CBSE NCERT Based Chapter wise Questions (2025-2026)

Class-XII

Subject: Mathematics

Total : 11 Marks (expected) [MCQ-1 Mark, VSA-2 Marks, SA-3 Marks, LA-5 Marks]

Chapter Name : *Vector Algebra* (Chap : 10)

Level 1 & 2 Combined

SECTION – A

MCQ Type (1 mark each):

1. If $|\vec{a}|=4$, $|\vec{b}|=2\sqrt{3}$ and $|\vec{a}\times\vec{b}|=12$, then the angle between the vectors $\vec{a}$ and $\vec{b}$ is

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

[Hints : Cross product]

2. If $\vec{a}=2\hat{i}+4\hat{j}-3\hat{k}$, $\vec{b}=\hat{i}+2\hat{j}+m\hat{k}$ and $|\vec{a}\times\vec{b}|=0$, then the value of m is

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

[Hints : Cross product]

3. If $\vec{a}=2\hat{i}-3\hat{j}+4\hat{k}$ and $\vec{b}=-6\hat{i}+9\hat{j}-12\hat{k}$, then

Ⓐ $\vec{a}\perp\vec{b}$ Ⓑ $\vec{a}\parallel\vec{b}$

Ⓒ angle between the vectors is $\frac{\pi}{3}$ Ⓓ none

[Hints : dot product]

4. Find the scalar projection of $\vec{a}=3\hat{i}-\hat{j}+4\hat{k}$ on $\vec{b}=2\hat{i}+3\hat{j}-6\hat{k}$.

Ⓐ -1 Ⓑ -2 Ⓒ -3 Ⓓ -4

[Hints : Concept of projection of $\vec{a}$ on $\vec{b}$]

5. If $\vec{a}$ and $\vec{b}$ are the diagonals of a rhombus. Then

Ⓐ $\vec{a}\cdot\vec{b}=0$ Ⓑ $\vec{a}\times\vec{b}=0$ Ⓒ $\vec{a}\cdot\vec{b}=\frac{\pi}{2}$ Ⓓ $\vec{a}\times\vec{b}=\frac{\pi}{2}$

[Hints : Diagonals are perpendicular]

6. For what values of p and q the vectors $2\hat{i}+p\hat{j}-3\hat{k}$ and $q\hat{i}-4\hat{j}+2\hat{k}$ are parallel?

Ⓐ $p=-\frac{4}{3}$, $q=6$ Ⓑ $p=6$, $q=-\frac{4}{3}$ Ⓒ $p=6$, $q=-4$ Ⓓ $p=-4$, $q=6$

[Hints : Concept of collinear vectors]

7. If $|\vec{\alpha}|=|\vec{\beta}|=|\vec{\gamma}|$ and $\vec{\alpha}+\vec{\beta}+\vec{\gamma}=\vec{0}$ then $\vec{\alpha}.\vec{\beta}+\vec{\beta}.\vec{\gamma}+\vec{\gamma}.\vec{\alpha}=$?

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

[Hints : Use $(\vec{a}+\vec{b}+\vec{c})^2=0$]

SECTION – B

Very Short Answer (VSA) (2 marks each questions):

1. If $\vec{a} = 2\hat{i} - \hat{j} + 3\hat{k}$ and $\vec{b} = 3\hat{i} + \hat{j} - 2\hat{k}$, find the angle between the vectors $(\vec{a} + \vec{b})$ and $(\vec{a} - \vec{b})$.

[Hints : dot product of $(\vec{a} + \vec{b})$ and $(\vec{a} - \vec{b})$]

2. Find the vector projection of $\vec{b}$ on $\vec{a}$ where $\vec{a} = \hat{i} + 2\hat{j} + 2\hat{k}$ and $\vec{b} = \hat{j} + 2\hat{k}$.

[Hints : Vector projection of $\vec{x}$ on $\vec{y}$]

3. If two vectors $\vec{a}$ and $\vec{b}$ are such that $|\vec{a} \cdot \vec{b}| = |\vec{a} \times \vec{b}|$. Then find the angle between $\vec{a}$ and $\vec{b}$.

[Hints : Definitions of dot and cross product]

4. Adjacent sides of a parallelogram are $\vec{a} = 3\hat{i} - \hat{j} + 4\hat{k}$ and $\vec{b} = \hat{i} - \hat{j} + \hat{k}$ find its area?

[Hints : Area $|\vec{a} \times \vec{b}|$]

5. In the question 4 if $\vec{a}$ and $\vec{b}$ vectors are the diagonals of the parallelogram then what will be the area of the parallelogram?

[Hints : Use, area $= \frac{1}{2}|\vec{d}_1 \times \vec{d}_2|$]

6. Prove that $(\vec{a} \times \vec{b})^2 + (\vec{a} \cdot \vec{b})^2 = |\vec{a}|^2 |\vec{b}|^2$

[Hints : Lagranges identity]

7. Prove that if $\vec{a} + \vec{b} + \vec{c} = 0$ show that, $\vec{a} \times \vec{b} = \vec{b} \times \vec{c} = \vec{c} \times \vec{a}$

[Hints : Take $\vec{a} \times$ with $(\vec{a} + \vec{b} + \vec{c})$ and again $\vec{b} \times$ with $(\vec{a} + \vec{b} + \vec{c})$]

SECTION – C

Short Answer (SA) (3 marks each questions):

1. Find the distance of the point (2, –1, 3) from the line $\vec{r} = (2\hat{i} - \hat{j} + 2\hat{k}) + \mu(3\hat{i} + 6\hat{j} + 2\hat{k})$ measured parallel to z–axis.

[Hints : Vector equation of line]

2. Find the point of intersection of the line $\vec{r} = (3\hat{i} + \hat{k}) + \mu(\hat{i} + \hat{j} + \hat{k})$ and the line through (2, –1, 1) parallel to the z axis. How far is this point from the z-axis?

[Hints : Vector equation of lines]

3. Verify that lines given by $\vec{r} = (1 - \lambda)\hat{i} + (\lambda - 2)\hat{j} + (3 - 2\lambda)\hat{k}$ and $\vec{r} = (\mu + 1)\hat{i} + (2\mu - 1)\hat{j} - (2\mu + 1)\hat{k}$ are skew lines. Hence, find shortest distance between the lines.

[Hints : Skew lines and shortest distance]

4. During a cricket match, the position of the bowler, the cricket keeper and leg slip fielder are in a line given by $\vec{B} = 2\hat{i} + 8\hat{j}$, $\vec{W} = 6\hat{i} + 12\hat{j}$ and $\vec{F} = 12\hat{i} + 8\hat{j}$ respectively. Calculate the ratio in which the wicketkeeper divides the line segment joining the bowler and the leg slip fielder.

[Hints : Section formula]

5. The position vectors of vertices of ΔABC are $A(2\hat{i}-\hat{j}+\hat{k})$, $B(\hat{i}-3\hat{j}-5\hat{k})$ and $C(3\hat{i}-4\hat{j}-4\hat{k})$. Find the angles of ΔABC.

[Hints : Use dot product]

6. Show that $\vec{a}+\vec{c}=t\vec{b}$ where t is a scalar if $\vec{a}\times\vec{b}=\vec{b}\times\vec{c}\neq\vec{0}$.

[Hints : Use cross product]

7. Find the point of intersection of the lines: $\vec{r}=(\hat{i}+\hat{j}-\hat{k})+\lambda(3\hat{i}-\hat{j})$
$\vec{r}=(4\hat{i}-\hat{k})+\mu(2\hat{i}+3\hat{k})$

[Hints : Consider general point and compare $\hat{i}$, $\hat{j}$, $\hat{k}$ components]

SECTION – D

Long Answer (LA) (5 marks each questions):

1. For two vectors $\vec{a}$ and $\vec{b}$, show that $|\vec{a}\times\vec{b}|^2 = \begin{vmatrix}\vec{a}\cdot\vec{a} & \vec{a}\cdot\vec{b}\\ \vec{a}\cdot\vec{b} & \vec{b}\cdot\vec{b}\end{vmatrix}$

[Hints : $|\vec{a}\times\vec{b}| = |\vec{a}||\vec{b}|\sin\theta$, change $\sin\theta$ to $\cos\theta$)]

2. If $\vec{a}$, $\vec{b}$ and $\vec{c}$ are three unit vectors such that $\vec{a}\cdot\vec{b}=\vec{a}\cdot\vec{c}=0$ and angle between $\vec{b}$ and $\vec{c}$ is $\frac{\pi}{6}$; prove that, $\vec{a}=\pm 2(\vec{b}\times\vec{c})$.

[Hints : $\vec{a}=\lambda(\vec{b}\times\vec{c})$]

3. If θ be the angle between two unit vectors $\vec{e}_1$ and $\vec{e}_2$, prove that $|\vec{e}_1-\vec{e}_2| = 2\sin\frac{\theta}{2}$

[Hints : $\vec{e}_1\cdot\vec{e}_2$ and $|\vec{e}_1-\vec{e}_2|^2=(\vec{e}_1-\vec{e}_2)\cdot(\vec{e}_1-\vec{e}_2)$]

4. Using vectors, prove that $\frac{a}{\sin A}=\frac{b}{\sin B}=\frac{c}{\sin C}$.

[Hints : $\vec{a}+\vec{b}+\vec{c}=\vec{0}$; $\vec{a}\times(\vec{a}+\vec{b}+\vec{c})=\vec{0}$]

5. Using vectors, prove that $a^2 = b^2 + c^2 - 2bc\cos A$

[Hints : $\vec{a}+\vec{b}+\vec{c}=0$, $\vec{a}.(\vec{a}+\vec{b}+\vec{c})=\vec{0}$]

6. Using vectors prove that $a = b\cos C + C\cos B$

[Hints : $\vec{a}\,(\vec{a}+\vec{b}+\vec{c})=\vec{0}$]

7. Using vectors prove that $(a_1b_1 + a_2b_2 + a_3b_3)^2 \le (a_1^2 + a_2^2 + a_3^2)(b_1^2 + b_2^2 + b_3^2)$

[Hints : $\vec{a}=a_1\hat{i}+a_2\hat{j}+a_3\hat{k}$; $\vec{b}=b_1\hat{i}+b_2\hat{j}+b_3\hat{k}$ apply $\vec{a}\,\vec{b}$]

ANSWER

MCQs →

1. Ⓐ
2. Ⓒ
3. Ⓑ
4. Ⓒ
5. Ⓐ
6. Ⓑ
7. Ⓑ

VSA →

1. $\frac{\pi}{2}$
2. $\frac{2}{3}(\hat{i}+2\hat{j}+2\hat{k})$
3. $\frac{\pi}{4}$
4. $\sqrt{42}$ units
5. $\frac{\sqrt{14}}{2}$

SA →

1. 1 unit
2. 1 unit
3. $\frac{8}{\sqrt{29}}$unit
4. 2 : 3 internally
5. $\cos^{-1}\sqrt{\frac{6}{41}}$, $\cos^{-1}\sqrt{\frac{35}{41}}, \frac{\pi}{2}$
7. (4, 4, –1)