

GRADE XII
Question Bank (MATHEMATICS)
Chapter-10 Vector Algebra

1 Marks:

1. The vector with terminal point $A(2, -3, 5)$ and initial point $B(3, -4, 7)$ is **[BOARD 2024]**
a) $\hat{i} - \hat{j} + 2\hat{k}$ b) $\hat{i} + \hat{j} + 2\hat{k}$ c) $-\hat{i} - \hat{j} - 2\hat{k}$ d) $-\hat{i} + \hat{j} - 2\hat{k}$
2. If in ΔABC , $\overrightarrow{BA} = 2\vec{a}$ and $\overrightarrow{BC} = 3\vec{b}$ then \overrightarrow{AC} is **[BOARD 2023]**
a) $2\vec{a} + 3\vec{b}$ b) $2\vec{a} - 3\vec{b}$ c) $3\vec{b} - 2\vec{a}$ d) $-2\vec{a} - 3\vec{b}$
3. Let \vec{a} be a position vector whose tip is the point $(2, -3)$. If $\overrightarrow{AB} = \vec{a}$ where coordinates of A are $(-4, 5)$ then the coordinates of B are **[BOARD 2025]**
a) $(-2, -2)$ b) $(2, -2)$ c) $(-2, 2)$ d) $(2, 2)$
4. The magnitude of the vector $6\hat{i} - 2\hat{j} + 3\hat{k}$ is **[BOARD 2023]**
a) 1 b) 5 c) 7 d) 12
5. A unit vector along the vector $4\hat{i} - 3\hat{k}$ is **[BOARD 2023]**
a) $\frac{1}{7}(4\hat{i} - 3\hat{k})$ b) $\frac{1}{5}(4\hat{i} - 3\hat{k})$ c) $\frac{1}{\sqrt{7}}(4\hat{i} - 3\hat{k})$ d) $\frac{1}{\sqrt{5}}(4\hat{i} - 3\hat{k})$
6. The unit vector perpendicular to both vectors $\hat{i} + \hat{k}$ and $\hat{i} - \hat{k}$ is **[BOARD 2024 & 2025]**
a) $2\hat{j}$ b) \hat{j} c) $\frac{\hat{i} - \hat{k}}{\sqrt{2}}$ d) $\frac{\hat{i} + \hat{k}}{\sqrt{2}}$
7. If $\vec{a} = 2\hat{i} - \hat{j} + \hat{k}$ and $\vec{b} = \hat{i} + \hat{j} - \hat{k}$ then \vec{a} and \vec{b} are **[BOARD 2024]**
a) Collinear vectors which are not parallel
b) Parallel vectors
c) Perpendicular vectors
d) Unit vectors
8. If $|\vec{a} + \vec{b}| = |\vec{a} - \vec{b}|$ for any two vectors then vectors \vec{a} and \vec{b} are **[BOARD 2025]**
a) Orthogonal vectors c) parallel to each other
b) Unit vectors d) collinear vectors

9. The vectors $\vec{a} = 2\hat{i} - \hat{j} + \hat{k}$, $\vec{b} = \hat{i} - 3\hat{j} - 5\hat{k}$ and $\vec{c} = -3\hat{i} + 4\hat{j} + 4\hat{k}$ represents the sides of **[BOARD 2024]**
- a) an equilateral triangle c) an isosceles triangle
b) an obtuse angle triangle d) a right-angled triangle
10. Two vectors $\vec{a} = a_1\hat{i} + a_2\hat{j} + a_3\hat{k}$ and $\vec{b} = b_1\hat{i} + b_2\hat{j} + b_3\hat{k}$ are collinear if **[BOARD 2023]**
- a) $a_1b_1 + a_2b_2 + a_3b_3 = 0$ c) $a_1 = b_1, a_2 = b_2, a_3 = b_3$
b) $\frac{a_1}{b_1} = \frac{a_2}{b_2} = \frac{a_3}{b_3}$ d) $a_1 + a_2 + a_3 = b_1 + b_2 + b_3$
11. If $|\vec{a}| = 2$ and $-3 \leq k \leq 2$ then $|k\vec{a}| \in$ **[BOARD 2024]**
- a) $[-6, 4]$ b) $[0, 4]$ c) $[4, 6]$ d) $[0, 6]$
12. Let $|\vec{a}| = 5$ and $-2 \leq k \leq 1$. Then the range of $|k\vec{a}| \in$ **[BOARD 2025]**
- a) $[5, 10]$ b) $[-2, 5]$ c) $[-2, 1]$ d) $[-10, 5]$
13. For any two vectors \vec{a} and \vec{b} which of the following statement is always true? **[BOARD 2024]**
- a) $\vec{a} \cdot \vec{b} \geq |\vec{a}||\vec{b}|$ b) $\vec{a} \cdot \vec{b} = |\vec{a}||\vec{b}|$ c) $\vec{a} \cdot \vec{b} \leq |\vec{a}||\vec{b}|$ d) $\vec{a} \cdot \vec{b} < |\vec{a}||\vec{b}|$
14. The value of $(\hat{i} \times \hat{j}) \cdot \hat{j} + (\hat{j} \times \hat{i}) \cdot \hat{k}$ is **[BOARD 2023]**
- a) 2 b) 0 c) 1 d) -1
15. If $\vec{a} \cdot \hat{i} = \vec{a} \cdot (\hat{i} + \hat{j}) = \vec{a} \cdot (\hat{i} + \hat{j} + \hat{k}) = 1$, then \vec{a} is **[BOARD 2023]**
- a) \hat{k} b) \hat{i} c) \hat{j} d) $\hat{i} + \hat{j} + \hat{k}$
16. If $\vec{a} + \vec{b} = \hat{i}$ and $\vec{a} = 2\hat{i} - 2\hat{j} + 2\hat{k}$ then $|\vec{b}|$ equals **[BOARD 2023]**
- a) $\sqrt{14}$ b) 3 c) $\sqrt{12}$ d) $\sqrt{17}$
17. The respective values of $|\vec{a}|$ and $|\vec{b}|$, if given $(\vec{a} - \vec{b}) \cdot (\vec{a} + \vec{b}) = 512$ and $|\vec{a}| = 3|\vec{b}|$ are **[BOARD 2025]**
- a) 48 and 16 b) 3 and 1 c) 24 and 8 d) 6 and 2
18. Let \vec{a} be any vector such that $|\vec{a}| = a$. The value of $|\vec{a} \times \hat{i}|^2 + |\vec{a} \times \hat{j}|^2 + |\vec{a} \times \hat{k}|^2$ is **[BOARD 2024]**
- a) a^2 b) $2a^2$ c) $3a^2$ d) 0
19. If \vec{p} and \vec{q} are unit vectors, then which of the following values of $\vec{p} \cdot \vec{q}$ is not possible? **[BOARD 2025]**
- a) $\frac{-1}{2}$ b) $\frac{1}{\sqrt{2}}$ c) $\frac{\sqrt{3}}{2}$ d) $\sqrt{3}$

20. If θ is the angle between two vectors \vec{a} and \vec{b} , then $\vec{a} \cdot \vec{b} \geq 0$ only when

[BOARD 2023]

- a) $0 < \theta < \frac{\pi}{2}$ b) $0 \leq \theta \leq \frac{\pi}{2}$ c) $0 < \theta < \pi$ d) $0 \leq \theta \leq \pi$

21. Let θ be the angle between two unit vectors \hat{a} and \hat{b} such that $\sin \theta = \frac{3}{5}$. Then $\hat{a} \cdot \hat{b}$ is equal to

[BOARD 2024]

- a) $\pm \frac{3}{5}$ b) $\pm \frac{3}{4}$ c) $\pm \frac{4}{5}$ d) $\pm \frac{4}{3}$

22. The sine of the angle between the vectors $\vec{a} = 3\hat{i} + \hat{j} + 2\hat{k}$ and $\vec{b} = \hat{i} + \hat{j} + 2\hat{k}$ is

[BOARD 2023]

- a) $\sqrt{\frac{5}{21}}$ b) $\frac{5}{\sqrt{21}}$ c) $\sqrt{\frac{3}{21}}$ d) $\frac{4}{\sqrt{21}}$

23. If a vector makes an angle of $\frac{\pi}{4}$ with the positive directions of both x-axis and y-axis, then the angle which it makes with positive z-axis is

[BOARD 2023]

- a) $\frac{\pi}{4}$ b) $\frac{3\pi}{4}$ c) $\frac{\pi}{2}$ d) 0

24. If \vec{a} , \vec{b} and $\vec{a} + \vec{b}$ are all unit vectors and θ is the angle between \vec{a} and \vec{b} then the value of θ is

[BOARD 2023]

- a) $\frac{2\pi}{3}$ b) $\frac{5\pi}{6}$ c) $\frac{\pi}{3}$ d) $\frac{\pi}{6}$

25. If $|\vec{a} \times \vec{b}| = \sqrt{3}$ and $\vec{a} \cdot \vec{b} = -3$ then angle between \vec{a} and \vec{b} is

[BOARD 2023]

- a) $\frac{2\pi}{3}$ b) $\frac{\pi}{6}$ c) $\frac{\pi}{3}$ d) $\frac{5\pi}{6}$

26. If \vec{a} and \vec{b} are two vectors such that $|\vec{a}| = 1$, $|\vec{b}| = 2$ and $\vec{a} \cdot \vec{b} = \sqrt{3}$ then the angle between $2\vec{a}$ and $-\vec{b}$ is

[BOARD 2024]

- a) $\frac{\pi}{6}$ b) $\frac{\pi}{3}$ c) $\frac{5\pi}{6}$ d) $\frac{11\pi}{6}$

27. If the angle between \vec{a} and \vec{b} is $\frac{\pi}{3}$ and $|\vec{a} \times \vec{b}| = 3\sqrt{3}$ then the value of $\vec{a} \cdot \vec{b}$ is

[BOARD 2023]

- a) 9 b) 3 c) $\frac{1}{9}$ d) $\frac{1}{3}$

28. If \vec{a} and \vec{b} are two vectors such that $\vec{a} \cdot \vec{b} > 0$ and $|\vec{a} \cdot \vec{b}| = |\vec{a} \times \vec{b}|$ then the angle between \vec{a} and \vec{b} is

[BOARD 2024]

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

29. If $\vec{a} + \vec{b} + \vec{c} = 0$, $|\vec{a}| = \sqrt{37}$, $|\vec{b}| = 3$ and $|\vec{c}| = 4$ then angle between \vec{b} and \vec{c} is

[BOARD 2025]

- a) $\frac{\pi}{6}$ b) $\frac{\pi}{4}$ c) $\frac{\pi}{3}$ d) $\frac{\pi}{2}$

30. The values of x for which the angle between the vectors $\vec{a} = 2x^2\hat{i} + 4x\hat{j} + \hat{k}$ and $\vec{b} = 7\hat{i} - 2\hat{j} + x\hat{k}$ is obtuse, is

[BOARD 2025]

- a) 0 or $\frac{1}{2}$ b) $x > \frac{1}{2}$ c) $(0, \frac{1}{2})$ d) $[0, \frac{1}{2}]$

31. A unit vector \hat{a} makes equal but acute angles on the co-ordinate axes. The projection of the vector \hat{a} on the vector $\vec{b} = 5\hat{i} + 7\hat{j} - \hat{k}$ is

[BOARD 2023]

- a) $\frac{11}{15}$ b) $\frac{11}{5\sqrt{3}}$ c) $\frac{4}{5}$ d) $\frac{3}{5\sqrt{3}}$

32. The projection vector of vector \vec{a} on vector \vec{b} is

[BOARD 2025]

- a) $\left(\frac{\vec{a} \cdot \vec{b}}{|\vec{b}|^2}\right)\vec{b}$ b) $\frac{\vec{a} \cdot \vec{b}}{|\vec{b}|}$ c) $\frac{\vec{a} \cdot \vec{b}}{|\vec{a}|}$ d) $\left(\frac{\vec{a} \cdot \vec{b}}{|\vec{a}|^2}\right)\vec{b}$

33. The projection of vector \hat{i} on the vector $\hat{i} + \hat{j} + 2\hat{k}$ is

[BOARD 2023]

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

34. Projection of vector $2\hat{i} + 3\hat{j}$ on the vector $3\hat{i} - 2\hat{j}$ is

[BOARD 2023]

- a) 0 b) 12 c) $\frac{12}{\sqrt{13}}$ d) $\frac{-12}{\sqrt{13}}$

35. For what value of λ , the projection vector $\hat{i} + \lambda\hat{j}$ on vector $\hat{i} - \hat{j}$ is $\sqrt{2}$?

[BOARD 2023 & 2025]

- a) -1 b) 1 c) 0 d) 3

36. What is the value of $\frac{\text{projection of } \vec{a} \text{ on } \vec{b}}{\text{projection of } \vec{b} \text{ on } \vec{a}}$ for vectors $\vec{a} = 2\hat{i} - 3\hat{j} - 6\hat{k}$ and $\vec{b} = 2\hat{i} - 2\hat{j} + \hat{k}$.

[BOARD 2024]

- a) $\frac{3}{7}$ b) $\frac{7}{3}$ c) $\frac{4}{3}$ d) $\frac{4}{7}$

37. If \vec{a} and \vec{b} are two non-zero vectors such that the projection of \vec{a} on \vec{b} is 0. The angle between \vec{a} and \vec{b} is

[BOARD 2023]

- a) $\frac{\pi}{2}$ b) $\frac{\pi}{4}$ c) π d) 0

38. If $\vec{\alpha} = \hat{i} - 4\hat{j} + 9\hat{k}$ and $\vec{\beta} = 2\hat{i} - 8\hat{j} + \lambda\hat{k}$ are two mutually parallel vectors, then λ is equal to

[BOARD 2025]

- a) -18 b) 18 c) $-\frac{34}{9}$ d) $\frac{34}{9}$

39. The value of p for which the vectors $2\hat{i} + p\hat{j} + \hat{k}$ and $-4\hat{i} - 6\hat{j} + 26\hat{k}$ are perpendicular to each other, is **[BOARD 2023]**
- a) 3 b) -3 c) $-\frac{17}{3}$ d) $\frac{17}{3}$
40. If the vector $\hat{i} - b\hat{j} + \hat{k}$ is equally inclined to the coordinate axes, then the value of b is **[BOARD 2023]**
- a) -1 b) 1 c) $-\sqrt{3}$ d) $-\frac{1}{\sqrt{3}}$
41. If ABCD is a parallelogram and AC and BD are its diagonals then $\overrightarrow{AC} + \overrightarrow{BD}$ is **[BOARD 2023]**
- a) $2\overrightarrow{DA}$ b) $2\overrightarrow{AB}$ c) $2\overrightarrow{BC}$ d) $2\overrightarrow{BD}$
42. The position vectors of three consecutive vertices of a parallelogram ABCD are $A(4\hat{i} + 2\hat{j} - 6\hat{k})$, $B(5\hat{i} - 3\hat{j} + \hat{k})$ and $C(12\hat{i} + 4\hat{j} + 5\hat{k})$. The position vector of D is given by **[BOARD 2023]**
- a) $-3\hat{i} - 5\hat{j} - 10\hat{k}$ b) $21\hat{i} + 3\hat{j}$ c) $11\hat{i} + 9\hat{j} - 2\hat{k}$ d) $-11\hat{i} - 9\hat{j} + 2\hat{k}$
43. The position vectors of points P and Q are \vec{p} and \vec{q} respectively. The point R divides line segment PQ in the ratio 3: 1 and S is the mid-point of line segment PR. The position vector of S is **[BOARD 2024]**
- a) $\frac{\vec{p}+3\vec{q}}{4}$ b) $\frac{\vec{p}+3\vec{q}}{8}$ c) $\frac{5\vec{p}+3\vec{q}}{4}$ d) $\frac{5\vec{p}+3\vec{q}}{8}$
44. Let P and Q be two points with position vectors $\vec{a} - 2\vec{b}$ and $2\vec{a} + \vec{b}$ respectively. The position vector of a point which divides the join of P and Q externally in the ratio 3:2 is **[BOARD 2023]**
- a) $4\vec{a} + 7\vec{b}$ b) $\frac{8\vec{a}+7\vec{b}}{5}$ c) $4\vec{a} - 7\vec{b}$ d) $\vec{a} + 4\vec{b}$
45. Unit vector along \overrightarrow{PQ} where coordinates of P and Q respectively are $(2, 1, -1)$ and $(4, 4, -7)$, is **[BOARD 2023]**
- a) $2\hat{i} + 3\hat{j} - 6\hat{k}$ b) $-2\hat{i} - 3\hat{j} + 6\hat{k}$ c) $-\frac{2}{7}\hat{i} - \frac{3}{7}\hat{j} + 6\hat{k}$ d) $\frac{2}{7}\hat{i} + \frac{3}{7}\hat{j} - \frac{6}{7}\hat{k}$
46. Position vector of the mid-point of line segment AB is $3\hat{i} + 2\hat{j} - 3\hat{k}$. If position vector of the point A is $2\hat{i} + 3\hat{j} - 4\hat{k}$, then position vector of the point B is **[BOARD 2023]**
- a) $\frac{5}{2}\hat{i} + \frac{5}{2}\hat{j} - \frac{7}{2}\hat{k}$ b) $4\hat{i} + \hat{j} - 2\hat{k}$ c) $5\hat{i} + 5\hat{j} - 7\hat{k}$ d) $\frac{1}{2}\hat{i} - \frac{1}{2}\hat{j} + \frac{1}{2}\hat{k}$

47. In ΔABC , $\overrightarrow{AB} = \hat{i} + \hat{j} + 2\hat{k}$ and $\overrightarrow{AC} = 3\hat{i} - \hat{j} + 4\hat{k}$. If D is mid-point of BC, then vector \overrightarrow{AD} is equal to **[BOARD 2023]**

- a) $4\hat{i} + 6\hat{k}$ b) $2\hat{i} - 2\hat{j} + 2\hat{k}$ c) $\hat{i} - \hat{j} + \hat{k}$ d) $2\hat{i} + 3\hat{k}$

48. If the sides AB and AC of ΔABC are represented by vectors $\hat{j} + \hat{k}$ and $3\hat{i} - \hat{j} + 4\hat{k}$ respectively, then the length of the median through A on BC is **[BOARD 2025]**

- a) $2\sqrt{2}$ units b) $\sqrt{18}$ units c) $\frac{\sqrt{34}}{2}$ units d) $\frac{\sqrt{48}}{2}$ units

49. If vectors $\vec{a} = 3\hat{i} + 2\hat{j} - \hat{k}$ and $\vec{b} = \hat{i} - \hat{j} + \hat{k}$ then which of the following is correct?

[BOARD 2025]

- a) $\vec{a} \parallel \vec{b}$ b) $\vec{a} \perp \vec{b}$ c) $|\vec{b}| > |\vec{a}|$ d) $|\vec{a}| = |\vec{b}|$

50. If $\overrightarrow{PQ} \times \overrightarrow{PR} = 4\hat{i} + 8\hat{j} - 8\hat{k}$ then the area (ΔPQR) is **[BOARD 2025]**

- a) 2 sq. units b) 4 sq. units c) 6 sq. units d) 12 sq. units

Options for Assertion and Reasoning Questions:

- a) Both assertion(A) and reason(R) are true and reason(R) is the correct explanation of assertion(A)
 b) Both assertion(A) and reason(R) are true but reason(R) is not the correct explanation of assertion(A)
 c) Assertion (A) is true but reason (R) is false.
 d) Assertion (A) is false but reason (R) is true.

51. **Assertion (A):** For any two non-zero vectors \vec{a} and \vec{b} , $\vec{a} \cdot \vec{b} = \vec{b} \cdot \vec{a}$.

Reason (R): For any two non-zero vectors \vec{a} and \vec{b} , $\vec{a} \times \vec{b} = \vec{b} \times \vec{a}$. **[BOARD 2024]**

52. **Assertion (A):** If $|\vec{a} \times \vec{b}|^2 + |\vec{a} \cdot \vec{b}|^2 = 256$ and $|\vec{b}| = 8$ then $|\vec{a}| = 2$. **[BOARD 2025]**

Reason (R): $\sin^2 \theta + \cos^2 \theta = 1$ and $|\vec{a} \times \vec{b}| = |\vec{a}||\vec{b}| \sin \theta$ and $\vec{a} \cdot \vec{b} = |\vec{a}||\vec{b}| \cos \theta$.

53. **Assertion (A):** $(\vec{b} \cdot \vec{c})\vec{a}$ is a scalar quantity.

Reason (R): Dot product of two vectors is a scalar quantity. **[BOARD 2024]**

54. **Assertion (A):** Projection of \vec{a} on \vec{b} is same as projection of \vec{b} on \vec{a} . **[BOARD 2024]**

Reason (R): Angle between \vec{a} and \vec{b} is same as angle between \vec{b} and \vec{a} numerically

55. **Assertion (A):** For any non-zero unit vector \vec{a} , $\vec{a} \cdot (-\vec{a}) = (-\vec{a}) \cdot \vec{a} = -1$.

Reason (R): Angle between \vec{a} and $(-\vec{a})$ is $\frac{\pi}{2}$. **[BOARD 2024]**

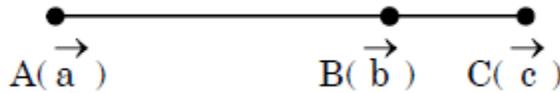
56. **Assertion (A):** The vectors $\vec{a} = 6\hat{i} + 2\hat{j} - 8\hat{k}$, $\vec{b} = 10\hat{i} - 2\hat{j} - 6\hat{k}$, $\vec{c} = 4\hat{i} - 4\hat{j} + 2\hat{k}$ represent the sides of a right angled triangle.

Reason (R): Three non-zero vectors of which none of two are collinear forms a triangle if their resultant is zero vector or sum of any two vectors is equal to the third. **[BOARD 2024]**

2 Marks:

1. If points A, B and C have position vectors $2\hat{i}, \hat{j}$ and $2\hat{k}$ respectively, then show that ΔABC is an isosceles triangle. **[BOARD 2023]**
2. If $\vec{a} = 4\hat{i} - \hat{j} + \hat{k}$ and $\vec{b} = 2\hat{i} - 2\hat{j} + \hat{k}$ then find a unit vector along the vector $\vec{a} \times \vec{b}$. **[BOARD 2023]**
3. If $\vec{r} = 3\hat{i} - 2\hat{j} + 6\hat{k}$, find the value of $(\vec{r} \times \hat{j}) \cdot (\vec{r} \times \hat{k}) - 12$. **[BOARD 2023]**
4. If three non-zero vectors are \vec{a}, \vec{b} and \vec{c} such that $\vec{a} \cdot \vec{b} = \vec{a} \cdot \vec{c}$ and $\vec{a} \times \vec{b} = \vec{a} \times \vec{c}$ then show that $\vec{b} = \vec{c}$. **[BOARD 2023 & 2025]**
5. If \vec{a}, \vec{b} and \vec{c} are three vectors such that $|\vec{a}| = 7, |\vec{b}| = 24, |\vec{c}| = 25$ and $\vec{a} + \vec{b} + \vec{c} = 0$ then find the value of $\vec{a} \cdot \vec{b} + \vec{b} \cdot \vec{c} + \vec{c} \cdot \vec{a}$. **[BOARD 2023]**
6. If $|\vec{a}| = 2, |\vec{b}| = 3$ and $\vec{a} \cdot \vec{b} = 4$ then evaluate $|\vec{a} + 2\vec{b}|$. **[BOARD 2025]**
7. If \vec{a} and \vec{b} are two non-zero vectors such that $(\vec{a} + \vec{b}) \perp \vec{a}$ and $(2\vec{a} + \vec{b}) \perp \vec{b}$ then prove that $|\vec{b}| = \sqrt{2}|\vec{a}|$. **[BOARD 2024]**
8. For the vectors $\vec{a} = \hat{i} - 2\hat{j} + 3\hat{k}$ and $\vec{b} = 2\hat{i} + 3\hat{j} - 5\hat{k}$ verify that the angle between \vec{a} and $\vec{a} \times \vec{b}$ is $\frac{\pi}{2}$. **[BOARD 2023]**
9. Two friends while flying kites from different locations, find the strings of their kites crossing each other. The string can be represented by vectors $\vec{a} = 3\hat{i} + \hat{j} + 2\hat{k}$ and $\vec{b} = 2\hat{i} - 2\hat{j} + 4\hat{k}$. Determine the angle formed between the kite strings. Assume there is no slack in the strings. **[BOARD 2025]**
10. Find a vector of magnitude 6, which is perpendicular to each of the vectors $\vec{a} + \vec{b}$ and $\vec{a} - \vec{b}$, where $\vec{a} = \hat{i} + \hat{j} + \hat{k}$ and $\vec{b} = \hat{i} + 2\hat{j} + 3\hat{k}$. **[BOARD 2023]**
11. Find a vector of magnitude 5 which is perpendicular to both the vectors $3\hat{i} - 2\hat{j} + \hat{k}$ and $4\hat{i} + 3\hat{j} - 2\hat{k}$. **[BOARD 2025]**
12. Find a vector of magnitude 21 units in the direction opposite to that of \vec{AB} where A and B are the points $A(2, 1, 3)$ and $B(8, -1, 0)$ respectively. **[BOARD 2025]**

13. A vector \vec{a} makes equal angles with all the three axes. If the magnitude of the vector is $5\sqrt{3}$ units, then find \vec{a} . **[BOARD 2025]**
14. Find all vectors of magnitude $3\sqrt{3}$ which are collinear to vector $\hat{i} + \hat{j} + \hat{k}$. **[BOARD 2023]**
15. If \vec{a} and \vec{b} are two non-collinear vectors, then find x , such that $\vec{\alpha} = (x - 2)\vec{a} + \vec{b}$ and $\vec{\beta} = (3 + 2x)\vec{a} - 2\vec{b}$ are collinear. **[BOARD 2025]**
16. Position vectors of the points A, B and C as shown in the figure below are \vec{a} , \vec{b} and \vec{c} respectively. **[BOARD 2023]**



- If $\vec{AC} = \frac{5}{4}\vec{AB}$, express \vec{c} in terms of \vec{a} and \vec{b} .
17. If the vectors \vec{a} and \vec{b} are such that $|\vec{a}| = 3$, $|\vec{b}| = \frac{2}{3}$ and $\vec{a} \times \vec{b}$ is a unit vector then find the angle between \vec{a} and \vec{b} . **[BOARD 2023]**
18. For two non-zero vectors \vec{a} and \vec{b} , if $|\vec{a} - \vec{b}| = |\vec{a} + \vec{b}|$ then find the angle between \vec{a} and \vec{b} . **[BOARD 2023]**
19. If \vec{a} , \vec{b} and \vec{c} are three unit vectors such that $\vec{a} + \vec{b} - \vec{c} = 0$, find the angle between vectors \vec{a} and \vec{c} . **[BOARD 2024]**
20. If \vec{a} , \vec{b} and \vec{c} are three non-zero unequal vectors such that $\vec{a} \cdot \vec{b} = \vec{a} \cdot \vec{c}$ then find the angle between \vec{a} and $\vec{b} - \vec{c}$. **[BOARD 2023]**
21. If \vec{a} , \vec{b} and \vec{c} are three mutually perpendicular unit vectors. If θ is the angle between \vec{a} and $(2\vec{a} + 3\vec{b} + 6\vec{c})$, find the value of $\cos \theta$. **[BOARD 2024]**
22. If the projection of the vector $\hat{i} + \hat{j} + \hat{k}$ on the vector $p\hat{i} + \hat{j} - 2\hat{k}$ is $\frac{1}{3}$, then find the value(s) of p . **[BOARD 2023]**
23. Find the position vector of point C which divides the line segment joining points A and B having position vectors $\hat{i} + 2\hat{j} - \hat{k}$ and $-\hat{i} + \hat{j} + \hat{k}$ respectively in the ratio 4: 1 externally. Further, find $|\vec{AB}| : |\vec{BC}|$. **[BOARD 2024]**
24. If \vec{a} and \vec{b} are position vectors of two points A and B respectively, then find the position vector of point C on BA produced such that $BC = 3BA$. **[BOARD 2025]**

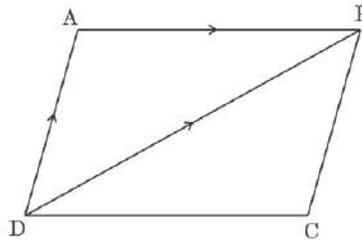
25. If \vec{a} and $\vec{\beta}$ are position vectors of two points P and Q respectively, then find the position vector of a point R in QP produced such that $QR = \frac{3}{2}QP$. **[BOARD 2025]**

26. Let \vec{a} and \vec{b} be two non-zero vectors. Prove that $|\vec{a} \times \vec{b}| \leq |\vec{a}||\vec{b}|$. State the condition under which equality holds, $|\vec{a} \times \vec{b}| = |\vec{a}||\vec{b}|$. **[BOARD 2024]**

27. Find the area of a parallelogram whose adjacent sides are determined by the vectors $\vec{a} = \hat{i} - \hat{j} + 3\hat{k}$ and $\vec{b} = 2\hat{i} - 7\hat{j} + \hat{k}$. **[BOARD 2023]**

28. The diagonals of a parallelogram are given by $\vec{a} = 2\hat{i} - \hat{j} + \hat{k}$ and $\vec{b} = \hat{i} + 3\hat{j} - \hat{k}$. Find the area of the parallelogram. **[BOARD 2025]**

29. In the given figure, ABCD is a parallelogram. If $\vec{AB} = 2\hat{i} - 4\hat{j} + 5\hat{k}$ and $\vec{DB} = 3\hat{i} - 6\hat{j} + 2\hat{k}$ then find \vec{AD} and hence find the area of parallelogram ABCD.



[BOARD 2024]

30. Let $\vec{p} = 2\hat{i} - 3\hat{j} - \hat{k}$, $\vec{q} = -3\hat{i} + 4\hat{j} + \hat{k}$ and $\vec{r} = \hat{i} + \hat{j} + 2\hat{k}$. Express \vec{r} in the form of $\vec{r} = \lambda\vec{p} + \mu\vec{q}$ and hence find the values of λ and μ . **[BOARD 2025]**

3 Marks:

1. 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 all the angles of ΔABC . **[BOARD 2024]**

2. If vectors \vec{a} , \vec{b} and $2\vec{a} + 3\vec{b}$ are unit vectors, then find the angle between \vec{a} and \vec{b} . **[BOARD 2024]**

3. If $\vec{a} + \vec{b} + \vec{c} = 0$ such that $|\vec{a}| = 3$, $|\vec{b}| = 5$, $|\vec{c}| = 7$ then find the angle between \vec{a} and \vec{b} . **[BOARD 2025]**

4. If \vec{a} and \vec{b} are unit vectors inclined with each other at an angle θ then prove that $\frac{1}{2}|\vec{a} - \vec{b}| = \sin\frac{\theta}{2}$. **[BOARD 2025]**

5. Find a vector of magnitude 4 units perpendicular to each of the vectors $2\hat{i} - \hat{j} + \hat{k}$ and $\hat{i} + \hat{j} - \hat{k}$ and hence verify your answer. **[BOARD 2024]**

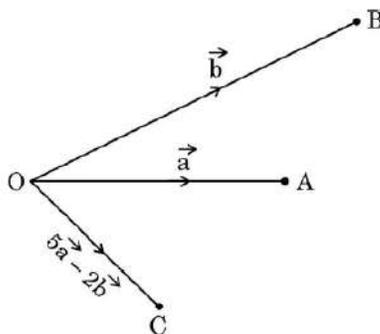
6. Given $\vec{a} = 2\hat{i} - \hat{j} + \hat{k}$, $\vec{b} = 3\hat{i} - \hat{k}$ and $\vec{c} = 2\hat{i} + \hat{j} - 2\hat{k}$. Find a vector \vec{d} which is perpendicular to both \vec{a} and \vec{b} and $\vec{c} \cdot \vec{d} = 3$. **[BOARD 2024]**
7. Find the projection of vector $(\vec{b} + \vec{c})$ on vector \vec{a} , where $\vec{a} = 2\hat{i} + 2\hat{j} + \hat{k}$, $\vec{b} = \hat{i} + 3\hat{j} + \hat{k}$ and $\vec{c} = \hat{i} + \hat{k}$. **[BOARD 2024]**
8. If the vectors \vec{a} , \vec{b} and \vec{c} represent the three sides of a triangle, then show that $\vec{a} \times \vec{b} = \vec{b} \times \vec{c} = \vec{c} \times \vec{a}$. **[BOARD 2024]**
9. Show that the vectors $3\hat{i} + \hat{j} - 2\hat{k}$, $2\hat{i} - \hat{j} - 8\hat{k}$ and $4\hat{i} - 2\hat{j} - 7\hat{k}$ form the vertices of a right triangle. **[BOARD 2024]**
10. Find all vectors of magnitude $8\sqrt{14}$ units that are perpendicular to the vectors $2\hat{i} - \hat{k}$ and $2\hat{j} + 3\hat{k}$. **[BOARD 2024]**
11. The scalar product of the vector $\vec{a} = \hat{i} - \hat{j} + 2\hat{k}$ with a unit vector along sum of vectors $\vec{b} = 2\hat{i} - 4\hat{j} + 5\hat{k}$ and $\vec{c} = \lambda\hat{i} - 2\hat{j} - 3\hat{k}$ is equal to 1. Find the value of λ . **[BOARD 2025]**
12. During a cricket match, the position of the bowler, the wicket keeper and the 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 $\vec{F} = 12\hat{i} + 18\hat{j}$ respectively. Calculate the ratio in which the wicket keeper divides the line segment joining the bowler and the leg slip fielder. **[BOARD 2025]**

5 Marks:

1. Show that the area of a parallelogram whose diagonals are represented by \vec{a} and \vec{b} is given by $\frac{1}{2}|\vec{a} \times \vec{b}|$. Also find the area of a parallelogram whose diagonals are $2\hat{i} - \hat{j} + \hat{k}$ and $\hat{i} + 3\hat{j} - \hat{k}$. **[BOARD 2025]**

Case Based Questions:

1. Three friends A, B and C move out from the same location O at the same time in three different directions to reach their destinations. They move out on straight paths and decide that A and B after reaching their destinations will meet up with C at his pre decided destination, following straight paths from A to C and B to C in such a way that $\vec{OA} = \vec{a}$, $\vec{OB} = \vec{b}$ and $\vec{OC} = 5\vec{a} - 2\vec{b}$ respectively.



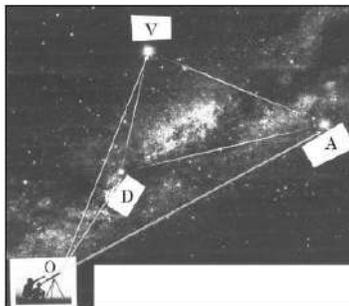
Based on the above information, answer for the following: [BOARD 2025]

- (i) Complete the given figure to explain their entire movement plan along the respective vectors. 1
- (ii) Find vectors \overrightarrow{AC} and \overrightarrow{BC} . 1
- (iii) (a) If $\vec{a} \cdot \vec{b} = 1$, distance of O to A is 1 km and that from O to B is 2 km, then find angle between \overrightarrow{OA} and \overrightarrow{OB} . Also find $|\vec{a} \times \vec{b}|$. 2

(OR)

- (b) If $\vec{a} = 2\hat{i} - \hat{j} + 4\hat{k}$ and $\vec{b} = \hat{j} - \hat{k}$ then find a unit vector perpendicular to $(\vec{a} + \vec{b})$ and $(\vec{a} - \vec{b})$. 2

2. An instructor at the astronomical centre shows three among the brightest stars in a particular constellation. Assume that the telescope is located at $O(0,0,0)$ and the three stars have their locations at the points D, A and V having position vectors $2\hat{i} + 3\hat{j} + 4\hat{k}$, $7\hat{i} + 5\hat{j} + 8\hat{k}$ and $-3\hat{i} + 7\hat{j} + 11\hat{k}$ respectively. **[BOARD 2024]**



Based on the above information, answer for the following:

- (i) How far is the star V from star A? 1
- (ii) Find a unit vector in the direction of \overrightarrow{DA} . 1
- (iii) (a) Find the measure of $\angle VDA$. 2

(OR)

- (b) What is the projection of vector \overrightarrow{DV} on vector \overrightarrow{DA} . 2