Announcements

• Final exam 12/16. Times posted in WebCT.
• Email me ASAP if you need to change time.
• Old labs available - December 11 for make-up. Labs accessible in 213 Armstrong.
• Old HW - December 16. Accessible from anywhere.
• Last new lab will be December 9. “Bonus” points.
• Miss a test? Makeup Wednesday December 7. Email me to arrange a time.
• Evaluation, review in class next Wednesday

Vector addition is **commutative**.

\[ \mathbf{v} + \mathbf{w} = \mathbf{w} + \mathbf{v} \]

Vector addition is **associative**.

\[ \mathbf{u} + (\mathbf{v} + \mathbf{w}) = (\mathbf{u} + \mathbf{v}) + \mathbf{w} \]

\[ \mathbf{v} + \mathbf{0} = \mathbf{0} + \mathbf{v} = \mathbf{v} \]

\[ \mathbf{v} + (-\mathbf{v}) = \mathbf{0} \]

Use the vectors illustrated below to graph each expression.
If \( \mathbf{v} \) is a vector, we use the symbol \( \| \mathbf{v} \| \) to represent the magnitude of \( \mathbf{v} \).

A vector \( \mathbf{u} \) for which \( \| \mathbf{u} \| = 1 \) is called a unit vector.

Let \( \mathbf{i} \) denote a unit vector whose direction is along the positive \( x \)-axis; let \( \mathbf{j} \) denote a unit vector whose direction is along the positive \( y \)-axis. If \( \mathbf{v} \) is a vector with initial point at the origin \( O \) and terminal point at \( P = (a, b) \), then

\[
\mathbf{v} = a\mathbf{i} + b\mathbf{j}
\]
Find the position vector of the vector \( \mathbf{v} = \overrightarrow{P_1P_2} \) if \( P_1 = (-2,1) \) and \( P_2 = (3,4) \).

\[
\mathbf{v} = (x_2 - x_1)\mathbf{i} + (y_2 - y_1)\mathbf{j}
\]

If \( \mathbf{v} = 3\mathbf{i} + 2\mathbf{j} \) and \( \mathbf{w} = -4\mathbf{i} + \mathbf{j} \), find \( 2\mathbf{v} + 3\mathbf{w} \).

\[
\mathbf{v} = 3\mathbf{i} + 2\mathbf{j}, \quad \mathbf{w} = -4\mathbf{i} + \mathbf{j}
\]

If \( \mathbf{v} = 3\mathbf{i} + 2\mathbf{j} \), find \( ||\mathbf{v}|| \)

(1) 4  (2) \( \sqrt{5} \)  (3) \( \sqrt{13} \)  (4) 5

**Theorem  Unit Vector in Direction of \( \mathbf{v} \)**

For any nonzero vector \( \mathbf{v} \), the vector

\[
\mathbf{u} = \frac{\mathbf{v}}{||\mathbf{v}||}
\]

is a unit vector that has the same direction as \( \mathbf{v} \).
Find a unit vector in the same direction as $v = 3i - 5j$. 