

Precalculus · Vectors in the Plane · Worksheet

Common Core N-VM.A.1, N-VM.A.2, N-VM.A.3, N-VM.B.4, N-VM.B.5 · mathovore.fr

Name: _____ Date: ____/____/____ Score: _____

This precalculus vectors worksheet gives 22 problems on vectors in the plane, ordered from easy to hard, with a separate answer key.

These 22 problems practice vectors in the plane at the Precalculus level: component form, magnitude and direction, addition, subtraction and scalar multiplication, unit vectors, and the dot product. Standards N-VM.A.1 through N-VM.B.5 are covered.

The problems run from short skill checks to multi-step word problems on displacement, river currents, wind, forces and work. Draw a sketch whenever a figure is not provided.

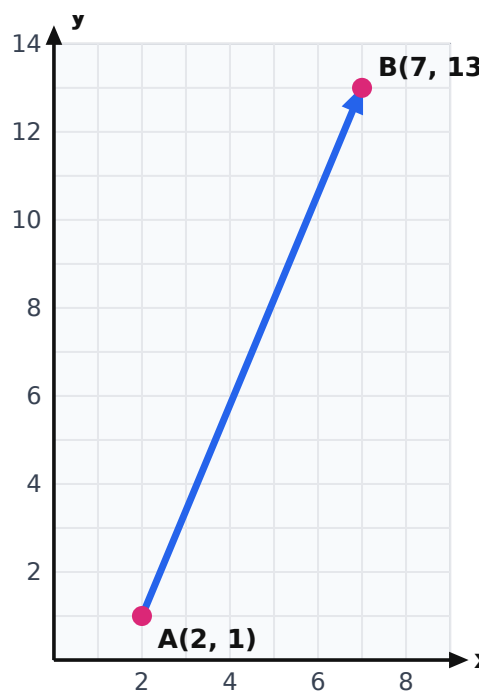
Precalculus Common Core: N-VM.A.1 · N-VM.A.2 · N-VM.A.3 · N-VM.B.4 · N-VM.B.5

Precalculus Vectors Worksheet: problems 1-5

Problem 1: Component form from two points

Write each vector in component form and find its magnitude.

- The vector from $A(2,1)$ to $B(7,13)$, shown below.
- The vector from $C(-3,4)$ to $D(1,-2)$.
- The vector from $E(5,5)$ to the origin.



Vector from A to B on a coordinate grid.

Problem 2: Magnitude of a vector

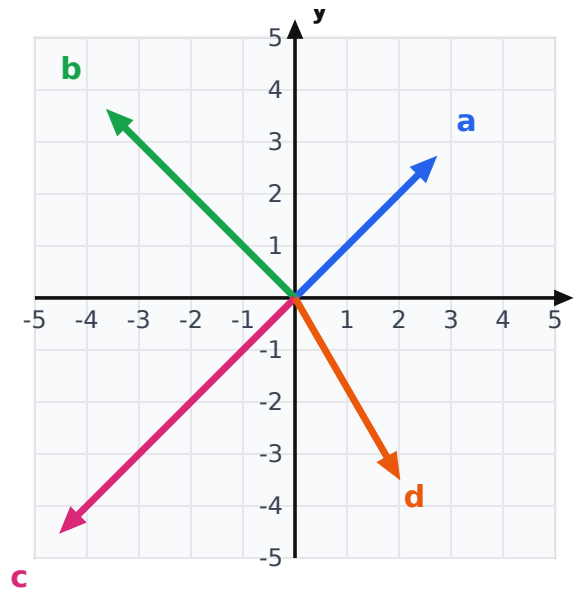
Find the magnitude of each vector.

- a. $\langle -6, 8 \rangle$
- b. $\langle 5, -12 \rangle$
- c. $\langle 9, -40 \rangle$
- d. $\langle 2, -3 \rangle$

Problem 3: Direction angles

Find the direction angle, from 0° up to but not including 360° , of each vector in the figure.

- a. $\vec{a} = \langle 3, 3 \rangle$
- b. $\vec{b} = \langle -4, 4 \rangle$
- c. $\vec{c} = \langle -5, -5 \rangle$
- d. $\vec{d} = \langle 1, -\sqrt{3} \rangle$



Four vectors in different quadrants (not all drawn to full length).

Problem 4: Components from magnitude and angle

Write the vector with the given magnitude and direction angle in component form. Give exact values.

- Magnitude 10, angle 30°
- Magnitude 8, angle 120°
- Magnitude 12, angle 270°
- Magnitude $6\sqrt{2}$, angle 45°

Problem 5: Add and subtract vectors

Let $\vec{u} = \langle 3, -2 \rangle$ and $\vec{v} = \langle -1, 5 \rangle$. Find each result.

- $\vec{u} + \vec{v}$
- $\vec{u} - \vec{v}$
- $\vec{v} - \vec{u}$

Precalculus Vectors Worksheet: problems 6-10

Problem 6: Scalar multiplication

Let $\vec{u} = \langle 3, -2 \rangle$, $\vec{v} = \langle -1, 5 \rangle$, $\vec{w} = \langle 6, -10 \rangle$ and $\vec{z} = \langle 9, -6 \rangle$. Find each vector.

- $4\vec{u}$
- $-3\vec{v}$
- $\frac{1}{2}\vec{w}$
- $-\frac{2}{3}\vec{z}$

Problem 7: Linear combinations

Use $\vec{u} = \langle 3, -2 \rangle$ and $\vec{v} = \langle -1, 5 \rangle$.

- Find $2\vec{u} - 3\vec{v}$.
- Find $3\vec{u} + 2\vec{v}$.
- Find the magnitude of $2\vec{u} - 3\vec{v}$.

Problem 8: Unit vectors

Find the unit vector in the direction of each vector.

- $\langle 8, -6 \rangle$
- $\langle 5, 12 \rangle$
- $\langle -7, 24 \rangle$
- $\langle 0, -9 \rangle$

Problem 9: Unit vector notation $\mathbf{i}$ and $\mathbf{j}$

Complete each part.

- Write $\langle 4, -3 \rangle$ in terms of $\vec{i}$ and $\vec{j}$.
- Write $7\vec{i} + 2\vec{j}$ in component form and find its magnitude.
- Write $-\vec{i} + 6\vec{j}$ in component form.
- Simplify $3(2\vec{i} - \vec{j}) + (\vec{i} + 4\vec{j})$.

Problem 10: Vectors with a given length

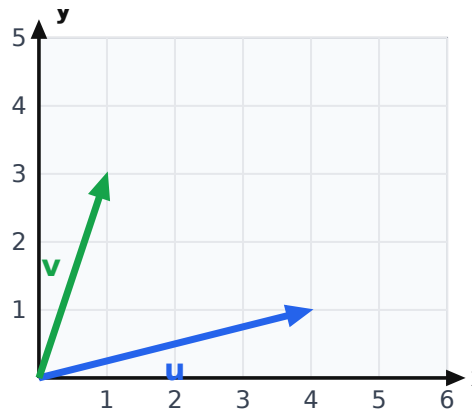
Complete each part.

- Find the vector of length 20 that points in the same direction as $\langle 3, 4 \rangle$.
- Find the vector of length 20 that points in the opposite direction.
- Find the vector of length 26 in the direction of $\langle -5, 12 \rangle$.

Precalculus Vectors Worksheet: problems 11-15

Problem 11: Parallelogram rule

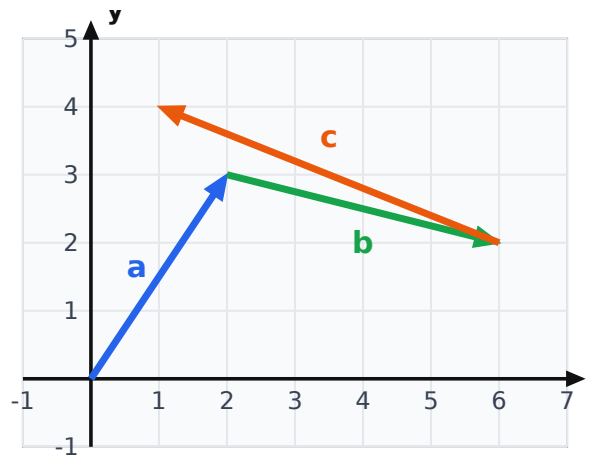
The figure shows $\vec{u} = \langle 4, 1 \rangle$ and $\vec{v} = \langle 1, 3 \rangle$. Complete the parallelogram, then find the diagonal $\vec{u} + \vec{v}$, the vector $\vec{u} - \vec{v}$, and the length of the diagonal to the nearest hundredth.



Vectors u and v from the origin.

Problem 12: Tip-to-tail path

A drone flies three legs, shown below: $\vec{a} = \langle 2, 3 \rangle$, $\vec{b} = \langle 4, -1 \rangle$ and $\vec{c} = \langle -5, 2 \rangle$, with distances in blocks. Find the single vector that takes the drone from its start to its end. Then find the magnitude and direction angle of that vector.



Three legs placed tip to tail.

Problem 13: Dot products

Find each dot product, then state which pair of vectors is perpendicular.

- $\langle 2, 3 \rangle \cdot \langle 4, -1 \rangle$
- $\langle 3, -4 \rangle \cdot \langle 4, 3 \rangle$
- $\langle -2, 6 \rangle \cdot \langle 1, 2 \rangle$
- $\langle -3, -5 \rangle \cdot \langle 2, -4 \rangle$

Problem 14: Angle between two vectors

Find the angle between each pair of vectors to the nearest tenth of a degree.

- a. $\langle 1,0 \rangle$ and $\langle 1,1 \rangle$
- b. $\langle 3,1 \rangle$ and $\langle 1,3 \rangle$
- c. $\langle 2,-1 \rangle$ and $\langle -4,2 \rangle$
- d. $\langle -1,2 \rangle$ and $\langle 3,1 \rangle$

Problem 15: Perpendicular and parallel vectors

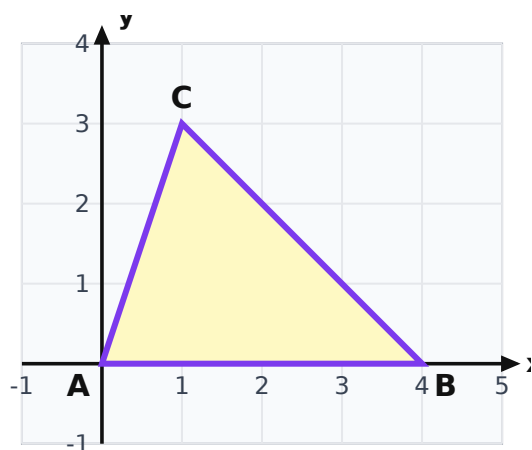
Complete each part.

- a. Find k so that $\langle k,3 \rangle$ is perpendicular to $\langle 4,-6 \rangle$.
- b. Find k so that $\langle k,6 \rangle$ is parallel to $\langle 2,3 \rangle$.
- c. Find a vector of length $\sqrt{29}$ that is perpendicular to $\langle 5,-2 \rangle$.

Precalculus Vectors Worksheet: problems 16-20

Problem 16: Angles of a triangle

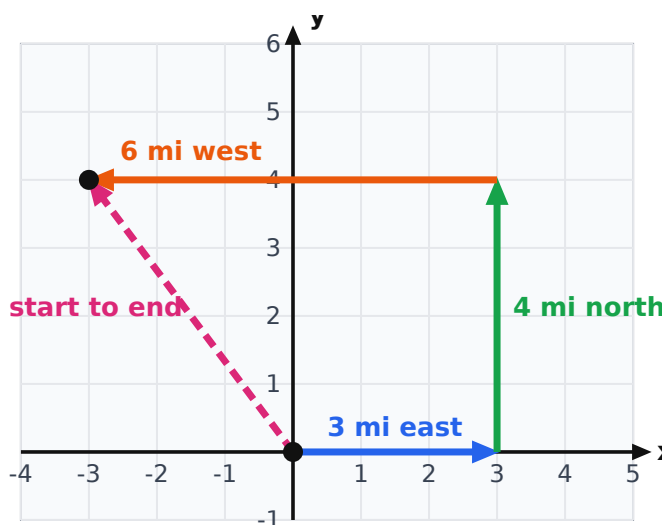
Triangle ABC has vertices $A(0,0)$, $B(4,0)$ and $C(1,3)$. Use vectors and the dot product to find all three interior angles to the nearest hundredth of a degree, and check that they add to 180° .



Triangle ABC.

Problem 17: Hiking displacement

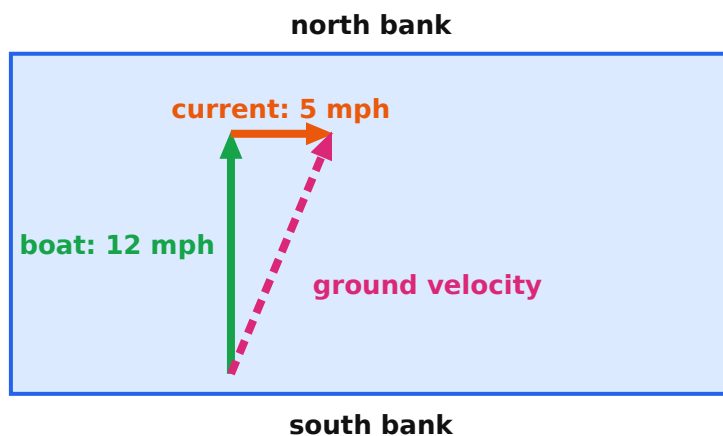
Maya hikes 3 miles east, then 4 miles north, then 6 miles west. Write her total displacement as a vector (east and north positive), then find how far she is from the trailhead and the direction angle of the straight line back from the trailhead to her.



Maya's three legs and her net displacement.

Problem 18: Boat crossing a river

A boat crosses a river 0.6 mile wide, heading straight across at 12 mph in still water. The current flows downstream at 5 mph. Find the boat's speed relative to the ground, the time to cross, and how far downstream the boat lands from the point directly across.



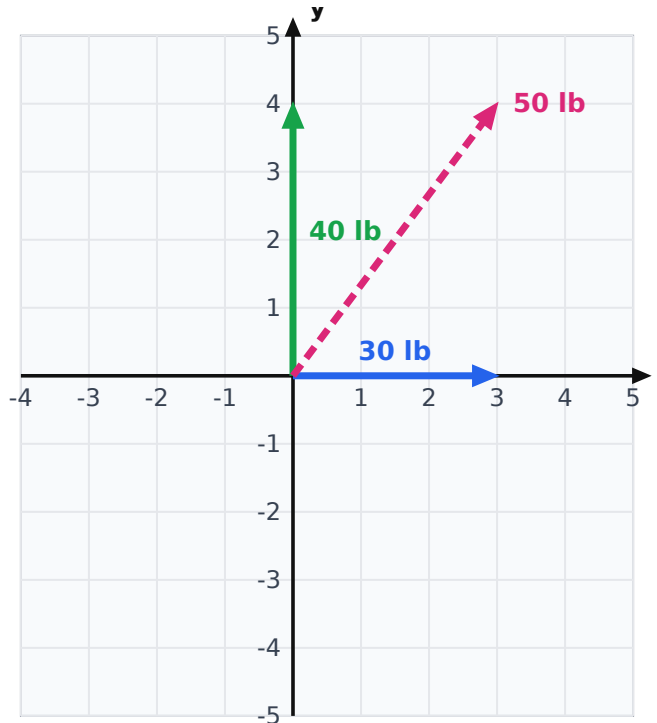
The boat heads across while the current carries it downstream.

Problem 19: Airplane and crosswind

A plane flies due north with an airspeed of 300 mph. A wind blows due east at 50 mph. Find the plane's ground speed and its direction measured east of north. How far does it travel over the ground in 2 hours?

Problem 20: Forces in equilibrium

Two ropes pull on a ring with a force of 30 pounds due east and 40 pounds due north. Find the resultant force and its direction angle. Then find the third force that would hold the ring in equilibrium (net force zero).



Two forces on a ring.

Precalculus Vectors Worksheet: problems 21-22

Problem 21: Work done by a force

Diego pulls a sled with a constant force of 40 pounds at an angle of 60° above the horizontal. The sled moves 25 feet along level ground. Write the force and displacement as vectors and use the dot product to find the work done.

Problem 22: Crate on a ramp

A 100-pound crate rests on a ramp inclined at 30° . Its weight is the vector $\langle 0, -100 \rangle$. The unit vector pointing down the ramp is $\langle \cos 30^\circ, -\sin 30^\circ \rangle$. Use the dot product to find the part of the weight that pulls the crate down the ramp, and the force needed to hold it in place.

How to use this precalculus vectors worksheet

Print this precalculus vectors worksheet as a PDF, solve every problem on paper, then compare with the answer key.

