I. TERMINOLOGY

A. Two attributes of a vector: _______direction_______ and _______magnitude_______
   Note: __________location_________ is not a requirement.

B. ___________Unit_________ vector: A vector where \(|\vec{u}| = 1\) or \(||\vec{u}|| = 1\)

C. Direction Angle: A precise way to specify the direction of a vector \(\vec{v}\) is to use its
direction angle, the angle \(\theta\) that \(\vec{v}\) makes with the positive ____X____-axis. Note that the
direction angle is always a _______positive_______ angle.

D. Standard unit vectors:
   1) \(\hat{i}\): (1,0)
   2) \(\hat{j}\): (0,1)

E. Forms of Vectors:
   1) _______Component-\(s_______: \langle a, b \rangle$
   2) Linear combination: \(a\hat{i} + b\hat{j}\)

F. Sweet Formulas
   1) \(\vec{v} = (|\vec{v}| \cos \theta)\hat{i} + (|\vec{v}| \sin \theta)\hat{j}\)
   2) Unit Vector \((\hat{u})\)
      \[\hat{u} = \frac{1}{|\vec{v}|} \vec{v} \quad \text{or} \quad \hat{v}\]

G. Applications:
   1) _______Velocity_________ is a vector because it has both
      magnitude and direction. The _______magnitude_______ is the speed.
      Examples will be done on the back. 😊
   2) Effect of gravity. Examples will be done on the back. 😊
   3) Feel free to refer to textbook. It will do the body good. 😊

Sample Notes:
II. Examples:

A) Find a unit vector in the direction of \( \vec{h} = (-5,6) \)

\[
\begin{align*}
\sqrt{1} & = \sqrt{61} \\
\frac{-5}{\sqrt{61}} & , \frac{6}{\sqrt{61}}
\end{align*}
\]

B) Find the vector with the given angle and magnitude. Round to the nearest hundredth if needed.

<table>
<thead>
<tr>
<th>Direction Angle</th>
<th>Magnitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>280°</td>
<td>9</td>
</tr>
<tr>
<td>240°</td>
<td>12</td>
</tr>
</tbody>
</table>

C) Find the magnitude and direction angle of each vector:

1) \( \vec{v} = (-4,7) \)

\[
\begin{align*}
|\vec{v}| & = \sqrt{65} \\
\theta & = 240.3° \\
\tan^{-1} \left( \frac{7}{4} \right) + 180°
\end{align*}
\]

2) \( \vec{b} = 8\hat{i} - 3\hat{j} \)

\[
\begin{align*}
|\vec{b}| & = \sqrt{73} \\
\theta & = 339.4° \\
360° - \tan^{-1} \left( \frac{3}{8} \right)
\end{align*}
\]
D) A jet aircraft is flying on a bearing of 50° at 450 mph. Find the component form of the velocity of the airplane. Recall that the bearing is the angle that the line of travel makes with due north, measured clockwise. See example 7 from textbook for more information.

1) Draw picture.

2) Find the horizontal and vertical components.

\[ \vec{v} = 450 \cos 50° \hat{i} + 450 \sin 50° \hat{j} \]

3) Final answer to the nearest hundredth.

\[ \langle 333.72, 289.25 \rangle \]

4) Understanding the answer?

Aircraft is traveling 333.72 mph East and 289.25 Northward.

E) A force of 40 pounds just keeps a box from sliding down the ram inclined at 25°. Find the weight of the box. See example 9 from textbook for more information.

Note: weight is a vector since weight is determined by gravity, which has direction of downward.

Force is a vector: Direction (40 pounds) is the magnitude.

\[ \sin 25° = \frac{40}{w} \]

\[ w = \frac{40}{\sin 25°} \]

Box weighs about 44.651 lbs
10 Lessons Mathletes Can Learn From Superheroes.

**Superheroes Never Give Up**
Like Batman, you have to keep pressing on to the very last breath. Challenges are overcome by wholeheartedly committing to unrelenting persistence.

**Superheroes Always Get the Job Done**
There are no excuses if you don’t save the girl from the burning house. There are just results, not reasons, you either save the day or you don’t. Gray area is for Kafka not comic heroes.

**Superheroes Are the Best at What They Do**
Flash is the fastest and we all know it. If you’re the back end developer, you are the best developer in the world, and everyone on your team knows it. Let great talent excel in areas where their superpowers are most needed.

**Superheroes Are Crystal Clear of their Purpose**
Captain Marvel may be a cheeseball, but he knows what he stands for. Mathletes die when they are not clear on their mission.

**Superheroes Are NOT Flawless**
Superheroes have flaws, every member of your team will also. The goal is not perfection; it’s the pursuit of perfection.

**Superheroes Do Not Seek Glory…But They Get it Anyway**
Don’t do it because you want the attention. If you do it right, you’ll get it anyway

**Superheroes Help Others**
Superheroes help people by solving problems. Mathletes should be obsessed NOT with themselves, but with how they are going to help other people and solve their issues.

**Superheroes Can Do it By Themselves But Are More Powerful in Teams**
You always have to have each other’s back. It’s you vs. the world and bringing together your own team of superheroes, and the mutual respect, loyalty, and camaraderie of that team is vital.

**Superheroes’ True Strength Comes From Their Character**
No matter how super you think you are, you’re strength comes from your character not your talent. Be courageous, be respectful, be honorable, and be selfless.

**Superheroes Accomplish Huge Feats**
The same effort it takes to start a lemonade stand or college club is the same raw effort it takes to change the world. Your goal is not to build a product or get traffic… Your goal is to accomplish the most amazing feat imaginable. Solve the equation; simplify expressions, Save the World.