

PART 1 - MATHEMATICS

Topic : Vector algebra

SECTION-A : (Maximum Marks : 12)

This section contains **THREE** questions.

Each question has **TWO** lists: **List-I** and **List-II**.

Four options are given representing matching of elements from List-I and List-II. **ONLY ONE** of these four options corresponds to a correct matching.

For each question, choose the option corresponding to the correct answer.

Answer to each question will be evaluated according to the following marking scheme :

Full Marks : +4 If **ONLY** the correct option is chosen;

Zero Marks : 0 If none of the options is chosen (i.e. the question is unanswered);

Negative Marks : -1 In all other cases.

1. For real numbers $\alpha, \beta, \gamma, \delta$ and μ , consider the matrix

$$M = \begin{bmatrix} \alpha & \frac{1}{\sqrt{2}} & -\frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{3}} & \beta & \frac{1}{\sqrt{3}} \\ \gamma & \delta & \mu \end{bmatrix}.$$

Suppose that $MM^T = I$, where M^T is the transpose of the matrix M , and I is the 3×3 identity matrix. Let

$$\vec{u} = \alpha \hat{i} + \frac{1}{\sqrt{3}} \hat{j} + \gamma \hat{k}, \quad \vec{v} = \frac{1}{\sqrt{2}} \hat{i} + \beta \hat{j} + \delta \hat{k} \quad \text{and} \quad \vec{w} = -\frac{1}{\sqrt{2}} \hat{i} + \frac{1}{\sqrt{3}} \hat{j} + \mu \hat{k}.$$

Match each entry in **List-I** to the correct entry in **List-II** and choose the correct option.

[JEE Advanced 2026 Paper 1]

List-I		List-II	
P.	The value of $\gamma^2 + \delta^2$ is	1.	0
Q.	If $x\vec{u} + y\vec{v} + z\vec{w} = \hat{j}$ for some real numbers x, y and z , then the value of x is	2.	1
R.	The value of $ \vec{u} \cdot (\vec{v} \times \vec{w}) $ is	3.	$\frac{1}{\sqrt{2}}$
S.	The value of $ \vec{u} \times (\vec{v} \times \vec{w}) $ is	4.	$\frac{1}{\sqrt{3}}$
		5.	$\frac{5}{6}$

Space for Rough Work

- (A) $(P) \rightarrow (5), (Q) \rightarrow (4), (R) \rightarrow (2), (S) \rightarrow (1)$ (B) $(P) \rightarrow (4), (Q) \rightarrow (5), (R) \rightarrow (1), (S) \rightarrow (2)$
 (C) $(P) \rightarrow (5), (Q) \rightarrow (3), (R) \rightarrow (2), (S) \rightarrow (1)$ (D) $(P) \rightarrow (5), (Q) \rightarrow (4), (R) \rightarrow (1), (S) \rightarrow (2)$

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2. Let $\vec{a}, \vec{b}$ be two vectors, and let P, Q and R be the points with position vectors $\vec{a}, \vec{b}$ and $\vec{a} + \vec{b}$, respectively, with respect to the origin O. If $|\vec{a} + \vec{b}| = \sqrt{21}$, $|\vec{a} - \vec{b}| = 3$, and $\vec{a}$ and $(\vec{a} - \vec{b})$ are perpendicular to each other, then the area of the triangle OPR is

[JEE Advanced 2026 Paper 2]

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

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3. Let $\vec{w} = \hat{i} + \hat{j} - 2\hat{k}$, and $\vec{u}$ and $\vec{v}$ be two vectors, such that $\vec{u} \times \vec{v} = \vec{w}$ and $\vec{v} \times \vec{w} = \vec{u}$. Let α, β, γ , and t be real numbers such that
 $\vec{u} = \alpha\hat{i} + \beta\hat{j} + \gamma\hat{k}$, $-t\alpha + \beta + \gamma = 0$, $\alpha - t\beta + \gamma = 0$, and $\alpha + \beta - t\gamma = 0$.

Match each entry in **List-I** to the correct entry in **List-II** and choose the correct option.

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List-I		List-II	
P.	$ \vec{v} ^2$ is equal to	1.	0
Q.	If $\alpha = \sqrt{3}$, then γ^2 is equal to	2.	1
R.	If $\alpha = \sqrt{3}$, then $(\beta + \gamma)^2$ is equal to	3.	2
S.	If $\alpha = \sqrt{2}$, then $t + 3$ is equal to	4.	3
		5.	5

- (A) $(P) \rightarrow (2), (Q) \rightarrow (1), (R) \rightarrow (4), (S) \rightarrow (5)$ (B) $(P) \rightarrow (2), (Q) \rightarrow (4), (R) \rightarrow (3), (S) \rightarrow (5)$
 (C) $(P) \rightarrow (2), (Q) \rightarrow (1), (R) \rightarrow (4), (S) \rightarrow (3)$ (D) $(P) \rightarrow (5), (Q) \rightarrow (4), (R) \rightarrow (1), (S) \rightarrow (3)$

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SECTION-B : (Maximum Marks : 16)

This section contains **FOUR** questions.

The answer to each question is a **NUMERICAL VALUE**.

For each question, enter the correct numerical value of the answer (in decimal notation, truncated / rounded-off to the **SECOND DECIMAL PLACE**; e.g. 6.25, 7.00, -0.33, -0.30, 30.27, -127.30) in the place designated to enter the answer.

Answer to each question will be evaluated according to the following marking scheme :

Full Marks : +4 If ONLY the correct answer is entered;

Zero Marks : 0 In all other cases.

4. For any two points M and N in the XY-plane, let $\vec{MN}$ denote the vector from M to N, and $\vec{0}$ denote the zero vector. Let P, Q and R be three distinct points in the XY-plane. Let S be a point inside the triangle ΔPQR such that

$$\vec{SP} + 5\vec{SQ} + 6\vec{SR} = \vec{0}.$$

Let E and F be the mid-points of the sides PR and QR, respectively. Then the value of

$\frac{\text{length of the line segment EF}}{\text{length of the line segment ES}}$

is _____.

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5. Consider the vectors

$$\vec{x} = \hat{i} + 2\hat{j} + 3\hat{k}, \quad \vec{y} = 2\hat{i} + 3\hat{j} + \hat{k}, \quad \text{and} \quad \vec{z} = 3\hat{i} + \hat{j} + 2\hat{k}.$$

For two distinct positive real numbers α and β , define

$$\vec{X} = \alpha\vec{x} + \beta\vec{y} - \vec{z}, \quad \vec{Y} = \alpha\vec{y} + \beta\vec{z} - \vec{x}, \quad \text{and} \quad \vec{Z} = \alpha\vec{z} + \beta\vec{x} - \vec{y}.$$

If the vectors $\vec{X}$, $\vec{Y}$, and $\vec{Z}$ lie in a plane, then the value of $\alpha + \beta - 3$ is _____.

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6. Let $\vec{OP} = \frac{\alpha-1}{\alpha}\hat{i} + \hat{j} + \hat{k}$, $\vec{OQ} = \hat{i} + \frac{\beta-1}{\beta}\hat{j} + \hat{k}$ and $\vec{OR} = \hat{i} + \hat{j} + \frac{1}{2}\hat{k}$ be three vectors, where

$\alpha, \beta \in \mathbb{R} - \{0\}$ and O denotes the origin. If $(\vec{OP} \times \vec{OQ}) \cdot \vec{OR} = 0$ and the point $(\alpha, \beta, 2)$ lies on

the plane $3x + 3y - z + l = 0$, then the value of l is _____.

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7. Let $\vec{p} = 2\hat{i} + \hat{j} + 3\hat{k}$ and $\vec{q} = \hat{i} - \hat{j} + \hat{k}$. If for some real numbers α , β , and γ , we have $15\hat{i} + 10\hat{j} + 6\hat{k} = \alpha(2\vec{p} + \vec{q}) + \beta(\vec{p} - 2\vec{q}) + \gamma(\vec{p} \times \vec{q})$, then the value of γ is _____.

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JEE ADVANCED VECTOR ALGEBRA — PYQS

Test Pattern : JEE (Advanced)

ANSWER KEY

SECTION-A																								
Ques.	1	2	3																					
Ans.	A	C	A																					

SECTION-B										
Ques.	4		5		6		7			
Ans.	1.15 to 1.25		-2		5		2			