

## 0.0.1 September 02, 2021 - Vectors

### 1 Remark

Let's suppose we have a vector  $A$  of length 2 meters and  $40^\circ$  N of E

We also have a vector  $B$  of length 2m and  $8^\circ$  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

$$\begin{aligned}\Delta y &= v_0 t + \frac{1}{2} a t^2 \\ t &= \frac{x}{v_0 \cos(\theta)} \\ y &= \frac{v_0 \sin(\theta) x}{v_0 \cos(\theta)} - \frac{g x^2}{2 v_0^2 \cos^2(\theta)} \\ y &= \tan(\theta) x - \frac{g x}{2 v_0^2 \cos^2(\theta)}\end{aligned}$$