MATHS

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VECTOR ALGEBRA

Example

1. Prove that $\left(\vec{a} \times \vec{b}\right)^2 = \begin{vmatrix} \vec{a}.\vec{a} & \vec{a}.\vec{b} \\ \vec{a}.\vec{b} & \vec{b}.\vec{b} \end{vmatrix}$.

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2. Using vectors,prove that angle in a semi circle is a right angle.

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3. Find a vector of magnitute 12 units perpendicular to the containing the vectors $4\hat{i}+6\hat{j}-\hat{k}$ and $3\hat{i}+8\hat{j}+\hat{k}$.

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4. Show that the area of the parallelogram having diagonals $3\hat{i}+\hat{j}-2\hat{k}$ and $\hat{i}-3\hat{j}+4\hat{k}$ is $5\sqrt{3}$

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

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6. If A(1,2,4) and B(2,-1,3) are two points (i)Find $\overrightarrow{AB}$

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7. If A(1,2,4) and B(2,-1,3) are two points (ii) Find unit vector along `vec(AB)

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8. Show that the points with position vectors $2\hat{i}+6\hat{j}+3\hat{k}$, $\hat{i}+2\hat{j}+7\hat{k}$ and $3\hat{i}+10\hat{j}-\hat{k}$ are collinear.

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9. Let the vectors 'veca, vecb, vecc' be given as 'a_1 hati+a_2 hatj+a_3 hatk, b_1 hati+b_2 hatj+b_3 hatk, c_1 hati+c_2 hatj+c_3 hatk', Then show that 'veca xx(vecb+vecc)=veca xx vecb+veca xx vecc'

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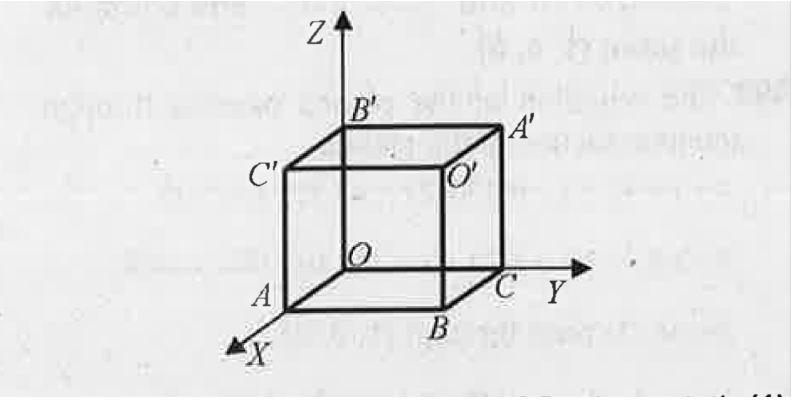
10. Consider a cube of side 'a' unit has one vertex at the origin O.

Show that the angle between the main diagonals of the above cube is $\cos^{-1}\left(\frac{1}{3}\right)$



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11. $\vec{a}, \vec{b}, \vec{c}$ are three non zero vectors such that $\vec{a} \times \vec{b} = \vec{c}, \vec{b} \times \vec{c} = \vec{a}$.Prove that $\vec{a}, \vec{b}, \vec{c}$ are

mutually at right angle and $\left|\vec{b}\right| = 1, \left|\vec{c}\right| = \left|\vec{a}\right|$.

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12. Find $\left|\vec{a} \times \vec{b}\right|$,If $\vec{a} = 2\hat{i} - \hat{j} + 3\hat{k}$ and $\vec{b} = \hat{i} + 2\hat{j} - \hat{k}$

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13. Choose the correct answer from the bracket.The angle between the vectors $\vec{a}$ and $\vec{b}$ with magnitude 1 and 2 respectively having $\vec{a} . \vec{b} = \sqrt{3}$ a) $\frac{\pi}{3}$ b) $\frac{\pi}{4}$ c) $\frac{\pi}{6}$ d) $\frac{\pi}{2}$

A. $\frac{\pi}{3}$

B. $\frac{\pi}{4}$

C. $\frac{\pi}{6}$

D. $\frac{\pi}{2}$

Answer:

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14. If the vectors $\vec{a} = \hat{i} + \hat{j} + \hat{k}$, $\vec{b} = 2\hat{i} - \hat{j} + \hat{k}$ and $\vec{c} = k\hat{i} - 2\hat{j} + 3\hat{k}$ are coplaner then find the value of k.

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15. Write two different vectors having same magnitude.

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16. Find the direction cosines of the vector $2\hat{i} + \hat{j} + 3\hat{k}$

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17. Consider two points A and B with position vectors $\overrightarrow{OA} = \vec{a} - 4\vec{b}$ and $\overrightarrow{OB} = \vec{a} - \vec{b}$ .Find the position vector of a point R which divides the line joining A and B in the ratio 2:1 internally

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18. Find a unit vector perpedicular to each of the vector $\vec{a} + \vec{b}$ and $\vec{a} - \vec{b}$ where $\vec{a} = 2\hat{i} + \hat{j} + \hat{k}$ and $\vec{b} = \hat{i} - \hat{j} + \hat{k}$

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19. Choose the correct answer from the backet. If a unit vector $\hat{a}$ makes angles $\frac{\pi}{4}$ with i and $\frac{\pi}{3}$ with j and acute angle θ with k.

then θ is

A. $\frac{\pi}{6}$

B. $\frac{\pi}{4}$

C. $\frac{\pi}{3}$

D. $\frac{\pi}{2}$

Answer:

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20. Find a unit vector $\hat{a}$.

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21. Write down a unit vector in XY plane, making an angle of 60° with the positive direction of x-axis.

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22. If $\vec{a}, \vec{b}, \vec{c}$ are three coplanar vectors, then $\left[\vec{a}\ \vec{b}\ \vec{c}\right]$ is

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23. Find P,if $\vec{a} = -2\hat{i} - \hat{j} + 2\hat{k}$ and $\vec{b} = \hat{i} + p\hat{j} + \hat{k}$ and $\vec{a} \times \vec{b} = 3\hat{i} + 4\hat{j} + 5\hat{k}$.

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24. $\vec{a} \times \vec{a}$ is equal to .....

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25. Find the area of a triangle with vertices A(2,3,1),B(1,1,2) and C(1,2,1).

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26. Consider the points A(0,-2,1),B(1,-1,-2) and C(-1,1,0) lyind in the plane. Compute $\overrightarrow{AB}$ and $\overrightarrow{AC}$.

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27. Consider the points A(0,-2,1),B(1,-1,-2) and C(-1,1,0) lyind in the plane. Find $\overrightarrow{AB} \times \overrightarrow{AC}$

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28. Let $\vec{a} = 7\hat{i} - 2\hat{j} + \hat{k}$, $\vec{b} = \hat{i} - 2\hat{j} + 2\hat{k}$ and $\vec{c} = 3\hat{i} - 8\hat{k}$

.i Compute $\vec{a} \times \vec{b}$ and $\vec{a} \times \vec{c}$.

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29. Let $\vec{a} = 7\hat{i} - 2\hat{j} + \hat{k}$, $\vec{b} = \hat{i} - 2\hat{j} + 2\hat{k}$ and $\vec{c} = 3\hat{i} - 8\hat{k}$

.ii Are the products $\vec{a}.\left(\vec{b} \times \vec{c}\right)$ and $\left(\vec{a} \times \vec{b}\right).\vec{c}$ obtained are same?

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30. Let $\vec{a} = 7\hat{i} - 2\hat{j} + \hat{k}$, $\vec{b} = \hat{i} - 2\hat{j} + 2\hat{k}$ and $\vec{c} = 3\hat{i} - 8\hat{k}$ and $\vec{d} = -\hat{j} + \hat{k}$.(i) Find $\vec{b} - \vec{a}$

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31. Let $\vec{a} = 7\hat{i} - 2\hat{j} + \hat{k}$, $\vec{b} = \hat{i} - 2\hat{j} + 2\hat{k}$ and $\vec{c} = 3\hat{i} - 8\hat{k}$ and $\vec{d} = -\hat{j} + \hat{k}$.(iii)Find the unit vector along $\vec{b} - \vec{a}$

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32. Given the position vectors of three points $A\left(\hat{i}-\hat{j}+2\hat{k}\right), B\left(4\hat{i}+5\hat{j}+8\hat{k}\right)$ and $C\left(3\hat{i}+3\hat{j}+6\hat{k}\right)$. Find the projection of $\overrightarrow{AB}$ on $\overrightarrow{AC}$.

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33. Given the position vectors of three points $A\left(\hat{i}-\hat{j}+2\hat{k}\right), B\left(4\hat{i}+5\hat{j}+8\hat{k}\right)$ and $C\left(3\hat{i}+3\hat{j}+6\hat{k}\right)$. Prove that A,B and C are collinear.

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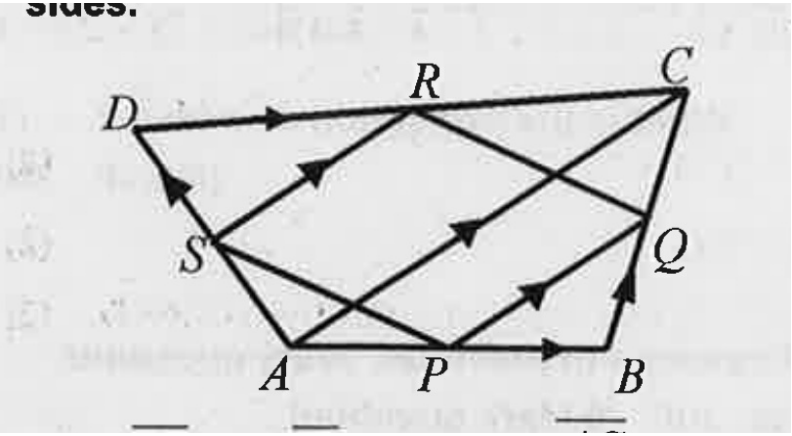
34. Consider the following quadrilateral ABCD in which P,Q,R,S are the mid points of the sides.

If $\vec{a}$ is any vector, prove that $\vec{a} = \left(\vec{a} \cdot i\right)i + \left(\vec{a} \cdot j\right)j + \left(\vec{a} \cdot k\right)k.$



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35. If $\vec{a}$ and $\vec{b}$ are unit vectors inclined at an angle θ ,then prove that $\sin\left(\frac{\theta}{2}\right) = \frac{1}{2}\left|\vec{a} - \vec{b}\right|$

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36. If $\vec{a} = x\hat{i} + 2\hat{j} - z\hat{k}$ and $\vec{b} = 3\hat{i} - y\hat{j} + \hat{k}$ are two equal vectors then write the value of x+y+z.

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37. If $\vec{a}, \vec{b}, \vec{c}$ are three vectors such that $\left|\vec{a}\right| = 5, \left|\vec{b}\right| = 12$ and $\left|\vec{c}\right| = 13$ and $\vec{a} + \vec{b} + \vec{c} = \vec{0}$, find the value of $\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a}.$

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38. If $i+j+k, 2i+5j, 3i+2j-3k, i-6j-k$ respectively are the position vector of points A,B,C and D. Then find the angle between the vectors $\overrightarrow{AB}$ and $\overrightarrow{CD}$.

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39. If $i+j+k, 2i+5j, 3i+2j-3k, i-6j-k$ respectively are the position vector of points A,B,C and D. Then

Deduce that $\overrightarrow{AB}$ parallel to $\overrightarrow{CD}$.

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40. Find the area of the parallelogram whose adjacent are determined by the vectors $\vec{a} = \hat{i} - \hat{j} + 3\hat{k} \text{and } \vec{b} = 2\hat{i} - 7\hat{j} + \hat{k}$.

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41. If 'veca.veca=0' and 'veca. vecb=0', then what can be concluded about the vector 'vecb' ?

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42. Let the vectors $\vec{a} \text{ and } \vec{b}$ be such that $\left|\vec{a}\right| = 3 \text{and} \left|\vec{b}\right| = \frac{\sqrt{2}}{3}$, then $\vec{a} \times \vec{b}$ is a unit vector, if

the angle between $\vec{a}$ and $\vec{b}$ is : a) $\frac{\pi}{6}$ b) $\frac{\pi}{4}$ c) $\frac{\pi}{3}$ d) $\frac{\pi}{2}$

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43. Find a unit vector perpendicular to the plane ABC where A,B,C are point (1,1,2),(2,3,5) and (1,5,5).

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44. The Cartesian equation of two lines are $\frac{x+1}{7} = \frac{y+1}{-6} = \frac{z+1}{1}$ and $\frac{x-3}{1} = \frac{y-5}{-2} = \frac{z-7}{1}$ .Write the vector equations.

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45. If $\vec{a}, \vec{b}, \vec{c}$ are three coplanar vectors, then $\left[\vec{a}\ \vec{b}\ \vec{c}\right]$ is

A. 1

B. 0

C. -1

D. not defined

Answer:

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46. If $\left|\vec{a}\right| = 2, \left|\vec{b}\right| = 3$ and θ is the angle between $\vec{a}$ and $\vec{b}$. Then the maximum value of $\vec{a}.\ \vec{b}$ occurs when

θ=.....a) $\frac{\pi}{2}$ b)π c)0 d) $\frac{\pi}{4}$

A. $\frac{\pi}{2}$

B. π

C. 0

D. $\frac{\pi}{4}$

Answer:

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47. If $\vec{b} = 2\hat{i} + \hat{j} - \hat{k}, \vec{c} = \hat{i} + 3\hat{k}$ and $\vec{a}$ is a unit vector. Find the maximum value of scalar triple product $\left[\vec{a}\ \vec{b}\ \vec{c}\right]$

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48. The position vectors of three points A,B,C are given to be $i+3j+3k$, $4i+4k$, $-2i+4j+2k$ respectively.Find the angle between $\overrightarrow{AB}$ and $\overrightarrow{AC}$

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49. The position vectors of three points A,B,C are given to be $i+3j+3k$, $4i+4k$, $(-2i+4j+2k$ respectively

Find a vector which is perpendicular to both $\overrightarrow{AB}$ and $\overrightarrow{AC}$ having magnitude 9 units.

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50. If $\bar{a}, \bar{b}, \bar{c}$ are coplaner vectors , write the vector perpendicular to $\bar{a}$

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51. If $\vec{a}, \vec{b}, \vec{c}$ are coplanar,prove that $\vec{a}+\vec{b}, \vec{b}+\vec{c}, \vec{c}+\vec{a}$ are coplanar.

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52. Prove that $\left[\vec{a}+\vec{b}\ \vec{b}+\vec{c}\ \vec{c}+\vec{a}\right]=2\left[\vec{a}\ \vec{b}\ \vec{c}\right]$

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53. Show that if $\vec{a}+\vec{b}, \vec{b}+\vec{c}, \vec{c}+\vec{a}$ are coplanar then $\vec{a}, \vec{b}, \vec{c}$ are also coplanar.

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54. If $\vec{a}=3\hat{i}+2\hat{j}+2\hat{k}, \vec{b}=\hat{i}+2\hat{j}-2\hat{k}$ Find $\vec{a}+\vec{b}$ and $\vec{a}-\vec{b}$

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55. If $\vec{a}=3\hat{i}+2\hat{j}+2\hat{k}, \vec{b}=\hat{i}+2\hat{j}-2\hat{k}$. Find a unit vector perpendicular to both $\vec{a}+\vec{b}$ and $\vec{a}-\vec{b}$

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56. Consider the points A(1.2.7),B(2,6,3),C(3,10,-1)

find $\overline{AB}$, $\overline{BC}$

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Exercise

1. If $\vec{a}$ and $\vec{b}$ are unit vectors inclined at an angle θ ,then prove that $\sin\left(\frac{\theta}{2}\right) = \frac{1}{2}\left|\vec{a} - \vec{b}\right|$

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