

Physics 1



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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. $\sqrt{45}$