



Attempt all questions before checking the answer key. i , j , k denote unit vectors along mutually perpendicular coordinate axes.

A. Very short answers - 1 mark each

1. Find the magnitude of $2i - 3j + 6k$.
2. Find a unit vector along $3i + 4j$.
3. State the dot-product condition for two non-zero vectors to be perpendicular.
4. State the cross-product condition for two non-zero vectors to be parallel.
5. What is the direction of $i \times j$?

B. Short answers / practice - 2 marks each

6. For $a = i + 2j - k$ and $b = 2i - j + 3k$, find $a + b$ and $a \cdot b$.
7. Find the angle between $i + j$ and $i - j$.
8. Find $(2i + j) \times (i + 3j)$.
9. Find direction cosines of a vector with direction ratios 2, -1, 2.
10. Find the scalar projection of $2i + 3j + 6k$ on $i + 2j + 2k$.
11. Find $|i+j+k|$.
12. Find $j \times i$.
13. Find $(2i-j) \cdot (i+3j)$.
14. Are two non-zero parallel vectors necessarily equal?
15. Find unit vector opposite to $3i+4j$.
16. Find angle between i and $i+j$.
17. Find area of triangle with sides $2i$ and $3j$ from one vertex.
18. Find λ if $(i+\lambda j) \cdot (2i-j)=0$.
19. Find projection of $3i+4j$ onto i .
20. Prove that $a \times a=0$ and explain geometrically.

C. Short answers - 3 marks each

21. Find a unit vector perpendicular to both $a = i + j$ and $b = j + k$. State both possible signs.
22. Find the area of the parallelogram with adjacent sides $2i + j$ and $i + 3j + 2k$.
23. Find λ if $(2i + \lambda j + k)$ is perpendicular to $(i - 2j + 3k)$.
24. Find the position vector of the point dividing $A(1, 2, 3)$ and $B(4, 5, 6)$ internally in ratio 2 : 1.
25. If $|a| = 3$, $|b| = 4$ and $a \cdot b = 6$, find $|a + b|$, $|a - b|$ and the angle between them.

D. Long answers - 5 marks each

26. Derive the vector section formula for internal division. Use it to find the centroid of the triangle with position vectors $i + j$, $2j + k$ and $3i - k$.
27. Prove that diagonals of a parallelogram with equal-length adjacent side vectors are perpendicular. Explain the geometric conclusion and its converse.
28. Find the area of triangle $A(1, 0, 0)$, $B(0, 1, 0)$, $C(0, 0, 1)$ using a cross product. Find a unit vector normal to its plane.
29. For $a = 2i - j + 2k$ and $b = i + 2j - 2k$, calculate dot and cross products and verify $|a \times b|^2 + (a \cdot b)^2 = |a|^2|b|^2$.
30. Prove $|a + b|^2 + |a - b|^2 = 2(|a|^2 + |b|^2)$. Interpret this geometrically and apply it when the diagonals of a parallelogram are 10 and 6 and one side is 5.

ANSWER KEY - Numerical / short answers

- 1) 7. 2) $(3i+4j)/5$. 3) $a \cdot b=0$. 4) $a \times b=0$. 5) $+k$. 6) $3i+j+2k$; -3 . 7) 90° . 8) $5k$. 9) $2/3, -1/3, 2/3$. 10) $20/3$. 11) $\sqrt{3}$. 12) $-k$. 13) -1 . 14) No. 15) $-(3i+4j)/5$. 16) 45° . 17) 3. 18) 2. 19) Scalar projection 3. 21) $\pm(i-j+k)/\sqrt{3}$. 22) $3\sqrt{5}$. 23) $\lambda=5/2$. 24) $3i+4j+5k$. 25) $\sqrt{37}$; $\sqrt{13}$; 60° . 26) Centroid $(4/3)i+j$. 28) Area $\sqrt{3}/2$; normal $\pm(i+j+k)/\sqrt{3}$. 29) Dot -4 ; cross $-2i+6j+5k$; $65+16=81$. 30) Other side $\sqrt{43}$.