# 2.2 Addition, Subtraction, and Scalar Multiplication of Vectors

## ADDITION & SUBTRACTION OF VECTORS

To add or subtract two vectors, add, or subtract their corresponding components.

To **ADD** the vectors and , begin by writing each in component form.

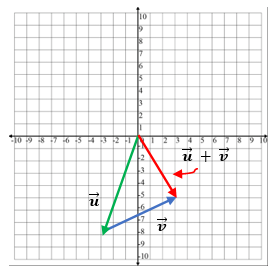
Example (1)

|  |  |
| --- | --- |
| Image of two vectors in a 2-dimensional coordinate system. | and  ADD their corresponding components.  So, |

|  |  |
| --- | --- |
| Now, graph this sum.   * Start at the origin. * Since the horizontal component is 3, move 3 units to the *right*. * Since the vertical component is , move 5 units *downward*. | Image of two vectors in a 2-dimensional coordinate system and a demonstration of graphing their sum. |

The addition of two vectors and can be demonstrated by placing the tail of one vector at the head of the other. Then connect the tail of to the head of .

Example (2)



To **SUBTRACT** the vector from the vector , begin by writing each in component  
 form.

Example (3)

|  |  |
| --- | --- |
| Image of two vectors in a 2-dimensional coordinate system. | and  SUBTRACT the components of from the corresponding components of .  So, |

|  |  |
| --- | --- |
| Now, graph this sum.   * Start at the origin. * Since the horizontal component is 9, move 9 units to the *right*. * Since the vertical component is 11, move 11 units *upward*. | Image of two vectors in a 2-dimensional coordinate system and an example of graphing their subtraction. |

## SCALARS

In contrast to a vector, and having both direction and magnitude, a SCALAR is a physical quantity defined by only its magnitude.

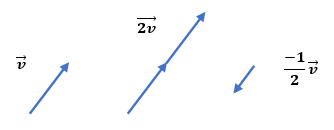
Examples are speed, time, distance, density, and temperature. They are represented by real numbers (both positive and negative), and they can be operated on using the regular laws of algebra.

The term *scalar* derives from this usage: *a scalar is that which scales, resizes a vector*.

Scalar multiplication is the multiplication of a vector by a real number (a scalar).

Suppose we let the letter represent a real number and be the vector Then, the scalar multiple of the vector is

To multiply a vector by a scalar (a constant), multiply each of its components by the constant.



1. Suppose and .

Then 3

1. Suppose and and .

Then

1. Suppose and and .

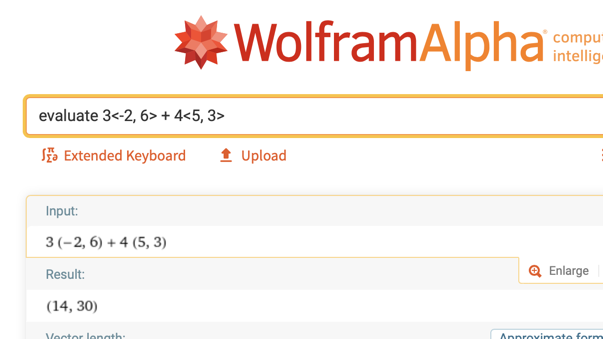
Then

## USING TECHNOLOGY

We can use technology to add and subtract vectors and to multiply a vector by a scalar.

Go to www.wolframalpha.com.

For the vectors and , use WolframAlpha to find . Enter evaluate 3<-2, 6> + 4<5, 3> in the entry field. Wolframalpha tells you what it thinks you entered, then tells you its answer. In this case, .



## EXAMPLES

1. Find the sum of the two vectors and .
2. Subtract the vector from the vector .
3. Perform the operation .

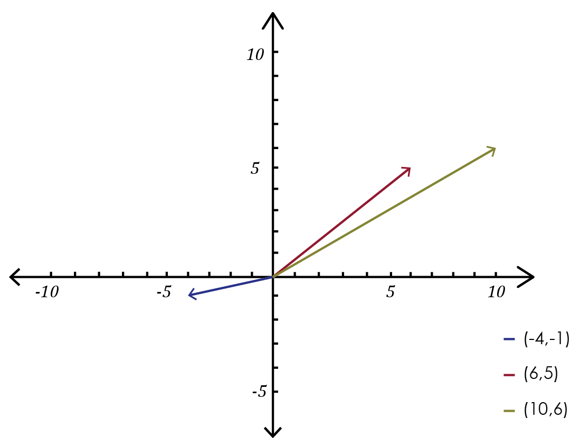
## NOTE TO INSTRUCTOR

Consider showing these examples on the board.

1. Using the vectors and show addition using both the arrows originating at the origin and then by placing the tail of onto the head of .

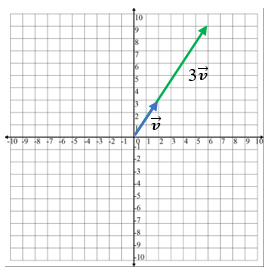
ANS:

1. Subtract the vector from the vector .



ANS:

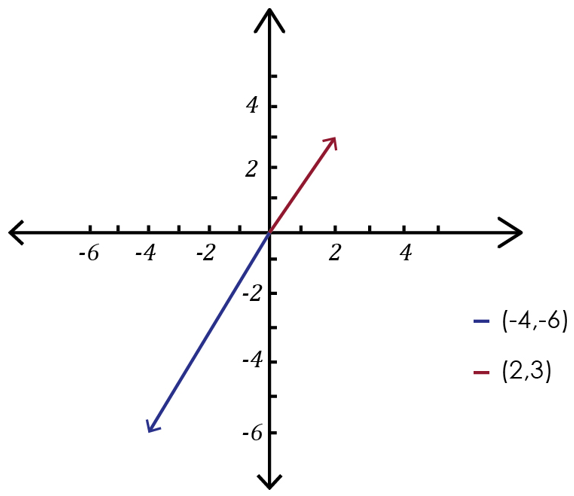
1. Multiply the vector by the scalar 3.



ANS:

Draw in one color and in another color. Point out how the length of vector tripled. That is, should look 3 times as long as . It can be a bit hard to show because the vectors will appear to be on top of the other.

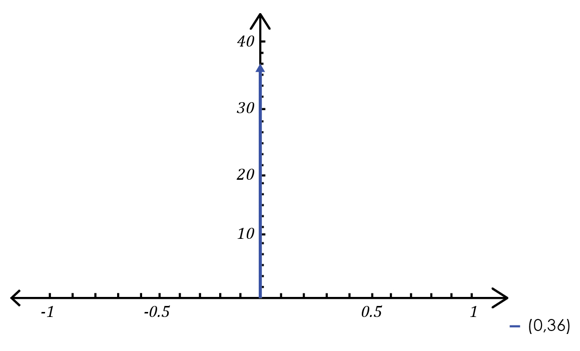
1. Multiply the vector by the scalar -2.



ANS:

Draw in one color and in another color. Point out how the length of vector doubled and points in the opposite direction of . That is, -2 should look twice as long as but pointing in the opposite direction.

1. Suppose and and . Find



[2-2\_addition\_subtraction\_and\_scalar\_multiplication\_of\_vectors.docx](https://oer4cte.org/math4gamedevelopers/teacher/2-2_addition_subtraction_and_scalar_multiplication_of_vectors.docx), attributed to Denny Burzynski (author) and Downey Unified School District (publisher) is licensed under CC BY-NC 4.0. To view a copy of this license, visit https://creativecommons.org/licenses/by-nc/4.0