

Section 3.4 Vectors and Dot Products

Objective: In this lesson you learned how to find the dot product of two vectors and find the angle between two vectors.

Course Number

Instructor

Date

Important Vocabulary Define each term or concept.

Angle between two nonzero vectors

Orthogonal

I. The Dot Product of Two Vectors (Pages 292–293)

The **dot product** of $\mathbf{u} = \langle u_1, u_2 \rangle$ and $\mathbf{v} = \langle v_1, v_2 \rangle$ is _____ . This product yields a _____ .

Let \mathbf{u} , \mathbf{v} , and \mathbf{w} be vectors in the plane or in space and let c be a scalar. Complete the following properties of the dot product:

- $\mathbf{u} \bullet \mathbf{v} =$ _____
- $\mathbf{0} \bullet \mathbf{v} =$ _____
- $\mathbf{u} \bullet (\mathbf{v} + \mathbf{w}) =$ _____
- $\mathbf{v} \bullet \mathbf{v} =$ _____
- $c(\mathbf{u} \bullet \mathbf{v}) =$ _____ = _____

Example 1: Find the dot product: $\langle 5, -4 \rangle \bullet \langle 9, -2 \rangle$.

What you should learn

How to find the dot product of two vectors and use the Properties of the Dot Product

II. The Angle Between Two Vectors (Pages 293–295)

If \mathbf{q} is the angle between two nonzero vectors \mathbf{u} and \mathbf{v} , then \mathbf{q} can be determined from _____ .

Example 2: Find the angle between $\mathbf{v} = \langle 5, -4 \rangle$ and $\mathbf{w} = \langle 9, -2 \rangle$.

What you should learn

How to find the angle between two vectors and how to determine whether two vectors are orthogonal

An alternative way to calculate the dot product between two vectors \mathbf{u} and \mathbf{v} , given the angle θ between them, is

_____.

Two vectors \mathbf{u} and \mathbf{v} are orthogonal if _____.

Example 3: Are the vectors $\mathbf{u} = \langle 1, -4 \rangle$ and $\mathbf{v} = \langle 6, 2 \rangle$ orthogonal?

III. Finding Vector Components (Pages 295–296)

Let \mathbf{u} and \mathbf{v} be nonzero vectors such that $\mathbf{u} = \mathbf{w}_1 + \mathbf{w}_2$, where \mathbf{w}_1 and \mathbf{w}_2 are orthogonal and \mathbf{w}_1 is parallel to (or a scalar multiple of) \mathbf{v} . The vectors \mathbf{w}_1 and \mathbf{w}_2 are called _____.

_____ . The vector \mathbf{w}_1 is the **projection** of \mathbf{u} onto \mathbf{v} and is denoted by _____ . The vector \mathbf{w}_2 is given by

_____ .

Let \mathbf{u} and \mathbf{v} be nonzero vectors. The projection of \mathbf{u} onto \mathbf{v} is given by $\text{proj}_{\mathbf{v}} \mathbf{u} =$ _____ .

What you should learn

How to write a vector as the sum of two vector components

IV. Work (Page 297)

The **work** W done by a constant force \mathbf{F} as its point of application moves along the vector \overrightarrow{PQ} is given by either of the following:

- 1.
- 2.

What you should learn

How to use vectors to find the work done by a force

Homework Assignment

Page(s)

Exercises