

Scalar Resolute

Student Activity

7 8 9 10 11 12



TI-Nspire



Investigation



Student



45 min

Introduction

The scalar projection of a vector onto another vector is also referred to as the scalar resolute. To understand the scalar resolute, begin by working and thinking in a two dimensional geometry environment, take this understanding and use it to work with vectors and vector equations in three dimensions.

For more examples, instructions and concept development, watch the video:

<http://bit.ly/ScalarResolute>

Scan to Watch



Scalar Resolute

Open the TI-nspire document: “Scalar Resolute”. Navigate to page 1.2 to explore how the magnitude of vector \underline{a} effects the scalar resolute of \underline{a} on \underline{b} .

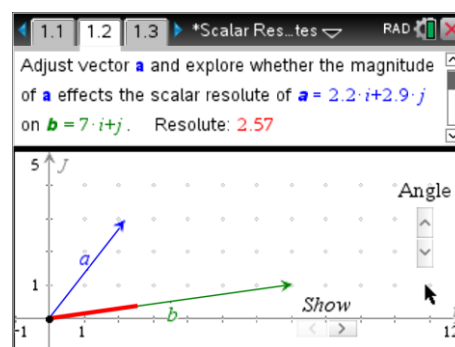
To grab vector \underline{a} or \underline{b} move the mouse over the head of the vector and hold down the mouse button or press Ctrl then Click. To release the grip (hand) press ESC.

The vectors have been set up so that the angle between them can only be change by using the “Angle” slider.

The scalar resolute of \underline{a} on \underline{b} is shown as a thick line.



To reveal information about the construction of the scalar resolute, click on the ‘show’ button. When this information is revealed it may be harder to grab the head of vector \underline{a} . The screen text tip will display ‘segment’, press TAB to change to ‘vector’.



Question: 1.

Change the magnitude (length) of vector \underline{a} and observe changes to the scalar resolute. How does the magnitude of \underline{a} change the scalar resolute?

Example: Would doubling the magnitude of \underline{a} double the scalar resolute?

The angle between the two vectors can be changed using the “Angle” slider. The exact value of the angle is not the focus, rather how it affects the scalar resolute. Change the angle by increasing or decreasing the slider and observe the changes to the scalar resolute.

Question: 2.

Under what circumstances will the scalar resolute equal zero?

Question: 3.

Under what circumstances will the scalar resolute of \underline{a} on \underline{b} be equal to $|\underline{a}|$?

Question: 4.

If $|\underline{a}| = |\underline{b}|$ and the scalar resolute of \underline{a} on \underline{b} is equal to $\frac{1}{2}|\underline{b}|$, determine the angle between the vectors \underline{a} and \underline{b} .

Question: 5.

Let θ be the angle between vectors \underline{a} and \underline{b} , such that $0 \leq \theta \leq \frac{\pi}{6}$. If the scalar resolute of \underline{a} on \underline{b} is greater than $|\underline{b}|$ determine the minimum value for $|\underline{a}|$ in terms of $|\underline{b}|$?

Question: 6.

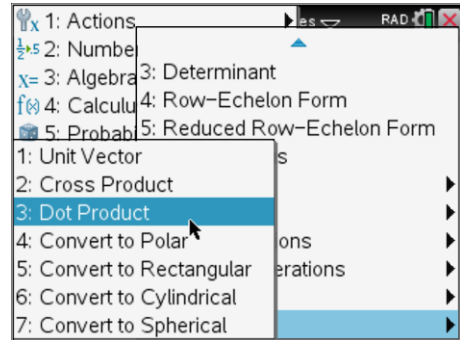
Use the 'hint' slider (show) to view a geometrical construction of the scalar resolute. Use this information to determine a rule for the scalar resolute of \underline{a} on \underline{b} .
Hint: Think in terms of a simple two dimensional geometry environment and remember that the 'length' of \underline{a} is written as: $|\underline{a}|$. Use the vectors and result on page 1.2 to check your rule.

Scalar Resolute - Calculations

The vectors on page 1.2 are stored in variables **a** and **b**.
Navigate to page 1.3, a calculator application.
Calculate the dot product of vectors \underline{a} and \underline{b} .

Menu > Matrix and Vector > Vector > Dot Product

A comma is used to separate the two vectors in the Dot Product command.

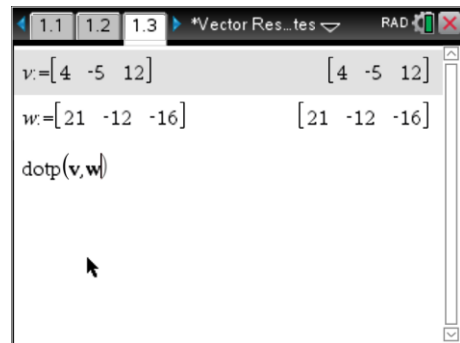


Define the following vectors using matrix notation:

$$\underline{v} = 4\underline{i} - 5\underline{j} + 12\underline{k}$$

$$\underline{w} = 21\underline{i} - 12\underline{j} - 16\underline{k}$$

Use `dotp(v,w)` to determine the dot product.

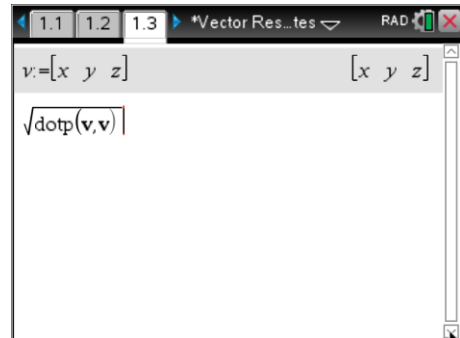


The magnitude of a vector can be calculated using the relationship:

$$|\underline{v}| = \sqrt{\underline{v} \cdot \underline{v}}$$

The scalar resolute of vector \underline{v} on \underline{w} can therefore be determined using:

$$\frac{\text{dotp}(v, w)}{\sqrt{\text{dotp}(w, w)}}$$



Question: 7.

Use the calculator to determine: `dotp(v,unitV(w))` and explain why the result is the same as the scalar resolute.

Question: 8.

Let $\underline{v} = 4\underline{i} - 3\underline{j}$ and $\underline{w} = x\underline{i} + y\underline{j}$, if $|\underline{w}| = 12$ and the scalar resolute of \underline{v} on \underline{w} equals zero, determine the values of x and y .