

Magnitude and Direction

Represent vectors and describe their sizes and directions.

HIGH SCHOOL • HSN-VM.A.1

CCSS.Math.Content.HSN-VM.A.1 "(+) Recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments, and use appropriate symbols for vectors and their magnitudes (e.g., v , $|v|$, $\|v\|$, v)."

NAME _____

DATE _____

THE BIG IDEA

A vector has both magnitude, or size, and direction. You can represent a vector with an arrow or with components such as $v = \langle a, b \rangle$, and write its magnitude as $|v|$.

WORKED EXAMPLE

Vector $h = \langle 8, 15 \rangle$. Find $|h|$.

1. Use the magnitude rule: $|h| = \sqrt{8^2 + 15^2}$.
2. Square and add: $|h| = \sqrt{64 + 225}$.
3. Simplify: $|h| = \sqrt{289} = 17$.

Answer: $|h| = 17$

PRACTICE 6 problems

- 1** Classify each quantity as a vector or a scalar: 18 mph north; 18 mph.

ANSWER _____

- 2** A vector v starts at $(2, -1)$ and ends at $(5, 3)$. Write v and $|v|$.

ANSWER _____

- 3** For $r = \langle 9, 0 \rangle$, state the magnitude and direction.

ANSWER _____

- 4** For $q = \langle -7, 24 \rangle$, find $|q|$.

ANSWER _____

- 5** Which vector could represent a move of 14 units west? A. $\langle 14, 0 \rangle$ B. $\langle -14, 0 \rangle$ C. $\langle 0, 14 \rangle$ D. $\langle 0, -14 \rangle$

ANSWER _____

- 6** A vector m represents a move of 20 units left and 21 units up. Write m and $|m|$.

ANSWER _____

APPLY IT Show your work

- 1** At a robotics competition, a drone flies 7 meters east and 24 meters north from its takeoff point. Write its displacement vector and find its magnitude. State the general direction.

WORK SPACE

ANSWER _____

- 2** A runner's fitness app shows that she ends 10 blocks west and 24 blocks north of where she started. Write her displacement vector and find its magnitude. State the general direction.

WORK SPACE

ANSWER _____

CHALLENGE One step up

CHALLENGE

Vectors $a = \langle -16, 30 \rangle$ and $b = \langle 16, -30 \rangle$ represent two displacements. Do they have the same magnitude? Do they have the same direction? Explain using the vectors.

PART 1 • PRACTICE

#	PROBLEM	ANSWER
1	Classify each quantity as a vector or a scalar: 18 mph north; 18 mph.	18 mph north is a vector. 18 mph is a scalar.
2	A vector v starts at $(2,-1)$ and ends at $(5,3)$. Write v and $ v $.	$v = \langle 3,4 \rangle$; $v = 5$
3	For $r = \langle 9,0 \rangle$, state the magnitude and direction.	$r = 9$; direction: right, or positive x-direction
4	For $q = \langle -7,24 \rangle$, find $ q $.	$q = 25$
5	Which vector could represent a move of 14 units west? A. $\langle 14,0 \rangle$ B. $\langle -14,0 \rangle$ C. $\langle 0,14 \rangle$ D. $\langle 0,-14 \rangle$	B. $\langle -14,0 \rangle$
6	A vector m represents a move of 20 units left and 21 units up. Write m and $ m $.	$m = \langle -20,21 \rangle$; $m = 29$

PART 2 • APPLY IT

- $d = \langle 7,24 \rangle$; $|d| = 25$ meters; northeast** Use east as positive x and north as positive y , so $d = \langle 7,24 \rangle$. Its magnitude is $\sqrt{7^2 + 24^2} = 25$.
- $r = \langle -10,24 \rangle$; $|r| = 26$ blocks; northwest** Use west as negative x and north as positive y , so $r = \langle -10,24 \rangle$. Its magnitude is $\sqrt{(-10)^2 + 24^2} = 26$.

CHALLENGE

They have the same magnitude, 34, but opposite directions. Since $b = -a$, each component of b is the opposite of the matching component of a .

Accept equivalent direction language, such as positive x -direction for right and up-left for northwest. Accept magnitude work written as $\sqrt{a^2 + b^2}$ before simplification.