1. The number of unit vectors perpendicular to the vectors $\vec{a} = \hat{i} + \hat{j}$ and $\vec{b} = \hat{j} + \hat{k}$ is
   a) 1 b) 2 c) 3 d) infinite
2. The volume of the parallelopiped whose sides are given by $\overrightarrow{OA} = 2\hat{i} - 3\hat{j}$, $\overrightarrow{OB} = \hat{i} + \hat{j} - \hat{k}$, $\overrightarrow{OC} = 3\hat{i} - \hat{k}$ is a) $\frac{4}{13}$ b) 4 c) $\frac{2}{7}$ d) none of these
3. Let $\vec{a} = \hat{i} + \hat{j} + \hat{k}$, $\vec{b} = -\hat{i} + \hat{j} + \hat{k}$, $\vec{c} = \hat{i} - \hat{j} + \hat{k}$, $\vec{d} = \hat{i} + \hat{j} - \hat{k}$. The line of intersection of the plane determined by $\vec{a}$ and $\vec{b}$ and the plane determined by $\vec{c}$ and $\vec{d}$ is parallel to
   a) x – axis b) y – axis c) z – axis d) none of these
4. Let $\vec{a} = 2\hat{i} - 3\hat{j} + 6\hat{k}$ and $\vec{b} = 2\hat{i} + 2\hat{j} - \hat{k}$. Then $\frac{\text{projection of } \vec{a} \text{ on } \vec{b}}{\text{projection of } \vec{b} \text{ on } \vec{a}} =$
   a) $\frac{3}{7}$ b) $\frac{7}{3}$ c) –4 d) 3
5. The distance between a point P whose position vector is $5\hat{i} + \hat{j} + 3\hat{k}$ and the line $\vec{r} = (3\hat{i} + 7\hat{j} + \hat{k}) + t(\hat{j} + \hat{k})$
   a) 3 b) 4 c) 5 d) 6
6. Let $\vec{a}, \vec{b}, \vec{c}$ be three non coplanar vectors such that $\vec{a} \times (\vec{b} \times \vec{c}) = \frac{\vec{b}}{2}$, then the angle between $\vec{a}$ and $\vec{b}$ is
   a) $\frac{3\pi}{4}$ b) $\frac{\pi}{4}$ c) $\frac{\pi}{2}$ d) π
7. The value of k for which the points A(1 , 0 , 3), B(–1 , 3 , 4), C(1 , 2 , 1) and D(k , 2 , 5) are coplanar, is a) 1 b) 2 c) 0 d) –1
8. Let $\hat{u}$ and $\hat{v}$ be unit vectors such that $\hat{u} \times \hat{v} + \hat{u} = \hat{w}$ and $\hat{w} \times \hat{u} = \hat{v}$, then the value of $[\vec{u}\vec{v}\vec{w}]$, is
   a) 1 b) –1 c) 0 d) none of these
9. If the position vectors $\vec{a}(3\hat{i} + 4\hat{j}), \vec{b}(5\hat{j}), \vec{c}(4\hat{i} - 3\hat{j})$ from a triangle ABC, then position vector of the orthocenter of the triangle, is
   a) $5\hat{i}$ b) $5\hat{k}$ c) $7\hat{i} + 6\hat{j}$ d) $7\hat{i} + 9\hat{j}$
10. The scalar $\vec{A}.\{(\vec{B} + \vec{C}) \times (\vec{A} + \vec{B} + \vec{C})\}$ equals
    a) 0 b) $[\vec{A}\vec{B}\vec{C}] + [\vec{B}\vec{C}\vec{C}]$ c) $[\vec{A}\vec{B}\vec{C}]$ d) none of these
11. The number of unit vectors perpendicular to $\vec{a}$ = (1,1,0) and $\vec{b}$ =(0,1,1) is
    a) one b) two c) three d) infinite
12. If $\vec{a}, \vec{b}, \vec{c}$ are non coplanar unit vectors such that $\vec{a} \times (\vec{b} \times \vec{c}) = \frac{(\vec{b} + \vec{c})}{\sqrt{2}}$, then the angle between $\vec{a}$ and $\vec{b}$ is a) $\frac{3\pi}{4}$ b) $\frac{\pi}{4}$ c) $\frac{\pi}{2}$ d) π
13. Let $\vec{a}, \vec{b}, \vec{c}$ be three non–coplanar vectors and $\vec{p}, \vec{q}, \vec{r}$ are 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 $(\vec{a} \times \vec{b}).\vec{p} + (\vec{b} \times \vec{c}).\vec{q}\,(\vec{c} \times \vec{a}).\vec{r}$ is equal to a) 0 b) 1 c) 2 d) 3

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14. If $\vec{a},\vec{b}$ and $\vec{c}$ are three non coplanar vectors, then $(\vec{a}+\vec{b}+\vec{c}).\left[(\vec{a}+\vec{b})\times(\vec{a}+\vec{c})\right]$ equals

a) 0 b) $\left[\vec{a}\vec{b}\vec{c}\right]$ c) $2\left[\vec{a}\vec{b}\vec{c}\right]$ d) $-\left[\vec{a}\vec{b}\vec{c}\right]$

15. If $\vec{a},\vec{b}$ and $\vec{c}$ are unit coplanar vectors, then the scalar triple product $\left[2\vec{a}-\vec{b}\,2\vec{b}-\vec{c}\,2\vec{c}-\vec{a}\right]=$

a) 0 b) 1 c) $-\sqrt{3}$ d) $\sqrt{3}$

16. If $\vec{a},\vec{b}$ and $\vec{c}$ are unit vectors, then $\left|\vec{a}-\vec{b}\right|^2+\left|\vec{b}-\vec{c}\right|^2+\left|\vec{c}-\vec{a}\right|^2$ does not exceed

a) 4 b) 9 c) 8 d) 6

17. If $|\vec{a}|=|\vec{b}|=|\vec{c}|=1$ and $\vec{a}.\vec{b}=\vec{b}=\vec{c}=\vec{c}.\vec{a}=\cos\theta$ then maximum value of θ is

a) $\frac{\pi}{2}$ b) $\frac{\pi}{5}$ c) $\frac{2\pi}{5}$ d) $\frac{\pi}{9}$

18. If $\vec{a},\vec{b},\vec{c}$ be three vectors such that $\left[\vec{a},\vec{b},\vec{c}\right]=4$ then $\left[\vec{a}\times\vec{b}\,\vec{b}\times\vec{c}\,\vec{c}\times\vec{a}\right]$ is equal to

a) 8 b) 16 c) 64 d) none of these

19. The vector component of $\vec{b}$ perpendicular to $\vec{a}$ is

a) $(\vec{b}.\vec{c})\vec{a}$ b) $\frac{\vec{a}\times(\vec{b}\times\vec{a})}{|\vec{a}|^2}$ c) $\vec{a}\times(\vec{b}\times\vec{a})$ d) none of these

20. Let $\vec{v}=2\hat{i}+\hat{j}-\hat{k},\vec{w}=\hat{i}+3\hat{k}$ and $\vec{u}$ is a unit vector then the maximum value of $(\vec{u}\vec{v}\vec{w})$ is

a) a) -1 b) $\sqrt{10}+\sqrt{6}$ c) $\sqrt{59}$ d) $\sqrt{60}$

21. If $\vec{a}=(\hat{i}+\hat{j}+\hat{k})\vec{a}.\vec{b}=1$ and $\vec{a}\times\vec{b}=\hat{j}-\hat{k}$ then $\vec{b}$ is

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

22. If $\vec{a}$ and $\vec{b}$ are two unit vectors inclined at an angle θ to each other , then $\left|\vec{a}\vec{b}\right|<1$ if

a) $\theta\frac{\pi}{6}$ b) $\theta\frac{\pi}{2}$ c) $\theta\frac{\pi}{3}$ d) $\frac{2\pi}{3}<\theta<\pi$

23. If $\vec{a}\perp\vec{b}$ then $\vec{a}\{\vec{a}\times\{\vec{a}\times\vec{b}\}\}$ is a) $|\vec{a}|^2\vec{b}$ b) $|\vec{a}|^3\vec{b}$ c) $|\vec{a}|^4\vec{b}$ d) $|\vec{a}|\vec{b}$

24. Vector $(\vec{b}\times\vec{c})\times(\vec{c}\times\vec{a})$ is a vector

a) along $\vec{b}$ b) in direction of $\hat{a}$ c) in the direction of $\vec{c}$ d) none of these

25. Let $\vec{u},\vec{v}$ and $\vec{w}$ be vectors such that $\vec{u}+\vec{v}+\vec{w}=0$. If $|\vec{u}|=3|\vec{v}|=4|\vec{w}|=5$ then $\vec{u}.\vec{v}+\vec{v}.\vec{w}+\vec{w}.\vec{u}$ is

a) 47 b) –25 c) 0 d) 25

26. The ratio in which the plan $\vec{r}\,.\,(\hat{j}-2\hat{j}+3\hat{k})=17$ divides the line joining the points $-2\hat{i}+3\hat{k}$ $-2\hat{i}+4\hat{j}+7\hat{k}$ and $-3\hat{i}-5\hat{j}+8\hat{k}$ is

a) 1:5 b) 1:10 c) 3:5 d) 3:10

27. If $\vec{a}=\hat{i}+\hat{j}+\hat{k},\vec{b}=4\hat{i}+3\hat{j}+4\hat{k},\vec{c}=\hat{i}+\alpha\hat{j}+\beta\hat{k}$ are linearly dependent vectors and $|\vec{c}|=\sqrt{3}$, then

a) α =1 , β = -1 b) α = 1, β = ±1 c) α = -1,β = ± 1 d) α = ± 1, β =1

28. 28. $\vec{a},\vec{b},\vec{c}$ are unit vectors $\vec{b}$ *and* $\vec{c}$ are inclined to $\vec{a}$ at an angle $\frac{\pi}{6}$ and the angle between $\vec{b}$ and $\vec{c}$ is $\frac{\pi}{3}$. Then $(\vec{a}\times\vec{b}).(\vec{a}\times\vec{c})=$ a) 0 b) 1 c) $\frac{1}{\sqrt{2}}$ d) $-\frac{1}{4}$

29. The angle between a diagonal of a cube and one of its edges is

a) $\cos^{-1}(1/\sqrt{3})$ b) π /4 c) π / 6 d) π /3

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30. A vector $\vec{a}$ of magnitude 50 is collinear with the vector $6\hat{i}-8\hat{j}-(15/2)\hat{k}$ making an obtuse angle with the z- axis is
    a) $24\hat{i}-32\hat{j}-30\hat{k}$ b) $-24\hat{i}+32\hat{j}+30\hat{k}$ c) $24\hat{i}+32\hat{j}-30\hat{k}$ d) none of these
31. Let $\vec{a}=3\hat{i}+2\hat{k}$ and $\vec{b}=2\hat{j}+\hat{k}$. If $\vec{c}$ is a unit vector, then the maximum value of the vector triple product $[\vec{a},\vec{b},\vec{c}]$, is
    a) $\sqrt{61}$ b) $\sqrt{59}$ c) $\sqrt{3}.\sqrt{36}$ d) None of these
32. Let $\vec{r}\times\vec{a}=\vec{b}\times\vec{a}$ and $\vec{r}.\vec{c}=0$, where $\vec{a}.\vec{c}\neq 0$ then $\vec{a}.\vec{c}(\vec{r}\times\vec{b})+\vec{b}.\vec{c}(\vec{a}\times\vec{r})$ equals to
    a) $\vec{c}$ b) $(\vec{a}.\vec{b})\vec{c}$ c) $(\vec{a}\times\vec{b})\times\vec{c}$ d) None of these
33. The vectors $x\hat{i}-3\hat{j}+7\hat{k}$ and $\hat{i}-y\hat{j}-z\hat{k}$ are collinear, then the value of $\frac{xy^2}{z}$ is equal to
    a) $\frac{9}{7}$ b) $-\frac{9}{7}$ c) $\frac{6}{7}$ d) $-\frac{6}{7}$
34. If vector $\vec{c}$ makes an angle $\frac{\pi}{3}$ with $\hat{i}+\hat{j}$, then the minimum and maximum values of $(\hat{i}\times\hat{j}).\vec{c}$, respectively , are
    a) $0,\frac{\sqrt{3}}{2}$ b) $-\frac{\sqrt{3}}{2},\frac{\sqrt{3}}{2}$ c) -1 , $\frac{\sqrt{3}}{2}$ d) None of these
35. Let $\vec{u}=\hat{i}+\hat{j},\vec{v}=\hat{i}-b\hat{f}$ j and $\hat{w}=\hat{i}+2\hat{j}+3\hat{k}$. If $b\,\hat{f}$ n is a unit vector such that $\vec{u}.\vec{n}=0$ and $\vec{v}.\vec{n}=0$, then $\vec{w}.\vec{n}$ is equal to a) 1 b) 2 c) 3 d) 0
36. The points with position vectors $60\hat{i}+3\hat{j},40\hat{i}-8\hat{j},a\hat{i}-52\hat{j}$ are collinear if
    a) a = -40 b) a =40 c) a = 20 d) none of these
37. Let $\vec{u},\vec{v}$ and $\vec{w}$ be vectors such that $\vec{u}+\vec{v}+\vec{w}=0$. If $|\vec{u}|=3$, $|\vec{v}|=4$ and $|\vec{w}|=5$, then $\vec{u}.\vec{v}+\vec{v}.\vec{w}+\vec{w}.\vec{u}$ is a) 47 b) -25 c) 0 d) 25
38. For three vectors u,v, w which of the following expression is not equal to any of the remaining three
    a) $\vec{u}.(\vec{v}\times\vec{w})$ b) $(\vec{v}\times\vec{w}).\vec{u}$ c) $\vec{v}.(\vec{u}\times\vec{w})$ d) $(\vec{u}\times\vec{v}).\vec{w}$
39. The value of 'a' so that the volume of parallelopiped formed by $\hat{i}+a\hat{j}+\hat{k},\hat{j}+a\hat{k}$ and $a\hat{i}+\hat{k}$ becomes minimum is a) -3 b) 3 c) $\frac{1}{\sqrt{3}}$ d) $\sqrt{3}$
40. If $\vec{a}$ and $\vec{b}$ are two unit vectors such that $\vec{a}+2\vec{b}$ and $5\vec{a}-4\vec{b}$ are perpendicular to each other then the angle between $\vec{a}$ and $\vec{b}$ is
    a) 45° b) 60° c) $\cos^{-2}\left(\frac{1}{3}\right)$ d) $\cos^{1}\left(\frac{2}{7}\right)$
41. The number of distinct real values of λ, for which the vectors $-\lambda^2\hat{i}+\hat{j}+\hat{k}$, $\hat{i}-\lambda^2\hat{j}+\hat{k}$ and $\hat{i}+\hat{j}-\lambda^2 k$ are coplanar is a) Zero b) one c) two d) three
42. If $\vec{a}+\vec{b}+\vec{c}=\alpha\vec{d},\vec{b}+\vec{c}+\vec{d}=\beta\vec{a}$ and $[\vec{a},\vec{b},\vec{c}]\neq 0$ then $\vec{a}+\vec{b}+\vec{c}+\vec{d}$ equals
    a) $a\vec{a}$ b) $\beta\vec{b}$ c) 0 d) $(\alpha+\beta)\vec{c}$
43. The number of all possible triplets (a_1, a_2, a_3) such that $a_1+a_2\cos(2x)+a_3\sin 2x = 0$□ x is
    a) zero b) one c) three d) infinite

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44. A plane which is perpendicular to two planes 2x -2y+ z =0 and x –y+2z = 4, passes through (1,-2,1). The distance of the plane from the point (1, 2, 2) is

    a) 0 b) 1 c) $\sqrt{2}$ d) $2\sqrt{2}$

45. The sum of the lengths of projections of $p\hat{i}+a\hat{j}+r\hat{k}$ on the coordinate axes where p =2, q= 3 and r= 1 is a) 6 b) 5 c) 4 d) 3

46. The vector equation of the plane passing through $\vec{a},\vec{b},\vec{c}$ is $\vec{r}=\alpha\vec{a}+\beta\vec{b}+\gamma\vec{c}$ provided

    a) $\alpha+\beta+\gamma=0$ b) $\alpha+\beta+\gamma=1$ c) $\alpha+\beta=\gamma$ d) $\alpha^2\beta^2+\gamma^2=1$

47. Volume of the tetrahedron included between the plane 2x - 3y – z - 6 = 0 and the coordinate planes is

    a)3 b) 6 c) 18 d) 22

48. If θ is the angle between two vectors $\vec{a}$ and $\vec{b}$ then $\vec{a}.\vec{b}>0$ only if

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

49. The direction cosines of line equally inclined with the co-ordiante axes are

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

50. Two points (1,-1,1) and (-2 ,0 ,5) with respect to the plane 2x+ 3y-z+7 =0 lie on

    a) opposite sides b) same side c) on the plane d) none of these

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