

Workbook



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Vectors

Basic Definitions and Operations

Questions

1) Adding and Subtracting Vectors.

We are given three vectors: $\vec{A} = (1, 3)$, $\vec{B} = (4, 2)$, $\vec{C} = (3, 5)$.

- Calculate: $\vec{A} + \vec{B} + \vec{C}$.
- Calculate: $\vec{A} - \vec{B} - \vec{C}$.
- Calculate: $2\vec{A} + 3\vec{B} - 4\vec{C}$.

Vector Multiplication in Three Dimensions

Questions

2) Calculating Size and Angles of Vectors

We are Given two vectors: $\vec{A} : (1, 5, 10)$, $\vec{B} : (3, 4, 5)$.

- What is the size of each vector?
- What is the angle between them?

3) Sum is Perpendicular to Difference

Prove that if the sum of two vectors is perpendicular to their difference, then their lengths are equal.

4) Perpendicular Vector

We are given two vectors: $\vec{A} : (1, 4, 8)$, $\vec{B} : (B_x, B_y, 0)$.

Find the components of vector \vec{B} , if we are told it's perpendicular to \vec{A} , and that its length is 10.

5) Net Force and Angles

Two forces are acting on a body. $\vec{A} : (1, 4, 5)$, $\vec{B} : (3, 6, 7)$.

- What is the net force?
- What is the size of the net force?
- What is the angle between the net force and each of the axis?

Vector Multiplication in Three Dimensions

Questions

6) Vector Multiplication.

The following vectors are given: $\vec{A} = (1, 2)$, $\vec{B} = (1, -3)$, $\vec{C} = (-1, 2, -2)$, $\vec{D} = (2, 0, 1)$.

- a. Calculate: $\vec{A} \cdot \vec{B}$.
- b. Calculate: $\vec{A} \times \vec{B}$.
- c. Calculate: $\vec{C} \times \vec{D}$.

Answer Key

- 1) a. $\vec{D} = (8, 10)$ b. $\vec{E} = (-6, -4)$ c. $\vec{F} = (2, -8)$
- 2) a. $|A| = \sqrt{126}$, $|B| = \sqrt{50}$ b. $\theta = 23^\circ$
- 3) Solution in the recording.
- 4) $\vec{B} = \left(-4\sqrt{\frac{100}{17}}, \sqrt{\frac{100}{17}}, 0 \right)$
- 5) a. $\vec{C} = \vec{A} + \vec{B} = (4, 10, 12)$ b. $|C| = \sqrt{260}$
 c. $\cos \alpha = \frac{\vec{A} \cdot \vec{B}}{|A||B|}$, $\alpha_x = 75.63$, $\alpha_y = 51.67$, $\alpha_z = 41.9$
- 6) a. -5 b. -5 c. $\sqrt{45}$