8.3: Unit Vectors and Direction Angle

**Unit Vector:** the vector with a magnitude of one

**Example:** Determine \( |\vec{u}| \) if \( \vec{u} = (4, 3) \)

**Solution:**

\[
|\vec{u}| = \sqrt{4^2 + 3^2} = \sqrt{25} = 5
\]

Divide our components by the magnitude of 5

\[
\frac{\vec{u}}{5} = \left( \frac{4}{5}, \frac{3}{5} \right)
\]

*the scalar multiple of \( \frac{1}{5} \)*

\[
\left| \frac{\vec{u}}{5} \right| = \sqrt{\left( \frac{4}{5} \right)^2 + \left( \frac{3}{5} \right)^2} = \sqrt{\frac{16}{25} + \frac{9}{25}} = \sqrt{\frac{25}{25}} = 1
\]

**Example:** Determine the angle in standard position of the vector
\[ \vec{V} = (6, 5) \]

**Solution**

Draw our vector \( \vec{V} \)

\[ \tan \theta = \frac{5}{6} \]

\[ \theta = \tan^{-1} \left( \frac{5}{6} \right) \]

\[ \theta = 39.81^\circ \text{ or } 0.695 \text{ radians} \]

**Example:** if \( \vec{V} = (4, 5) \) and \( \vec{U} = (3, -4) \), what is the angle in standard position of \( \vec{V} + 2\vec{U} \)

**Solution**

\[ \tan \theta = \frac{3}{10} \]
$\theta = 16.7^\circ$

$\theta = -16.7^\circ$ or $343.3^\circ$

**Force:** a direction and magnitude (angle) (Newtons)

**Example:** A 80 N box is on a frictionless floor, what force is needed to move the box if the direction applied is completely horizontal?

**Solution**

it will take any minute force because it is a frictionless environment

read example #6 p.266

**Example:** Determine the force need to move an 80 N box up on an incline of 20° on a frictionless surface?
\[ \sin 20^\circ = \frac{x}{80} \]
\[ 80 \sin 20^\circ = x \]
\[ 27.4 \, N = x \]