Course Number
Instructor
Date

Section 10.3 The Cross Product of Two Vectors

Objective: In this lesson you learned how to find cross products of vectors in space, use geometric properties of the cross product, and use triple scalar products to find volumes of parallelepipeds.

What you should learn How to find cross products of vectors in space

I. The Cross Product (Pages 757–758)

A vector in space that is orthogonal to two given vectors is called their ____________________.

Let $\mathbf{u} = u_1\mathbf{i} + u_2\mathbf{j} + u_3\mathbf{k}$ and $\mathbf{v} = v_1\mathbf{i} + v_2\mathbf{j} + v_3\mathbf{k}$ be two vectors in space. The **cross product** of **u** and **v** is the vector

$\mathbf{u} \times \mathbf{v} =$ ____

Describe a convenient way to remember the formula for the cross product.

Example 1: Given $\mathbf{u} = -2\mathbf{i} + 3\mathbf{j} - 3\mathbf{k}$ and $\mathbf{v} = \mathbf{i} - 2\mathbf{j} + \mathbf{k}$, find the cross product $\mathbf{u} \times \mathbf{v}$.

Let **u**, **v**, and **w** be vectors in space and let c be a scalar. Complete the following properties of the cross product:

1. $\mathbf{u} \times \mathbf{v} =$ ________________
2. $\mathbf{u} \times (\mathbf{v} + \mathbf{w}) =$ ______________________
3. $c(\mathbf{u} \times \mathbf{v}) =$ ________________________
4. $\mathbf{u} \times \mathbf{0} =$ ________________
5. $\mathbf{u} \times \mathbf{u} =$ ___________
6. $\mathbf{u} \bullet (\mathbf{v} \times \mathbf{w}) =$ __________________

II. Geometric Properties of the Cross Product
(Pages 759–760)

> ***What you should learn***
> How to use geometric properties of cross products of vectors in space

Complete the following geometric properties of the cross product, given **u** and **v** are nonzero vectors in space and θ is the angle between **u** and **v**.

1. $\mathbf{u} \times \mathbf{v}$ is orthogonal to ____________________.
2. $\| \mathbf{u} \times \mathbf{v} \| =$ ____________________________.
3. $\mathbf{u} \times \mathbf{v} = \mathbf{0}$ if and only if ________________________________.
4. $\| \mathbf{u} \times \mathbf{v} \| =$ area of the parallelogram having _______________ ____________________.

III. The Triple Scalar Product (Page 761)

> ***What you should learn***
> How to use triple scalar products to find volumes of parallelepipeds

For vectors **u**, **v**, and **w** in space, the dot product of **u** and $\mathbf{v} \times \mathbf{w}$ is called the ____________________________ of **u**, **v**, and **w**, and is found as

$$\mathbf{u} \bullet (\mathbf{v} \times \mathbf{w}) = \left| \quad \quad \quad \right|$$

The volume V of a parallelepiped with vectors **u**, **v**, and **w** as adjacent edges is _________________________.

Example 2: Find the volume of the parallelepiped having $\mathbf{u} = 2\mathbf{i} + \mathbf{j} - 3\mathbf{k}$, $\mathbf{v} = \mathbf{i} - 2\mathbf{j} + 3\mathbf{k}$, and $\mathbf{w} = 4\mathbf{i} - 3\mathbf{k}$ as adjacent edges.

> **Homework Assignment**
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