LaTeX to PDF and MathJax: Example 2

## LaTeX to PDF and MathJax: Example 2

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### [Using this document](#x1-3000)

This is a second example of a document compiled from LATEX  into multiple formats.

* [Standard print PDF](https://stem-enable.github.io/LaTeXtoPDFandMathJax-Example2/LaTeXtoPDFandMathJax-2-standard.pdf)
* [Clearer print PDF](https://stem-enable.github.io/LaTeXtoPDFandMathJax-Example2/LaTeXtoPDFandMathJax-2-clear.pdf)
* [Accessible web format](https://stem-enable.github.io/LaTeXtoPDFandMathJax-Example2/)
* [Accessible Word document](https://stem-enable.github.io/LaTeXtoPDFandMathJax-Example2/LaTeXtoPDFandMathJax-2.docx)

The outputs can be used to test setups and as a second example for students to try out.

### 1 [The scalar product](#QQ2-1-4)

Consider two vectors and drawn so their tails are at the same point.

Two vectors, labelled a and b, are drawn as line segments. Their start points coincide and their end points do not. There is an acute angle of theta between them. Each line segment has an arrow on it pointing from the start point to the end point.

Figure 1: Two vectors with angle between them.

We define the scalar product of and as follows.

Definition 1.1 (Scalar product).  
The scalar product of and is

where

* is the modulus of ,
* is the modulus of , and
* is the angle between and .

Remark 1.2.  
It is important to use the dot symbol for the scalar product (also called the dot product). You must not use a symbol as this denotes the vector product which is defined differently.

Example 1.3.  
Let

The angle between these vectors is . Then and . So,

Note that the result is a scalar, not a vector.

#### 1.1 [Vectors in cartesian form](#QQ2-1-6)

When vectors are given in cartesian form there is an alternative formula for calculating the scalar product.

Proposition 1.4.  
If and then

Proof.  Consider the vector . The modulus of this is

Note from figure [2](#x1-50022) that the vectors , and form a triangle:

Two vectors, labelled a and b, are drawn as line segments. Their start points coincide and their end points do not. There is an acute angle of theta between them. Forming a triangle, a third line segment, labelled b-a is added. This vector starts at the end point of a and ends at the end point of b. Each line segment has an arrow on it pointing from the start point to the end point.

Figure 2: A triangle is formed by two vectors and their difference.

Let denote the angle between and . Then, the cosine rule yields:

|  |  |
| --- | --- |
|  | (1) |

Substituting the definition of the scalar product of and into equation [1](#x1-5003r1) gives:

Rearranging:

Writing this in terms of components produces:

as required. □

Example 1.5.  
Consider again the vectors

Calculating the scalar product using the components:

Note that if we are given vectors in this form, the scalar product may be used to calculate the angle between them. Since and we have:

Hence,

Rearranging:

### 2 [Using Matlab](#QQ2-1-8)

Two calculate the scalar product in Matlab the dot function is used.

Create two vectors:

> A = [4 -1 2];   
> B = [2 -2 -1];

Calculate the scalar product:

> C = dot(A,B)   
   
    C = 8