Class 12 Maths Chapter 10: Vector Algebra - Notes, Important Questions and MCQs (2026-27)

Free PDF notes from Nextoper.in | Session 2026-27 | Read online:
https://nextoper.in/class-12-maths-chapter-10-pdf-notes/

These Class 12 Maths Chapter 10 notes cover “Vector Algebra” from the NCERT Mathematics Part II textbook (2026-27): vectors and scalars, types of vectors, direction cosines, addition and scalar multiplication, components, section formula, scalar (dot) product with projection, and vector (cross) product with areas – with comparison tables, solved examples, Q&A, 10 MCQs and a free PDF.

Use the table of contents below to jump to the part you need, or read top to bottom for a complete revision of the chapter.

Table of Contents

- Chapter Overview
- Important Topics and Concepts
- Dot vs Cross Product
- Types of Vectors
- Important Definitions and Terms
- Short Answer Questions
- Long Answer Questions
- MCQs with Answers
- Quick Revision Points
- Chapter Summary
- Exam Tips and PYQ Pattern
- Frequently Asked Questions
- Conclusion

Want notes for every chapter? Explore the full Class 12 Maths notes on Nextoper, arranged book-wise and chapter-wise.

Chapter Overview

A vector is a quantity with both magnitude and direction, represented by a directed line segment. A scalar has only magnitude. In three dimensions, a vector is written $\mathbf{a} = a_1\hat{i} + a_2\hat{j} + a_3\hat{k}$ with magnitude $|\mathbf{a}| = \sqrt{(a_1^2 + a_2^2 + a_3^2)}$.

Vectors can be added (triangle and parallelogram laws), multiplied by scalars, and multiplied with each other in two ways – the scalar product $\mathbf{a}\cdot\mathbf{b}$ (a number) and the vector product $\mathbf{a} \times \mathbf{b}$ (a vector perpendicular to both).

Important Topics and Concepts

Basic Concepts and Types

- Position vector of P(x, y, z): OP = $x\hat{i} + y\hat{j} + z\hat{k}$.
- Direction cosines l, m, n = cos α, cos β, cos γ with $l^2 + m^2 + n^2 = 1$.
- Direction ratios: numbers proportional to l, m, n.
- Types: zero, unit, co-initial, collinear, equal, negative vectors.
- Unit vector $\hat{a} = a/|a|$.

Addition and Scalar Multiplication

- Triangle law: AB + BC = AC.
- Parallelogram law: diagonal gives the sum.
- Properties: commutative and associative.
- λa has magnitude $|\lambda||a|$; same direction if $\lambda > 0$.
- Vector joining $P_1(x_1, y_1, z_1)$ to P_2: $(x_2 - x_1)\hat{i} + (y_2 - y_1)\hat{j} + (z_2 - z_1)\hat{k}$.

Section Formula

- Internal division in m : n: $r = (mb + na)/(m + n)$.
- External division: $r = (mb - na)/(m - n)$.
- Midpoint: $(a + b)/2$.

Scalar (Dot) Product

- $a \cdot b = |a||b| \cos \theta$.
- $a \cdot b = a_1b_1 + a_2b_2 + a_3b_3$.
- $a \cdot b = 0 \Leftrightarrow a \perp b$ (non-zero vectors).
- $\hat{i} \cdot \hat{i} = \hat{j} \cdot \hat{j} = \hat{k} \cdot \hat{k} = 1$; $\hat{i} \cdot \hat{j} = 0$.
- Projection of a on b = $(a \cdot b)/|b|$.
- $\cos \theta = (a \cdot b)/(|a||b|)$.

Vector (Cross) Product

- $a \times b = |a||b| \sin \theta \, \hat{n}$, $\hat{n}$ perpendicular to both (right-hand rule).
- $a \times b$ = determinant $|\hat{i}\ \hat{j}\ \hat{k};\ a_1\ a_2\ a_3;\ b_1\ b_2\ b_3|$.
- $a \times b = -(b \times a)$; $a \times b = 0 \Leftrightarrow a \parallel b$.
- $\hat{i} \times \hat{j} = \hat{k}$, $\hat{j} \times \hat{k} = \hat{i}$, $\hat{k} \times \hat{i} = \hat{j}$.
- Area of parallelogram = $|a \times b|$; area of triangle = $\frac{1}{2}|a \times b|$.

Dot vs Cross Product

Comparison.

Basis	Dot product	Cross product
Result	Scalar	Vector
Formula	$\|a\|\|b\| \cos \theta$	$\|a\|\|b\| \sin \theta \, \hat{n}$
Commutative	Yes	No (anti-commutative)
Zero when	Perpendicular	Parallel
Use	Angle, projection	Area, normal vector

Types of Vectors

Type	Meaning
Zero vector	Magnitude 0, no fixed direction
Unit vector	Magnitude 1
Co-initial	Same initial point
Collinear	Parallel to same line
Equal	Same magnitude and direction
Negative	Same magnitude, opposite direction

Important Definitions and Terms

Term	Meaning
Vector	Quantity with magnitude and direction
Scalar	Quantity with magnitude only
Position vector	Vector from origin to a point
Unit vector	Vector of magnitude 1
Direction cosines	Cosines of angles with axes
Direction ratios	Numbers proportional to DCs
Collinear vectors	Parallel vectors
Scalar product	$a \cdot b = \|a\|\|b\| \cos \theta$
Vector product	$a \times b = \|a\|\|b\| \sin \theta \hat{n}$
Projection	Component of a along b

Short Answer Questions

Q1. Find $|2\hat{i} + 3\hat{j} + 6\hat{k}|$.

$\sqrt{(4 + 9 + 36)} = 7$.

Q2. What is the unit vector along a?

$a/|a|$.

Q3. When is $a \cdot b = 0$?

When a and b are perpendicular (non-zero vectors).

Q4. What is $\hat{i} \times \hat{j}$?

$\hat{k}$.

Q5. Write the projection of a on b.

$(a \cdot b)/|b|$.

Q6. What is $l^2 + m^2 + n^2$?

1.

½|a × b|.

Q8. When is a × b = 0?

When a and b are parallel (or one is zero).

Long Answer Questions

Q1. Find the angle between a = î + ĵ – k̂ and b = î – ĵ + k̂.

a·b = 1 – 1 – 1 = –1.

|a| = |b| = √3.

cos θ = –1/3.

θ = cos⁻¹(–1/3).

Use dot product formula.

Q2. Find the area of a parallelogram with adjacent sides a = 3î + ĵ + 4k̂ and b = î – ĵ + k̂.

a × b = |î ĵ k̂; 3 1 4; 1 –1 1|.

= î(1 + 4) – ĵ(3 – 4) + k̂(–3 – 1).

= 5î + ĵ – 4k̂.

|a × b| = √42.

Area = √42 sq units.

Q3. Find the position vector of the point dividing the join of A(a) and B(b) in ratio 2 : 1 internally.

Formula r = (mb + na)/(m + n).

m = 2, n = 1.

r = (2b + a)/3.

For externally: (2b – a)/1.

Substitute given vectors.

MCQs with Answers

1. |î + ĵ + k̂| =(a) 1 (b) √3 (c) 3 (d) √2Answer: (b) √3

2. a·b = 0 means(a) parallel (b) perpendicular (c) equal (d) collinearAnswer: (b) perpendicular

3. ĵ × k̂ =(a) î (b) –î (c) k̂ (d) 0Answer: (a) î

4. a × b =(a) b × a (b) –(b × a) (c) a·b (d) 0 alwaysAnswer: (b) –(b × a)

5. î·î =(a) 0 (b) 1 (c) î (d) –1Answer: (b) 1

6. Area of triangle with sides a, b(a) |a × b| (b) ½|a × b| (c) a·b (d) ½ a·bAnswer: (b) ½|a × b|

7. l² + m² + n² =(a) 0 (b) 1 (c) 2 (d) 3Answer: (b) 1

8. Projection of a on b(a) a·b (b) (a·b)/|a| (c) (a·b)/|b| (d) |a × b|Answer: (c) (a·b)/|b|

9. Dot product of perpendicular unit vectors(a) 1 (b) 0 (c) –1 (d) √2Answer: (b) 0

Quick Revision Points

- Vector vs scalar; position vector.
- DCs and DRs.
- Types of vectors.
- Section formula.
- Dot product: angle, projection.
- Cross product: area, perpendicularity.

Chapter Summary

Vectors have magnitude and direction and are written in component form $a_1\hat{i} + a_2\hat{j} + a_3\hat{k}$. Direction cosines satisfy $l^2 + m^2 + n^2 = 1$, and the section formula gives points dividing a segment in a given ratio.

The dot product $a \cdot b = |a||b| \cos\theta$ gives angles and projections and is zero for perpendicular vectors. The cross product $a \times b = |a||b| \sin\theta\, \hat{n}$ gives a perpendicular vector whose magnitude is the area of a parallelogram.

Exam Tips and PYQ Pattern

- Learn $\hat{i}$, $\hat{j}$, $\hat{k}$ product tables.
- Use determinant form for cross product.
- Check perpendicularity with dot product.
- Write units for areas.
- Practise projection questions.

Frequently Asked Questions

Is this chapter in the 2026-27 CBSE syllabus?

Yes. It is part of the NCERT Class 12 Mathematics Part II textbook, prescribed in the CBSE 2026-27 syllabus.

Can I download these notes as a PDF?

Yes. Use the free PDF link at the top of this page – no signup needed.

What is the difference between dot and cross product?

The dot product gives a scalar $|a||b| \cos\theta$; the cross product gives a vector of magnitude $|a||b| \sin\theta$ perpendicular to both.

How do you find the area of a triangle using vectors?

Area = $\frac{1}{2}|a \times b|$ where a and b are two adjacent sides.

Conclusion

Vector Algebra is formula-driven and scoring. Learn the tables and save the free PDF.

More Notes: Class 12 Maths Chapter 9: Differential Equations notes | Class 12 Maths Chapter 11: Three Dimensional Geometry notes | All Class 12 Maths notes

Author Bio: Written and reviewed by the Nextoper Editorial Team, a group of CBSE maths educators who build chapter notes directly from the NCERT textbook and past board paper patterns.

Freshness Note: These notes follow the NCERT Class 12 Maths textbook, Mathematics Part II (NCERT reprint 2026-27, rationalised syllabus), and the CBSE syllabus for the 2026-27 session. Last checked on 26 November 2026.