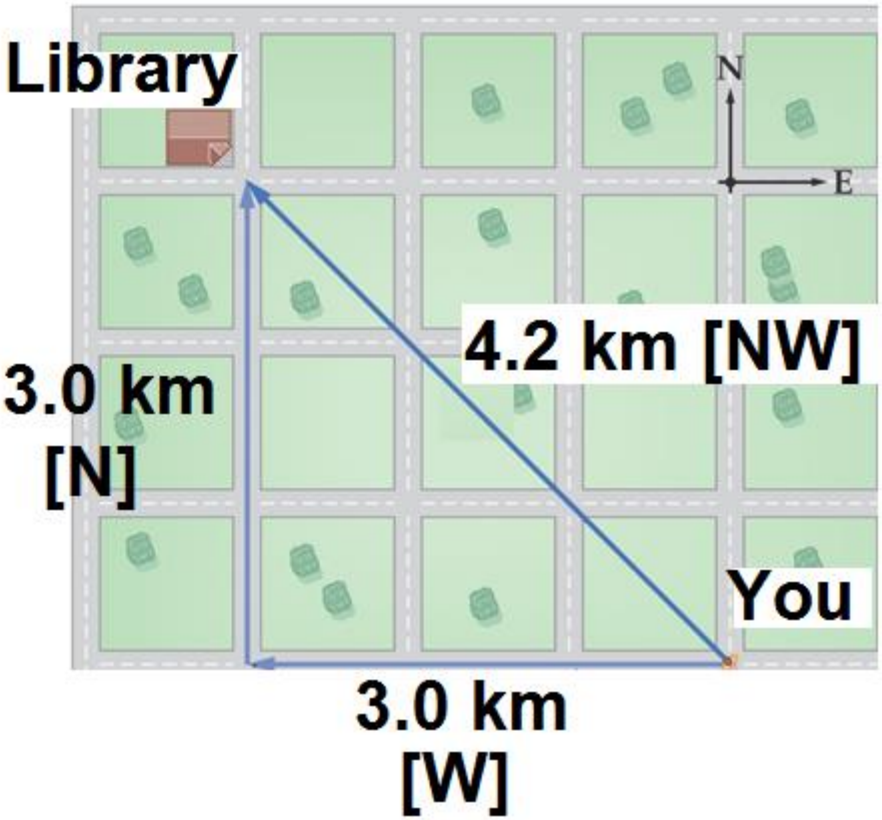
Using Components 2D Vector Analysis

- The Components of a Vector
- Adding and Subtracting Vectors using components

The Components of a Vector

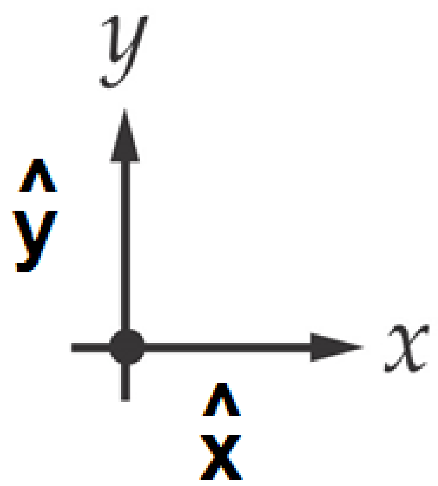
Consider the diagram below: The library is 4.2 km [NW] of your location. How will you get there?



Walk 3.0 km [W] and then 3.0 km [N].

Cartesion Components:

In a 2D plane, we can define a co-ordinate system made up of 2 orthogonal (perpendicular) unit vectors:



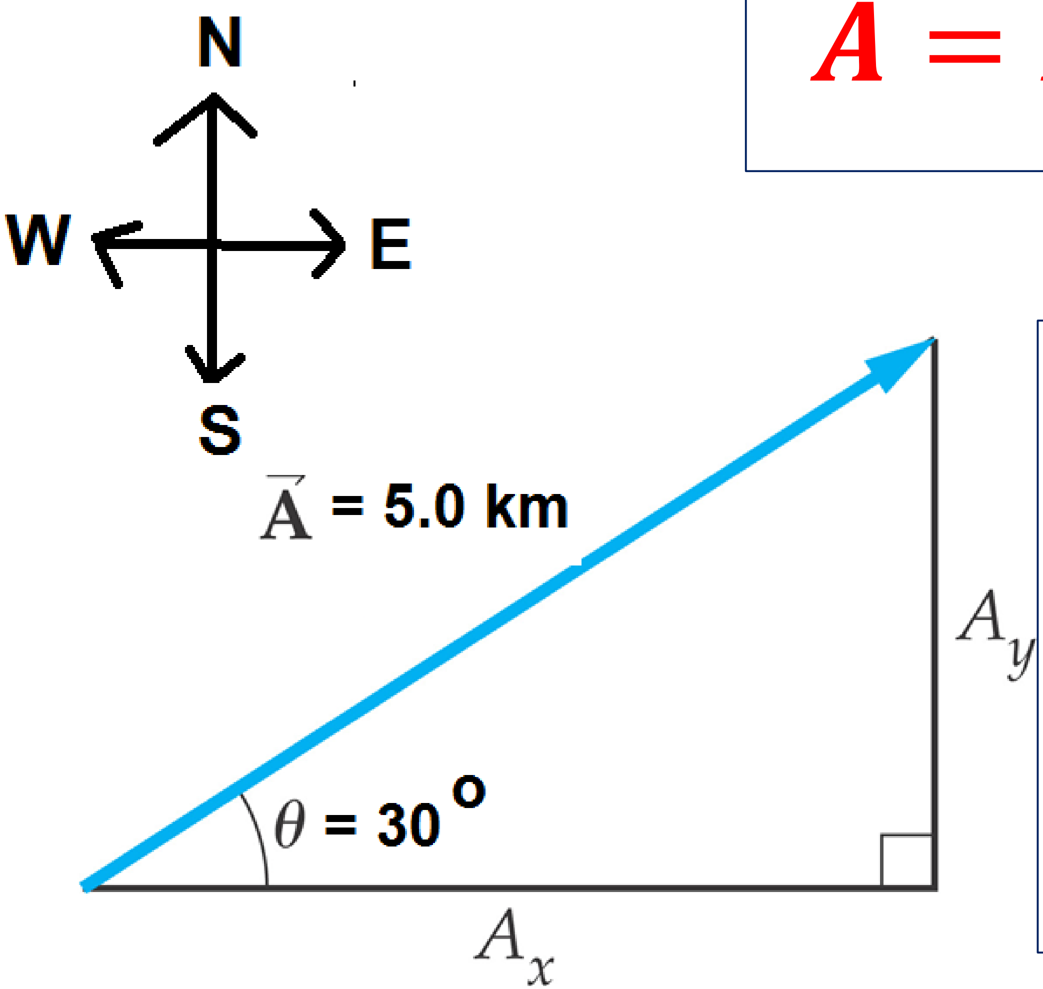
- Unit vector- Means they are 1 unit long

We can resolve or break down any vector in a 2D plane into components in each unit vector direction:

Position vector Vector A can be written two ways:

Method 2:

$$\vec{A} = A_x\hat{x} + A_y\hat{y}$$



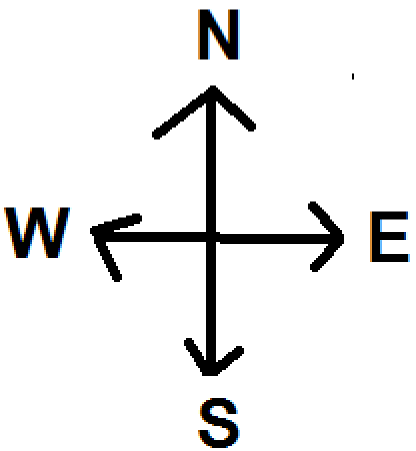
Method 1:
magnitude [angle]

$\vec{A}$ = 5.0 km [E 30 º N]

We can find the values of Ax and Ay using Trig!

Let E= +x

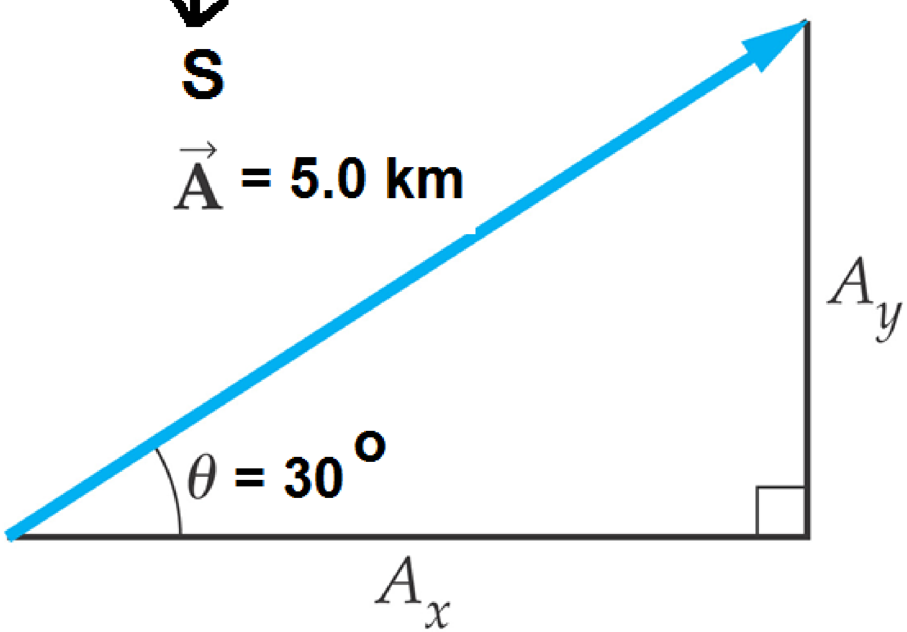
Let N= +y



$$\vec{A} = A_x\hat{x} + A_y\hat{y}$$

$$\vec{A} = 4.33\hat{x} + 2.5\hat{y}$$

$$\vec{A} = 4.33[E] + 2.5[N]$$



Ax = A cosθ

= 5.0 cos 30°

=4.33 km

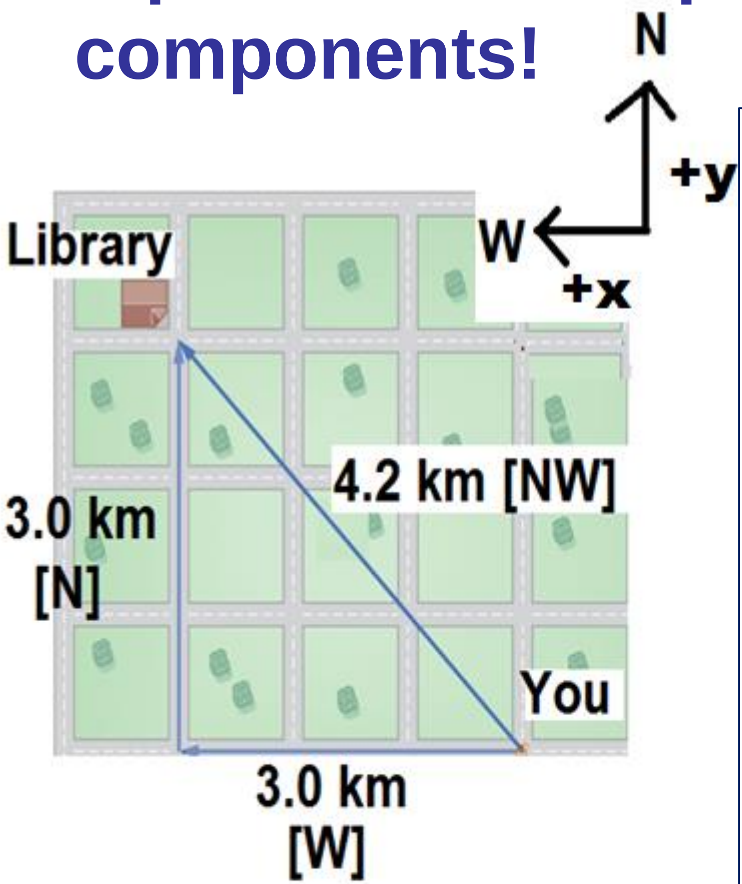
Ay = A sinθ

= 5.0 sin 30°

=2.5 km

The Components of a Vector

Back to the library displacement! We can represent the displacement using components!



Let West be +x

Let North be +y

$$\overrightarrow{\Delta d} = 3.0\ km\ \hat{x} + 3.0\ km\ \hat{y}$$

$$\overrightarrow{\Delta d} = 3.0\ km\ [W] + 3.0\ km\ [N]$$

Adding vectors using components!

$$\overrightarrow{\Delta d_R} = \overrightarrow{\Delta d_1} + \overrightarrow{\Delta d_2} + \overrightarrow{\Delta d_3}$$

Find the x and y components for each vector:

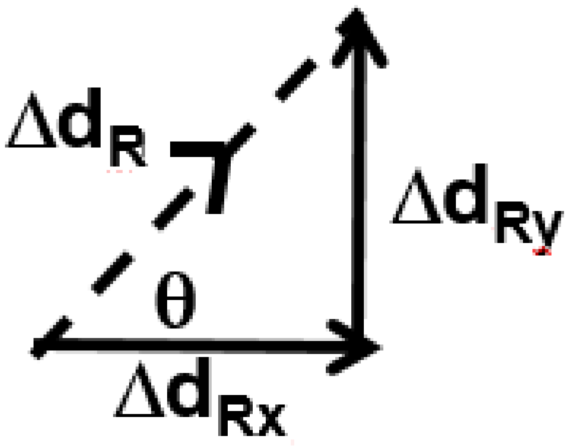
e.g. $\Delta d_{1x}, \Delta d_{1y}$ **etc.**

Add up all of the x and y components:

$$\Delta d_{Rx} = \Delta d_{1x} + \Delta d_{2x} + \Delta d_{3x}$$

$$\Delta d_{Ry} = \Delta d_{1y} + \Delta d_{2y} + \Delta d_{3y}$$

Sketch the total x and y components and use Pythagorean Theorem & SOHCAHTOA to write in magnitude angle form.



$$\Delta d_R = \sqrt{{\Delta d_{Rx}}^2 + {\Delta d_{Ry}}^2}$$

$$\theta = \tan^{-1}\frac{\Delta d_{Ry}}{\Delta d_{Rx}}$$