

# Vector Labs

San Diego , Walt Disney World, and Tower Hill School

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## Scalars

- Numbers with magnitude and units only.
- today's temperature is 84 °F
- the car was driving for 4.3 s
- the block has a mass of 1.25 kg

**magn·i·tude** | 'magnəˌtoʊd |  
noun  
1 the great size or extent of something: they may feel discouraged at the magnitude of the task before them.  
• great importance: events of tragic magnitude.  
2 size: electoral college of less than average magnitude.  
• a numerical quantity or value: the magnitudes of all the economic variables could be determined.  
of all the brightness of a star. The brightness of a star. The brightness of a star. The brightness of a star.

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## Vectors

- Numbers with magnitude and direction
- Scalar numbers have magnitude only
- Notation:  $\vec{A} = 25\text{m}$ , at  $174^\circ$
- Don't use @ (this is NOT email)

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## Vectors can cause strange results

take 10 steps East and 4 steps West



"What is the total distance that you have travelled?"  
**14 steps**

"What is your *displacement* from where you started?"  
**6 steps East**

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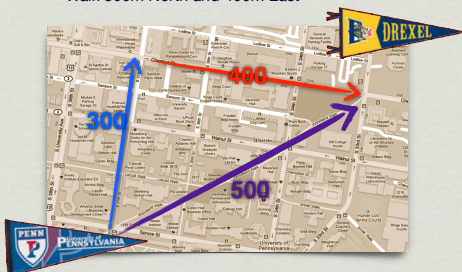
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## Two Directions Change the Math

"Walk 300m North and 400m East"



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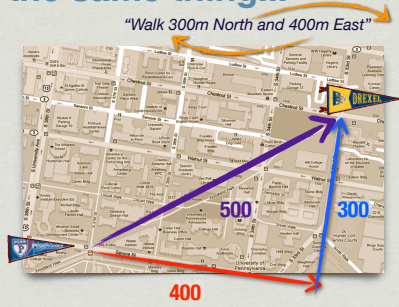
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## It's the same thing...



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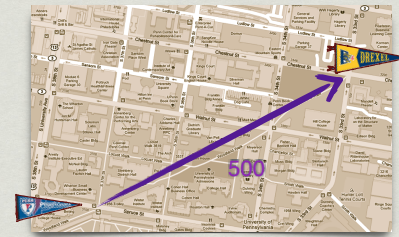
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## Or, Just take one walk and get to the same place.



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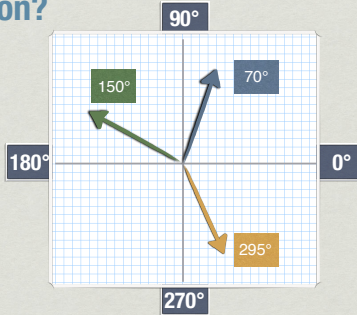
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## What Direction?

- Positive values only
- NOT the angle from a previous measurement



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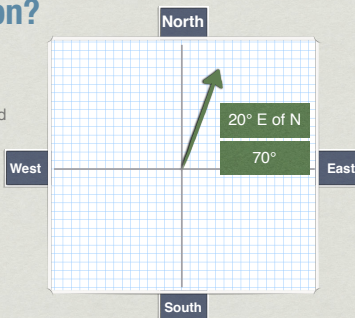
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## What Direction?

- Textbook writers sometimes try to make things sound better, and end up confusing students.
- 20° E of N
- Change map directions to angles first
- 70°



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## Why In the World Is My Car In San Diego?

Do you even remember...?



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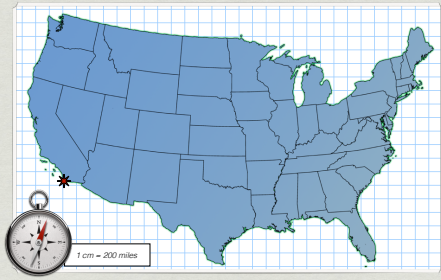
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### Why in the world, is my car in San Diego?



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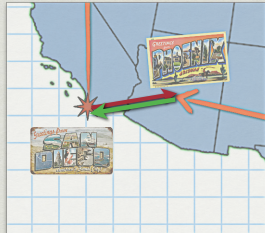
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### Equilibrant and Resultant



The Equilibrant vector would balance the vectors in one step. An equilibrant vector goes from the finish to the start.

**E = 360 miles, at 188°**

The Resultant vector is the total of all vectors in one step. A displacement vector goes from the start to the finish.

**R = 360 miles, at 8°**

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### Where in "the World" will you go?

Another cartoon



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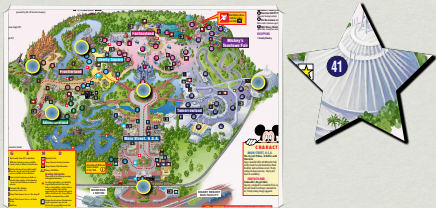
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### Where in Disney World will you go?



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### Step 4: Measure, Name, and Label Each Vector



**A = 26.0cm, at 142°**

**B = 10.8cm, at 113°**

**C = 10.5cm, at 23°**

**D = 16.1cm, at 325°**

**E = 25.4cm, at 3°**

**F = 32.5cm, at 223°**

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Step 5: Trace your steps by drawing the vectors to a 1/2 scale.

**Don't cheat on the last step!!!**



- A = 26.0cm, at 142°
- B = 10.8cm, at 113°
- C = 10.5cm, at 23°
- D = 16.1cm, at 325°
- E = 25.4cm, at 3°
- F = 32.5cm, at 223°

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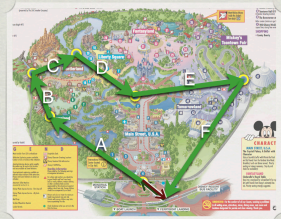
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### Graphical Addition

- Called the "Head to Tail" method
- One Vector starts where the previous vector stops
- Vector Sum (Resultant) is from the tail of the first to the head of the last



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### Graphical Addition

- My Results - Typical
- Which one is the Resultant?
- Extend the line if it helps.
- Measure the Green Vector
- Measure the Red Vector



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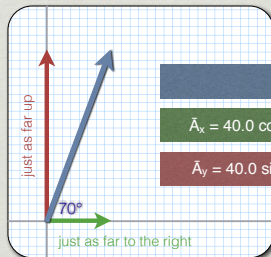
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### Component Method: Find the X and Y components



$\vec{A} = 40.0 \text{ cm, at } 70^\circ$

$\vec{A}_x = 40.0 \cos 70^\circ$

$\vec{A}_x = 13.7 \text{ cm}$

$\vec{A}_y = 40.0 \sin 70^\circ$

$\vec{A}_y = 37.6 \text{ cm}$

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### Break Down Your Vectors Into Components

Step 6. Find the horizontal and vertical components of each of the 6 vectors. Watch negatives!

X components

Y components

_____	_____
_____	_____
_____	_____

Step 7. Find the total x and total y of the resultant.

$R_x$  \_\_\_\_\_  $R_y$  \_\_\_\_\_

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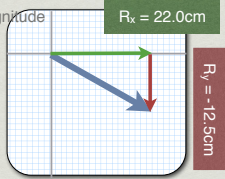
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**Component Method: Find the Resultant**

$$R = \sqrt{R_x^2 + R_y^2}, \text{ at } (\text{Tan}^{-1} \frac{R_y}{R_x})$$

- Pythagorean to find Magnitude
- Trig to find Direction
- Careful with the angle



N

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**Almost Done**

**Step 8.** Calculate the resultant and the equilibrant vectors.

R= \_\_\_\_\_

E= \_\_\_\_\_

**Step 9.** Conclusion

Compare and contrast the two methods of vector addition. Be sure to mention the simplicity and accuracy of each method.

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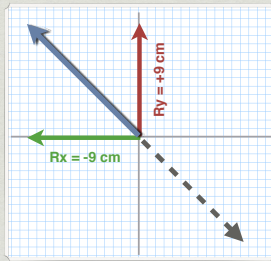
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**Dumb Calculator, Maybe..**



- Pythagorean to find Magnitude
- Be Careful.. 12.8cm (it's certainly NOT 0.0 cm)
- $\text{Tan}^{-1} (9/-9)$  to find Direction
- My calculator says  $-45^\circ$ .
- Fix it. You know better.

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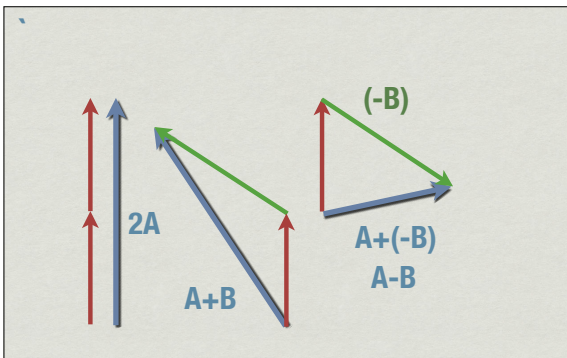
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