PART 1 - MATHEMATICS

Topic : Vector algebra

SECTION–1 : (Maximum Marks : 3)

- This section contains **ONE** question.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.
- 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	: +3	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. 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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Space for Rough Work

SECTION–2 : (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, −.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.

2. For any two points M and N in the XY-plane, let $\overrightarrow{MN}$ 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

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

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 _____.

[JEE Advanced 2025 Paper 1]

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3. 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 α + β − 3 is _____.

[JEE Advanced 2025 Paper 2]

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4. Let $\overrightarrow{OP} = \frac{\alpha - 1}{\alpha}\hat{i} + \hat{j} + \hat{k}$, $\overrightarrow{OQ} = \hat{i} + \frac{\beta - 1}{\beta}\hat{j} + \hat{k}$ and $\overrightarrow{OR} = \hat{i} + \hat{j} + \frac{1}{2}\hat{k}$ be three vectors, where $\alpha, \beta \in R - \{0\}$ and O denotes the origin. If $(\overrightarrow{OP} \times \overrightarrow{OQ}) \cdot \overrightarrow{OR} = 0$ and the point (α, β,2) lies on the plane 3x + 3y − z + l = 0, then the value of l is _____.

[JEE Advanced 2024 Paper 1]

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5. 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 _____.

[JEE Advanced 2024 Paper 2]

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SECTION–3 : (Maximum Marks : 8)

- This section contains **TWO** 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.

6. For real numbers α, β, γ, δ 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 $\vec{u} = \alpha\hat{i} + \frac{1}{\sqrt{3}}\hat{j} + \gamma\hat{k}$, $\vec{v} = \frac{1}{\sqrt{2}}\hat{i} + \beta\hat{j} + \delta\hat{k}$ and $\vec{w} = -\frac{1}{\sqrt{2}}\hat{i} + \frac{1}{\sqrt{3}}\hat{j} + \mu\hat{k}$.

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 $\lvert\vec{u} \cdot (\vec{v} \times \vec{w})\rvert$ is	3.	$\frac{1}{\sqrt{2}}$
S.	The value of $\lvert\vec{u} \times (\vec{v} \times \vec{w})\rvert$ is	4.	$\frac{1}{\sqrt{3}}$
		5.	$\frac{5}{6}$

(A) (P) → (5), (Q) → (4), (R) → (2), (S) → (1)
(B) (P) → (4), (Q) → (5), (R) → (1), (S) → (2)
(C) (P) → (5), (Q) → (3), (R) → (2), (S) → (1)
(D) (P) → (5), (Q) → (4), (R) → (1), (S) → (2)

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Space for Rough Work

7. 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

$\vec{u} = \alpha\hat{i} + \beta\hat{j} + \gamma\hat{k}$, $\quad -t\alpha + \beta + \gamma = 0$, $\quad \alpha - t\beta + \gamma = 0$, $\quad$ and $\alpha + \beta - t\gamma = 0$.

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

[JEE Advanced 2025 Paper 1]

	List-I		List-II
P.	$\lvert\vec{v}\rvert^2$ 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) → (2), (Q) → (1), (R) → (4), (S) → (5)
(B) (P) → (2), (Q) → (4), (R) → (3), (S) → (5)
(C) (P) → (2), (Q) → (1), (R) → (4), (S) → (3)
(D) (P) → (5), (Q) → (4), (R) → (1), (S) → (3)

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JEE ADVANCED VECTOR ALGEBRA — PYQS

Test Pattern : **JEE (Advanced)**

ANSWER KEY

SECTION–1

Ques.	1
Ans.	C

SECTION–2

Ques.	2	3	4	5
Ans.	1.15 to 1.25	-2	5	2

SECTION–3

Ques.	6	7
Ans.	A	A

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