Let V Be The Vector From Initial Point P To Terminal Point P2. Write V In Terms Of I And J.P = (-5,3),

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Understanding Vectors and Their Components

Vectors are fundamental entities in mathematics and physics, representing quantities that have both magnitude and direction. In the coordinate plane, vectors are often expressed in terms of their components along the x-axis and y-axis, typically using the unit vectors i and j. Understanding how to represent a vector in terms of i and j is crucial for solving many problems related to vector addition, subtraction, and scalar multiplication.

In this article, we will explore how to write the vector V that originates from an initial point P and terminates at point P2, with specific emphasis on expressing V in terms of the unit vectors i and j. We will work through a detailed example with the initial point P = (-5, 3), and guide you step-by-step on how to find the vector V in component form.

Defining the Vector V in the Coordinate Plane

What is a Vector From P to P2?

Given two points in the coordinate plane:

- Initial point $P(x_1, y_1)$
- Terminal point $P_2(x_2, y_2)$

The vector V from P to P_2 is defined as:

$$
\vec{V} = \text{P}_2 - \text{P}
$$

which involves subtracting the coordinates of P from those of P_2:

$$
\vec{V} = (x_2 - x_1, y_2 - y_1)
$$

This vector points from P towards P_2, and its components describe the change in the x and y directions.

Expressing V in Terms of I and J

In Cartesian coordinates, the unit vectors i and j are used to denote directions along the x- and y-axes, respectively:

- i = (1, 0)
- j = (0, 1)

Any vector in the plane can be expressed as a linear combination of these unit vectors:

$$
\vec{V} = V_x \, \mathbf{i} + V_y \, \mathbf{j}
$$

where:

- V_x is the x-component of the vector
- V_y is the y-component of the vector

Expressing V in terms of i and j allows for straightforward visualization and computation, especially when performing vector operations.

Given Data and Objective

In our specific scenario, the initial point P is given as:

$$
P = (-5, 3)
$$

The terminal point P_2 is not directly provided, but the problem focuses on expressing the vector V from P to P_2 in terms of i and j once P_2 is known.

For the purposes of this example, let's assume P_2 is at an arbitrary point (x_2, y_2); the method remains the same regardless of the specific terminal point chosen.

Step-by-Step Guide to Write V in Terms of I and J

Step 1: Identify the Coordinates of P and P_2

- Initial point P: $(-5, 3)$
- Terminal point P_2: (x_2, y_2) (unknown or given)

Step 2: Calculate the Components of V

The vector V from P to P_2 is:

$$
\vec{V} = (x_2 - (-5), y_2 - 3) = (x_2 + 5, y_2 - 3)
$$

This gives the change in the x- and y-components.

Step 3: Express V in Terms of I and J

Using the components:

$$
\vec{V} = (x_2 + 5) \, \mathbf{i} + (y_2 - 3) \, \mathbf{j}
$$

where:

- $(x_2 + 5)$ is the coefficient for i
- $(y_2 - 3)$ is the coefficient for j

This is the general form of the vector in terms of i and j.

Example: Specific Terminal Point P_2

To make this more concrete, let's assume a specific terminal point P_2, for example:

$$
P_2 = (2, 7)
$$

Now, compute V:

$$
V_x = 2 - (-5) = 2 + 5 = 7
$$
$$
V_y = 7 - 3 = 4
$$

Expressed in i and j:

$$
\vec{V} = 7 \, \mathbf{i} + 4 \, \mathbf{j}
$$

This vector indicates a movement of 7 units along the x-axis and 4 units along the y-axis from point P to P_2.

General Formula for Vectors From Any Point P to P_2

If the initial point $P(x_1, y_1)$ and terminal point $P_2(x_2, y_2)$ are known, then:

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$$
\vec{V} = (x_2 - x_1) \, \mathbf{i} + (y_2 - y_1) \, \mathbf{j}
$$

This formula provides a direct way to write the vector in component form, which is essential in many applications such as physics, engineering, and computer graphics.

Applications of Vector Representation in Real Life

Understanding how to express vectors in terms of i and j is fundamental in various fields. Here are some common applications:

- Physics: Calculating displacement, velocity, and force vectors.
- Engineering: Analyzing forces acting on structures.
- Computer Graphics: Moving objects along specified directions.
- Navigation: Determining the shortest path between two points.

Summary and Key Takeaways

- The vector V from an initial point $P(x_1, y_1)$ to a terminal point $P_2(x_2, y_2)$ is given by:

$$
\vec{V} = (x_2 - x_1) \, \mathbf{i} + (y_2 - y_1) \, \mathbf{j}
$$

- When P is (-5, 3), the vector components depend on the coordinates of P_2.
- Expressing vectors in terms of i and j simplifies calculations and visualizations.
- The method applies universally, regardless of the specific points involved.

Conclusion

Mastering how to write vectors in terms of i and j starting from given points is a foundational skill in vector mathematics. Whether working on physics problems, computer graphics, or navigation, this approach provides clarity and efficiency. Remember to always identify the coordinates of your initial and terminal points, subtract accordingly to find the components, and then express your vector in the standard form:

$$
\vec{V} = V_x \, \mathbf{i} + V_y \, \mathbf{j}
$$

By practicing with different points and scenarios, you'll develop confidence in manipulating and applying vectors to a wide range of problems.

Keywords: vectors, coordinate plane, initial point, terminal point, components, unit vectors, i, j, vector

Frequently Asked Questions

What is the vector V in terms of i and j if P = (-5, 3) and P2 is a point with coordinates (x2, y2)?

The vector V is given by V = (x2 - (-5))i + (y2 - 3)j = (x2 + 5)i + (y2 - 3)j.

How do you find the vector V from point P = (-5, 3) to a point P2 = (x2, y2)?

Subtract the coordinates of P from P2: V = (x2 - (-5))i + (y2 - 3)j = (x2 + 5)i + (y2 - 3)j.

If the terminal point P2 is at (2, -1), what is the vector V in component form?

V = (2 - (-5))i + (-1 - 3)j = (7)i + (-4)j, so V = 7i - 4j.

What does the vector V represent in the context of points P and P2?

V represents the directed displacement from the initial point P to the terminal point P2.

How can you express the vector V in terms of the components of P2, given P = (-5, 3)?

V = (x2 + 5)i + (y2 - 3)j, where (x2, y2) are the coordinates of P2.

If P2 is at (0, 0), what is the vector V from P = (-5, 3)?

V = (0 - (-5))i + (0 - 3)j = 5i - 3j.

Why is it important to write the vector V in terms of i and j?

Writing V in terms of i and j provides a clear component form that describes the vector's magnitude and direction in the coordinate plane.

Can the vector V be expressed without knowing P2? Why or why not?

No, because the components of V depend on the specific coordinates of P2; without P2, the vector cannot be fully determined.

How does the initial point P = (-5, 3) influence the components of the vector V?

The initial point P determines the subtraction operation when calculating V; it shifts the vector components relative to P's coordinates.

Additional Resources

Let V Be The Vector From Initial Point P To Terminal Point P2. Write V In Terms Of I And J. P = (-5, 3)

Introduction

Vectors are fundamental entities in mathematics and physics, encapsulating both magnitude and direction. They serve as essential tools for describing motion, forces, and various spatial relationships. In the realm of coordinate geometry, representing vectors in terms of the unit vectors i and j is a standard and powerful approach, allowing for clear and precise computations.

This article explores the process of deriving a vector V from an initial point P to a terminal point P_2, with a specific focus on expressing V in terms of the unit vectors i and j. Using the given initial point P = (-5, 3), we will delve into the fundamental principles, step-by-step calculations, and broader implications of vector representation in Cartesian coordinates.

Understanding the Fundamentals of Vectors in the Cartesian Plane

What Is a Vector?

In two-dimensional space, a vector is a directed line segment characterized by its magnitude and direction. It is typically represented as:

- A pair of components corresponding to its displacement along the x-axis (horizontal direction) and y-axis (vertical direction).
- An expression involving i and j, where:

- i is the unit vector in the x-direction (1, 0)
- j is the unit vector in the y-direction (0, 1)

The Role of Unit Vectors

Expressing vectors in terms of i and j provides a standardized form:

$$
\vec{V} = V_x \mathbf{i} + V_y \mathbf{j}
$$

where:

- V_x is the x-component (horizontal displacement)
- V_y is the y-component (vertical displacement)

This form allows for straightforward addition, subtraction, and scalar multiplication of vectors, making it integral to vector calculus and physics.

The Problem Context: From Point P to P_2

Given:

- Initial point $P = (-5, 3)$
- Terminal point $P_2 = (x_2, y_2)$ (unknown)

Our goal:

- To determine the vector $\vec{V}$ from P to P_2.
- To express $\vec{V}$ explicitly in terms of i and j.

Step-by-Step Derivation of the Vector $\vec{V}$

1. Understanding the Vector from P to P_2

The vector $\vec{V}$ that originates at P and terminates at P_2 is given by:

$$
\vec{V} = \overrightarrow{PP_2} = (x_2 - x_1, y_2 - y_1)
$$

where:

- (x_1, y_1) are the coordinates of P
- (x_2, y_2) are the coordinates of P_2

Given $P = (-5, 3)$, this simplifies to:

$$
\vec{V} = (x_2 + 5, y_2 - 3)
$$

Note: The subtraction reflects the displacement from P to P_2.

2. Expressing $\vec{V}$ in Terms of $\mathbf{i}$ and $\mathbf{j}$

Using the general form:

$$
\vec{V} = (x_2 + 5) \mathbf{i} + (y_2 - 3) \mathbf{j}
$$

This expression explicitly shows how the vector components relate to the coordinates of the terminal point.

Specific Cases and Additional Constraints

In many practical scenarios, the terminal point P_2 may be known, or additional information such as the magnitude or direction of $\vec{V}$ might be provided.

Case 1: Known P_2

Suppose $P_2 = (x_2, y_2)$ is known, then:

$$
\vec{V} = (x_2 + 5) \mathbf{i} + (y_2 - 3) \mathbf{j}
$$

which is a direct and explicit representation.

Case 2: Known magnitude and direction

If the magnitude $|\vec{V}|$ and the direction (angle θ) are known, then:

$$
\vec{V} = |\vec{V}| \cos \theta \, \mathbf{i} + |\vec{V}| \sin \theta \, \mathbf{j}
$$

and the terminal point coordinates can be derived accordingly.

Broader Implications and Applications

Vector Representation in Physics

Expressing vectors in terms of i and j underpins the analysis of physical phenomena such as projectile motion, forces, and velocity. For example, a velocity vector can be broken down into horizontal and vertical components, facilitating the calculation of resultant motion.

Engineering and Computer Graphics

In engineering design and computer graphics, vectors are used extensively to model movements, forces, and transformations. The ability to articulate a vector from any point to another in terms of unit vectors simplifies complex calculations and visualizations.

Navigation and Geospatial Analysis

In navigation, especially in GPS and GIS systems, representing displacement vectors in terms of components allows for precise calculations of routes, distances, and directions.

Extending the Analysis: Additional Vector Operations

Once a vector $\vec{V}$ is expressed in component form, various operations become accessible:

- Vector Addition and Subtraction: Combining multiple vectors to find resultant displacements.
- Scalar Multiplication: Scaling the vector to change its magnitude.
- Dot Product: Calculating angles between vectors or projecting one onto another.
- Cross Product (in 3D): Determining the area of parallelograms formed by vectors.

Practical Example: Computing a Specific $\vec{V}$

Suppose we are given that $P_2 = (2, 7)$. Then:

$$
\vec{V} = (2 + 5) \mathbf{i} + (7 - 3) \mathbf{j} = 7 \mathbf{i} + 4 \mathbf{j}
$$

This vector indicates a displacement of 7 units in the x-direction and 4 units in the y-direction from point P.

Significance of Expressing Vectors in Terms of $\mathbf{i}$ and $\mathbf{j}$

The ability to write vectors explicitly in terms of unit vectors:

- Provides clarity in geometric interpretations.
- Simplifies algebraic manipulations.
- Facilitates the use of vector calculus techniques.
- Enables seamless transition between geometric and algebraic perspectives.

Conclusion

Representing the vector V from an initial point $P = (-5, 3)$ to a terminal point P_2 in terms of i and j is a fundamental skill that bridges coordinate geometry and vector algebra. It underpins a wide array of applications across physics, engineering, navigation, and computer science.

By understanding how to derive $\vec{V}$ explicitly as:

$$
\vec{V} = (x_2 + 5) \mathbf{i} + (y_2 - 3) \mathbf{j}
$$

we gain a versatile tool for analyzing and solving real-world problems involving displacement, motion, and force analysis. Mastery of this concept enhances one's ability to translate geometric intuition into precise algebraic expressions, a cornerstone of mathematical literacy.

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Note: For specific calculations involving P_2, substitute the known coordinates into the component form to obtain the vector $\vec{V}$.

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