# 2.3 Magnitude, Direction, and Components of a Vector

## THE MAGNITUDE OF A VECTOR

It is productive to represent the horizontal and vertical components of a vector as and , respectively.

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| --- | --- |
| The magnitude (the length) of a vector is | A diagram showing the magnitude of a vector and its horizontal and vertical components. |

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| --- | --- |
| The vector has magnitude:    = =  Interpret this as the length of the vector is units. | An example of a vector magnitude in a 2-dimension coordinate system. |

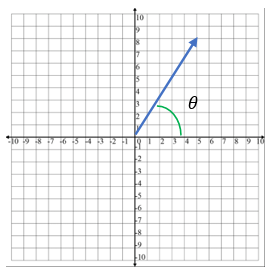
## THE DIRECTION OF A VECTOR

The direction of a vector is the angle the vector makes with the positive -axis.

It is typically represented with the uppercase Greek letter theta . We use some trigonometry to determine the angle .

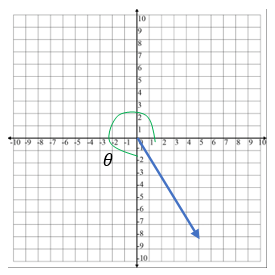
|  |  |
| --- | --- |
| or  The angle is always between 0° and 360°. | Image illustrating a direction of a vector and the angle it makes with the positive x-axis. |

To approximate the direction of the vector , use with and



Using a calculator, we get

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Vertical component is in Quadrant IV and must be in the interval , therefore we calculate by

## THE COMPONENTS OF A VECTOR

The lengths of the - and - components of a vector

in two dimensions can be found using trigonometric ratios.

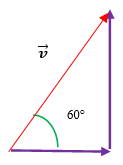
and

is the horizontal component of and is the vertical component.

The angle is always between 0° and 360°.

Suppose the magnitude of a vector is 20 units, and that makes a 60° angle with the horizontal. Then, the components of are

and



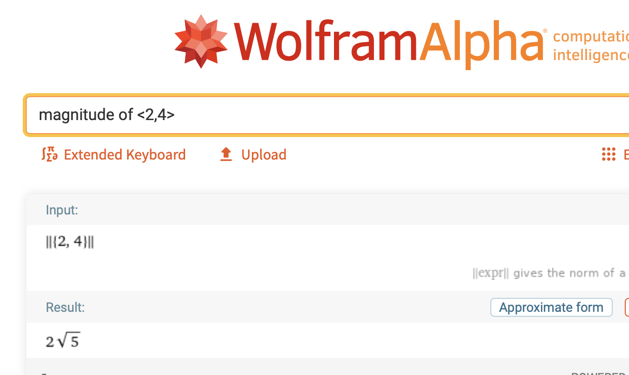
So, we could write as

## USING TECHNOLOGY

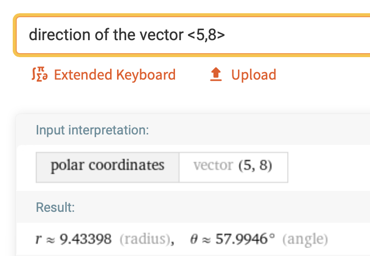
We can use technology to determine the magnitude of a vector.

Go to www.wolframalpha.com.

To find the magnitude of the vector enter magnitude of <2,4> in the entry field. Wolframalpha tells you what it thinks you entered, then tells you its answer. In this case, .

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To find the direction of the vector enter direction of the vector <5,8>in the entry field. Wolframalpha answers .

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## EXAMPLES

1. Find the magnitude of the vector

ANS:

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ANS:

1. Find the components of the vector if the magnitude of is 6 and it makes a 30° angle with the horizontal.

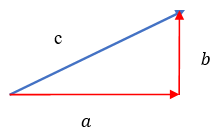
ANS: and

1. Approximate the direction of the vector .

ANS:

## NOTE TO INSTRUCTOR

1. Remind students of the Pythagorean Theorem.



1. Consider deriving the magnitude of a vector using the Pythagorean Theorem. Note that the and the in represent the lengths of the horizontal and vertical components, respectively, of .

|  |  |
| --- | --- |
|  | A diagram showing the magnitude of a vector and its horizontal and vertical components. |

Use as an example of the vector . The magnitude of is

1. Demonstrate how to find the magnitude of .
2. Find the components of the vector if the magnitude of is 7 and it makes a 30° angle with the horizontal.

So, and

1. Approximate the components of the vector if the magnitude of is 16 and it makes a 128° angle with the horizontal.

So, and

1. Approximate the direction of the vector .

Using a calculator, we get

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