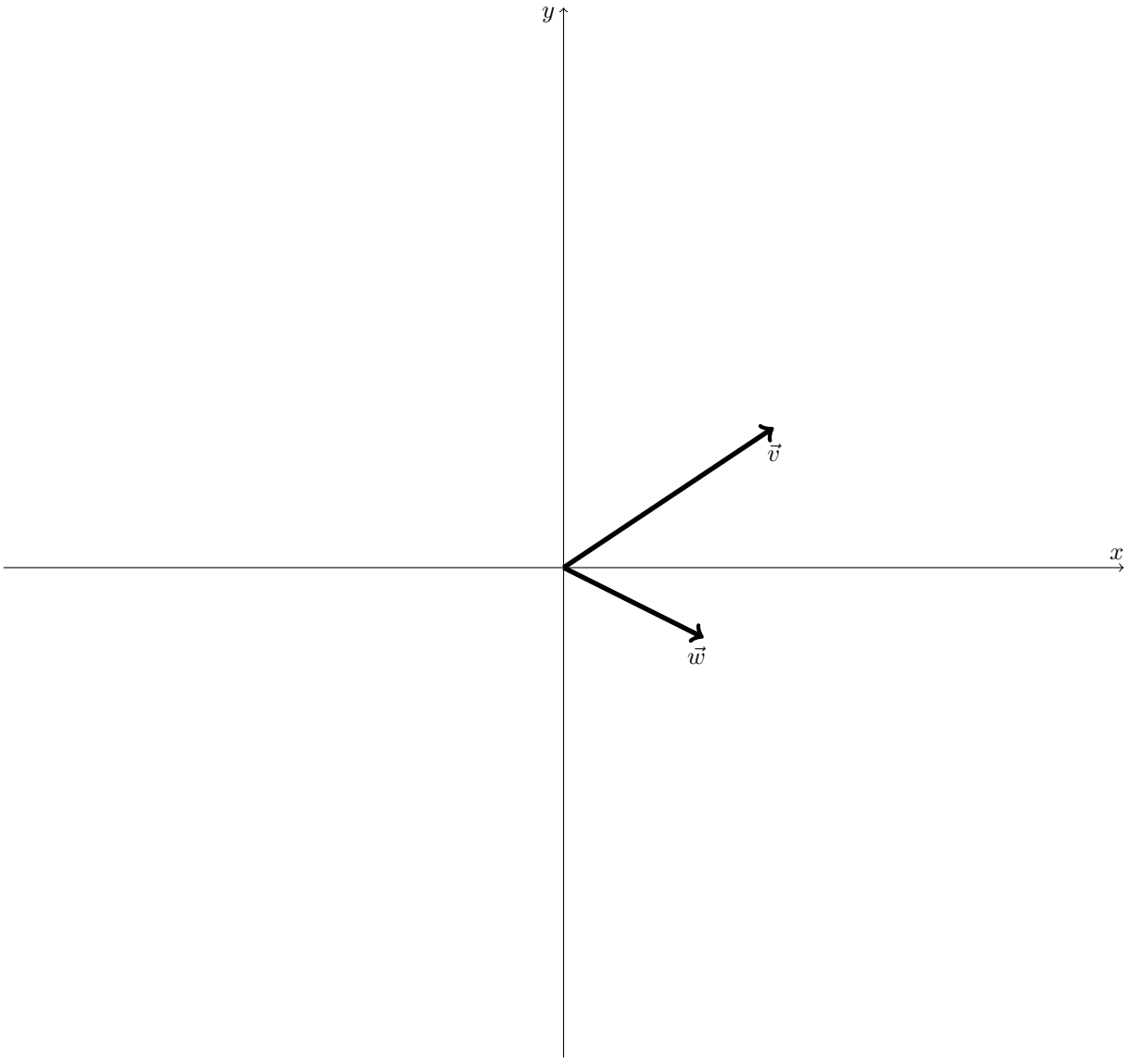
Practice with Vectors

1. On the given set of axes, sketch $\vec{v} + \vec{w}$, $\vec{w} - \vec{v}$, $2\vec{v}$, $-3\vec{w}$, and $2\vec{v} - 3\vec{w}$.



2. Let $\vec{v} = \langle 1, 11, 3 \rangle$ and $\vec{w} = \langle -2, 8, 6 \rangle$. Find $\vec{v} - \vec{w}$ and the unit vector $\vec{u}$ pointing in the direction of $\vec{v} - \vec{w}$.

3. Find the angle between each given pair of vectors.
   (a) $\vec{a} = \langle 2, 7 \rangle$, $\vec{b} = \langle 3, -1 \rangle$
   (b) $\vec{v} = 3\hat{\mathbf{i}} - 2\hat{\mathbf{j}} - \hat{\mathbf{k}}$, $\vec{w} = -5\hat{\mathbf{i}} + 6\hat{\mathbf{j}} - 2\hat{\mathbf{k}}$

4. Find a vector that is orthogonal to each given pair of vectors.
   (a) $\vec{a} = 2\hat{\mathbf{i}} + 4\hat{\mathbf{j}} + 6\hat{\mathbf{k}}$, $\vec{b} = 3\hat{\mathbf{i}} - 3\hat{\mathbf{j}} + \hat{\mathbf{k}}$
   (b) $\vec{v} = \langle 10, 5, -3 \rangle$, $\vec{w} = \langle 4, 7, 2 \rangle$

5. James Bond is in a boat located at $(1, 6)$ and perceives that Mr. Green's boat is located at $(-4, -2)$. If Bond's boat is currently facing in the direction $\langle -1, 2 \rangle$, find the angle the boat must turn through to be facing in the direction of Mr. Green's boat.

6. Suppose we apply a force $\vec{F} = \langle -6, 1, 11 \rangle$ (force is in Newtons) to move an object from $(4, -3, -3)$ to $(8, 1, 7)$ (distance is in m). Compute the work done by the force.

7. Consider the vector $\vec{a} = \langle -4, 5, 2 \rangle$.
   (a) Find a vector $\vec{b}$ that is orthogonal to $\vec{a}$ (there are infinitely many possibilities!).
   (b) Find a vector $\vec{c}$ that is orthogonal to both $\vec{a}$ and $\vec{b}$.

8. A particle moves in the direction $\langle 1, -3, 2 \rangle$. If a force of $\langle 2a, a, 3 \rangle$ Newtons is applied to the particle, for what value(s) of the constant a will the total work done by the force be zero?