LESSON MAKER PRO

Vector Route Builder

Add directions, components, and diagonal results.

HIGH SCHOOL · HSN-VM.B.4a

CCSS.Math.Content.HSN-VM.B.4a "Add vectors end-to-end, component-wise, and by the parallelogram rule. Understand that the magnitude of a sum of two vectors is typically not the sum of the magnitudes."

NAME _____ DATE _____

BUILDING A VECTOR SUM

To add vectors end-to-end, place the tail of the second vector at the head of the first vector, then draw the resultant from the first tail to the final head. Add component-wise by adding horizontal components and vertical components, or place both tails together and use the diagonal of the parallelogram. The magnitude of a sum is usually not the same as the sum of the two magnitudes because vector directions can partly cancel.

WORKED EXAMPLE

Add <8, -7> + <-3, 4>. Then compare |<8, -7> + <-3, 4>| with |<8, -7>| + |<-3, 4>|.

1. Add horizontal components: 8 + (-3) = 5.
2. Add vertical components: -7 + 4 = -3.
3. Write the sum: <8, -7> + <-3, 4> = <5, -3>.
4. Find magnitudes: |<5, -3>| = sqrt(34), while |<8, -7>| + |<-3, 4>| = sqrt(113) + 5.

Answer: <5, -3>; sqrt(34) is not equal to sqrt(113) + 5.

PRACTICE 6 problems

1 Find the sum: <2, 1> + <6, -9>.

ANSWER _____

2 Find the sum: <-10, 12> + <9, 2>.

ANSWER _____

3 A vector moves 11 units right and 2 units down. A second vector then moves 1 unit left and 10 units up. Write the resultant vector.

ANSWER _____

4 Two adjacent sides of a parallelogram are represented by <6, 9> and <-2, 11>. What vector represents the diagonal from their shared tail?

ANSWER _____

5 Let u = <12, 9> and v = <-6, 2>. Find u + v, |u + v|, and |u| + |v|. Are the last two values equal?

ANSWER _____

6 Find the sum: <-9, 13> + <11, -6>.

ANSWER _____

APPLY IT Show your work

1 During a campus scavenger hunt, Jordan walks 12 blocks east and then 5 blocks north. Represent the overall displacement as a vector and find its magnitude. Is the displacement magnitude equal to the total number of blocks walked?

WORK SPACE

ANSWER _____

2 In a video game, an avatar moves 9 units left and 6 units up, then moves 4 units right and 14 units down. What is the avatar's net displacement vector and its magnitude?

WORK SPACE

ANSWER _____

CHALLENGE One step up

CHALLENGE

Two vectors are u = <6, 8> and v = <8, -6>. Each vector has magnitude 10. Find u + v and |u + v|. Then explain why |u + v| is less than |u| + |v|.

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_____

ANSWER KEY

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PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	Find the sum: <2, 1> + <6, -9>.	**<8, -8>**
2	Find the sum: <-10, 12> + <9, 2>.	**<-1, 14>**
3	A vector moves 11 units right and 2 units down. A second vector then moves 1 unit left and 10 units up. Write the resultant vector.	**<10, 8>**
4	Two adjacent sides of a parallelogram are represented by <6, 9> and <-2, 11>. What vector represents the diagonal from their shared tail?	**<4, 20>**
5	Let u = <12, 9> and v = <-6, 2>. Find u + v, |u + v|, and |u| + |v|. Are the last two values equal?	**u + v = <6, 11>; |u + v| = sqrt(157); |u| + |v| = 15 + 2sqrt(10); no.**
6	Find the sum: <-9, 13> + <11, -6>.	**<2, 7>**

PART 2 · APPLY IT

1. **Overall displacement: <12, 5>. Magnitude: 13 blocks. No, Jordan walks 17 blocks total.** Use east as positive horizontal and north as positive vertical, so the sum is <12, 5>. Its magnitude is sqrt(12^2 + 5^2) = 13, which is less than 12 + 5.
2. **Net displacement: <-5, -8>. Magnitude: sqrt(89) units.** Add the movement vectors <-9, 6> and <4, -14> to get <-5, -8>. The magnitude is sqrt((-5)^2 + (-8)^2) = sqrt(89).

CHALLENGE

u + v = <14, 2> and |u + v| = sqrt(200) = 10sqrt(2). Since 10sqrt(2) is less than 20, the sum has a smaller magnitude than |u| + |v|. The vertical components partly cancel because one vector points up and the other points down.

Accept equivalent vector notation, including ordered pairs, when component order is clear. Accept sqrt(200) or 10sqrt(2) for the challenge magnitude, and require an explanation of partial cancellation for the challenge.