7.6 The Cross Product

The **Cross Product** is sometimes called the Vector Product because it produces a **vector**.

Note: 1) The cross product is only used in $\mathbb{R}^3$.

2) Given two vectors $\vec{a}$ and $\vec{b}$ in $\mathbb{R}^3$ the cross product

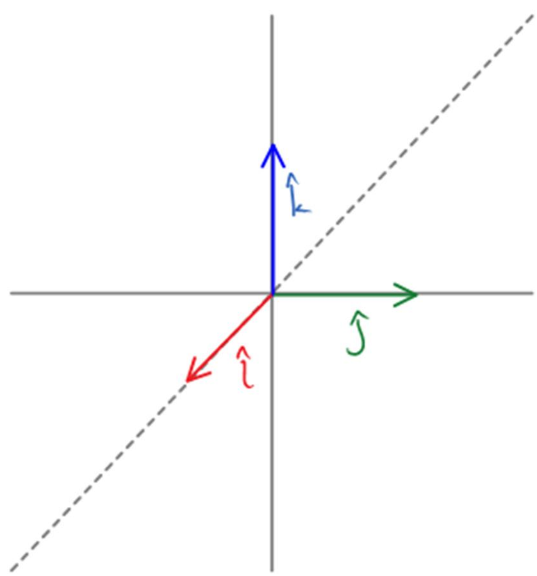
Picture:

3) We determine the **direction** of

4) Clearly

Algebraic View of the Cross Product

Consider: $\hat{i} \times \hat{j} =$



Consider two general vectors in $\mathbb{R}^3$: $\vec{a}=(a_1,a_2,a_3)$ and $\vec{b}=(b_1,b_2,b_3)$. If we write the vectors as linear combinations of the standard unit vectors we can use the above ideas to calculate $\vec{a}\times\vec{b}$.

Let $\vec{a}=a_1\hat{i}+a_2\hat{j}+a_3\hat{k}$ and $\vec{b}=b_1\hat{i}+b_2\hat{j}+b_3\hat{k}$. Then:

$$\vec{a}\times\vec{b}=$$

Another “pattern” for developing the algebraic cross product

Example 7.6.1

Given $\vec{a} = (3, -2, 5)$ and $\vec{b} = (2, 1, 0)$ determine $\vec{a} \times \vec{b}$.

Example 7.6.2

Given $\vec{a} = (3, 1, 0)$ and $\vec{b} = (4, -1, 3)$, find:

a) $\vec{a} \cdot (\vec{a} \times \vec{b})$

b) $\vec{b} \cdot (\vec{a} \times \vec{b})$

c) $\vec{a} \times (\vec{a} \cdot \vec{b})$

Q. Of the following two vector expressions, which is meaningful?

i) $(\vec{a} \cdot \vec{b})(\vec{a} \times \vec{b})$, or *ii*) $\vec{a} \times (\vec{a} \times \vec{b})$

Class/Homework for Section 7.6

Pg. 405 Investigation (optional)
Pg. 407 – 408 #1, 3, 4def, 5 – 7, 8a, 11