

MISSION NDA MATHEMATICS

COMPLETE TOPICWISE QUESTIONS

VECTOR ALGEBRA

- If $\vec{u} = \vec{a} - \vec{b}$, $\vec{v} = \vec{a} + \vec{b}$ and $|\vec{a}| = |\vec{b}| = 2$, then $|\vec{u} \times \vec{v}|$ is
 (a) $2\sqrt{16 - (\vec{a} \cdot \vec{b})^2}$ (b) $2\sqrt{4 - (\vec{a} \cdot \vec{b})^2}$
 (c) $\sqrt{16 - (\vec{a} \cdot \vec{b})^2}$ (d) $\sqrt{4 - (\vec{a} \cdot \vec{b})^2}$
- The points with position vector $10\hat{i} + 3\hat{j}$, $12\hat{i} - 5\hat{j}$ and $a\hat{i} + 11\hat{j}$ are collinear if a equals
 (a) -8 (b) 4
 (c) 8 (d) 12
- Let $\vec{b} = 4\hat{i} + 3\hat{j}$ and $\vec{c}$ be two vectors perpendicular to each other in the xy -plane. Then a vector in the same plane having projections 1 and 2 along $\vec{b}$ and $\vec{c}$, respectively, is
 (a) $\hat{i} + 2\hat{j}$ (b) $2\hat{i} - \hat{j}$
 (c) $2\hat{i} + \hat{j}$ (d) none of these
- The number of vectors of unit length perpendicular to vectors $\vec{a} = (1,1,0)$ and $\vec{b} = (0,1,1)$ is
 (a) one (b) two
 (c) three (d) infinite
- Two sides of a triangle are formed by the vectors $\vec{a} = 3\hat{i} + 6\hat{j} - 2\hat{k}$ and $\vec{b} = 4\hat{i} - \hat{j} + 3\hat{k}$. The angles of the triangle are
 (i) $\cos^{-1} \frac{7}{\sqrt{75}}$ (ii) $\cos^{-1} \sqrt{\frac{26}{75}}$ (iii) $\cos^{-1} \frac{3}{\sqrt{15}}$ (iv) $\cos^{-1} \frac{2}{3}$
 (a) (i) and (iii) (b) (ii) and (iii)
 (c) (iii) and (iv) (d) (i) and (ii)
- If $\vec{a} = \hat{i} + \hat{j}$, $\vec{b} = \hat{j} + \hat{k}$ and $\vec{c} = \hat{k} + \hat{i}$, then the projection of vector $\vec{a}$ on vector $\vec{b} \times \vec{c}$ is
 (a) $2\sqrt{3}$ (b) $2\sqrt{3}/3$
 (c) $\sqrt{2}$ (d) none of these
- If $\vec{a}$ and $\vec{b}$ are not perpendicular to each other and $\vec{r} \times \vec{a} = \vec{b} \times \vec{a}$, $\vec{r} \cdot \vec{c} = 0$, then $\vec{r}$ is equal to
 (a) $\vec{a} - \vec{c}$ (b) $\vec{b} + x\vec{a}$ for all scalars x
 (c) $\vec{b} - \left(\frac{\vec{b} \cdot \vec{c}}{\vec{a} \cdot \vec{c}}\right) \cdot \vec{a}$ (d) none of these
- The area of the triangle whose vertices are $\vec{a}, \vec{b}, \vec{c}$ is
 (a) $|\vec{a} \times \vec{b} + \vec{b} \times \vec{c} + \vec{c} \times \vec{a}|$ (b) $\frac{1}{2} |(\vec{b} - \vec{a}) \times (\vec{c} - \vec{b})|$
 (c) $2|\vec{a} \times \vec{b} + \vec{b} \times \vec{c} + \vec{c} \times \vec{a}|$ (d) none of these



9. The area of the triangle whose two adjacent sides are $\vec{a} = 3\hat{i} + 4\hat{j}$ and $\vec{b} = -5\hat{i} + 7\hat{j}$ is
 (a) 10 (b) 39
 (c) 3 (d) $39/2$
10. Let G be the centroid of $\triangle ABC$. If $\overrightarrow{AB} = \vec{a}$ and $\overrightarrow{AC} = \vec{b}$, then $\overrightarrow{AG}$, in terms of $\vec{a}$ and $\vec{b}$, is
 (a) $\frac{2}{3}(\vec{a} + \vec{b})$ (b) $\frac{1}{6}(\vec{a} + \vec{b})$
 (c) $\frac{1}{3}(\vec{a} + \vec{b})$ (d) $\frac{1}{2}(\vec{a} + \vec{b})$
11. If $\vec{a}, \vec{b}, \vec{c}$ are vectors such that $\vec{a} \cdot \vec{b} = 0$ and $\vec{a} + \vec{b} = \vec{c}$, then
 (a) $|\vec{a}|^2 + |\vec{b}|^2 = |\vec{c}|^2$ (b) $|\vec{a}|^2 = |\vec{b}|^2 + |\vec{c}|^2$
 (c) $|\vec{b}|^2 = |\vec{a}|^2 + |\vec{c}|^2$ (d) none of these
12. If $\vec{a} \cdot \vec{b} = 0$ and also $\vec{a} \times \vec{b} = 0$, then
 (a) $\vec{a}$ is parallel to $\vec{b}$ (b) $\vec{a}$ is perpendicular to $\vec{b}$
 (c) either $\vec{a}$ or $\vec{b}$ is a non-zero vector (d) none of these
13. If $\vec{r} = 3\hat{i} + 2\hat{j} - 5\hat{k}$, $\vec{a} = 2\hat{i} - \hat{j} + \hat{k}$, $\vec{b} = \hat{i} + 3\hat{j} - 2\hat{k}$ and $\vec{c} = -2\hat{i} + \hat{j} - 3\hat{k}$ such that $\vec{r} = x\vec{a} + y\vec{b} + z\vec{c}$, then
 (a) x, y, z are in A.P. (b) x, y, z are in G.P.
 (c) x, y, z are in H.P. (d) $y, (x/2), z$ are in A.P.
14. The acute angle that the vector $2\hat{i} - 2\hat{j} + \hat{k}$ makes with the plane contained by the two vectors $2\hat{i} + 3\hat{j} - \hat{k}$ and $\hat{i} - \hat{j} + 2\hat{k}$ is given by
 (a) $\cos^{-1} \left(\frac{1}{\sqrt{3}} \right)$ (b) $\sin^{-1} \left(\frac{1}{\sqrt{5}} \right)$
 (c) $\tan^{-1} (\sqrt{2})$ (d) $\cot^{-1} (\sqrt{2})$
15. Let $\overrightarrow{AB} = 3\hat{i} + \hat{j} - \hat{k}$ and $\overrightarrow{AC} = \hat{i} - \hat{j} + 3\hat{k}$ and a point P on the line segment BC be equidistant from AB and AC , then $\overrightarrow{AP}$ is
 (a) $2\hat{i} - \hat{k}$ (b) $\hat{i} - 2\hat{k}$
 (c) $2\hat{i} + \hat{k}$ (d) none of these
16. If $|\vec{a}| = 4$, $|\vec{b}| = 2$ and the angle between $\vec{a}$ and $\vec{b}$ is $\pi/6$, then $(\vec{a} \times \vec{b})^2$ is
 (a) 48 (b) 32
 (c) 16 (d) 8
17. If point A is $\vec{a} + 2\vec{b}$, P is $\vec{a}$ and P divides AB in the ratio 2:3, then the position vector of B is
 (a) $2\vec{a} - \vec{b}$ (b) $\vec{b} - 2\vec{a}$
 (c) $\vec{a} - 3\vec{b}$ (d) $\vec{b}$
18. The vector $\vec{c}$ directed along the internal bisector of the angle between the vectors $\vec{a} = 7\hat{i} - 4\hat{j} - 4\hat{k}$ and $\vec{b} = -2\hat{i} - \hat{j} + 2\hat{k}$ with $|\vec{c}| = 5\sqrt{6}$ is
 (a) $\frac{5}{3}(\hat{i} - 7\hat{j} + 2\hat{k})$ (b) $\frac{5}{3}(5\hat{i} + 5\hat{j} + 2\hat{k})$
 (c) $\frac{5}{3}(\hat{i} + 7\hat{j} + 2\hat{k})$ (d) $\frac{5}{3}(-5\hat{i} + 5\hat{j} + 2\hat{k})$
19. If $\hat{a}, \hat{b}, \hat{c}$ are unit vectors such that $\hat{a} + \hat{b} + \hat{c} = 0$, then the value of $\hat{a} \cdot \hat{b} + \hat{b} \cdot \hat{c} + \hat{c} \cdot \hat{a}$ is
 (a) 1 (b) 3
 (c) $-(3/2)$ (d) none of these



20. If $\hat{a}, \hat{b}, \hat{c}$ are three unit vectors such that $\hat{b}$ and $\hat{c}$ are non-parallel and $\hat{a} \times (\hat{b} \times \hat{c}) = (1/2)\hat{b}$, then the angle between $\hat{a}$ and $\hat{c}$ is
 (a) 30° (b) 45°
 (c) 60° (d) 90°
21. The position vectors of the points A, B, C and D are $3\hat{i} - 2\hat{j} - \hat{k}, 2\hat{i} + 3\hat{j} - 4\hat{k}, -\hat{i} + \hat{j} + 2\hat{k}$ and $4\hat{i} + 5\hat{j} + \lambda\hat{k}$. It is known that these points are coplanar, then λ is equal to
 (a) $-(146/17)$ (b) $-(137/17)$
 (c) $-(154/17)$ (d) none of these
22. The unit vector perpendicular to each of the vectors $2\hat{i} - \hat{j} + \hat{k}$ and $3\hat{i} + 4\hat{j}$ is
 (a) $\frac{1}{\sqrt{146}}(4\hat{i} - 3\hat{j} + 11\hat{k})$ (b) $\frac{1}{\sqrt{146}}(-4\hat{i} + 3\hat{j} + 11\hat{k})$
 (c) $\frac{1}{\sqrt{146}}(4\hat{i} + 3\hat{j} + 11\hat{k})$ (d) none of these
23. A unit vector perpendicular to the plane of $\vec{a} = 2\hat{i} - 6\hat{j} - 3\hat{k}, \vec{b} = 4\hat{i} + 3\hat{j} - \hat{k}$ is
 (a) $\frac{4\hat{i}+3\hat{j}-\hat{k}}{\sqrt{26}}$ (b) $\frac{2\hat{i}-6\hat{j}-3\hat{k}}{7}$
 (c) $\frac{3\hat{i}-2\hat{j}+6\hat{k}}{7}$ (d) $\frac{2\hat{i}-3\hat{j}-6\hat{k}}{7}$
24. The line joining the points $6\vec{a} - 4\vec{b} - 5\vec{c}, -4\vec{c}$ and the line joining the points $-\vec{a} - 2\vec{b} - 3\vec{c}, \vec{a} + 2\vec{b} - 5\vec{c}$ intersect at
 (a) $2\vec{c}$ (b) $-4\vec{c}$
 (c) $8\vec{c}$ (d) none of these
25. If $\vec{r} \cdot \hat{i} = \vec{r} \cdot \hat{j} = \vec{r} \cdot \hat{k}$ and $|\vec{r}| = 3$, then $\vec{r} =$
 (a) $\pm 3(\hat{i} + \hat{j} + \hat{k})$ (b) $\pm \frac{1}{3}(\hat{i} + \hat{j} + \hat{k})$
 (c) $\pm \frac{1}{\sqrt{3}}(\hat{i} + \hat{j} + \hat{k})$ (d) $\pm \sqrt{3}(\hat{i} + \hat{j} + \hat{k})$
26. Let $\vec{a}, \vec{b}, \vec{c}$ be three non-coplanar vectors and $\vec{p}, \vec{q}, \vec{r}$ be vectors defined by the relations

$$\vec{p} = \frac{\vec{b} \times \vec{c}}{[\vec{a}\vec{b}\vec{c}]}, \vec{q} = \frac{\vec{c} \times \vec{a}}{[\vec{a}\vec{b}\vec{c}]}, \vec{r} = \frac{\vec{a} \times \vec{b}}{[\vec{a}\vec{b}\vec{c}]}$$
 then the value of the expression $(\vec{a} + \vec{b}) \cdot \vec{p} + (\vec{b} + \vec{c}) \cdot \vec{q} + (\vec{c} + \vec{a}) \cdot \vec{r}$ is equal to
 (a) 0 (b) 1
 (c) 2 (d) 3
27. If the position vector of a point A is $\vec{a} + 2\vec{b}$ and $\vec{a}$ divides $\overline{AB}$ in the ratio 2:3, then the position vector of B is
 (a) $2\vec{a} - \vec{b}$ (b) $\vec{b} - 2\vec{a}$
 (c) $\vec{a} - 3\vec{b}$ (d) $\vec{b}$



28. The position vectors of A and B are $2\hat{i} + 2\hat{j} + \hat{k}$ and $2\hat{i} + 4\hat{j} + 4\hat{k}$. The length of the internal bisector of $\angle BOA$ of the triangle AOB is

- (a) $\sqrt{\frac{136}{9}}$ (b) $\frac{\sqrt{139}}{9}$
 (c) $\frac{20}{3}$ (d) $\sqrt{\frac{217}{9}}$

29. If $\vec{a}, \vec{b}, \vec{c}$ are mutually perpendicular vectors of equal magnitudes, then the angle between the vectors $\vec{a}$ and $\vec{a} + \vec{b} + \vec{c}$ is

- (a) $\pi/3$ (b) $\pi/6$
 (c) $\cos^{-1}(1/\sqrt{3})$ (d) $\pi/2$

30. For non-zero vectors $\vec{a}, \vec{b}, \vec{c}$, $(\vec{a} \times \vec{b}) \cdot \vec{c} = |\vec{a}||\vec{b}||\vec{c}|$ holds if

- (a) $\vec{a} \cdot \vec{b} = 0, \vec{b} \cdot \vec{c} = 0, \vec{c} \cdot \vec{a} \neq 0$ (b) $\vec{b} \cdot \vec{c} = 0, \vec{c} \cdot \vec{a} = 0, \vec{a} \cdot \vec{b} \neq 0$
 (c) $\vec{c} \cdot \vec{a} = 0, \vec{a} \cdot \vec{b} = 0, \vec{b} \cdot \vec{c} \neq 0$ (d) $\vec{a} \cdot \vec{b} = 0, \vec{b} \cdot \vec{c} = 0, \vec{c} \cdot \vec{a} = 0$

31. If $|\vec{a}| = |\vec{b}|$, then $(\vec{a} + \vec{b}) \cdot (\vec{a} - \vec{b})$ is

- (a) positive (b) negative
 (c) zero (d) none of these

32. The area of the triangle whose vertices are $A(1, -1, 2)$, $B(2, 1, -1)$ and $C(3, -1, 2)$ is

- (a) 13 (b) $\sqrt{13}$
 (c) 6 (d) $\sqrt{6}$

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

- (a) $\sqrt{\frac{74}{99}}$ (b) $\sqrt{\frac{25}{99}}$
 (c) $\sqrt{\frac{37}{99}}$ (d) $\frac{5}{\sqrt{41}}$

34. The area of the triangle having vertices as $\hat{i} - 2\hat{j} + 3\hat{k}$, $-2\hat{i} + 3\hat{j} - \hat{k}$, $4\hat{i} - 7\hat{j} + 7\hat{k}$ is

- (a) 36 sq. units (b) 0 sq. unit
 (c) 39 sq. units (d) 11 sq. units

35. The area of a parallelogram whose two adjacent sides are represented by the vectors $3\hat{i} - \hat{k}$ and $\hat{i} + 2\hat{j}$ is

- (a) $\frac{1}{2}\sqrt{17}$ (b) $\frac{1}{2}\sqrt{14}$
 (c) $\sqrt{41}$ (d) $\frac{1}{2}\sqrt{7}$



36. A unit vector perpendicular to each of the vectors $-6\hat{i} + 8\hat{k}$ and $8\hat{i} + 6\hat{k}$ forming a right-handed system is
- (a) $-\hat{j}$ (b) $\hat{j}$
 (c) $\frac{6\hat{i}+8\hat{k}}{10}$ (d) $\frac{-6\hat{i}+8\hat{k}}{10}$
37. If $\hat{a}, \hat{b}, \hat{c}$ are mutually perpendicular unit vectors, then $|\hat{a} + \hat{b} + \hat{c}|$ is equal to
- (a) $\sqrt{3}$ (b) 3
 (c) 1 (d) 0
38. $\hat{i} \times (\vec{a} \times \hat{i}) + \hat{j} \times (\vec{a} \times \hat{j}) + \hat{k} \times (\vec{a} \times \hat{k})$ is always equal to
- (a) $\vec{a}$ (b) $-\vec{a}$
 (c) $2\vec{a}$ (d) $-2\vec{a}$
39. The area of the parallelogram whose diagonals are given by vectors $3\hat{i} + \hat{j} - 2\hat{k}$ and $\hat{i} - 3\hat{j} + 4\hat{k}$ is
- (a) $10\sqrt{3}$ (b) $5\sqrt{3}$
 (c) 8 (d) 4
40. The angle between the vectors $\vec{a} + \vec{b}$ and $\vec{a} - \vec{b}$, when $\vec{a} = (1, 1, 4)$ and $\vec{b} = (1, -1, 4)$, is
- (a) 90° (b) 45°
 (c) 30° (d) 15°
41. If I is the centre of a circle inscribed in a triangle ABC , then $|\vec{BC}|\vec{IA} + |\vec{CA}|\vec{IB} + |\vec{AB}|\vec{IC}$ is
- (a) $\vec{0}$ (b) $\vec{IA} + \vec{IB} + \vec{IC}$
 (c) $\frac{\vec{IA} + \vec{IB} + \vec{IC}}{3}$ (d) none of these
42. $(\vec{a} \times \vec{b})^2$ is equal to
- (a) $\vec{a}^2 \vec{b}^2 - (\vec{a} \cdot \vec{b})^2$ (b) $\vec{a}^2 \vec{b}^2 + (\vec{a} \cdot \vec{b})^2$
 (c) $(\vec{a} \cdot \vec{b})^2$ (d) $\vec{a}^2 \vec{b}^2$
43. The unit vector perpendicular to both $\hat{i} + \hat{j}$ and $\hat{j} + \hat{k}$ is
- (a) $\hat{i} - \hat{j} + \hat{k}$ (b) $\hat{i} + \hat{j} + \hat{k}$
 (c) $\frac{\hat{i} + \hat{j} - \hat{k}}{\sqrt{3}}$ (d) $\frac{\hat{i} - \hat{j} + \hat{k}}{\sqrt{3}}$
44. If θ is the angle between the unit vectors $\hat{a}$ and $\hat{b}$, then $\cos(\theta/2) =$
- (a) $\frac{1}{2}|\hat{a} - \hat{b}|$ (b) $\frac{1}{2}|\hat{a} + \hat{b}|$
 (c) $\frac{|\hat{a} - \hat{b}|}{|\hat{a} + \hat{b}|}$ (d) $\frac{|\hat{a} + \hat{b}|}{|\hat{a} - \hat{b}|}$



45. The vectors $2\hat{i} - \hat{j} + \hat{k}$, $\hat{i} - 3\hat{j} - 5\hat{k}$ and $\sqrt{3}\hat{i} - 4\hat{j} - 4\hat{k}$ are the sides of a triangle, which is
 (a) equilateral (b) isosceles only
 (c) right-angled only (d) right-angled and isosceles
46. Let $\hat{a}$ and $\hat{b}$ be two unit vectors such that the angle between them is 60° . Then $|\hat{a} - \hat{b}|$ is equal to
 (a) $\sqrt{5}$ (b) $\sqrt{3}$
 (c) 0 (d) 1
47. If $|\vec{a}| = 3$, $|\vec{b}| = 4$ and the angle between $\vec{a}$ and $\vec{b}$ is 120° , then $|4\vec{a} + 3\vec{b}| =$
 (a) 25 (b) 12
 (c) 13 (d) 7
48. If $\vec{a} = 2\hat{i} + 3\hat{j} - \hat{k}$, $\vec{\beta} = -\hat{i} + 2\hat{j} - 4\hat{k}$ and $\vec{\gamma} = \hat{i} + \hat{j} + \hat{k}$, then $(\vec{a} \times \vec{\beta}) \cdot (\vec{a} \times \vec{\gamma})$ is
 (a) 60 (b) 64
 (c) 74 (d) -74
49. If $\vec{a}$ is perpendicular to $\vec{b}$ and $\vec{c}$, $|\vec{a}| = 2$, $|\vec{b}| = 3$, $|\vec{c}| = 4$ and the angle between $\vec{b}$ and $\vec{c}$ is $2\pi/3$, then $[\vec{a}\vec{b}\vec{c}]$ is equal to
 (a) $4\sqrt{3}$ (b) $6\sqrt{3}$
 (c) $12\sqrt{3}$ (d) $18\sqrt{3}$
50. Let $\hat{a}$ and $\hat{b}$ be two unit vectors inclined at an angle θ , then $\sin(\theta/2)$ is equal to
 (a) $\frac{1}{2}|\hat{a} - \hat{b}|$ (b) $\frac{1}{2}|\hat{a} + \hat{b}|$
 (c) $|\hat{a} - \hat{b}|$ (d) $|\hat{a} + \hat{b}|$
51. The scalar $\vec{A} \cdot (\vec{B} + \vec{C}) \times (\vec{A} + \vec{B} + \vec{C})$ is
 (a) 0 (b) $[\vec{A}\vec{B}\vec{C}] + [\vec{B}\vec{C}\vec{A}]$
 (c) $2[\vec{A}\vec{B}\vec{C}]$ (d) $[\vec{A}\vec{B}\vec{C}]$
52. If $\vec{a}$ and $\vec{b}$ are two non-collinear vectors and $x\vec{a} + y\vec{b} = \vec{0}$, then
 (a) $x = 0$ but y is not necessarily zero (b) $y = 0$ but x is not necessarily zero
 (c) $x = 0, y = 0$ (d) none of these
53. Projection of $\hat{i} + 2\hat{j} + 3\hat{k}$ on $\hat{i} - 2\hat{j} - 2\hat{k}$ is equal to
 (a) 3 (b) -3
 (c) 9 (d) -9
54. If $\vec{a}$ and $\vec{b}$ are two vectors such that $\vec{a} \cdot \vec{b} = 0$ and $\vec{a} \times \vec{b} = \vec{0}$, then
 (a) $\vec{a}$ is parallel to $\vec{b}$ (b) $\vec{a} \perp \vec{b}$
 (c) either $\vec{a}$ or $\vec{b}$ is a null vector (d) none of these



55. The position vectors of the points A, B, C are $2\hat{i} + \hat{j} - \hat{k}$, $3\hat{i} - 2\hat{j} + \hat{k}$ and $\hat{i} + 4\hat{j} - 3\hat{k}$, respectively. These points
- (a) form an isosceles triangle (b) form a right-angled triangle
- (c) are collinear (d) form a scalene triangle

ANSWER KEY

1. (a)	2. (c)	3. (b)	4. (b)	5. (d)	6. (b)	7. (c)	8. (b)
9. (d)	10. (c)	11. (a)	12. (d)	13. (d)	14. (d)	15. (c)	16. (c)
17. (c)	18. (a)	19. (c)	20. (c)	21. (a)	22. (b)	23. (c)	24. (b)
25. (d)	26. (d)	27. (c)	28. (a)	29. (c)	30. (d)	31. (c)	32. (b)
33. (a)	34. (b)	35. (c)	36. (b)	37. (a)	38. (c)	39. (c)	40. (a)
41. (a)	42. (a)	43. (d)	44. (b)	45. (d)	46. (d)	47. (b)	48. (d)
49. (c)	50. (a)	51. (a)	52. (c)	53. (b)	54. (c)	55. (a)	

