

**Topic: Vector Algebra**

Mathematics

Topic-wise JEE Main PYQ Part-1

Chetan Sir

Topic 1: Dot Product Identities**Q1. JEE Main 2026**

For three unit vectors $\vec{a}, \vec{b}, \vec{c}$ satisfying $|\vec{a} - \vec{b}|^2 + |\vec{b} - \vec{c}|^2 + |\vec{c} - \vec{a}|^2 = 9$ and $|2\vec{a} + k\vec{b} + k\vec{c}| = 3$, the positive value of k is :

- (A) 4 (B) 5 (C) 6 (D) 3

Q2. JEE Main 2021

Let $\vec{a}, \vec{b}, \vec{c}$ be three mutually perpendicular vectors of the same magnitude and equally inclined at an angle θ , with the vector $\vec{a} + \vec{b} + \vec{c}$. Then $36\cos^2 2\theta$ is equal to _____.

Q3. JEE Main 2021

Let $\vec{a}$ and $\vec{b}$ be two vectors such that $|2\vec{a} + 3\vec{b}| = |3\vec{a} + \vec{b}|$ and the angle between $\vec{a}$ and $\vec{b}$ is 60° . If $\frac{1}{8}\vec{a}$ is a unit vector, then $|\vec{b}|$ is equal to :

- (A) 4 (B) 6 (C) 5 (D) 8

Q4. JEE Main 2020

If $\vec{x}$ and $\vec{y}$ be two non-zero vectors such that $|\vec{x} + \vec{y}| = |\vec{x}|$ and $2\vec{x} + \lambda\vec{y}$ is perpendicular to $\vec{y}$, then the value of λ is _____.

Q5. JEE Main 2020

Let $\vec{a}, \vec{b}$ and $\vec{c}$ be three unit vectors such that $|\vec{a} - \vec{b}|^2 + |\vec{a} - \vec{c}|^2 = 8$. Then $|\vec{a} + 2\vec{b}|^2 + |\vec{a} + 2\vec{c}|^2$ is equal to _____.

Q6. JEE Main 2003

$\vec{a}, \vec{b}, \vec{c}$ are 3 vectors, such that $\vec{a} + \vec{b} + \vec{c} = 0$, $|\vec{a}| = 1$, $|\vec{b}| = 2$, $|\vec{c}| = 3$, then $\vec{a} \cdot \vec{b} + \vec{b} \cdot \vec{c} + \vec{c} \cdot \vec{a}$ is equal to :

- (A) 1 (B) 0 (C) -7 (D) 7

Q7. JEE Main 2002

If $|\vec{a}| = 5$, $|\vec{b}| = 4$, $|\vec{c}| = 3$ thus what will be the value of $|\vec{a} \cdot \vec{b} + \vec{b} \cdot \vec{c} + \vec{c} \cdot \vec{a}|$, given that $\vec{a} + \vec{b} + \vec{c} = 0$:

- (A) 25 (B) 50 (C) -25 (D) -50

Topic 2: Dot Product Angle**Q8. JEE Main 2026**

Let a vector $\vec{a} = \sqrt{2}\hat{i} - \hat{j} + \lambda\hat{k}$, $\lambda > 0$, make an obtuse angle with the vector $\vec{b} = -\lambda^2\hat{i} + 4\sqrt{2}\hat{j} + 4\sqrt{2}\hat{k}$ and an angle θ , $\frac{\pi}{6} < \theta < \frac{\pi}{2}$, with the positive z -axis. If the set of all possible values of λ is $(\alpha, \beta) - \{\gamma\}$, then $\alpha + \beta + \gamma$ is equal to _____.

Q9. JEE Main 2026

Let the vectors $\vec{a} = -\hat{i} + \hat{j} + 3\hat{k}$ and $\vec{b} = \hat{i} + 3\hat{j} + \hat{k}$. For some $\lambda, \mu \in \mathbb{R}$, let $\vec{c} = \lambda\vec{a} + \mu\vec{b}$. If $\vec{c} \cdot (3\hat{i} - 6\hat{j} + 2\hat{k}) = 10$ and $\vec{c} \cdot (\hat{i} + \hat{j} + \hat{k}) = -2$, then $|\vec{c}|^2$ is equal to:

- (A) 8 (B) 12 (C) 14 (D) 15

Q10. JEE Main 2025

Let $\vec{a}$ and $\vec{b}$ be two unit vectors such that the angle between them is $\frac{\pi}{3}$. If $\lambda\vec{a} + 2\vec{b}$ and $3\vec{a} - \lambda\vec{b}$ are perpendicular to each other, then the number of values of λ in $[-1, 3]$ is :

- (A) 1 (B) 3 (C) 2 (D) 0

Q11. JEE Main 2024

Let a unit vector $\hat{u} = x\hat{i} + y\hat{j} + z\hat{k}$ make angles $\frac{\pi}{2}, \frac{\pi}{3}$ and $\frac{2\pi}{3}$ with the vectors $\frac{1}{\sqrt{2}}\hat{i} + \frac{1}{\sqrt{2}}\hat{k}$, $\frac{1}{\sqrt{2}}\hat{j} + \frac{1}{\sqrt{2}}\hat{k}$ and $\frac{1}{\sqrt{2}}\hat{i} + \frac{1}{\sqrt{2}}\hat{j}$ respectively. If $\vec{v} = \frac{1}{\sqrt{2}}\hat{i} + \frac{1}{\sqrt{2}}\hat{j} + \frac{1}{\sqrt{2}}\hat{k}$ then $|\hat{u} - \vec{v}|^2$ is equal to

- (A)
- $\frac{11}{2}$
- (B)
- $\frac{5}{2}$
- (C) 7 (D) 9

Q12. JEE Main 2024

The least positive integral value of α , for which the angle between the vectors $\alpha\hat{i} - 2\hat{j} + 2\hat{k}$ and $\alpha\hat{i} + 2\alpha\hat{j} - 2\hat{k}$ is acute, is _____.

Q13. JEE Main 2024

Let a unit vector which makes an angle of 60° with $2\hat{i} + 2\hat{j} - \hat{k}$ and an angle of 45° with $\hat{i} - \hat{k}$ be $\vec{C}$. Then $\vec{C} + (-\frac{1}{2}\hat{i} + \frac{1}{3\sqrt{2}}\hat{j} - \frac{\sqrt{2}}{3}\hat{k})$ is:

(A) $-\frac{\sqrt{2}}{3}\hat{i} + \frac{\sqrt{2}}{3}\hat{j} + (\frac{1}{2} + \frac{2\sqrt{2}}{3})\hat{k}$

(B) $(\frac{1}{\sqrt{3}} + \frac{1}{2})\hat{i} + (\frac{1}{\sqrt{3}} - \frac{1}{3\sqrt{2}})\hat{j} + (\frac{1}{\sqrt{3}} + \frac{\sqrt{2}}{3})\hat{k}$

(C) $\frac{\sqrt{2}}{3}\hat{i} - \frac{1}{2}\hat{k}$

(D) $\frac{\sqrt{2}}{3}\hat{i} + \frac{1}{3\sqrt{2}}\hat{j} - \frac{1}{2}\hat{k}$

Q14. JEE Main 2024

For $\lambda > 0$, let θ be the angle between the vectors $\vec{a} = \hat{i} + \lambda\hat{j} - 3\hat{k}$ and $\vec{b} = 3\hat{i} - \hat{j} + 2\hat{k}$. If the vectors $\vec{a} + \vec{b}$ and $\vec{a} - \vec{b}$ are mutually perpendicular, then the value of $(14 \cos \theta)^2$ is equal to

- (A) 25 (B) 50 (C) 20 (D) 40

Q15. JEE Main 2024

Let $\vec{a} = \hat{i} + 2\hat{j} + 3\hat{k}$, $\vec{b} = 2\hat{i} + 3\hat{j} - 5\hat{k}$ and $\vec{c} = 3\hat{i} - \hat{j} + \lambda\hat{k}$ be three vectors. Let $\vec{r}$ be a unit vector along $\vec{b} + \vec{c}$. If $\vec{r} \cdot \vec{a} = 3$, then 3λ is equal to:

- (A) 21 (B) 25 (C) 27 (D) 30

Q16. JEE Main 2024

The set of all α , for which the vectors $\vec{a} = \alpha\hat{i} + 6\hat{j} - 3\hat{k}$ and $\vec{b} = \hat{i} - 2\hat{j} - 2\alpha\hat{k}$ are inclined at an obtuse angle for all $t \in \mathbb{R}$, is

- (A) $[0, 1]$ (B) $(-\frac{4}{3}, 0]$
(C) $(-2, 0]$ (D) $(-\frac{4}{3}, 1)$

Q17. JEE Main 2022

Let S be the set of all $a \in \mathbb{R}$ for which the angle between the vectors $\vec{u} = a(\log_e b)\hat{i} - 6\hat{j} + 3\hat{k}$ and $\vec{v} = (\log_e b)\hat{i} + 2\hat{j} + 2a(\log_e b)\hat{k}$, ($b > 1$) is acute. Then S is equal to :

- (A) $(-\infty, -\frac{4}{3})$ (B) Φ
(C) $(-\frac{4}{3}, 0)$ (D) $(\frac{12}{7}, \infty)$

Q18. JEE Main 2021

If $(\vec{a} + 3\vec{b})$ is perpendicular to $(7\vec{a} - 5\vec{b})$ and $(\vec{a} - 4\vec{b})$ is perpendicular to $(7\vec{a} - 2\vec{b})$, then the angle between $\vec{a}$ and $\vec{b}$ (in degrees) is _____.

Q19. JEE Main 2019

Let $\vec{a} = 2\hat{i} + \lambda_1\hat{j} + 3\hat{k}$, $\vec{b} = 4\hat{i} + (3 - \lambda_2)\hat{j} + 6\hat{k}$, and $\vec{c} = 3\hat{i} + 6\hat{j} + (\lambda_3 - 1)\hat{k}$ be three vectors such that $\vec{b} = 2\vec{a}$ and $\vec{a}$ is perpendicular to $\vec{c}$. Then a possible value of $(\lambda_1, \lambda_2, \lambda_3)$ is :

- (A) (1, 5, 1) (B) (1, 3, 1)
(C) $(-\frac{1}{2}, 4, 0)$ (D) $(\frac{1}{2}, 4, -2)$

Q20. JEE Main 2012

Let $\vec{a}$ and $\vec{b}$ be two unit vectors. If the vectors $\vec{c} = \vec{a} + 2\vec{b}$ and $\vec{d} = 5\vec{a} - 4\vec{b}$ are perpendicular to each other, then the angle between $\vec{a}$ and $\vec{b}$ is :

- (A) $\frac{\pi}{6}$ (B) $\frac{\pi}{2}$ (C) $\frac{\pi}{3}$ (D) $\frac{\pi}{4}$

Q21. JEE Main 2010

If the vectors $\vec{a} = \hat{i} - \hat{j} + 2\hat{k}$, $\vec{b} = 2\hat{i} + 4\hat{j} + \hat{k}$ and $\vec{c} = \lambda\hat{i} + \hat{j} + \mu\hat{k}$ are mutually orthogonal, then (λ, μ) is equal to :

- (A) (2, -3)
(B) (-2, 3)
(C) (3, -2)
(D) (-3, 2)

Topic 3: Dot Product Projection

Q22. JEE Main 2026

Let $\vec{AB} = 2\hat{i} + 4\hat{j} - 5\hat{k}$ and $\vec{AD} = \hat{i} + 2\hat{j} + \lambda\hat{k}$, $\lambda \in \mathbb{R}$. Let the projection of the vector $\vec{v} = \hat{i} + \hat{j} + \hat{k}$ on the diagonal $\vec{AC}$ of the parallelogram ABCD be of length one unit. If α, β , where $\alpha > \beta$, be the roots of the equation $\lambda^2 x^2 - 6\lambda x + 5 = 0$, then $2\alpha - \beta$ is equal to

- (A) 3 (B) 6
(C) 4 (D) 1

Q23. JEE Main 2026

Let $\vec{a} = 2\hat{i} - \hat{j} - \hat{k}$, $\vec{b} = \hat{i} + 3\hat{j} - \hat{k}$ and $\vec{c} = 2\hat{i} + \hat{j} + 3\hat{k}$. Let $\vec{v}$ be the vector in the plane of the vectors $\vec{a}$ and $\vec{b}$, such that the length of its projection on the vector $\vec{c}$ is $\frac{1}{\sqrt{14}}$. Then $|\vec{v}|$ is equal to

- (A) $\frac{\sqrt{35}}{2}$ (B) 13 (C) $\frac{\sqrt{21}}{2}$ (D) 7

Q24. JEE Main 2025

If the components of $\vec{a} = \alpha\hat{i} + \beta\hat{j} + \gamma\hat{k}$ along and perpendicular to $\vec{b} = 3\hat{i} + \hat{j} - \hat{k}$ respectively, are $\frac{16}{11}(3\hat{i} + \hat{j} - \hat{k})$ and $\frac{1}{11}(-4\hat{i} - 5\hat{j} - 17\hat{k})$, then $\alpha^2 + \beta^2 + \gamma^2$ is equal to :

- (A) 16 (B) 23 (C) 26 (D) 18

Q25. JEE Main 2025

If $\vec{a}$ is a nonzero vector such that its projections on the vectors $2\hat{i} - \hat{j} + 2\hat{k}$, $\hat{i} + 2\hat{j} - 2\hat{k}$ and $\hat{k}$ are equal, then a unit vector along $\vec{a}$ is :

- (A) $\frac{1}{\sqrt{155}}(-7\hat{i} + 9\hat{j} + 5\hat{k})$
(B) $\frac{1}{\sqrt{155}}(-7\hat{i} + 9\hat{j} - 5\hat{k})$
(C) $\frac{1}{\sqrt{155}}(7\hat{i} + 9\hat{j} - 5\hat{k})$
(D) $\frac{1}{\sqrt{155}}(7\hat{i} + 9\hat{j} + 5\hat{k})$

Q26. JEE Main 2025

Consider two vectors $\vec{u} = 3\hat{i} - \hat{j}$ and $\vec{v} = 2\hat{i} + \hat{j} - \lambda\hat{k}$, $\lambda > 0$. The angle between them is given by $\cos^{-1}(\frac{\sqrt{5}}{2\sqrt{7}})$.

Let $\vec{v} = \vec{v}_1 + \vec{v}_2$, where $\vec{v}_1$ is parallel to $\vec{u}$ and $\vec{v}_2$ is perpendicular to $\vec{u}$. Then the value $|\vec{v}_1|^2 + |\vec{v}_2|^2$ is equal to

- (A) $\frac{23}{2}$ (B) $\frac{25}{2}$ (C) 10 (D) 14

Q27. JEE Main 2023

Let $\vec{a} = 5\hat{i} - \hat{j} - 3\hat{k}$ and $\vec{b} = \hat{i} + 3\hat{j} + 5\hat{k}$ be two vectors. Then which one of the following statements is TRUE ?

- (A) Projection of $\vec{a}$ on $\vec{b}$ is $\frac{-13}{\sqrt{35}}$ and the direction of the projection vector is opposite to the direction of $\vec{b}$.
- (B) Projection of $\vec{a}$ on $\vec{b}$ is $\frac{13}{\sqrt{35}}$ and the direction of the projection vector is opposite to the direction of $\vec{b}$.
- (C) Projection of $\vec{a}$ on $\vec{b}$ is $\frac{13}{\sqrt{35}}$ and the direction of the projection vector is same as of $\vec{b}$.
- (D) Projection of $\vec{a}$ on $\vec{b}$ is $\frac{-13}{\sqrt{35}}$ and the direction of the projection vector is same as of $\vec{b}$.

Q28. JEE Main 2023

Let $\vec{a} = 4\hat{i} + 3\hat{j} + 5\hat{k}$ and $\vec{b} = \hat{i} + 2\hat{j} - 4\hat{k}$. Let $\vec{\beta}_1$ be parallel to $\vec{a}$ and $\vec{\beta}_2$ be perpendicular to $\vec{a}$. If $\vec{\beta} = \vec{\beta}_1 + \vec{\beta}_2$, then the value of $5\vec{\beta}_2 \cdot (\hat{i} + \hat{j} + \hat{k})$ is :

- (A) 9 (B) 7 (C) 6 (D) 11

Q29. JEE Main 2021

If the projection of the vector $\hat{i} + 2\hat{j} + \hat{k}$ on the sum of the two vectors $2\hat{i} + 4\hat{j} - 5\hat{k}$ and $-\lambda\hat{i} + 2\hat{j} + 3\hat{k}$ is 1, then λ is equal to _____.

Q30. JEE Main 2020

Let the vectors $\vec{a}, \vec{b}, \vec{c}$ be such that $|\vec{a}| = 2, |\vec{b}| = 4$ and $|\vec{c}| = 4$. If the projection of $\vec{b}$ on $\vec{a}$ is equal to the projection of $\vec{c}$ on $\vec{a}$ and $\vec{b}$ is perpendicular to $\vec{c}$, then the value of $|\vec{a} + \vec{b} - \vec{c}|$ is _____.

Q31. JEE Main 2019

Let $\vec{a} = 3\hat{i} + \hat{j}$ and $\vec{b} = 2\hat{i} - \hat{j} + 3\hat{k}$. If $\vec{\beta} = \vec{\beta}_1 - \vec{\beta}_2$, where $\vec{\beta}_1$ is parallel to $\vec{a}$ and $\vec{\beta}_2$ is perpendicular to $\vec{a}$, then $\vec{\beta}_1 \times \vec{\beta}_2$ is equal to

- (A) $3\hat{i} - 9\hat{j} - 5\hat{k}$
 (B) $\frac{1}{2}(-3\hat{i} + 9\hat{j} + 5\hat{k})$
 (C) $-3\hat{i} + 9\hat{j} + 5\hat{k}$
 (D) $\frac{1}{2}(3\hat{i} - 9\hat{j} + 5\hat{k})$

Q32. JEE Main 2019

The distance of the point having position vector $-\hat{i} + 2\hat{j} + 6\hat{k}$ from the straight line passing through the point $(2, 3, -4)$ and parallel to the vector, $6\hat{i} + 3\hat{j} - 4\hat{k}$ is :

- (A) 6 (B) 7 (C) $2\sqrt{13}$ (D) $4\sqrt{3}$

Q33. JEE Main 2019

Let $\vec{a} = \hat{i} + \hat{j} + \sqrt{2}\hat{k}, \vec{b} = b_1\hat{i} + b_2\hat{j} + \sqrt{2}\hat{k}, \vec{c} = 5\hat{i} + \hat{j} + \sqrt{2}\hat{k}$ be three vectors such that the projection vector of $\vec{b}$ on $\vec{a}$ is $\vec{a}$. If $\vec{a} + \vec{b}$ is perpendicular to $\vec{c}$, then $|\vec{b}|$ is equal to :

- (A) $\sqrt{32}$ (B) 6 (C) $\sqrt{22}$ (D) 4

Q34. JEE Main 2017

If the vector $\vec{b} = 3\hat{j} + 4\hat{k}$ is written as the sum of a vector $\vec{b}_1$, parallel to $\vec{a} = \hat{i} + \hat{j}$ and a vector $\vec{b}_2$, perpendicular to $\vec{a}$, then $\vec{b}_1 \times \vec{b}_2$ is equal to :

- (A) $-3\hat{i} + 3\hat{j} - 9\hat{k}$
 (B) $6\hat{i} - 6\hat{j} + \frac{9}{2}\hat{k}$
 (C) $-6\hat{i} + 6\hat{j} - \frac{9}{2}\hat{k}$
 (D) $3\hat{i} - 3\hat{j} + 9\hat{k}$

Q35. JEE Main 2004

Let $\vec{u}, \vec{v}, \vec{w}$ be such that $|\vec{u}| = 1, |\vec{v}| = 2, |\vec{w}| = 3$. If the projection $\vec{v}$ along $\vec{u}$ is equal to that of $\vec{w}$ along $\vec{u}$ and $\vec{v}, \vec{w}$ are perpendicular to each other then $|\vec{u} - \vec{v} + \vec{w}|$ equals :

- (A) 14 (B) $\sqrt{7}$ (C) $\sqrt{14}$ (D) 2

Topic 4: Parallel / Collinear Vectors

Q36. JEE Main 2024

Let $\vec{a}, \vec{b}$ and $\vec{c}$ be three non-zero vectors such that $\vec{b}$ and $\vec{c}$ are non-collinear. If $\vec{a} + 5\vec{b}$ is collinear with $\vec{c}$, $\vec{b} + 6\vec{c}$ is collinear with $\vec{a}$ and $\vec{a} + \alpha\vec{b} + \beta\vec{c} = \vec{0}$, then $\alpha + \beta$ is equal to

- (A) 30 (B) -30 (C) -25 (D) 35

Q37. JEE Main 2023

If the points with position vectors $\hat{a}\hat{i} + 10\hat{j} + 13\hat{k}, 6\hat{i} + 11\hat{j} + 11\hat{k}, \frac{9}{2}\hat{i} + \beta\hat{j} - 8\hat{k}$ are collinear, then $(19\alpha - 6\beta)^2$ is equal to :

- (A) 16 (B) 49 (C) 36 (D) 25

Q38. JEE Main 2021

If vectors $\vec{a}_1 = x\hat{i} - \hat{j} + \hat{k}$ and $\vec{a}_2 = \hat{i} + y\hat{j} + z\hat{k}$ are collinear, then a possible unit vector parallel to the vector $x\hat{i} + y\hat{j} + z\hat{k}$ is :

- (A) $\frac{1}{\sqrt{3}}(\hat{i} - \hat{j} + \hat{k})$
 (B) $\frac{1}{\sqrt{2}}(-\hat{j} + \hat{k})$
 (C) $\frac{1}{\sqrt{2}}(\hat{i} - \hat{j})$
 (D) $\frac{1}{\sqrt{3}}(\hat{i} + \hat{j} - \hat{k})$

Q39. JEE Main 2019

If $\vec{a} = (\lambda - 2)\vec{a} + \vec{b}$ and $\vec{\beta} = (4\lambda - 2)\vec{a} + 3\vec{b}$ be two given vectors $\vec{a}$ and $\vec{b}$ are non-collinear. The value of λ for which vectors $\vec{a}$ and $\vec{\beta}$ are collinear, is -

- (A) 4 (B) 3 (C) -3 (D) -4

Q40. JEE Main 2004

Let $\vec{a}, \vec{b}$ and $\vec{c}$ be three non-zero vectors such that no two of these are collinear. If the vector $\vec{a} + 2\vec{b}$ is collinear with $\vec{c}$ and $\vec{b} + 3\vec{c}$ is collinear with $\vec{a}$ (λ being some non-zero scalar) then $\vec{a} + 2\vec{b} + 6\vec{c}$ equals to :

- (A) $\vec{0}$ (B) $\lambda \vec{b}$ (C) $\lambda \vec{c}$ (D) $\lambda \vec{a}$

Topic 5: Theorem in a Plane

Q41. JEE Main 2025

Let $\vec{a} = \hat{i} + 2\hat{j} + \hat{k}$ and $\vec{b} = 2\hat{i} + \hat{j} - \hat{k}$. Let $\hat{e}$ be a unit vector in the plane of the vectors $\vec{a}$ and $\vec{b}$ and be perpendicular to $\vec{a}$. Then such a vector $\hat{e}$ is:

- (A) $\frac{1}{\sqrt{2}}(-\hat{i} + \hat{k})$
 (B) $\frac{1}{\sqrt{5}}(\hat{j} - 2\hat{k})$
 (C) $\frac{1}{\sqrt{3}}(\hat{i} - \hat{j} + \hat{k})$
 (D) $\frac{1}{\sqrt{3}}(-\hat{i} + \hat{j} - \hat{k})$

Q42. JEE Main 2021

Let $\vec{a} = 2\hat{i} - \hat{j} + 2\hat{k}$ and $\vec{b} = \hat{i} + 2\hat{j} - \hat{k}$. Let a vector $\vec{v}$ be in the plane containing $\vec{a}$ and $\vec{b}$. If $\vec{v}$ is perpendicular to the vector $3\hat{i} + 2\hat{j} - \hat{k}$ and its projection on $\vec{a}$ is 19 units, then $|2\vec{v}|^2$ is equal to _____.

Q43. JEE Main 2021

Let $\vec{x}$ be a vector in the plane containing vectors $\vec{a} = 2\hat{i} - \hat{j} + \hat{k}$ and $\vec{b} = \hat{i} + 2\hat{j} - \hat{k}$. If the vector $\vec{x}$ is perpendicular to $(3\hat{i} + 2\hat{j} - \hat{k})$ and its projection on $\vec{a}$ is $\frac{17\sqrt{6}}{2}$, then the value of $|\vec{x}|^2$ is equal to _____.

Q44. JEE Main 2018

Let $\vec{u}$ be a vector coplanar with the vectors $\vec{a} = 2\hat{i} + 3\hat{j} - \hat{k}$ and $\vec{b} = \hat{j} + \hat{k}$. If $\vec{u}$ is perpendicular to $\vec{a}$ and $\vec{u} \cdot \vec{b} = 24$, then $|\vec{u}|^2$ is equal to

- (A) 336 (B) 315
 (C) 256 (D) 84

Topic 6: Cross Product Calculation

Q45. JEE Main 2024

Let $\vec{a} = 3\hat{i} + 2\hat{j} + \hat{k}$, $\vec{b} = 2\hat{i} - \hat{j} + 3\hat{k}$ and $\vec{c}$ be a vector such that $(\vec{a} + \vec{b}) \times \vec{c} = 2(\vec{a} \times \vec{b}) + 24\hat{j} - 6\hat{k}$ and $(\vec{a} - \vec{b} + \hat{i}) \cdot \vec{c} = -3$. Then $|\vec{c}|^2$ is equal to _____.

Q46. JEE Main 2025

Let $\vec{a} = 3\hat{i} - \hat{j} + 2\hat{k}$, $\vec{b} = \vec{a} \times (\hat{i} - 2\hat{k})$ and $\vec{c} = \vec{b} \times \hat{k}$. Then the projection of $\vec{c} - 2\hat{j}$ on $\vec{a}$ is:

- (A) $2\sqrt{7}$ (B) $3\sqrt{7}$
 (C) $\sqrt{14}$ (D) $2\sqrt{14}$

Q47. JEE Main 2024

Let $\vec{a} = 2\hat{i} + \hat{j} - \hat{k}$, $\vec{b} = ((\vec{a} \times (\hat{i} + \hat{j})) \times \hat{i}) \times \hat{i}$. Then the square of the projection of $\vec{a}$ on $\vec{b}$ is:

- (A) $\frac{1}{3}$ (B) $\frac{1}{5}$
 (C) 2 (D) $\frac{2}{3}$

Q48. JEE Main 2026

Let $\vec{a} = -\hat{i} + 2\hat{j} + 2\hat{k}$, $\vec{b} = 8\hat{i} + 7\hat{j} - 3\hat{k}$ and $\vec{c}$ be a vector such that $\vec{a} \times \vec{c} = \vec{b}$. If $\vec{c} \cdot (\hat{i} + \hat{j} + \hat{k}) = 4$, then $|\vec{a} + \vec{c}|^2$ is equal to:

- (A) 30 (B) 33
 (C) 27 (D) 35

Q49. JEE Main 2026

If $\vec{a} = \hat{i} + \hat{j} + \hat{k}$, $\vec{b} = \hat{j} - \hat{k}$ and $\vec{c}$ be three vectors such that $\vec{a} \times \vec{c} = \vec{b}$ and $\vec{a} \cdot \vec{c} = 3$, then $\vec{c} \cdot (\vec{a} - 2\vec{b})$ is equal to _____.

Q50. JEE Main 2023

Let $\vec{a} = -\hat{i} - \hat{j} + \hat{k}$, $\vec{a} \cdot \vec{b} = 1$ and $\vec{a} \times \vec{b} = \hat{i} - \hat{j}$. Then $\vec{a} - 6\vec{b}$ is equal to:

- (A) $3(\hat{i} + \hat{j} + \hat{k})$ (B) $3(\hat{i} - \hat{j} - \hat{k})$
 (C) $3(\hat{i} + \hat{j} - \hat{k})$ (D) $3(\hat{i} - \hat{j} + \hat{k})$

Q51. JEE Main 2022

Let $\vec{a} = \alpha\hat{i} + 3\hat{j} - \hat{k}$, $\vec{b} = 3\hat{i} - \beta\hat{j} + 4\hat{k}$ and $\vec{c} = \hat{i} + 2\hat{j} - 2\hat{k}$ where $\alpha, \beta \in R$, be three vectors. If the projection of $\vec{a}$ on $\vec{c}$ is $\frac{10}{3}$ and $\vec{b} \times \vec{c} = -6\hat{i} + 10\hat{j} + 7\hat{k}$, then the value of $\alpha + \beta$ is equal to:

- (A) 3 (B) 4
 (C) 5 (D) 6

Q52. JEE Main 2022

Let $\vec{a} = \alpha\hat{i} + \hat{j} - \hat{k}$ and $\vec{b} = 2\hat{i} + \hat{j} - \alpha\hat{k}$, $\alpha > 0$. If the projection of $\vec{a} \times \vec{b}$ on the vector $-\hat{i} + 2\hat{j} - 2\hat{k}$ is 30, then α is equal to:

- (A) $\frac{15}{2}$ (B) 8
 (C) $\frac{13}{2}$ (D) 7

Q53. JEE Main 2022

Let $\vec{a} = \alpha\hat{i} + \hat{j} + \beta\hat{k}$ and $\vec{b} = 3\hat{i} - 5\hat{j} + 4\hat{k}$ be two vectors, such that $\vec{a} \times \vec{b} = -\hat{i} + 9\hat{j} + 12\hat{k}$. Then the projection of $\vec{b} - 2\vec{a}$ on $\vec{b} + \vec{a}$ is equal to:

- (A) 2 (B) $\frac{39}{5}$ (C) 9 (D) $\frac{46}{5}$

Q54. JEE Main 2022

Let $\vec{a}$ be a vector which is perpendicular to the vector $3\hat{i} + \frac{1}{2}\hat{j} + 2\hat{k}$. If $\vec{a} \times (2\hat{i} + \hat{k}) = 2\hat{i} - 13\hat{j} - 4\hat{k}$, then the projection of the vector $\vec{a}$ on the vector $2\hat{i} + 2\hat{j} + \hat{k}$ is:

- (A) $\frac{1}{3}$ (B) 1 (C) $\frac{5}{3}$ (D) $\frac{7}{3}$

Q55. JEE Main 2022

Let $\vec{b} = \hat{i} + \hat{j} + \lambda\hat{k}$, $\lambda \in R$. If $\vec{a}$ is a vector such that $\vec{a} \times \vec{b} = 13\hat{i} - \hat{j} - 4\hat{k}$ and $\vec{a} \cdot \vec{b} + 21 = 0$, then $(\vec{b} - \vec{a}) \cdot (\hat{k} - \hat{j}) + (\vec{b} + \vec{a}) \cdot (\hat{i} - \hat{k})$ is equal to _____.

Q56. JEE Main 2021

Let $\vec{p} = 2\hat{i} + 3\hat{j} + \hat{k}$ and $\vec{q} = \hat{i} + 2\hat{j} + \hat{k}$ be two vectors. If a vector $\vec{r} = (\alpha\hat{i} + \beta\hat{j} + \gamma\hat{k})$ is perpendicular to each of the vectors $(\vec{p} + \vec{q})$ and $(\vec{p} - \vec{q})$, and $|\vec{r}| = \sqrt{3}$, then $|\alpha| + |\beta| + |\gamma|$ is equal to _____.

Q57. JEE Main 2021

Let $\vec{c}$ be a vector perpendicular to the vectors, $\vec{a} = \hat{i} + \hat{j} - \hat{k}$ and $\vec{b} = \hat{i} + 2\hat{j} + \hat{k}$. If $\vec{c} \cdot (\hat{i} + \hat{j} + 3\hat{k}) = 8$ then the value of $\vec{c} \cdot (\vec{a} \times \vec{b})$ is equal to _____.

Q58. JEE Main 2019

Let $\vec{a} = 3\hat{i} + 2\hat{j} + 2\hat{k}$ and $\vec{b} = \hat{i} + 2\hat{j} - 2\hat{k}$ be two vectors. If a vector perpendicular to both the vectors $\vec{a} + \vec{b}$ and $\vec{a} - \vec{b}$ has the magnitude 12 then one such vector is :

- (A) $4(2\hat{i} - 2\hat{j} - \hat{k})$
 (B) $4(-2\hat{i} - 2\hat{j} + \hat{k})$
 (C) $4(2\hat{i} + 2\hat{j} + \hat{k})$
 (D) $4(2\hat{i} + 2\hat{j} - \hat{k})$

Q59. JEE Main 2019

Let $\vec{a} = \hat{i} - \hat{j}$, $\vec{b} = \hat{i} + \hat{j} + \hat{k}$ and $\vec{c}$ be a vector such that $\vec{a} \times \vec{c} + \vec{b} = \vec{0}$ and $\vec{a} \cdot \vec{c} = 4$, then $|\vec{c}|^2$ is equal to :

- (A) 8 (B) $\frac{19}{2}$ (C) 9 (D) $\frac{17}{2}$

Q60. JEE Main 2018

Let $\vec{a} = \hat{i} + \hat{j} + \hat{k}$, $\vec{c} = \hat{j} - \hat{k}$ and a vector $\vec{b}$ be such that $\vec{a} \times \vec{b} = \vec{c}$ and $\vec{a} \cdot \vec{b} = 3$. Then $|\vec{b}|$ equals :

- (A) $\frac{11}{3}$ (B) $\frac{11}{\sqrt{3}}$ (C) $\sqrt{\frac{11}{3}}$ (D) $\frac{\sqrt{11}}{3}$

Q61. JEE Main 2005

For any vector $\vec{a}$, the value of $(\vec{a} \times \hat{i})^2 + (\vec{a} \times \hat{j})^2 + (\vec{a} \times \hat{k})^2$ is equal to :

- (A) $3\vec{a}^2$ (B) $\vec{a}^2$ (C) $2\vec{a}^2$ (D) $4\vec{a}^2$

Topic 7: Cross Product Properties**Q62. JEE Main 2026**

For a triangle ABC , let $\vec{p} = \overrightarrow{BC}$, $\vec{q} = \overrightarrow{CA}$ and $\vec{r} = \overrightarrow{BA}$. If $|\vec{p}| = 2\sqrt{3}$, $|\vec{q}| = 2$ and $\cos \theta = \frac{1}{\sqrt{3}}$, where θ is the angle between $\vec{p}$ and $\vec{q}$, then $|\vec{p} \times (\vec{q} - 3\vec{r})|^2 + 3|\vec{r}|^2$ is equal to :

- (A) 200 (B) 220 (C) 410 (D) 340

Q63. JEE Main 2026

Let $\vec{a} = 2\hat{i} + \hat{j} - 2\hat{k}$, $\vec{b} = \hat{i} + \hat{j}$ and $\vec{c} = \vec{a} \times \vec{b}$. Let $\vec{d}$ be a vector such that $|\vec{d} - \vec{a}| = \sqrt{11}$, $|\vec{c} \times \vec{d}| = 3$ and the angle between $\vec{c}$ and $\vec{d}$ is $\frac{\pi}{4}$. Then $\vec{a} \cdot \vec{d}$ is equal to

- (A) 0 (B) 1 (C) 3 (D) 11

Q64. JEE Main 2025

Let $\hat{a}$ be a unit vector perpendicular to the vectors $\vec{b} = \hat{i} - 2\hat{j} + 3\hat{k}$ and $\vec{c} = 2\hat{i} + 3\hat{j} - \hat{k}$, and $\hat{a}$ makes an angle of $\cos^{-1}(-\frac{1}{3})$ with the vector $\hat{i} + \hat{j} + \hat{k}$. If $\hat{a}$ makes an angle of $\frac{\pi}{3}$ with the vector $\hat{i} + \hat{a}\hat{j} + \hat{k}$, then the value of a is:

- (A) $\sqrt{3}$ (B) $\sqrt{6}$ (C) $-\sqrt{6}$ (D) $-\sqrt{3}$

Q65. JEE Main 2024

Let $\vec{a} = \hat{i} + \alpha\hat{j} + \beta\hat{k}$, $\alpha, \beta \in \mathbb{R}$. Let a vector $\vec{b}$ be such that the angle between $\vec{a}$ and $\vec{b}$ is $\frac{\pi}{4}$ and $|\vec{b}|^2 = 6$. If $\vec{a} \cdot \vec{b} = 3\sqrt{2}$, then the value of $(\alpha^2 + \beta^2) |\vec{a} \times \vec{b}|^2$ is equal to

- (A) 85 (B) 90 (C) 75 (D) 95

Q66. JEE Main 2023

Let $|\vec{a}| = 2$, $|\vec{b}| = 3$ and the angle between the vectors $\vec{a}$ and $\vec{b}$ be $\frac{\pi}{4}$. Then $|\vec{a} + 2\vec{b}| \times |2\vec{a} - 3\vec{b}|^2$ is equal to :

- (A) 441 (B) 482 (C) 841 (D) 882

Q67. JEE Main 2023

Let $\vec{a} = 3\hat{i} + \hat{j} - \hat{k}$ and $\vec{c} = 2\hat{i} - 3\hat{j} + 3\hat{k}$. If $\vec{b}$ is a vector such that $\vec{a} = \vec{b} \times \vec{c}$ and $|\vec{b}|^2 = 50$, then $|72 - |\vec{b} + \vec{c}|^2|$ is equal to

_____.

Q68. JEE Main 2026

Let $\vec{a} = \hat{i} - 2\hat{j} + 3\hat{k}$, $\vec{b} = 2\hat{i} + \hat{j} - \hat{k}$, $\vec{c} = \lambda\hat{i} + \hat{j} + \hat{k}$ and $\vec{v} = \vec{a} \times \vec{b}$. If $\vec{v} \cdot \vec{c} = 11$ and the length of the projection of $\vec{b}$ on $\vec{c}$ is p , then $9p^2$ is equal to

- (A) 9 (B) 6 (C) 4 (D) 12

Q69. JEE Main 2023

Let $\vec{a} = 2\hat{i} + 7\hat{j} - \hat{k}$, $\vec{b} = 3\hat{i} + 5\hat{k}$ and $\vec{c} = \hat{i} - \hat{j} + 2\hat{k}$. Let $\vec{d}$ be a vector which is perpendicular to both $\vec{a}$ and $\vec{b}$, and $\vec{c} \cdot \vec{d} = 12$. Then $(-\hat{i} + \hat{j} - \hat{k}) \cdot (\vec{c} \times \vec{d})$ is equal to :

- (A) 24 (B) 42 (C) 44 (D) 48

Q70. JEE Main 2023

Let $\vec{a}$ and $\vec{b}$ be two vectors such that $|\vec{a}| = \sqrt{14}$, $|\vec{b}| = \sqrt{6}$ and $|\vec{a} \times \vec{b}| = \sqrt{48}$. Then $(\vec{a} \cdot \vec{b})^2$ is equal to _____.

Q71. JEE Main 2023

Let $\vec{a} = 2\hat{i} + 3\hat{j} + 4\hat{k}$, $\vec{b} = \hat{i} - 2\hat{j} - 2\hat{k}$ and $\vec{c} = -\hat{i} + 4\hat{j} + 3\hat{k}$. If $\vec{d}$ is a vector perpendicular to both $\vec{b}$ and $\vec{c}$, and $\vec{a} \cdot \vec{d} = 18$, then $|\vec{a} \times \vec{d}|^2$ is equal to :

- (A) 680 (B) 720 (C) 760 (D) 640

Q72. JEE Main 2022

Let $\vec{a} = \hat{i} - \hat{j} + 2\hat{k}$ and let $\vec{b}$ be a vector such that $\vec{a} \times \vec{b} = 2\hat{i} - \hat{k}$ and $\vec{a} \cdot \vec{b} = 3$. Then the projection of $\vec{b}$ on the vector $\vec{a} - \vec{b}$ is :

- (A) $\frac{2}{\sqrt{21}}$ (B) $2\sqrt{\frac{3}{7}}$
 (C) $\frac{2}{3}\sqrt{\frac{7}{3}}$ (D) $\frac{2}{3}$

Q73. JEE Main 2022

Let $\vec{a}$ and $\vec{b}$ be two vectors such that $|\vec{a} + \vec{b}|^2 = |\vec{a}|^2 + 2|\vec{b}|^2$, $\vec{a} \cdot \vec{b} = 3$ and $|\vec{a} \times \vec{b}|^2 = 75$. Then $|\vec{a}|^2$ is equal to _____.

Q74. JEE Main 2022

Let θ be the angle between the vectors $\vec{a}$ and $\vec{b}$, where $|\vec{a}| = 4$, $|\vec{b}| = 3$ and $\theta \in (\frac{\pi}{4}, \frac{\pi}{3})$. Then $|\vec{a} - \vec{b}|^2 + 4(\vec{a} \cdot \vec{b})^2$ is equal to _____.

Q75. JEE Main 2022

Let $\hat{a}$ and $\hat{b}$ be two unit vectors such that $|(\hat{a} + \hat{b}) + 2(\hat{a} \times \hat{b})| = 2$. If $\theta \in (0, \pi)$ is the angle between $\hat{a}$ and $\hat{b}$, then among the statements :

(S1) : $2|\hat{a} \times \hat{b}| = |\hat{a} - \hat{b}|$

(S2) : The projection of $\hat{a}$ on $(\hat{a} + \hat{b})$ is $\frac{1}{2}$

(A) Only (S1) is true.

(B) Only (S2) is true.

(C) Both (S1) and (S2) are true.

(D) Both (S1) and (S2) are false.

Q76. JEE Main 2022

Let $\hat{a}$, $\hat{b}$ be unit vectors. If $\vec{c}$ be a vector such that the angle between $\hat{a}$ and $\vec{c}$ is $\frac{\pi}{12}$, and $\hat{b} = \vec{c} + 2(\vec{c} \times \hat{a})$, then $|6\vec{c}|^2$ is equal to :

(A) $6(3 - \sqrt{3})$

(B) $3 + \sqrt{3}$

(C) $6(3 + \sqrt{3})$

(D) $6(\sqrt{3} + 1)$

Q77. JEE Main 2021

If $|\vec{a}| = 2$, $|\vec{b}| = 5$ and $|\vec{a} \times \vec{b}| = 8$, then $|\vec{a} \cdot \vec{b}|$ is equal to :

(A) 6

(B) 4

(C) 3

(D) 5

Q78. JEE Main 2021

Let $\vec{a} = \hat{i} + 5\hat{j} + a\hat{k}$, $\vec{b} = \hat{i} + 3\hat{j} + \beta\hat{k}$ and $\vec{c} = -\hat{i} + 2\hat{j} - 3\hat{k}$ be three vectors such that, $|\vec{b} \times \vec{c}| = 5\sqrt{3}$ and $\vec{a}$ is perpendicular to $\vec{b}$. Then the greatest amongst the values of $|\vec{a}|^2$ is _____.

Q79. JEE Main 2018

If $\vec{a}$, $\vec{b}$, and $\vec{c}$ are unit vectors such that $\vec{a} + 2\vec{b} + 2\vec{c} = \vec{0}$, then $|\vec{a} \times \vec{c}|$ is equal to :

(A) $\frac{\sqrt{15}}{4}$

(B) $\frac{1}{4}$

(C) $\frac{15}{16}$

(D) $\frac{\sqrt{15}}{16}$

Q80. JEE Main 2003

Let $\vec{u} = \hat{i} + \hat{j}$, $\vec{v} = \hat{i} - \hat{j}$ and $\vec{w} = \hat{i} + 2\hat{j} + 3\hat{k}$. If $\hat{n}$ is a unit vector such that $\vec{u} \cdot \hat{n} = 0$ and $\vec{v} \cdot \hat{n} = 0$, then $|\vec{w} \cdot \hat{n}|$ is equal to :

(A) 3

(B) 0

(C) 1

(D) 2

Q81. JEE Main 2002

If $|\vec{a}| = 4$, $|\vec{b}| = 2$ and the angle between $\vec{a}$ and $\vec{b}$ is $\pi/6$ then $(\vec{a} \times \vec{b})^2$ is equal to :

(A) 48

(B) 16

(C) $\vec{a}$

(D) none of these

Topic 8: Cross Product Application: Area**Q82. JEE Main 2026**

Let $\vec{a} = 2\hat{i} + 3\hat{j} + 3\hat{k}$ and $\vec{b} = 6\hat{i} + 3\hat{j} + 3\hat{k}$. Then the square of the area of the triangle with adjacent sides determined by the vectors $(2\vec{a} + 3\vec{b})$ and $(\vec{a} - \vec{b})$ is :

(A) 450

(B) 900

(C) 1800

(D) 2400

Q83. JEE Main 2023

Let for a triangle ABC,

$$\vec{AB} = -2\hat{i} + \hat{j} + 3\hat{k}$$

$$\vec{CB} = \alpha\hat{i} + \beta\hat{j} + \gamma\hat{k}$$

$$\vec{CA} = 4\hat{i} + 3\hat{j} + \delta\hat{k}$$

If $\delta > 0$ and the area of the triangle ABC is $5\sqrt{6}$, then $\vec{CB} \cdot \vec{CA}$ is equal to

(A) 60

(B) 54

(C) 120

(D) 108

Q84. JEE Main 2024

Let three vectors $\vec{a} = \alpha\hat{i} + 4\hat{j} + 2\hat{k}$, $\vec{b} = 5\hat{i} + 3\hat{j} + 4\hat{k}$, $\vec{c} = x\hat{i} + y\hat{j} + z\hat{k}$ form a triangle such that $\vec{c} = \vec{a} - \vec{b}$ and the area of the triangle is $5\sqrt{6}$. If α is a positive real number, then $|\vec{c}|^2$ is equal to:

(A) 14

(B) 12

(C) 16

(D) 10

Q85. JEE Main 2024

Let ABC be a triangle of area $15\sqrt{2}$ and the vectors $\vec{AB} = \hat{i} + 2\hat{j} - 7\hat{k}$, $\vec{BC} = \alpha\hat{i} + \beta\hat{j} + \gamma\hat{k}$ and $\vec{AC} = 6\hat{i} + d\hat{j} - 2\hat{k}$, $d > 0$. Then the square of the length of the largest side of the triangle ABC is _____.

Q86. JEE Main 2024

If A(1, -1, 2), B(5, 7, -6), C(3, 4, -10) and D(-1, -4, -2) are the vertices of a quadrilateral ABCD, then its area is :

(A) $24\sqrt{7}$

(B) $48\sqrt{7}$

(C) $24\sqrt{29}$

(D) $12\sqrt{29}$

Q87. JEE Main 2023

A(2, 6, 2), B(-4, 0, λ), C(2, 3, -1) and D(4, 5, 0), $|\lambda| \leq 5$ are the vertices of a quadrilateral ABCD. If its area is 18 square units, then $5 - 6\lambda$ is equal to _____.

Q88. JEE Main 2023

The area of the quadrilateral ABCD with vertices A(2, 1, 1), B(1, 2, 5), C(-2, -3, 5) and D(1, -6, -7) is equal to :

(A) 48

(B) $8\sqrt{38}$

(C) 54

(D) $9\sqrt{38}$

Q89. JEE Main 2022

Let $\vec{a} = a\hat{i} + 2\hat{j} - \hat{k}$ and $\vec{b} = -2\hat{i} + a\hat{j} + \hat{k}$, where $a \in R$. If the area of the parallelogram whose adjacent sides are represented by the vectors $\vec{a}$ and $\vec{b}$ is $\sqrt{15(a^2 + 4)}$, then the value of $2|\vec{a}|^2 + (\vec{a} \cdot \vec{b})|\vec{b}|^2$ is equal to :

- (A) 10
(B) 7
(C) 9
(D) 14

Q90. JEE Main 2021

Let $\vec{a} = \hat{i} + a\hat{j} + 3\hat{k}$ and $\vec{b} = 3\hat{i} - a\hat{j} + \hat{k}$. If the area of the parallelogram whose adjacent sides are represented by the vectors $\vec{a}$ and $\vec{b}$ is $8\sqrt{3}$ square units, then $\vec{a} \cdot \vec{b}$ is equal to _____.

Q91. JEE Main 2017

The area (in sq. units) of the parallelogram whose diagonals are along the vectors $8\hat{i} - 6\hat{j}$ and $3\hat{i} + 4\hat{j} - 12\hat{k}$, is :

- (A) 26 (B) 65
(C) 20 (D) 52

Topic 9: Most Repeated Pattern**Q92. JEE Main 2026**

Let $\vec{a} = \sqrt{7}\hat{i} + \hat{j} - \hat{k}$ and $\vec{b} = \hat{j} + 2\hat{k}$. If $\vec{r}$ is a vector such that $\vec{r} \times \vec{a} + \vec{a} \times \vec{b} = \vec{0}$ and $\vec{r} \cdot \vec{a} = 0$, then $|3\vec{r}|^2$ is equal to:

- (A) 44 (B) 54 (C) 86 (D) 132

Q93. JEE Main 2025

Let $\vec{a} = \hat{i} + \hat{j} + \hat{k}$, $\vec{b} = 3\hat{i} + 2\hat{j} - \hat{k}$, $\vec{c} = \lambda\hat{j} + \mu\hat{k}$ and $\hat{d}$ be a unit vector such that $\vec{a} \times \hat{d} = \vec{b} \times \hat{d}$ and $\vec{c} \cdot \hat{d} = 1$. If $\vec{c}$ is perpendicular to $\vec{a}$, then $|3\lambda\hat{d} + \mu\vec{c}|^2$ is equal to _____

Q94. JEE Main 2025

Let $\vec{a} = \hat{i} + 2\hat{j} + \hat{k}$, $\vec{b} = 3\hat{i} - 3\hat{j} + 3\hat{k}$, $\vec{c} = 2\hat{i} - \hat{j} + 2\hat{k}$ and $\vec{d}$ be a vector such that $\vec{b} \times \vec{d} = \vec{c} \times \vec{d}$ and $\vec{a} \cdot \vec{d} = 4$. Then $|(\vec{a} \times \vec{d})|^2$ is equal to _____.

Q95. JEE Main 2023

Let $\vec{a} = \hat{i} + 4\hat{j} + 2\hat{k}$, $\vec{b} = 3\hat{i} - 2\hat{j} + 7\hat{k}$ and $\vec{c} = 2\hat{i} - \hat{j} + 4\hat{k}$. If a vector $\vec{d}$ satisfies $\vec{d} \times \vec{b} = \vec{c} \times \vec{b}$ and $\vec{d} \cdot \vec{a} = 24$, then $|\vec{d}|^2$ is equal to :

- (A) 313 (B) 413 (C) 423 (D) 323

Q96. JEE Main 2024

Let $\vec{a} = 3\hat{i} + \hat{j} - 2\hat{k}$, $\vec{b} = 4\hat{i} + \hat{j} + 7\hat{k}$ and $\vec{c} = \hat{i} - 3\hat{j} + 4\hat{k}$ be three vectors. If a vectors $\vec{p}$ satisfies $\vec{p} \times \vec{b} = \vec{c} \times \vec{b}$ and $\vec{p} \cdot \vec{a} = 0$, then $\vec{p} \cdot (\hat{i} - \hat{j} - \hat{k})$ is equal to

- (A) 24 (B) 32 (C) 36 (D) 28

Q97. JEE Main 2024

Let $\vec{a} = \hat{i} + \hat{j} + \hat{k}$, $\vec{b} = -\hat{i} - 8\hat{j} + 2\hat{k}$ and $\vec{c} = 4\hat{i} + c_2\hat{j} + c_3\hat{k}$ be three vectors such that $\vec{b} \times \vec{a} = \vec{c} \times \vec{a}$. If the angle between the vector $\vec{c}$ and the vector $3\hat{i} + 4\hat{j} + \hat{k}$ is θ , then the greatest integer less than or equal to $\tan^2 \theta$ is _____.

Q98. JEE Main 2024

Let $\vec{a} = 4\hat{i} - \hat{j} + \hat{k}$, $\vec{b} = 11\hat{i} - \hat{j} + \hat{k}$ and $\vec{c}$ be a vector such that $(\vec{a} + \vec{b}) \times \vec{c} = \vec{c} \times (-2\vec{a} + 3\vec{b})$. If $(2\vec{a} + 3\vec{b}) \cdot \vec{c} = 1670$, then $|\vec{c}|^2$ is equal to:

- (A) 1600 (B) 1618 (C) 1627 (D) 1609

Q99. JEE Main 2024

Let $\vec{a} = \hat{i} - 3\hat{j} + 7\hat{k}$, $\vec{b} = 2\hat{i} - \hat{j} + \hat{k}$ and $\vec{c}$ be a vector such that $(\vec{a} + 2\vec{b}) \times \vec{c} = 3(\vec{c} \times \vec{a})$. If $\vec{a} \cdot \vec{c} = 130$, then $\vec{b} \cdot \vec{c}$ is equal to _____.

Q100. JEE Main 2024

Let $\vec{a} = 2\hat{i} + 5\hat{j} - \hat{k}$, $\vec{b} = 2\hat{i} - 2\hat{j} + 2\hat{k}$ and $\vec{c}$ be three vectors such that $(\vec{c} + \hat{i}) \times (\vec{a} + \vec{b} + \hat{i}) = \vec{a} \times (\vec{c} + \hat{i})$. If $\vec{a} \cdot \vec{c} = -29$, then $\vec{c} \cdot (-2\hat{i} + \hat{j} + \hat{k})$ is equal to:

- (A) 15 (B) 10 (C) 5 (D) 12

Q101. JEE Main 2023

Let $\vec{a} = \hat{i} + 2\hat{j} + \lambda\hat{k}$, $\vec{b} = 3\hat{i} - 5\hat{j} - \lambda\hat{k}$, $\vec{a} \cdot \vec{c} = 7$, $2\vec{b} \cdot \vec{c} + 43 = 0$, $\vec{a} \times \vec{c} = \vec{b} \times \vec{c}$. Then $|\vec{a} \cdot \vec{b}|$ is equal to :

Q102. JEE Main 2026

Let $\vec{a} = 2\hat{i} - 5\hat{j} + 5\hat{k}$ and $\vec{b} = \hat{i} - \hat{j} + 3\hat{k}$. If $\vec{c}$ is a vector such that $2(\vec{a} \times \vec{c}) + 3(\vec{b} \times \vec{c}) = \vec{0}$ and $(\vec{a} - \vec{b}) \cdot \vec{c} = -97$, then $|\vec{c} \times \hat{k}|^2$ is equal to

- (A) 193 (B) 205 (C) 218 (D) 233

Q103. JEE Main 2026

Let $\vec{a} = 4\hat{i} - \hat{j} + 3\hat{k}$, $\vec{b} = 10\hat{i} + 2\hat{j} - \hat{k}$ and a vector $\vec{c}$ be such that $2(\vec{a} \times \vec{b}) + 3(\vec{b} \times \vec{c}) = \vec{0}$. If $\vec{a} \cdot \vec{c} = 15$, then $\vec{c} \cdot (\hat{i} + \hat{j} - 3\hat{k})$ is equal to :

- (A) -6 (B) -5 (C) -4 (D) -3

Q104. JEE Main 2025

Let $\vec{a} = 2\hat{i} - \hat{j} + 3\hat{k}$, $\vec{b} = 3\hat{i} - 5\hat{j} + \hat{k}$ and $\vec{c}$ be a vector such that $\vec{a} \times \vec{c} = \vec{a} \times \vec{b} = \vec{c} \times \vec{b}$ and $(\vec{a} + \vec{c}) \cdot (\vec{b} + \vec{c}) = 168$. Then the maximum value of $|\vec{c}|^2$ is :

- (A) 77 (B) 154 (C) 308 (D) 462

Q105. JEE Main 2026

Let $\vec{a}, \vec{b}, \vec{c}$ be three vectors such that $\vec{a} \times \vec{b} = 2(\vec{a} \times \vec{c})$. If $|\vec{a}| = 1$, $|\vec{b}| = 4$, $|\vec{c}| = 2$, and the angle between $\vec{b}$ and $\vec{c}$ is 60° , then $|\vec{a} \cdot \vec{c}|$ is equal to

- (A) 2 (B) 0 (C) 1 (D) 4

ANSWER KEY

1. B	2. 4	3. C	4. 1	5. 2	6. C	7. A	8. 5	9. B	10. D
11. B	12. 5	13. C	14. A	15. B	16. B	17. B	18. 60	19. C	20. C
21. D	22. A	23. -	24. C	25. D	26. D	27. A	28. B	29. 5	30. 6
31. B	32. B	33. B	34. B	35. C	36. D	37. C	38. A	39. D	40. A
41. A	42. 1494	43. 486	44. A	45. 38	46. D	47. C	48. C	49. 3	50. A
51. A	52. D	53. D	54. C	55. 14	56. 3	57. 28	58. A	59. B	60. C
61. C	62. A	63. A	64. C	65. B	66. D	67. 66	68. D	69. C	70. 36
71. B	72. A	73. 14	74. 576	75. C	76. C	77. A	78. 90	79. A	80. A
81. B	82. C	83. A	84. A	85. 54	86. D	87. 11	88. B	89. D	90. 2
91. B	92. A	93. 5	94. 128	95. B	96. B	97. 38	98. B	99. 30	100. C
101. 8	102. C	103. B	104. C	105. C					