CHAPTER

Vectors

02

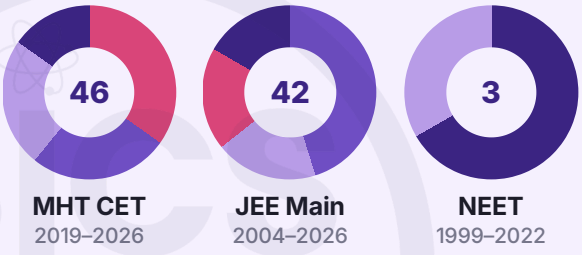
MHT CET · JEE · NEET Physics

PHYSICS CIRCLE

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EXAM WEIGHTAGE



	CET	JEE	NEET
Addition & Subtraction of Vectors	12 (26%)	19 (45%)	0 (0%)
Scalar (Dot) Product	16 (35%)	8 (19%)	0 (0%)
Vector Basics, Unit Vectors & Components	11 (24%)	8 (19%)	1 (33%)
Vector (Cross) Product	7 (15%)	7 (17%)	2 (67%)

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01 CONCEPT Vector Basics, Unit Vectors & Components

IN ONE LINE

A vector has a **size and a direction** and adds by the triangle law. Split it into $\hat{i}$, $\hat{j}$, $\hat{k}$ parts and every vector sum becomes simple algebra.

2.1.1 Scalars and vectors

- Scalar: magnitude only (mass, time, work, energy). Added like ordinary numbers.
- Vector: magnitude and direction, and it must obey the laws of vector addition (displacement, velocity, force, momentum, torque).
- Electric current has a direction but adds like a number, so it is a scalar.
- Pressure, stress, moment of inertia: neither a plain scalar nor a vector (tensors).

2.1.2 Types of vectors

Type	Meaning
Equal	same size, same direction
Parallel	same direction: $\mathbf{A} = n\mathbf{B}$, $n > 0$
Anti-parallel	opposite direction: $\mathbf{A} = n\mathbf{B}$, $n < 0$
Collinear	along the same line (parallel or anti-parallel)
Zero (null)	zero size, any direction
Coplanar	lie in one plane; any two vectors are coplanar
Polar	start from a point: displacement, force
Axial	along the axis of rotation: ω, torque, angular momentum

- Parallel vectors have equal ratios of components: $\frac{A_x}{B_x} = \frac{A_y}{B_y} = \frac{A_z}{B_z}$.
- Multiplying by −1 reverses the direction.

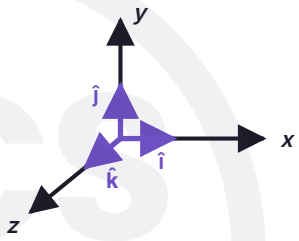
2.1.3 Unit vector

$$\hat{A} = \frac{\mathbf{A}}{|\mathbf{A}|}$$

$$\mathbf{A} = A\,\hat{A}$$

- A unit vector has size 1 and no unit: it only gives the direction.
- For a unit vector $a\,\hat{i} + b\,\hat{j} + c\,\hat{k}$: $a^2 + b^2 + c^2 = 1$.
- Unit vector along a sum: add first, then divide by the size of the sum.

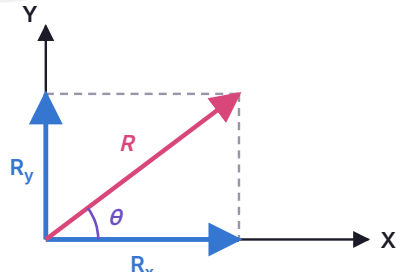
2.1.4 $\hat{i}, \hat{j}, \hat{k}$



Right-handed axes: curl the fingers from x to y, the thumb gives z

- $\hat{i}$, $\hat{j}$, $\hat{k}$ are unit vectors along x, y and z.
- They form a right-handed set.

2.1.5 Resolution into components



R split into R_x along X and R_y along Y

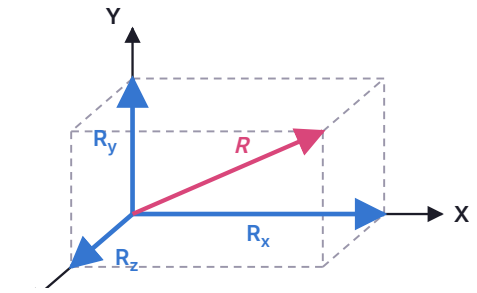
$$R_x = R\cos\theta,\ R_y = R\sin\theta$$

$$R = \sqrt{R_x^2 + R_y^2},\ \tan\theta = \frac{R_y}{R_x}$$

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- θ is measured from the x-axis. If the angle is given from the y-axis, the y-part takes the cosine.
- A component can never be bigger than the vector itself.
- Two vectors are added part by part: $(A_x + B_x)\,\hat{i} + (A_y + B_y)\,\hat{j}$.

2.1.6 Components in space



R is the diagonal of the box with edges R_x, R_y, R_z

$$\vec{R} = R_x\,\hat{i} + R_y\,\hat{j} + R_z\,\hat{k}$$

$$R = \sqrt{R_x^{\,2} + R_y^{\,2} + R_z^{\,2}}$$

2.1.7 Direction cosines

$$\cos\alpha = \frac{R_x}{R},\ \cos\beta = \frac{R_y}{R},\ \cos\gamma = \frac{R_z}{R}$$

$$\cos^2\alpha + \cos^2\beta + \cos^2\gamma = 1$$

- α, β, γ = angles with the x, y and z axes.
- $\hat{i} + \hat{j} + \hat{k}$ makes the same angle with all three axes: $\cos\alpha = \frac{1}{\sqrt{3}}$, $\alpha \approx 54.7°$.
- In a plane: $\cos^2\alpha + \cos^2\beta = 1$, so $\alpha + \beta = 90°$.

2.1.8 Position and displacement vectors

- Point P(x, y, z): position vector $\vec{r} = x\,\hat{i} + y\,\hat{j} + z\,\hat{k}$.
- From (x_1, y_1, z_1) to (x_2, y_2, z_2): displacement = $(x_2 - x_1)\,\hat{i} + (y_2 - y_1)\,\hat{j} + (z_2 - z_1)\,\hat{k}$.

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Solved Examples 01 Vector Basics, Unit Vectors & Components

SOLVED 1 MHT CET 2026 · 15 Apr · Shift 2

Let **A** and **B** be two non-zero vectors of different magnitude. Which one of the following is the correct equation?

(a) $\mathbf{A}\cdot\mathbf{B} = -\mathbf{B}\cdot\mathbf{A}$
(b) $\mathbf{A} \times \mathbf{B} = \mathbf{B} \times \mathbf{A}$
(c) $\mathbf{A} + \mathbf{B} = \mathbf{B} + \mathbf{A}$
(d) $\mathbf{A} - \mathbf{B} = \mathbf{B} - \mathbf{A}$

STEP 1 Vector addition is commutative
STEP 2 Dot product is commutative too, but not equal to its negative; cross product changes sign; subtraction is not commutative
STEP 3 Correct: $\mathbf{A} + \mathbf{B} = \mathbf{B} + \mathbf{A}$

Answer: **(c)**

SOLVED 2 MHT CET 2026 · 17 Apr · Shift 2

There are two vectors $\mathbf{A} = 6\hat{i} + 9\hat{j} - \hat{k}$ and $\mathbf{B} = 2\hat{i} + 3\hat{j} - p\hat{k}$ which have the same direction. The value of p is

(a) 3 (b) $\frac{1}{3}$
(c) $\frac{2}{3}$ (d) $-\frac{1}{3}$

STEP 1 Same direction $\Rightarrow \mathbf{A} = n\mathbf{B}$ with $n > 0$
STEP 2 $\frac{6}{2} = \frac{9}{3} = 3 \Rightarrow n = 3$
STEP 3 $-1 = 3(-p) \Rightarrow p = \frac{1}{3}$

Answer: **(b)**

SOLVED 3 MHT CET 2026 · 18 Apr · Shift 2

If a unit vector is represented by $\mathbf{U} = 0.9\hat{i} - 0.2\hat{j} + m\hat{k}$, then the value of m is

(a) 0.85 (b) $\sqrt{0.15}$
(c) 1 (d) $\sqrt{0.77}$

STEP 1 For a unit vector, $|U|^2 = 1$
STEP 2 $0.81 + 0.04 + m^2 = 1$
STEP 3 $m^2 = 0.15 \Rightarrow m = \sqrt{0.15}$

Answer: **(b)**

SOLVED 4 MHT CET 2026 · 15 Apr · Shift 1

A vector **A** when added to the sum of the vectors $(\hat{i} - 2\hat{j} + 2\hat{k})$ and $(-2\hat{i} + \hat{j} - \hat{k})$ gives a unit vector along the Y axis. The magnitude of vector **A** is

(a) $\sqrt{3}$ (b) $\sqrt{6}$
(c) $\sqrt{8}$ (d) $\sqrt{10}$

STEP 1 Sum of the two vectors $= -\hat{i} - \hat{j} + \hat{k}$
STEP 2 $\mathbf{A} + (-\hat{i} - \hat{j} + \hat{k}) = \hat{j} \Rightarrow \mathbf{A} = \hat{i} + 2\hat{j} - \hat{k}$
STEP 3 $|\mathbf{A}| = \sqrt{1 + 4 + 1} = \sqrt{6}$

Answer: **(b)**

SOLVED 5 JEE Main 2023 · 11 Apr · Shift 2

When vector $\mathbf{A} = 2\hat{i} + 3\hat{j} + 2\hat{k}$ is subtracted from vector **B**, it gives a vector equal to $2\hat{j}$. Then the magnitude of vector **B** will be

(a) 3 (b) $\sqrt{33}$
(c) $\sqrt{6}$ (d) $\sqrt{5}$

STEP 1 $\mathbf{B} - \mathbf{A} = 2\hat{j} \Rightarrow \mathbf{B} = \mathbf{A} + 2\hat{j}$
STEP 2 $\mathbf{B} = 2\hat{i} + 5\hat{j} + 2\hat{k}$
STEP 3 $|\mathbf{B}| = \sqrt{4 + 25 + 4} = \sqrt{33}$

Answer: **(b)**

SOLVED 6 MHT CET 2025 · 20 Apr · Shift 2

Three vectors are expressed as $\mathbf{a} = 4\hat{i} - \hat{j}$, $\mathbf{b} = -3\hat{i} + 2\hat{j}$ and $\mathbf{c} = -\hat{k}$. The unit vector along the direction of the sum of these vectors is

(a) $\frac{\hat{i} + \hat{j} - \hat{k}}{\sqrt{3}}$
(b) $\frac{1}{3}(\hat{i} - \hat{j} + \hat{k})$
(c) $\frac{1}{\sqrt{2}}(\hat{i} - \hat{j} + \hat{k})$
(d) $\frac{1}{\sqrt{2}}(\hat{i} + \hat{j} + \hat{k})$

STEP 1 Sum $= (4 - 3)\hat{i} + (-1 + 2)\hat{j} - \hat{k} = \hat{i} + \hat{j} - \hat{k}$
STEP 2 Magnitude $= \sqrt{3}$
STEP 3 Unit vector $= \frac{\hat{i} + \hat{j} - \hat{k}}{\sqrt{3}}$

Answer: **(a)**

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Solved Examples 01 Vector Basics, Unit Vectors & Components (contd.)

SOLVED 7 MHT CET 2025 · 21 Apr · Shift 2

A unit vector in the direction of the resultant of $\mathbf{A} = -2\hat{i} + 3\hat{j} + \hat{k}$ and $\mathbf{B} = \hat{i} + 2\hat{j} - 4\hat{k}$ is

(a) $\frac{-3\hat{i} + \hat{j} + 5\hat{k}}{\sqrt{35}}$

(b) $\frac{\hat{i} + 2\hat{j} - 4\hat{k}}{\sqrt{35}}$

(c) $\frac{-2\hat{i} + 3\hat{j} + \hat{k}}{\sqrt{35}}$

(d) $\frac{-\hat{i} + 5\hat{j} - 3\hat{k}}{\sqrt{35}}$

STEP 1 $\mathbf{R} = \mathbf{A} + \mathbf{B} = -\hat{i} + 5\hat{j} - 3\hat{k}$

STEP 2 $|\mathbf{R}| = \sqrt{1 + 25 + 9} = \sqrt{35}$

STEP 3 $\hat{R} = \frac{-\hat{i} + 5\hat{j} - 3\hat{k}}{\sqrt{35}}$

Answer: **(d)**

SOLVED 8 MHT CET 2026 · 15 May · Shift 2

The angle made by the vector $\mathbf{B} = 3\hat{i} + 2\hat{j} + 4\hat{k}$ with the Y axis is

(a) $\cos^{-1}\frac{4}{\sqrt{11}}$ (b) $\cos^{-1}\frac{3}{\sqrt{17}}$

(c) $\cos^{-1}\frac{2}{\sqrt{29}}$ (d) $\cos^{-1}\frac{5}{\sqrt{23}}$

STEP 1 $|\mathbf{B}| = \sqrt{9 + 4 + 16} = \sqrt{29}$

STEP 2 $\cos\beta = \frac{B_y}{B} = \frac{2}{\sqrt{29}}$

STEP 3 $\beta = \cos^{-1}\frac{2}{\sqrt{29}}$

Answer: **(c)**

SOLVED 9 MHT CET 2026 · 18 Apr · Shift 1

The angles made by the vector $\mathbf{A} = 2\hat{i} + 3\hat{j}$ with the x-axis and with the y-axis are respectively

(a) $\tan^{-1}2\sqrt{13}, \tan^{-1}3\sqrt{13}$

(b) $\cos^{-1}\frac{2}{\sqrt{13}}, \cos^{-1}\frac{3}{\sqrt{13}}$

(c) $\cos^{-1}\frac{1}{\sqrt{2}}, \cos^{-1}\frac{1}{\sqrt{3}}$

(d) $\sin^{-1}\frac{1}{\sqrt{6}}, \sin^{-1}\frac{1}{2\sqrt{3}}$

STEP 1 $|\mathbf{A}| = \sqrt{4 + 9} = \sqrt{13}$

STEP 2 $\cos\alpha = \frac{2}{\sqrt{13}}, \cos\beta = \frac{3}{\sqrt{13}}$

STEP 3 Angles: $\cos^{-1}\frac{2}{\sqrt{13}}, \cos^{-1}\frac{3}{\sqrt{13}}$

Answer: **(b)**

SOLVED 10 MHT CET 2020 · 19 Oct · Shift 2

The angle subtended by the vector $\mathbf{A} = 4\hat{i} + 3\hat{j} + 12\hat{k}$ with the X-axis is

(a) $\cos^{-1}\frac{3}{13}$ (b) $\sin^{-1}\frac{3}{13}$

(c) $\sin^{-1}\frac{4}{13}$ (d) $\cos^{-1}\frac{4}{13}$

STEP 1 $|\mathbf{A}| = \sqrt{16 + 9 + 144} = 13$

STEP 2 $\cos\alpha = \frac{A_x}{A} = \frac{4}{13}$

STEP 3 $\alpha = \cos^{-1}\frac{4}{13}$

Answer: **(d)**

SOLVED 11 MHT CET 2020 · 16 Oct · Shift 2

The x, y components of vector **P** have magnitudes 1 and 3, and the x, y components of the resultant of **P** and **Q** have magnitudes 5 and 6 respectively. What is the magnitude of **Q**?

(a) 5 (b) 4

(c) 3 (d) 2

STEP 1 $\mathbf{Q} = \mathbf{R} - \mathbf{P}$

STEP 2 $Q_x = 5 - 1 = 4, Q_y = 6 - 3 = 3$

STEP 3 $|\mathbf{Q}| = \sqrt{16 + 9} = 5$

Answer: **(a)**

SOLVED 12 MHT CET 2019 · 3 May · Shift 1

A vector **P** has X and Y components of magnitude 2 units and 4 units respectively. A vector **Q** along the negative X-axis has magnitude 6 units. The vector $(\mathbf{Q} - \mathbf{P})$ will be

(a) $4(2\hat{i} - \hat{j})$ (b) $-4(2\hat{i} - \hat{j})$

(c) $4(2\hat{i} + \hat{j})$ (d) $-4(2\hat{i} + \hat{j})$

STEP 1 $\mathbf{P} = 2\hat{i} + 4\hat{j}, \mathbf{Q} = -6\hat{i}$

STEP 2 $\mathbf{Q} - \mathbf{P} = -8\hat{i} - 4\hat{j}$

STEP 3 $= -4(2\hat{i} + \hat{j})$

Answer: **(d)**

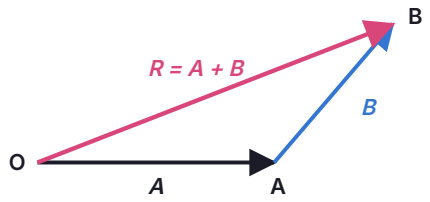
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02 CONCEPT Addition & Subtraction of Vectors

IN ONE LINE

Two vectors at angle θ add to $R^2 = A^2 + B^2 + 2AB\cos\theta$. To subtract, add the reversed vector: cos θ just changes sign.

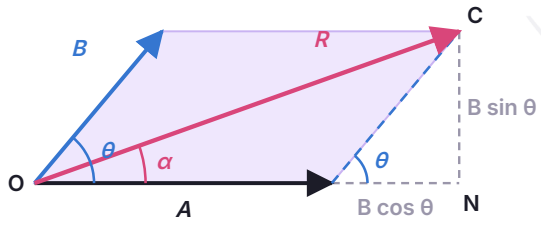
2.2.1 Triangle law



Head of A joined to the tail of B; R closes the triangle

- Place the vectors head to tail. The resultant goes from the first tail to the last head.
- Vector addition is commutative and associative: A + B = B + A.

2.2.2 Parallelogram law



A and B from one point O; R is the diagonal OC

$$R = \sqrt{(A^2 + B^2 + 2AB\cos\theta)}$$

$$\tan\alpha = \frac{B\sin\theta}{A + B\cos\theta}$$

- θ = angle between A and B (tails together). α = angle of R with A.
- R leans towards the bigger vector.

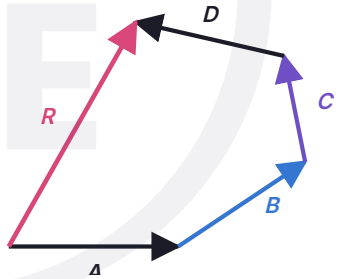
2.2.3 Special cases

θ	R	Note
0°	A + B	maximum
90°	$\sqrt{A^2 + B^2}$	perpendicular
120° (A = B)	A	resultant equals each vector
180°	$\lvert A - B\rvert$	minimum

$$\lvert A - B\rvert \le R \le A + B$$

- Two unequal vectors can never add to zero.
- Fewest vectors that add to zero: 2 if equal, 3 if unequal and coplanar, 4 if not coplanar.
- If A + B = C with $A^2 + B^2 = C^2$, then A ⊥ B (e.g. 3, 4, 5).

2.2.4 Polygon law



A, B, C, D head to tail; R closes the polygon

$$R = A + B + C + D$$

- If the vectors form a closed figure taken in order, their sum is zero.
- **A + B + C = 0** ⇒ the three vectors are coplanar.

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VECTORS

LEVEL 1 · EASY

Topic-wise Previous Year Questions

MHT CET · NEET · JEE Main

44	10	4
questions	concepts	topics

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	Answer key		

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TOPIC 01

Vector Basics, Unit Vectors & Components

13 PYQs · Easy 13 · Medium 0 · Difficult 0 | MHT CET 10 · NEET 1 · JEE 2

Concepts covered: Types of vectors & vector laws (2) · Unit vector & magnitude (5) · Components & direction cosines (6)

LEVEL 1 · EASY 13 questions

◆ Types of vectors & vector laws 2 Qs

1. There are two vectors $\vec{A} = 6\hat{i} + 9\hat{j} - \hat{k}$ and $\vec{B} = 2\hat{i} + 3\hat{j} - p\hat{k}$ which have the same direction. The value of 'p' is

MHT CET 2026 · 17 APR · SHIFT 2

(a) 3 (b) $\frac{1}{3}$ (c) $\frac{2}{3}$ (d) $-\frac{1}{3}$

2. Let $\vec{A}$ and $\vec{B}$ be two non-zero vectors of different magnitude. Which one of the following is the correct equation?

MHT CET 2026 · 15 APR · SHIFT 2

(a) $\vec{A} \cdot \vec{B} = -\vec{B} \cdot \vec{A}$ (b) $\vec{A} \times \vec{B} = \vec{B} \times \vec{A}$
(c) $\vec{A} + \vec{B} = \vec{B} + \vec{A}$ (d) $\vec{A} - \vec{B} = \vec{B} - \vec{A}$

◆ Unit vector & magnitude 5 Qs

3. If a unit vector is represented by $\vec{U} = 0.9\,\hat{i} - 0.2\,\hat{j} + m\hat{k}$, then the value of m is

MHT CET 2026 · 18 APR · SHIFT 2

(a) 0.85 (b) $\sqrt{0.15}$ (c) 1 (d) $\sqrt{0.77}$

4. A vector $\vec{A}$ when added to the sum of the vectors $(\hat{i} - 2\hat{j} + 2\hat{k})$ and $(-2\hat{i} + \hat{j} - \hat{k})$ gives a unit vector along Y axis. The magnitude of vector $\vec{A}$ is

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(a) $\sqrt{3}$ (b) $\sqrt{6}$ (c) $\sqrt{8}$ (d) $\sqrt{10}$

5. Three vectors are expressed as $\vec{a} = 4\hat{i} - \hat{j}, \vec{b} = -3\hat{i} + 2\hat{j}$ and $\vec{c} = -\hat{k}$. The unit vector along the direction of sum of these vectors is

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(a) $\frac{\hat{i}+\hat{j}-\hat{k}}{\sqrt{3}}$ (b) $\frac{1}{3}(\hat{i} - \hat{j} + \hat{k})$
(c) $\frac{1}{\sqrt{2}}(\hat{i} - \hat{j} + \hat{k})$ (d) $\frac{1}{\sqrt{2}}(\hat{i} + \hat{j} + \hat{k})$

6. If a unit vector is represented by $0.5\hat{i} + 0.8\hat{j} + c\hat{k}$, the value of c is

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(a) 1 (b) $\sqrt{0.11}$ (c) $\sqrt{0.01}$ (d) 0.39

7. When vector $\vec{A} = 2\hat{i} + 3\hat{j} + 2\hat{k}$ is subtracted from vector $\overrightarrow{B}$, it gives a vector equal to $2\hat{j}$. Then the magnitude of vector $\overrightarrow{B}$ will be:

JEE MAIN 2023 · 11 APR · SHIFT 2

(a) 3 (b) $\sqrt{33}$ (c) $\sqrt{6}$ (d) $\sqrt{5}$

◆ Components & direction cosines 6 Qs

8. The angle made by a vector $\vec{B} = 3\hat{i} + 2\hat{j} + 4\hat{k}$ with Y axis is

MHT CET 2026 · 15 MAY · SHIFT 2

(a) $\cos^{-1}\left(\frac{4}{\sqrt{11}}\right)$ (b) $\cos^{-1}\left(\frac{3}{\sqrt{17}}\right)$
(c) $\cos^{-1}\left(\frac{2}{\sqrt{29}}\right)$ (d) $\cos^{-1}\left(\frac{5}{\sqrt{23}}\right)$

9. The angle made by vector $\vec{A} = 2\hat{i} + 3\hat{j}$ with x-axis and that with y-axis are respectively.

MHT CET 2026 · 18 APR · SHIFT 1

(a) $\tan^{-1} 2\sqrt{13}$ $\tan^{-1} 3\sqrt{13}$
(b) $\cos^{-1}\frac{2}{\sqrt{13}}$ $\cos^{-1}\frac{3}{\sqrt{13}}$
(c) $\cos^{-1}\frac{1}{\sqrt{2}}$ $\cos^{-1}\frac{1}{\sqrt{3}}$
(d) $\sin^{-1}\frac{1}{\sqrt{6}}$ $\sin^{-1}\frac{1}{2\sqrt{3}}$

10. The angle subtended by the vector $A = 4\hat{\mathbf{i}} + 3\hat{\mathbf{j}} + 12\hat{\mathbf{k}}$ with the X-axis is

MHT CET 2020 · 19 OCT · SHIFT 2

(a) $\cos^{-1}\left(\frac{3}{13}\right)$ (b) $\sin^{-1}\left(\frac{3}{13}\right)$
(c) $\sin^{-1}\left(\frac{4}{13}\right)$ (d) $\cos^{-1}\left(\frac{4}{13}\right)$

11. The x, y components of vector $\mathbf{P}$ have magnitudes 1 and 3 and x, y components of resultant of $\mathbf{P}$ and $\mathbf{Q}$ have magnitudes 5 and 6, respectively. What is the magnitude of $\mathbf{Q}$?

MHT CET 2020 · 16 OCT · SHIFT 2

(a) 5 (b) 4 (c) 3 (d) 2

12. A vector P has X and Y components of magnitude 2 units and 4 units respectively. A vector Q along negative X-axis has magnitude 6 units. The vector $(\mathbf{Q} - \mathbf{P})$ will be

MHT CET 2019 · 3 MAY · SHIFT 1

(a) $4(2\hat{i} - \hat{j})$ (b) $-4(2\hat{\mathbf{i}} - \hat{\mathbf{j}})$
(c) $4(2\hat{i} + \hat{j})$ (d) $-4(2\hat{i} + \hat{j})$

13. A vector in $x - y$ plane makes an angle of 30° with y-axis. The magnitude of y-component of vector is $2\sqrt{3}$. The magnitude of x-component of the vector will be:

JEE MAIN 2023 · 15 APR · SHIFT 1

(a) $\sqrt{3}$ (b) 2 (c) 6 (d) $\frac{1}{\sqrt{3}}$

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TOPIC 02

Addition & Subtraction of Vectors

8 PYQs · Easy 8 · Medium 0 · Difficult 0 | MHT CET 4 · NEET 0 · JEE 4

Concepts covered: Resultant of two vectors (5) · Subtraction of vectors (2) · Polygon law & triangle of vectors (1)

LEVEL 1 · EASY 8 questions

◆ Resultant of two vectors 5 Qs

14. Resultant of two vectors $\vec{P}$ and $\vec{Q}$ is of magnitude A. If $\vec{Q}$ is reversed, then the resultant is of magnitude B. The value of $A^2 + B^2$ is

MHT CET 2026 · 17 APR · SHIFT 1

(a) $P^2 + Q^2$ (b) $P^2 - Q^2$
(c) $2(P^2 + Q^2)$ (d) $2(P^2 - Q^2)$

15. Two vectors of same magnitude have a resultant equal to either of the two vectors. The angle between two vectors is

MHT CET 2020 · 16 OCT · SHIFT 1

(a) $\cos^{-1}(-0.5)$ (b) $\cos^{-1}(-0.4)$
(c) $\cos^{-1}(-0.3)$ (d) $\cos^{-1}(-0.6)$

16. The angle between vector $\vec{Q}$ and the resultant of $(2\vec{Q} + 2\vec{P})$ and $(2\vec{Q} - 2\vec{P})$ is:

JEE MAIN 2024 · 5 APR · SHIFT 1

(a) $\tan^{-1}(P/Q)$ (b) 0°
(c) $\tan^{-1}\frac{(2\vec{Q}-2\vec{P})}{2\vec{Q}+2\vec{P}}$ (d) $\tan^{-1}(2Q/P)$

17. If two vectors $\vec{A}$ and $\vec{B}$ having equal magnitude R are inclined at angle θ, then

JEE MAIN 2024 · 31 JAN · SHIFT 2

(a) $|\vec{A} + \vec{B}| = 2R\cos\left(\frac{\theta}{2}\right)$
(b) $|\vec{A} - \vec{B}| = 2R\cos\left(\frac{\theta}{2}\right)$
(c) $|\vec{A} - \vec{B}| = \sqrt{2}R\sin\left(\frac{\theta}{2}\right)$
(d) $|\vec{A} + \vec{B}| = 2R\sin\left(\frac{\theta}{2}\right)$

18. Two forces having magnitude A and $\frac{A}{2}$ are perpendicular to each other. The magnitude of their resultant is:

JEE MAIN 2023 · 8 APR · SHIFT 1

(a) $\frac{5A}{2}$ (b) $\frac{\sqrt{5}A}{4}$ (c) $\frac{\sqrt{5}A}{2}$ (d) $\frac{\sqrt{5}A^2}{2}$

◆ Subtraction of vectors 2 Qs

19. Let $\vec{P} = \hat{i} + \hat{j} + \hat{k}$ and $\vec{Q} = -\hat{i} - \hat{j} - \hat{k}$. The angle between $(\vec{P} - \vec{Q})$ and $\vec{P}$ is

MHT CET 2026 · 20 MAY · SHIFT 1

(a) 90° (b) 30° (c) 60° (d) 0°

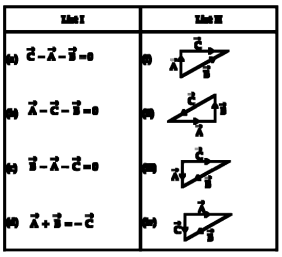
20. Let $\vec{P} = \hat{i} + \hat{j} + \hat{k}$ and $\vec{Q} = -(\hat{i} + \hat{j} + \hat{k})$. The angle between $(\vec{P} - \vec{Q})$ and $\vec{P}$ is

MHT CET 2026 · 16 APR · SHIFT 1

(a) 90° (b) 60° (c) 0° (d) 30°

◆ Polygon law & triangle of vectors 1 Q

21. Match List - I with List - II



Choose the correct answer from the options given below:

JEE MAIN 2021 · 25 JUL · SHIFT 1

(a) (a) → (iv), (b) → (i), (c) → (iii), (d) → (ii)
(b) (a) → (iv), (b) → (iii), (c) → (i), (d) → (ii)
(c) (a) → (iii), (b) → (ii), (c) → (iv), (d) → (i)
(d) (a) → (i), (b) → (iv), (c) → (ii), (d) → (iii)

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TOPIC 03

Scalar (Dot) Product

16 PYQs · Easy 16 · Medium 0 · Difficult 0 | MHT CET 12 · NEET 0 · JEE 4

Concepts covered: Dot product: value (4) · Perpendicular vectors (8) · Angle & projection (4)

LEVEL 1 · EASY 16 questions

◆ Dot product: value 4 Qs

22. A vector $\vec{A}$ of magnitude $7\sqrt{2}$ unit, another vector $\vec{B}$ of magnitude 14 unit are inclined at an angle of 60°. The magnitude of the scalar product $(\vec{A}\cdot\vec{B})$ is $\left[\cos(60)^\circ = \frac{1}{2}\right]$

MHT CET 2026 · 19 MAY · SHIFT 2

(a) $49\sqrt{2}$ (b) $7\sqrt{2}$ (c) $14\sqrt{2}$ (d) $9\sqrt{2}$

23. In a vector $\vec{p}$, 'x' and 'y' components have magnitudes 2 units and 5 units respectively. A vector $\vec{q}$, along negative Y axis has magnitude of 3 units. Then $\vec{p}\cdot\vec{q}$ is

MHT CET 2026 · 19 MAY · SHIFT 1

(a) -6 (b) -9 (c) -10 (d) -15

24. Given $\vec{A} = (2\hat{i} - 3\hat{j} + \hat{k})$, $\vec{B} = (3\hat{i} + \hat{j} - 2\hat{k})$ and $\vec{C} = (3\hat{i} + 2\hat{j} + \hat{k})$, then $(\vec{A} + \vec{B})\cdot\vec{C}$ will be

MHT CET 2025 · 22 APR · SHIFT 2

(a) 10 (b) 12 (c) 18 (d) 20

25. Given $\vec{A} = (2\hat{i} - 3\hat{j} + \hat{k})$, $\vec{B} = (3\hat{i} + \hat{j} - 2\hat{k})$ and $\vec{C} = (3\hat{i} + 2\hat{j} + \hat{k})$, then $(\vec{A} + \vec{B})\cdot\vec{C}$ will be

MHT CET 2025 · 22 APR · SHIFT 2

(a) 10 (b) 12 (c) 18 (d) 20

◆ Perpendicular vectors 8 Qs

26. The vector $\vec{P} = a\hat{i} + a\hat{j} + 3\hat{k}$ and $\vec{Q} = a\hat{i} - 2\hat{j} - \hat{k}$ are perpendicular to each other. Then positive value of 'a' is

MHT CET 2026 · 13 MAY · SHIFT 2

(a) 3 (b) 4 (c) 9 (d) 13

27. If $\vec{A} = 5\hat{i} + 2\hat{j}$ and $\vec{B} = a\hat{i} + 3\hat{j}$ are perpendicular to each other, the value of 'a' is

MHT CET 2026 · 12 MAY · SHIFT 1

(a) $\frac{-6}{5}$ (b) $\frac{6}{5}$ (c) $\frac{4}{5}$ (d) $\frac{-4}{5}$

28. If two vectors $\vec{A} = 4\hat{i} + n\hat{j} + 2\hat{k}$ and $\vec{B} = 2\hat{i} + 2\hat{j} - \hat{k}$ are mutually perpendicular to each other then value of 'n' is

MHT CET 2026 · 20 APR · SHIFT 2

(a) $+3$ (b) $+1$ (c) -3 (d) -1

29. The vector sum of the two forces $\vec{A}$ and $\vec{B}$ is perpendicular to their vector difference. Hence forces $\vec{A}$ and $\vec{B}$ are

MHT CET 2026 · 13 APR · SHIFT 1

(a) perpendicular to each other
(b) unequal in magnitude
(c) parallel to each other
(d) equal in magnitude

30. The vectors $(\vec{A} + \vec{B})$ and $(\vec{A} - \vec{B})$ are perpendicular to each other. This is possible under the condition

MHT CET 2026 · 11 APR · SHIFT 2

(a) $|\vec{A}| = |\vec{B}|$ (b) $\vec{A}\cdot\vec{B} = 0$
(c) $\vec{A}\times\vec{B} = 0$ (d) $\vec{A}\cdot\vec{B} = 1$

31. The vector sum of two forces $\vec{A}$ and $\vec{B}$ is perpendicular to their vector difference. Hence forces $\vec{A}$ and $\vec{B}$ are

MHT CET 2025 · 26 APR · SHIFT 2

(a) perpendicular to each other.
(b) parallel to each other.
(c) unequal in magnitude.
(d) equal in magnitude.

32. The vectors $(\mathbf{A} + \mathbf{B})$ and $(\mathbf{A} - \mathbf{B})$ are at right angles to each other. This is possible under the condition

MHT CET 2019 · 3 MAY · SHIFT 1

(a) $|A| = |B|$ (b) $A\cdot B = 0$
(c) $A\cdot B = 1$ (d) $A\times B = 0$

33. If two vectors $\vec{P} = \hat{i} + 2m\hat{j} + m\hat{k}$ and $\vec{Q} = 4\hat{i} - 2\hat{j} + m\hat{k}$ are perpendicular to each other. Then, the value of m will be:

JEE MAIN 2023 · 24 JAN · SHIFT 2

(a) -1 (b) 3 (c) 1 (d) 2

◆ Angle & projection 4 Qs

34. $\mathbf{P}$ and $\mathbf{Q}$ are two non-zero vectors inclined to each other at an angle 'θ'. 'p' and 'q' are unit vectors along $\mathbf{P}$ and $\mathbf{Q}$ respectively. The component of $\mathbf{Q}$ in the direction of $\mathbf{P}$ will be

MHT CET 2019 · 2 MAY · SHIFT 2

(a) $p\cdot Q$ (b) $\frac{P\times Q}{P}$ (c) $\frac{P\cdot Q}{Q}$ (d) $p\cdot q$

35. What will be the projection of vector $\vec{A} = \hat{i} + \hat{j} + \hat{k}$ on vector $\vec{B} = \hat{i} + \hat{j}$?

JEE MAIN 2021 · 22 JUL · SHIFT 2

(a) $\sqrt{2}(\hat{i} + \hat{j} + \hat{k})$ (b) $(\hat{i} + \hat{j})$
(c) $\sqrt{2}(\hat{i} + \hat{j})$ (d) $2(\hat{i} + \hat{j} + \hat{k})$

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36. If the projection of $2\hat{i}+4\hat{j}-2\hat{k}$ on $\hat{i}+2\hat{j}+\alpha\hat{k}$ is zero. Then, the value of α will be _____.

JEE MAIN 2022 · 28 JUL · SHIFT 1 *(Numerical)*

37. If $\vec{A}=(2\hat{i}+3\hat{j}-\hat{k})\,\mathrm{m}$ and $\vec{B}=(\hat{i}+2\hat{j}+2\hat{k})\,\mathrm{m}$. The magnitude of component of vector $\vec{A}$ along vector $\vec{B}$ will be _____ m.

JEE MAIN 2022 · 26 JUL · SHIFT 2 *(Numerical)*

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TOPIC 04

Vector (Cross) Product

7 PYQs · Easy 7 · Medium 0 · Difficult 0 | MHT CET 3 · NEET 1 · JEE 3

Concepts covered: Cross product & area (7)

LEVEL 1 · EASY 7 questions

38. If $|\vec{a}| = \sqrt{26}, |\vec{b}| = 7$ $|\vec{a} \times \vec{b}| = 35$, find $\vec{a} \cdot \vec{b}$

MHT CET 2025 · 26 APR · SHIFT 1

(a) 4 (b) 5 (c) 6 (d) 7

39. Vector $\vec{A}$ of magnitude $5\sqrt{3}$ units, another vector $\vec{B}$ of magnitude of 10 units are inclined to each other at an angle of 30°. The magnitude of vector product of the two vectors is $\left[\sin 30^\circ = \frac{1}{2}\right]$

MHT CET 2025 · 25 APR · SHIFT 1

(a) $5\sqrt{3}$ units (b) 10 units
(c) $25\sqrt{3}$ units (d) 75 units

40. What is the angle between resultant of $A + B$ and $\mathbf{A} \times \mathbf{B}$.

MHT CET 2020 · 19 OCT · SHIFT 2

(a) πrad (b) 0° (c) $\frac{\pi}{4}$rad (d) $\frac{\pi}{2}$rad

41. If $\overrightarrow{F} = 2\hat{i} + \hat{j} - \hat{k}$ and $\overrightarrow{r} = 3\hat{i} + 2\hat{j} - 2\hat{k}$, then the scalar and vector products of $\overrightarrow{F}$ and $\overrightarrow{r}$ have the magnitudes respectively as

NEET 2022 · PHASE 2

(a) 10, 2 (b) 5, $\sqrt{3}$ (c) 4, $\sqrt{5}$ (d) 10, $\sqrt{2}$

42. $\overrightarrow{A}$ is a vector quantity such that $|\overrightarrow{A}|$ = non-zero constant. Which of the following expression is true for $\overrightarrow{A}$?

JEE MAIN 2022 · 25 JUN · SHIFT 1

(a) $\overrightarrow{A} . \overrightarrow{A} = 0$ (b) $\overrightarrow{A} \times \overrightarrow{A} < 0$
(c) $\overrightarrow{A} \times \overrightarrow{A} = 0$ (d) $\overrightarrow{A} \times \overrightarrow{A} > 0$

43. If $\overrightarrow{A} \times \overrightarrow{B} = \overrightarrow{B} \times \overrightarrow{A}$, then the angle between A and B is

AIEEE 2004

(a) $\frac{\pi}{2}$ (b) $\frac{\pi}{3}$ (c) π (d) $\frac{\pi}{4}$

44. If $\overrightarrow{P} \times \overrightarrow{Q} = \overrightarrow{Q} \times \overrightarrow{P}$, the angle between $\overrightarrow{P}$ and $\overrightarrow{Q}$ is $\theta (0^\circ < \theta < 360^\circ)$. The value of '$\theta$' will be _____$^\circ$.

JEE MAIN 2021 · 25 FEB · SHIFT 2 *(Numerical)*

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ANSWER KEY

Shaded by level: **Easy**

01 Vector Basics, Unit Vectors & Components

1. (b)	2. (c)	3. (b)	4. (b)	5. (a)	6. (b)	7. (b)	8. (c)	9. (b)	10. (d)
11. (a)	12. (d)	13. (b)							

02 Addition & Subtraction of Vectors

14. (c)	15. (a)	16. (b)	17. (a)	18. (c)	19. (d)	20. (c)	21. (b)		

03 Scalar (Dot) Product

22. (a)	23. (d)	24. (a)	25. (a)	26. (a)	27. (a)	28. (c)	29. (d)	30. (a)	31. (d)
32. (a)	33. (d)	34. (a)	35. (b)	36. 5	37. 2				

04 Vector (Cross) Product

38. (d)	39. (c)	40. (d)	41. (d)	42. (c)	43. (c)	44. 180			

Note: *"Bonus" = no option is correct as the question is printed (dropped in the official key). Numerical questions show the numerical answer.*

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