0.0.1 September 02, 2021 - Vectors

1 **Remark**

Let's suppose we have a vector A of length 2 meters and 40° N of E

We also have a vector B of lf length $2m$ and 8° W of S

We wish to compute $A + B$

Graph A:

Graph B:

Let's convert vectors to x and y coordinates, then

$$A = \begin{bmatrix} 1.53209 \\ 1.28558 \end{bmatrix}, B = \begin{bmatrix} -0.273846 \\ -1.98054 \end{bmatrix}$$

Then,

$$A + B = \begin{bmatrix} 1.53209 + (-0.273846) \\ 1.28558 + (-1.98054) \end{bmatrix} = \begin{bmatrix} 1.25374 \\ -0.694956 \end{bmatrix} = 1.25374\hat{i} - 0.694956\hat{j}]$$

To find the length, we can use the Pythagorean theorem:

$$1.25374^2 + (-0.694956)^2 = 1.43347$$

2 **Definition** (Unit Vectors)

- $\hat{i}$ is the unit vector in the x direction
- $\hat{j}$ is the unit vector in the y direction
- $\hat{k}$ is the unit vector in the z direction

3 **Remark**

The syntax for a vector in the TI-89 graphing calculator is $[r, \angle\theta$.

- You can also switch between polar (cylindrical) and rectangular.

4 **Remark**

You can take the derivative of a vector with respect to each of its components.

0.0.2 September 03, 2021 - Derivations

5 **Example**

$$\Delta y = v_0 t + \frac{1}{2} a t^2$$

$$t = \frac{x}{v_0 cos(\theta)}$$

$$y = \frac{v_0 \sin(\theta) x}{v_0 \cos(\theta)} - \frac{g x^2}{2 v_0^2 cos^2(\theta)}$$

$$y = \tan(\theta) x - \frac{g x}{2 v_0^2 cos^2(\theta)}$$