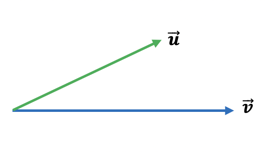
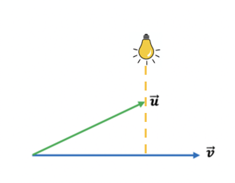
# 2.6 The Vector Projection of One Vector onto Another

## PROJECTION

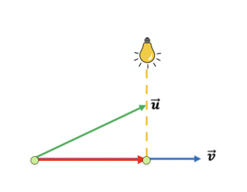
Let’s project vector onto the vector .



To do so, imagine a light bulb above shining perpendicular onto .



The light from the bulb will cast a shadow of onto ,and it is this shadow that we are looking for. The shadow is the projection of onto .



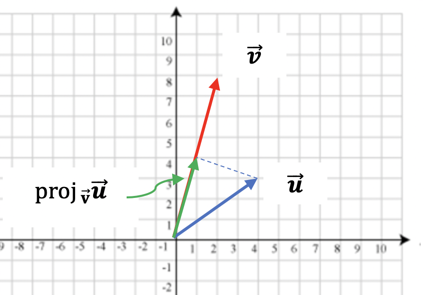
The red vector is the projection of onto . The notation commonly used to represent the projection of onto is .

Vector parallel to with magnitude in the direction of is called projection of onto .

The formula for is

To find the projection of ⟨4, onto ⟨2, , we need to compute both the dot product of and , and the magnitude of , then apply the formula.

Example (1)

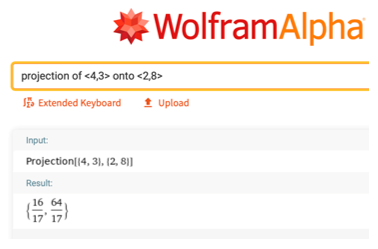


## USING TECHNOLOGY

We can use technology to determine the projection of one vector onto another.

Go to www.wolframalpha.com.

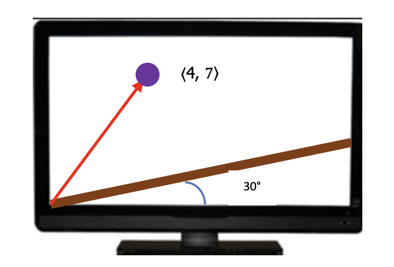
To find the projection of onto ⟨2, , use the “projection” command. In the entry field enter projection of <4, 3> onto <2, 8>.



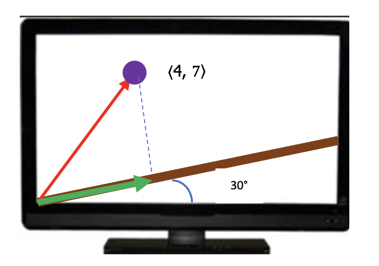
Wolframalpha tells you what it thinks you entered, then tells you its answer. In this case, .

As an applied example, suppose a video game has a ball moving near a wall.

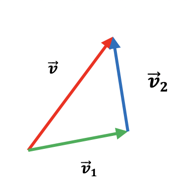
Example (2)



We take the origin at the bottom-left-most corner of the screen. The wall is at a 30° angle to the horizontal, and at a point in time, the ball is at position ⟨4,. To find the perpendicular distance from the ball to the wall, we use the projection formula to project the vector ⟨4, onto the wall.

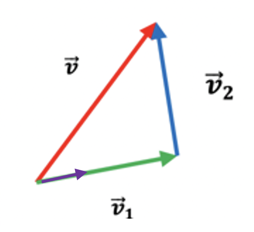


We begin by decomposing into two vectors and so that and lies along the wall**.**



The length (magnitude) of the vector is then the distance from the ball to the wall.

The vector is the projection of onto the wall. We can get by scaling (multiplying) a unit vector that lies along the wall and, thus, along with .



Since lies at a 30° angle to the horizontal, , using the projection formula, we get the projection of that lies along the wall.

|  |  |
| --- | --- |
|  | An illustration showing vector decompose into two vectors creating a triangle. |

|  |  |
| --- | --- |
| Since that , subtraction get us  To get the magnitude of , we use | An image exampling a monitor with a ball and vector movement creating an angle and showing the projection of the vector with its measurements. |

## EXAMPLES

1. Find the projection of the vector onto the vector .

ANS:

1. Find , where .

ANS:

## NOTE TO INSTRUCTOR

When presenting the projection formula, consider pointing out that the numerator is a dot product and a scalar (a real number). The denominator is a length, so it, too, is a scalar. A scalar divided by a scalar is also a scalar, so the formula shows a vector is multiplied by a scalar. That is, it shows a vector scaled longer or shorter. That scaled vector is the projection.

Consider working through these problems as examples.

1. Find the projection of the vector onto the vector .

ANS:

1. Find , where

ANS:

1. Find , where

ANS: These two vectors are orthogonal (perpendicular to each other).

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