

## 10.1: Definition

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In the arithmetic you're accustomed to (involving scalars), there is only one type of multiplication defined for example,  $2 \times 3 = 6$ . But with vectors, there are three different kinds of multiplication:

- The dot product  $\mathbf{A} \cdot \mathbf{B}$ , in which you multiply two vectors together and get a scalar result.
- The cross product  $\mathbf{A} \times \mathbf{B}$ , in which you multiply two vectors together and get another vector as the result.
- The direct product  $\mathbf{A}\mathbf{B}$ , in which you multiply two vectors together and get a tensor result.

In this chapter we'll look at the dot product, which is sometimes called the scalar product.

The dot product of two vectors  $\mathbf{A}$  and  $\mathbf{B}$  (written  $\mathbf{A} \cdot \mathbf{B}$ , and pronounced "A dot B ") is defined to be the product of their magnitudes, times the cosine of the angle between them:

$$\mathbf{A} \cdot \mathbf{B} = AB \cos \theta. \quad (10.1.1)$$

Why do we define it this way? It turns out that this combination occurs frequently in physics; the dot product is related to the projection of one vector onto the other.

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