214}$

<228.1, 260.4>

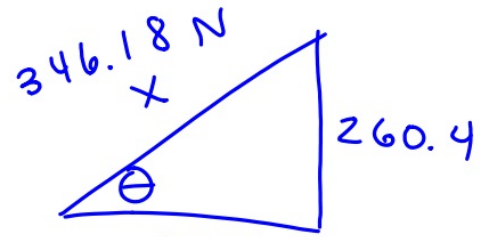


$\cos 58 = \frac{x}{135}$

$135 \cos 58 = x$

$\sin 58 = \frac{y}{135}$

$y = 135 \sin 58$



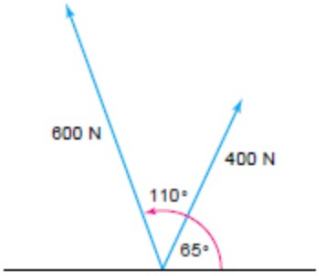
$\tan\theta = \frac{260.4}{228.1}$

$\theta = 49$

$119837.77 = h^2$

. Ms. Gonzalez is pushing the stretcher with a force of 135 newtons at 58° with the horizontal, while Mr. Howard is pulling the stretcher with a force of 214 newtons at 43° with the horizontal. What is the magnitude of the force exerted on the stretcher? *This problem will be solved in Example 3.*

13. Construction The Walker family is building a cabin for vacationing. Mr. Walker and his son Terrell have erected a scaffold to stand on while they build the walls of the cabin. As they stand on the scaffold Terrell pulls on a rope attached to a support beam with a force of 400 newtons (N) at an angle of 65° with the horizontal. Mr. Walker pulls with a force of 600 newtons at an angle of 110° with the horizontal. What is the magnitude of the combined force they exert on the log?



15-43 odd