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Score: $\qquad$ /20

## Practice with Vectors

Please staple your work and use this page as a cover page.

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) $\vec{a}=2 \hat{\mathbf{\imath}}+4 \hat{\mathbf{j}}+6 \hat{\mathbf{k}}, \vec{b}=3 \hat{\mathbf{\imath}}-3 \hat{\mathbf{j}}+\hat{\mathbf{k}}$
(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 $\langle 2 a, a, 3\rangle$ Newtons is applied to the particle, for what value(s) of the constant $a$ will the total work done by the force be zero?
