

# Workbook



## Table of Contents

Vectors .....	2
Basic Definitions and Operations.....	2
Vector Multiplication in Three Dimensions .....	2
Vector Multiplication in Three Dimensions .....	3



# 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.  $\sqrt{45}$