

Vectors in the Plane

Work in two dimensions. Give exact magnitudes and angles when possible, and show vector operations component by component.

1. Treat u and v as successive displacements. $u = \langle 9, -3 \rangle$ and $v = -1i + 0.5j$; find $u + v$, $u - v$, and $2u$.

2. Find the resultant $u + v$ for $u = 1.5i + 2j$ and $v = \langle -2, 2 \rangle$.

Math Sheet

Name _____ Score _____ Teacher _____ Date _____

Vectors in the Plane

Work in two dimensions. Give exact magnitudes and angles when possible, and show vector operations component by component.

3. Two displacement directions are $\mathbf{u} = \langle 4, -5 \rangle$ and $\mathbf{v} = -\mathbf{i} + 1.5\mathbf{j}$. Compute $\mathbf{u} \cdot \mathbf{v}$ and decide whether they are perpendicular; if not, give the included angle to the nearest hundredth of a degree.

4. Find a unit vector in the direction of $\mathbf{v} = 2.5\mathbf{i} + 3\mathbf{j}$.

Math Sheet

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Vectors in the Plane

Work in two dimensions. Give exact magnitudes and angles when possible, and show vector operations component by component.

5. Find the exact magnitude and direction angle ($0^\circ \leq \theta < 360^\circ$) of the displacement = $\langle 6, -2 \rangle$. Round a nonstandard direction angle to the nearest hundredth of a degree.

6. A vector starts at P(-1, 1) and ends at Q(2.5, 2.5). Write it in both component and i, j form.

Vectors in the Plane

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7. Two displacement directions are $u = \langle 8, -4 \rangle$ and $v = -1i + 0.5j$. Compute $u \cdot v$ and decide whether they are perpendicular; if not, give the included angle to the nearest hundredth of a degree.

8. A vector starts at $P(1, 0)$ and ends at $Q(5.5, 2.5)$. Write it in both component and i, j form.

Vectors in the Plane

Worked Answer Key

Work in two dimensions. Give exact magnitudes and angles when possible, and show vector operations component by component.

- 1.** Treat u and v as successive displacements. $u = \langle 9, -3 \rangle$ and $v = -1i + 0.5j$; find $u + v$, $u - v$, and $2u$.

Answer: $\langle 8, -2.5 \rangle$; $\langle 10, -3.5 \rangle$; $\langle 18, -6 \rangle$.

1. Combine corresponding components for addition and subtraction.
2. Multiply both components for scalar multiplication.

- 2.** Find the resultant $u + v$ for $u = 1.5i + 2j$ and $v = \langle -2, 2 \rangle$.

Answer: $-0.5i + 4j$; magnitude $\sqrt{16.25}$.

1. Add horizontal components, then vertical components.
2. Use the Pythagorean formula for the resultant magnitude.

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Vectors in the Plane

Worked Answer Key

Work in two dimensions. Give exact magnitudes and angles when possible, and show vector operations component by component.

3. Two displacement directions are $\mathbf{u} = \langle 4, -5 \rangle$ and $\mathbf{v} = -1\mathbf{i} + 1.5\mathbf{j}$. Compute $\mathbf{u} \cdot \mathbf{v}$ and decide whether they are perpendicular; if not, give the included angle to the nearest hundredth of a degree.

Answer: $\mathbf{u} \cdot \mathbf{v} = -11.5$; not perpendicular, theta approximately 175.03° .

1. Multiply corresponding components and add.
2. Use $\cos(\theta) = (\mathbf{u} \cdot \mathbf{v}) / (|\mathbf{u}||\mathbf{v}|)$.

4. Find a unit vector in the direction of $\mathbf{v} = 2.5\mathbf{i} + 3\mathbf{j}$.

Answer: $2.5/\sqrt{15.25}\mathbf{i} + 3/\sqrt{15.25}\mathbf{j}$.

1. $|\mathbf{v}| = \sqrt{15.25}$.
2. Divide each component by the nonzero magnitude.

Vectors in the Plane

Worked Answer Key

Work in two dimensions. Give exact magnitudes and angles when possible, and show vector operations component by component.

5. Find the exact magnitude and direction angle ($0^\circ \leq \theta < 360^\circ$) of the displacement $\mathbf{v} = \langle 6, -2 \rangle$. Round a nonstandard direction angle to the nearest hundredth of a degree.

Answer: $|\mathbf{v}| = \sqrt{40}$; θ approximately 341.57° .

1. Magnitude is $\sqrt{x^2 + y^2}$.
2. Use $\text{atan2}(y, x)$ or adjust arctangent to the vector's quadrant.

6. A vector starts at $P(-1, 1)$ and ends at $Q(2.5, 2.5)$. Write it in both component and i, j form.

Answer: $\langle 3.5, 1.5 \rangle = 3.5\mathbf{i} + 1.5\mathbf{j}$.

1. Subtract initial coordinates from terminal coordinates.
2. $\mathbf{Q} - \mathbf{P} = \langle 2.5 - (-1), 2.5 - 1 \rangle$.

Vectors in the Plane

Worked Answer Key

Work in two dimensions. Give exact magnitudes and angles when possible, and show vector operations component by component.

7. Two displacement directions are $\mathbf{u} = \langle 8, -4 \rangle$ and $\mathbf{v} = -1\mathbf{i} + 0.5\mathbf{j}$. Compute $\mathbf{u} \cdot \mathbf{v}$ and decide whether they are perpendicular; if not, give the included angle to the nearest hundredth of a degree.

Answer: $\mathbf{u} \cdot \mathbf{v} = -10$; not perpendicular, theta approximately 180.00° .

1. Multiply corresponding components and add.
2. Use $\cos(\theta) = (\mathbf{u} \cdot \mathbf{v}) / (|\mathbf{u}||\mathbf{v}|)$.

8. A vector starts at $P(1, 0)$ and ends at $Q(5.5, 2.5)$. Write it in both component and $\mathbf{i}, \mathbf{j}$ form.

Answer: $\langle 4.5, 2.5 \rangle = 4.5\mathbf{i} + 2.5\mathbf{j}$.

1. Subtract initial coordinates from terminal coordinates.
2. $\mathbf{Q} - \mathbf{P} = \langle 5.5 - 1, 2.5 - 0 \rangle$.