

Vector Resultant Routes

Add direction vectors with components.

HIGH SCHOOL • HSN-VM.B.4b

CCSS.Math.Content.HSN-VM.B.4b "Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum."

NAME _____

DATE _____

COMPONENT PATH

Write each vector as an x-component and a y-component: $x = r \cos(\theta)$ and $y = r \sin(\theta)$. Add the x-components and add the y-components. Then use the Pythagorean Theorem for the magnitude and use the signs of the components to choose the direction angle.

WORKED EXAMPLE

Find the sum of vectors $\langle 10, 30^\circ \rangle$ and $\langle 10, 150^\circ \rangle$.

- $\langle 10, 30^\circ \rangle = (5\sqrt{3}, 5)$ and $\langle 10, 150^\circ \rangle = (-5\sqrt{3}, 5)$.
- Add components: $(5\sqrt{3} - 5\sqrt{3}, 5 + 5) = (0, 10)$.
- Magnitude = $\sqrt{0^2 + 10^2} = 10$.
- The resultant points straight up, so its direction is 90° .

Answer: 10 units at 90°

PRACTICE 6 problems

- 1** Find the sum of vectors $\langle 6, 45^\circ \rangle$ and $\langle 6, 135^\circ \rangle$.

ANSWER _____

- 2** Find the sum of vectors $\langle 9, 0^\circ \rangle$ and $\langle 12, 90^\circ \rangle$.

ANSWER _____

- 3** Find the sum of vectors $\langle 13, 210^\circ \rangle$ and $\langle 4, 210^\circ \rangle$.

ANSWER _____

- 4** Find the sum of vectors $\langle 14, 180^\circ \rangle$ and $\langle 3, 0^\circ \rangle$.

ANSWER _____

- 5** Find the sum of vectors $\langle 8\sqrt{2}, 45^\circ \rangle$ and $\langle 8\sqrt{2}, 315^\circ \rangle$.

ANSWER _____

- 6** Find the sum of vectors $\langle 7\sqrt{2}, 135^\circ \rangle$ and $\langle 7\sqrt{2}, 225^\circ \rangle$.

ANSWER _____

APPLY IT Show your work

- 1** In a video game, a character moves 16 grid units at 0° . A moving platform then pushes the character 12 grid units at 90° . Find the magnitude and direction of the character's total displacement.

WORK SPACE

ANSWER _____

- 2** A student in a drone club sets a drone's airspeed to 18 km/h at 60° . The wind velocity is 18 km/h at 120° . Find the magnitude and direction of the drone's ground velocity. Angles are measured counterclockwise from east.

WORK SPACE

ANSWER _____

CHALLENGE One step up

CHALLENGE

Three forces act on an object: $\langle 11, 0^\circ \rangle$, $\langle 6, 90^\circ \rangle$, and $\langle 8, 180^\circ \rangle$. Find the magnitude and direction of the resultant force. Give the direction as an exact inverse-tangent expression.

PART 1 • PRACTICE

#	PROBLEM	ANSWER
1	Find the sum of vectors $\langle 6, 45^\circ \rangle$ and $\langle 6, 135^\circ \rangle$.	$6\sqrt{2}$ units at 90°
2	Find the sum of vectors $\langle 9, 0^\circ \rangle$ and $\langle 12, 90^\circ \rangle$.	15 units at $\tan^{-1}(4/3)^\circ$
3	Find the sum of vectors $\langle 13, 210^\circ \rangle$ and $\langle 4, 210^\circ \rangle$.	17 units at 210°
4	Find the sum of vectors $\langle 14, 180^\circ \rangle$ and $\langle 3, 0^\circ \rangle$.	11 units at 180°
5	Find the sum of vectors $\langle 8\sqrt{2}, 45^\circ \rangle$ and $\langle 8\sqrt{2}, 315^\circ \rangle$.	16 units at 0°
6	Find the sum of vectors $\langle 7\sqrt{2}, 135^\circ \rangle$ and $\langle 7\sqrt{2}, 225^\circ \rangle$.	14 units at 180°

PART 2 • APPLY IT

- 20 grid units at $\tan^{-1}(3/4)^\circ$** The component sum is (16, 12). Its magnitude is $\sqrt{16^2 + 12^2} = 20$, and its direction is $\tan^{-1}(12/16) = \tan^{-1}(3/4)^\circ$.
- $18\sqrt{3}$ km/h at 90°** The horizontal components cancel. The vertical components add to $18\sqrt{3}$, so the resultant points at 90° .

CHALLENGE

$3\sqrt{5}$ units at $\tan^{-1}(2)^\circ$

Accept coterminal direction angles, such as 360° for 0° . For inverse-tangent answers, accept equivalent ratios after simplification and directions placed in the correct quadrant.