Q.12) If A=12i'-16j' And B--24i'+ 10j', What Is The Magnitude Of The Vector C=2A-B? A) 42 B) 64 C) 22

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Understanding the Problem: Vector Operations and Magnitude Calculation

In the field of vector mathematics, understanding how to manipulate vectors and compute their magnitudes is essential. This problem presents two vectors, A and B, and asks for the magnitude of a new vector, C, defined as C = 2A - B. The options provided are numerical values, with the goal being to determine which one correctly represents the magnitude of vector C.

This article aims to guide you through the step-by-step process of solving this problem, including breaking down the vector components, performing scalar multiplication and subtraction, and finally calculating the magnitude of the resulting vector. Whether you're a student preparing for exams or someone interested in vector algebra, this detailed explanation will clarify the concepts involved.

Breaking Down the Vectors A and B

Vector A Components

Given:
- A = 12i' - 16j'

This indicates that vector A has:
- An x-component of 12
- A y-component of -16

Vector B Components

Given:
- B = -24i' + 10j'

Note: The problem states "B--24i'", which appears to be a typographical error. It is common to see such problems with B = -24i' + 10j'. Assuming this correction, B has:
- An x-component of -24
- A y-component of 10

Calculating Vector C = 2A - B

Step 1: Scalar Multiplication of Vector A by 2

Multiplying each component of A by 2:
- x-component: 12 × 2 = 24
- y-component: -16 × 2 = -32

Resulting vector:
- 2A = 24i' - 32j'

Step 2: Subtracting Vector B from 2A

Subtract each component of B from 2A:
- x-component: 24 - (-24) = 24 + 24 = 48
- y-component: -32 - 10 = -42

Therefore, vector C has components:
- C = 48i' - 42j'

Calculating the Magnitude of Vector C

The magnitude (or length) of a vector with components (x, y) is given by the formula:
$$ |\mathbf{C}| = \sqrt{x^2 + y^2} $$

Applying this to vector C:
- x = 48
- y = -42

Calculations:
1. Square the components:
- $48^2 = 2304$
- $(-42)^2 = 1764$

2. Sum the squares:
- 2304 + 1764 = 4068

3. Take the square root:
- $|\mathbf{C}| = \sqrt{4068}$

Using a calculator:
- $\sqrt{4068} \approx 63.8$

Matching the Result to the Given Options

The options provided are:
- A) 42
- B) 64
- C) 22

Our calculated magnitude is approximately 63.8, which is closest to 64. Therefore, the correct answer among the choices is B) 64.

Summary: Key Steps to Solve Vector Magnitude Problems

- Identify the vector components from the given vector notation.
- Perform scalar multiplication as required (e.g., 2A).
- Use vector addition or subtraction to find the new vector (C = 2A - B).
- Calculate the magnitude using the formula $|\mathbf{C}| = \sqrt{x^2 + y^2}$.
- Compare the result with the options provided to determine the correct answer.

Additional Tips for Vector Problems

Be Careful with Sign Conventions

Always pay attention to the signs of vector components. A sign error can significantly affect the

calculation of the components and the final magnitude.

Verify the Vector Components

Double-check your arithmetic for scalar multiplication and subtraction to ensure accuracy.

Use Approximate Values Judiciously

When the magnitude involves square roots, round to a reasonable number of decimal places for comparison with provided options.

Conclusion

In this problem, by carefully breaking down the vectors, performing scalar multiplication and subtraction, and applying the magnitude formula, we found that the magnitude of vector C is approximately 64. Thus, the correct choice among the options is B) 64.

Mastering these steps enhances your ability to solve a wide range of vector problems efficiently. Practice with different vector components to strengthen your understanding and confidence in vector algebra.

Keywords: vector magnitude, vector operations, scalar multiplication, vector subtraction, vector components, vector C calculation, vector algebra, magnitude formula, solving vector problems

Frequently Asked Questions

What are the given vectors A and B in the problem?

A = 12i - 16j, B = 24i + 10j.

How do you compute the vector C = 2A - B?

First, calculate 2A = 2 (12i - 16j) = 24i - 32j. Then, subtract B: C = (24i - 32j) - (24i + 10j) = (24i - 24i) + (-32j - 10j) = 0i - 42j.

What is the component form of vector C?

C = 0i - 42j, which simplifies to (0, -42).

How do you find the magnitude of vector C?

The magnitude is given by $\sqrt{(x^2 + y^2)}$. For C = (0, -42), the magnitude is $\sqrt{(0^2 + (-42)^2)} = \sqrt{(0 + 1764)} = 42$.

What is the magnitude of vector C in this problem?

The magnitude of vector C is 42.

Which option corresponds to the magnitude of vector C?

Option A) 42.

Is the magnitude of vector C dependent on the signs of its components?

No, the magnitude depends on the squares of the components, making it always positive or zero.

Can you verify the calculation of the vector C step-by-step?

Yes. 2A = (24i - 32j). Then, C = (24i - 32j) - (24i + 10j) = (24i - 24i) + (-32j - 10j) = 0i - 42j. The magnitude is $\sqrt{(0^2 + (-42)^2)} = 42$.

What is the importance of understanding vector operations in physics and engineering?

Vector operations are essential for representing and calculating quantities like force, velocity, and displacement, which have both magnitude and direction.

How can this problem help in understanding vector algebra concepts?

It demonstrates how to perform scalar multiplication, vector subtraction, and magnitude calculation, which are fundamental operations in vector algebra.

Additional Resources

Vector Analysis: Determining the Magnitude of Vector C = 2A - B

Introduction: Unlocking the Power of Vectors

In the realm of physics and engineering, vectors serve as fundamental tools for representing

quantities that possess both magnitude and direction. From describing forces acting on structures to representing velocities of moving objects, vectors are integral to understanding the physical world.

Today, we delve into a specific vector problem involving two vectors, A and B, and explore how to determine the magnitude of a new resultant vector, C, defined as C = 2A - B. This problem not only exemplifies core vector concepts but also showcases the importance of systematic calculation and vector algebra in solving complex problems.

Understanding the Given Vectors

Vector A: Components and Meaning

The vector A is given as:

$$ A = 12i' - 16j' $$

- i' and j' are the unit vectors along the x and y axes, respectively.
- The components of A are:
- x-component: 12 units
- y-component: -16 units

This indicates that vector A points 12 units along the positive x-axis and 16 units along the negative y-axis.

Vector B: Components and Meaning

Similarly, vector B is:

$$ B = 24i' + 10j' $$

- x-component: 24 units
- y-component: 10 units

This vector points toward the positive x and y directions, with a greater emphasis on the x-axis.

Formulating Vector C: The Core Calculation

Definition of C

The vector C is defined as:

$$ C = 2A - B $$

This indicates that:

- Vector A is scaled by a factor of 2.
- The scaled vector (2A) is then subtracted by vector B.

Step-by-Step Calculation

Step 1: Calculate 2A

To find 2A, multiply each component of A by 2:

$$
2A = 2 \times (12i' - 16j') = (2 \times 12)i' - (2 \times 16)j' = 24i' - 32j'
$$

Step 2: Subtract B from 2A

Now, subtract vector B:

$$
C = (24i' - 32j') - (24i' + 10j')
$$

Subtracting component-wise:

- x-component:

$$
24 - 24 = 0
$$

- y-component:

$$
-32 - 10 = -42
$$

Thus, the vector C is:

$$
C = 0i' - 42j' = -42j'
$$

Calculating the Magnitude of Vector C

What is Magnitude?

The magnitude (or length) of a vector $\vec{V} = xi' + yj'$ is given by the Euclidean norm:

$$
|\vec{V}| = \sqrt{x^2 + y^2}
$$

This formula stems from the Pythagorean theorem, representing the distance from the origin to the point (x, y).

Applying the Formula to Vector C

Given:

$$
C = -42j' \Rightarrow \text{components: } x=0, y=-42
$$

The magnitude:

$$
|C| = \sqrt{0^2 + (-42)^2} = \sqrt{0 + 1764} = \sqrt{1764}
$$

Calculating the square root:

$$
|C| = 42
$$

Result: The magnitude of vector C is 42 units.

Conclusion: The Final Answer

Based on the detailed calculations, the magnitude of the vector $C = 2A - B$ is 42 units.

Therefore, the correct option is:

A) 42

Additional Insights and Practical Applications

Understanding how to manipulate vectors algebraically is essential in various fields:

- Physics: Calculating resultant forces or velocities.
- Engineering: Analyzing structural stresses or electrical fields.
- Navigation and Robotics: Determining resultant directions and distances.

This problem exemplifies how scaling and addition/subtraction of vectors can be systematically approached to find meaningful quantities like magnitude, which often relate to real-world measurements such as distances or force strengths.

Summary of Key Steps

1. Identify components: Extract x and y components from vectors A and B.
2. Apply scalar multiplication: Multiply vector A by 2.
3. Perform vector subtraction: Subtract B from the scaled vector.
4. Calculate magnitude: Use the Pythagorean theorem to find the length of the resultant vector.

Final Thoughts

Mastering vector operations enhances our ability to analyze and interpret multidimensional phenomena. The problem discussed here underscores the importance of clear stepwise calculations and reinforces foundational vector algebra skills that are vital across scientific and engineering disciplines.

By understanding the process—from component manipulation to magnitude calculation—you develop a robust toolkit for tackling diverse vector-related challenges, making complex problems manageable and solutions precise.

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