

Vector Algebra — Assignment 2

Class 12 Maths · Higher-difficulty challenge set + integrated problems · Answer key included · Narayan Gurukul Academy

Instructions: (1) Attempt all questions; start with the topic-wise challenge set, then attempt the integrated (multi-topic) problems.
 (2) Give all answers with correct SI units. $g = 10 \text{ m/s}^2$ unless stated.
 (3) A final answer key is provided at the end — try the full set before checking it.

Part A — Topic-wise challenge questions

Vectors and Components

1. Find the magnitude of $2\hat{i} + 3\hat{j} + 6\hat{k}$.
2. Find a unit vector in the direction of $\hat{i} + \hat{j} + \hat{k}$.
3. Find a vector of magnitude 6 in the direction of $2\hat{i} - \hat{j} + 2\hat{k}$.

Dot (Scalar) Product

1. Find $a \cdot b$ if $a = \hat{i} + 2\hat{j}$ and $b = 2\hat{i} + \hat{j}$.
2. Find the angle between $\hat{i} + \hat{j}$ and $\hat{i} - \hat{j}$.
3. Find the projection of $a = 2\hat{i} + 3\hat{j}$ on $b = \hat{i} + \hat{j}$.

Cross (Vector) Product

1. Find $a \times b$ if $a = \hat{i} + \hat{j}$ and $b = \hat{j} + \hat{k}$.
2. Find the area of the parallelogram with adjacent sides $\hat{i}$ and $\hat{j}$.
3. Find the area of the triangle with vertices $A(1, 1, 1)$, $B(1, 2, 3)$ and $C(2, 3, 1)$.

Collinearity and Coplanarity

1. Show that the points $(1, 1)$, $(2, 2)$, $(3, 3)$ are collinear using vectors.
2. Find $[a, b, c]$ if $a = \hat{i}$, $b = \hat{j}$, $c = \hat{k}$.
3. Show that the vectors $a = \hat{i} + \hat{j}$, $b = \hat{j} + \hat{k}$, $c = \hat{k} + \hat{i}$ are coplanar or not.

Part B — Integrated problems (multi-topic)

1. Find the magnitude of $2\hat{i} + 3\hat{j} + 6\hat{k}$.
2. Find the angle between $\hat{i} + \hat{j}$ and $\hat{i} - \hat{j}$.
3. Find the area of the parallelogram with adjacent sides $\hat{i}$ and $\hat{j}$.
4. Find the scalar triple product of $\hat{i}, \hat{j}, \hat{k}$.
5. Find a unit vector in the direction of $3\hat{i} + 4\hat{j}$.

Answer Key

Vectors and Components

7. $(\hat{i} + \hat{j} + \hat{k})/\sqrt{3}$. $6(2\hat{i} - \hat{j} + 2\hat{k})/3 = 2(2\hat{i} - \hat{j} + 2\hat{k})$.

Dot (Scalar) Product

$a \cdot b = 4$. Angle = 90° . Projection = $5/\sqrt{2}$.

Cross (Vector) Product

$a \times b = \hat{i} - \hat{j} + \hat{k}$. Area = 1. Area = $\frac{1}{2}|AB \times AC| = \sqrt{6}/2$.

Collinearity and Coplanarity

$AB \times AC = 0$ collinear. $[a, b, c] = 1$. Not coplanar: $[a, b, c] = 2 \neq 0$.

Integrated problems

1: 7. 2: 90° . 3: 1. 4: 1. 5: $(3\hat{i} + 4\hat{j})/5$.