MATHS

BOOKS - CHHAYA PUBLICATION MATHS (BENGALI ENGLISH)

PRODUCTS OF TWO VECTORS

Example

1. Find the cosine of the angle between the vectors

$\vec{a} = 3\hat{i} + 2\hat{k}$ and $\vec{b} = 2\hat{i} - 2\hat{j} + 4\hat{k}$

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2. If the vectors $3\hat{i} - 2\hat{j} + m\hat{k}$ and $-2\hat{i} + \hat{j} + 4\hat{k}$ are perpendicular to each other , find the value of m

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3. Find the scalar and vector projections of $3\hat{i} - \hat{j} + 4\hat{k}$ on $2\hat{i} + 3\hat{j} - 6\hat{k}$

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4. Using vector method show that the diagonals of a rhombus are at right angles .

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5. If $\vec{a}$, $\vec{b}$ and $\vec{c}$ are three mutually perpendicular vectors of equal magnitude , show that , vectors $\vec{a}$, $\vec{b}$, $\vec{c}$ make an equal angle with $\vec{a} + \vec{b} + \vec{c}$

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6. If $\vec{a}, \vec{b}$ and $\vec{c}$ are three vectors of magnitude 3,4 and 5 respectively such that each vector is perpendicular to the sum of the other two vectors , prove that $\left|\vec{a}+\vec{b}+\vec{c}\right|=5\sqrt{2}$

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7. If the sum of two unit vectors is a unit vector then show that the magnitude of their difference is $\sqrt{3}$

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8. Find λ where projection of $\vec{a}=\lambda\hat{i}+\hat{j}+4\hat{k}$ on $\vec{b}=2\hat{i}+6\hat{i}+3\hat{k}$ is 4 unit

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9. Let $\vec{a} = \hat{i} + 4\hat{j} + 2\hat{k}$, $\vec{b} = 3\hat{i} - 2\hat{j} - 7\hat{k}$ and $\vec{c} = 2\hat{i} - \hat{j} + 4\hat{k}$. Find a vector $\vec{d}$ which is perpendicular to both $\vec{a}$ and $\vec{b}$ and $\vec{c}.\vec{d} = 18$

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10. Show that the perpendicular from the vertices of a triangle to the opposites sides are concurrent .

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11. If $\vec{a} = 3\hat{i} - 2\hat{j} + \hat{k}$ and $\vec{b} = \hat{i} - 3\hat{j} + 4\hat{k}$, find $\vec{a} \times \vec{b}$ and the area of the parallelogram whose adjacent sides are $\vec{a}$ and $\vec{b}$

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12. Find a unit vector perpendicular to both the vectors $2\hat{i} - 3\hat{j} + 6\hat{k}$ and $3\hat{j} - 4\hat{k}$. Also find the sine of the angle between the given vectors .

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13. For what values of p and q the vectors $2\hat{i} + p\hat{j} - 3\hat{k}$ and $q\hat{i} - 4\hat{j} + 2\hat{k}$ are parallel ?

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14. By vector method find the area of the triangle whose vertices are (1,1,1) ,(2,0,1) and $(3, -2, 0)$

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15. If $\vec{a} = a_1\hat{i} + a_2\hat{j} + a_3\hat{k}$, $\vec{b} = b_1\hat{i} + b_2\hat{j} + b_3\hat{k}$ and $\vec{c} = c_1\hat{i} + c_2\hat{j} + c_3\hat{k}$ prove that $\vec{a} \times \left(\vec{b} + \vec{c}\right) = \vec{a} \times \vec{b} + \vec{a} \times \vec{c}$

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16. Find the vector α which is perpendicular to both $4\hat{i} + 5\hat{j} - \hat{k}$ and $\hat{i} - 4\hat{j} + 5\hat{k}$ and which satisfies the relation $\alpha.\beta = 21$ where $\beta = 3\hat{i} + 5\hat{j} - \hat{k}$

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17. If $\vec{\alpha}, \vec{\beta}, \vec{\gamma}$ be unit vectors satisfying the condition $\vec{a} + \vec{\beta} + \vec{\gamma} = \vec{0}$ show that $\vec{\alpha}.\vec{\beta} + \vec{\beta}.\vec{\gamma} + \vec{\gamma}.\vec{\alpha} = -\frac{3}{2}$

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18. If $\vec{a} \times \vec{b} = \vec{c} \times \vec{d}$ and $\vec{a} \times \vec{c} = \vec{b} \times \vec{d}$, show that $\vec{a} - \vec{d}$ is parallel $\vec{b} - \vec{c}$, where to $\vec{a} \neq \vec{d}$ and $\vec{b} \neq \vec{c}$

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19. If $\vec{a} + \vec{b} + \vec{c} = \vec{0}$ and $|\vec{a}| = 3, |\vec{b}| = 5$ and $|\vec{c}| = 7,$, find the angle between the vectors $\vec{a}$ and $\vec{b}$

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20. If $\vec{a} = 4\hat{i} - 3\hat{k}$ and $\vec{b} = -2\hat{i} + \hat{j} + 2\hat{k}$ be two diagonals of parallelogram , then find its area .

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21. The dot products of a vector with the vectors $\hat{i} - 3\hat{k}, \hat{i} - 2\hat{k}$ and $\hat{i} + \hat{j} + 4\hat{j}$ are 0,5,8 respectively . Find the vector .

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22. If $\vec{p}$ is a unit vector and $\left(\vec{x}-\vec{p}\right).\left(\vec{x}+\vec{p}\right)=8$, then find $\left|\vec{x}\right|$

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23. If $\vec{p}$ is a unit and $\left(\vec{x}-\vec{p}\right).\left(\vec{x}+\vec{p}\right)=80$ then find $\left|\vec{x}\right|$

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24. Let $\vec{a}=2\hat{i}+\hat{k}$, $\vec{b}=\hat{i}+\hat{j}+\hat{k}$ and $\vec{c}=4\hat{i}-3\hat{j}+7\hat{k}$ be three given vectors . Find a vector $\vec{c}$ which satisfies the relations $\vec{r}\times\vec{b}=\vec{c}\times\vec{b}$ and $\vec{r}.\vec{a}=0$

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25. If $\vec{a}, \vec{b}$ and $\vec{c}$ are three unit vectors such that $\vec{a}.\vec{b} = \vec{a}.\vec{c} = 0$ and angle between $\vec{b}$ and $\vec{c}$ is $\frac{\pi}{6}$, prove that, $\vec{a} = \pm 2\left(\vec{b} \times \vec{c}\right)$

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26. Using vectors, prove that in a triangle ABC

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

where a,b,c are lengths of the ideas opposite to the angles A,B,C of triangle ABC respectively.

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27. Using vectors, prove that in a triangle ABC

$$a^2 = b^2 + c^2 - 2bc\cos A$$

where a,b,c are lengths of the ideas opposite to the angles A,B,C of triangle ABC respectively.

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28. Using vectors , prove that in a triangle ABC

$a = b\cos C + c\cos B$

where a,b,c are lengths of the ideas opposite to the angles A,B,C of triangle ABC respectively .

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Exercise 2 A Choose The Correct Question

1. If $\vec{a} = 2\hat{i} - \hat{j} + \hat{k}$ and $\vec{b} = -\hat{i} + 3\hat{j} + 4\hat{k}$, then value of $\vec{a} . \vec{b}$ is -

A. 1

B. 3

C. -3

D. -1

Answer: d

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2. If $\vec{a} = 2\hat{i} - 3\hat{j} + 4\hat{k}$ and $\vec{b} = -6\hat{i} + 9\hat{j} - 12\hat{k}$, then

A. $\vec{a} \perp \vec{b}$

B. $\vec{a} || \vec{b}$

C. angle between the vectors is $\cos^{-1}.\frac{3}{4}$

D. angle between the vectors is $\frac{\pi}{3}$

Answer: b

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3. The scalar projection of $\vec{a} = 2\hat{i} - 3\hat{j} + \hat{k}$ on $\vec{b} = 3\hat{i} - 6\hat{j} - 2\hat{k}$

A. $\frac{22}{7}$

B. $\frac{26}{7}$

C. $\frac{22}{\sqrt{14}}$

D. $\frac{26}{\sqrt{14}}$

Answer: a

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4. If the vectors $\vec{a} = 3\hat{j} + 6\hat{k}$ and $\vec{b} = -2\hat{i} + m\hat{j} - 3\hat{k}$ are perpendicular to each other , then the value of m is -

A. 12

B. -6

C. -12

D. 6

Answer: d

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5. If $\vec{a} = 2\hat{i} - \hat{j}$ and $\vec{b} = 3\hat{i} - 2\hat{j} + 4\hat{k}$, then the value of $\vec{a} \times \vec{b}$ is -

A. $4\hat{i} - 8\hat{i} - \hat{k}$

B. $-4\hat{j} - \hat{j} + \hat{k}$

C. $4\hat{i} - 8\hat{j} + \hat{k}$

D. $-4\hat{i} - 8\hat{j} - \hat{k}$

Answer: d

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6. If $\vec{a} = 2\hat{i} - 2\hat{j} + \hat{k}$, $\vec{b} = \hat{i} + \hat{j} - \hat{k}$ and $\left|\vec{a} \times \vec{b}\right| = \sqrt{13m}$ then the value of m is -

A. 3

B. 4

C. 2

D. 1

Answer: c

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7. If $\left|\vec{a}\right| = 4, \left|\vec{b}\right| = 2\sqrt{3}$ and $\left|\vec{a} \times \vec{b}\right| = 12$, then the angle between the vectors $\vec{a}$ and $\vec{b}$ is -

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

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

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

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

Answer: a

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8. If $\vec{a} = 2\hat{i} + 4\hat{j} - 3\hat{k}, \vec{b} = \hat{i} + m\hat{k}$ and $\left|\vec{a} \times \vec{b}\right| = 0$, then the values of m is -

A. $\frac{3}{2}$

B. -3

C. $-\frac{3}{2}$

D. 3

Answer: c

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Exercise 2 A Very Short Aanswer Type Questions

1. Define scalar product of two vectors . Show of two vectors . Show that scalar product of vectors satisfies the commutative and distributive laws.

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2. Find the scalar product of the following pair of vectors and the angle between them :

$\hat{i}+\hat{j}$ and $\hat{j}+\hat{k}$

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3. Find the scalar product of the following pair of vectors and the angle between them :

$\vec{a}=2\hat{i}+3\hat{j}-4\hat{k}$ and $\vec{b}=\hat{i}+2\hat{j}+\hat{k}$

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4. Find the scalar product of the following pair of vectors and the angle between them :

$\vec{a}=2\hat{i}-5\hat{j}+3\hat{k}$ and $\vec{b}=\hat{i}-2\hat{j}-4\hat{k}$

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5. Show that the vectors

$$\left|\vec{a}\times\vec{b}\right|^2=\begin{vmatrix}\vec{a}.\vec{a} & \vec{a}.\vec{b}\\ \vec{a}.\vec{b} & \vec{b}.\vec{b}\end{vmatrix}$$

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6. If $\vec{a} = 2\hat{i} - 3\hat{j} + 4\hat{k}$ and $\vec{b} = -6\hat{i} + 9\hat{j} - 12\hat{k}$, then

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7. Show that the vectors are mutually perpendicular

$\hat{i} + 2\hat{j} + \hat{k}, \hat{i} + \hat{j} - 3\hat{k}$ and $7\hat{i} - 4\hat{j} + \hat{k}$

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8. Show that the vectors

$a = 2\hat{i} + 3\hat{j} + 6\hat{k}, b = 3\hat{i} - 6\hat{j} + 2\hat{k}$ and $c = 6\hat{i} + 2\hat{j} - 3\hat{k}$ are mutually perpendicular

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9. In each of the following cases two vectors are perpendicular to each other, find m

$m\hat{i} - 2\hat{j} + \hat{k}$ and $3\hat{i} - 2\hat{j} - 7\hat{k}$

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10. In each of the following cases two vectors are perpendicular to each other, find m

$\vec{a} = m\hat{i} - 2\hat{j} - 5\hat{k}$ and $\vec{b} = -3\hat{i} - \hat{j} + 4\hat{k}$

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11. In the following cases two vectors are perpendicular to each other, find m

$a(1, 1, m)$ and $\vec{b} = 3\hat{i} - \hat{j} + 2\hat{k}$

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12. If $\vec{a} = 3\hat{i} + 2\hat{j} + 9\hat{k}$ and $\vec{b} = \hat{i} + \lambda\hat{j} + 3\hat{k}$, then find the value of λ so that the vectors $\left(\vec{a} + \vec{b}\right)$ and $\left(\vec{a} - \vec{b}\right)$ are perpendicular to each other .

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13. If $\vec{a} = 2\hat{i} - 3\hat{j} + 4\hat{k}$ and $\vec{b} = -6\hat{i} + 9\hat{j} - 12\hat{k}$, then

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14. Find the scalar and vector components of $\vec{a}$ in the direction of $\vec{b}$ where

$\vec{a} = \hat{i} + \hat{j}$ and $\vec{b} = \hat{j} + \hat{k}$

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15. Find the scalar and vector components of $\vec{a}$ in the direction of $\vec{b}$ where

$\vec{a} = 3\hat{i} + \vec{j} + 3\hat{k}$ and $\vec{b} = \hat{i} - \hat{j} - \hat{k}$

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16. Find the scalar and vector projection of $\vec{b}$ on a $\vec{a}$ where $\vec{a} = \hat{i} + 2\hat{j} + 2\hat{k}$ and $\vec{b} = \hat{j} + 2\hat{k}$

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17. Find the projection of vector $\left(\vec{b} + \vec{a}\right)$ on vector $\vec{a}$ where $\vec{a} = 2\hat{i} - \hat{j} + 2\hat{k}$ and $\vec{b} = \hat{j} + 2\hat{k}$

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18. Find the projection of vector $\left(\vec{b} + \vec{c}\right)$ on vector $\vec{a}$ where $\vec{a} = \hat{i} + 2\hat{j} + \hat{k}$, $\vec{b} = \hat{i} + 3\hat{j} + \hat{k}$ and $\vec{c} = \hat{i} + \hat{k}$

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19. If $|\vec{a}| = \sqrt{3}, \left|\vec{b}\right| = 2$ and $\vec{a} . \vec{b} = \sqrt{6}$, then find angle between the vectors $\vec{a}$ and $\vec{b}$

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20. Find the angle made by the vector $\sqrt{2}\hat{i} + \hat{j} + \hat{k}$ with the y - axis

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21. Find $\left|\vec{a} - \vec{b}\right|$, if two vectors $\vec{a}$ and $\vec{b}$ are such that $\left|\vec{a}\right| = 2, \left|\vec{b}\right| = 3$ and $\vec{a} . \vec{b} = 4$

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22. Define the vector product of two vectors $\vec{a}$ and $\vec{b}$. Give geometrical interpretation of $\vec{a} \times \vec{b}$. Show that the satisfies the distributive law .

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23. If $\left|\vec{a}\right| = 3, \left|\vec{b}\right| = 4$ and $\left|\vec{a} \times \vec{b}\right| = 6$, then find the angle between the vectors $\vec{a}$ and $\vec{b}$

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24. If $\vec{a}, \vec{b}$ and $\vec{a} \times \vec{b}$ are three unit vectors, find the angles beween the vectors $\vec{a}$ and $\vec{b}$

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25. If two vectors $\vec{a}$ and $\vec{b}$ are such that $\left|\vec{a}.\vec{b}\right| = \left|\vec{a} \times \vec{b}\right|$, then find the angle the vectors $\vec{a}$ and $\vec{b}$

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26. If two vectors $\vec{a}$ and $\vec{b}$ are such that $\left|\vec{a}.\vec{b}\right| = \left|\vec{a} \times \vec{b}\right|$, then find the angle the vectors $\vec{a}$ and $\vec{b}$

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27. If vectors $\vec{a} = p\hat{i} + 8\hat{j} + 6\hat{k}$ and $\vec{b} = -3\hat{i} + 4\hat{j} + q\hat{k}$ are parallel , find p and q

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28. If $\left(2\hat{i} + 6\hat{j} + 27\hat{k}\right) \times \left(\hat{i} + 3\hat{j} + p\hat{k}\right) = \vec{0}$, find p

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29. If $\left(2\hat{i} + 6\hat{j} + 14\hat{k}\right) \times \left(\hat{i} - \lambda\hat{j} + 7\hat{k}\right) = \vec{0}$ find λ

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30. Find the area of the parallelogram whose

adjacent sides are $\vec{a} = 3\hat{i} - \hat{j} + 4\hat{k}$ and $\vec{b} = \hat{i} - \hat{j} + \hat{k}$

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31. Find the area of the parallelogram whose

whose vertices are the points

$(0, -3, -1), (2, 1, -1), (3, -3, 2)$ and $(1, -7, 2)$ taken in order .

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32. Find the area of the parallelogram whose

Whose diagonals are the vectors $3\hat{i} + \hat{j} - 2\hat{k}$ and $\hat{i} - 3\hat{j} + 4\hat{k}$

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33. Find the area of triangle

(i) drawn on the vectors $\vec{a} = 6\hat{i} + 2\hat{j} - 3\hat{k}$ and $\vec{b} = 4\hat{i} - \hat{j} - 2\hat{k}$

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34. Find the area of triangle

whose vertices have position vectors

$\hat{i} + \hat{j} + 2\hat{k}, 2\hat{i} + 2\hat{j} + 3\hat{k}$ and $3\hat{i} - \hat{j} - \hat{k}$

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35. Find the area of the triangle

whose vertices are the points (1,2,3) (2,3,1) and (1,1,1)

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Exercise 2 A Short Answer Type Questions

1. Two vectors $\vec{a}$ and $\vec{b}$ are such that $\left|\vec{a}\right| = 2, \left|\vec{b}\right| = 1$ and $\vec{a} . \vec{b} = 1$, then find the value of $\left(3\vec{a} - 5\vec{b}\right) . \left(2\vec{a} + 7\vec{b}\right)$

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2. If $\left|\vec{a}\right| = 2, \left|\vec{b}\right| = 3$ and $\vec{a} . \vec{b} = 3$, then find the projection of $\vec{b}$ on $\vec{a}$

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3. If projection of vector $\lambda\hat{i} - \hat{j}$ on vector $\hat{i} + \hat{j}$ is zero , find λ

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4. If $\left|\vec{a}\right| = 4$ and $\left|\vec{b}\right| = 3$ find the value of λ for which the vectors $\vec{a} + \lambda\vec{b}$ and $\vec{a} - \lambda\vec{b}$ are perependicular to each other .

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5. The vectors $\vec{a}, \vec{b}, \vec{c}$ are such that $\vec{a} + \vec{b} + \vec{c} = \vec{0}$. If $\left|\vec{a}\right| = 3, \left|\vec{b}\right| = 4$ and $\left|\vec{c}\right| = 5$, show that $\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a} = -25$

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6. If $\vec{a} = \hat{i} - \hat{j} + 2\hat{k}, \vec{b} = \hat{i} + \hat{j} + \hat{k}$ and $\vec{c} = 2\hat{i} - \hat{j} + \hat{k}$ find the vector $\vec{r}$ satisfying the relations, $\vec{a}.\vec{r} = 1, \vec{b}.\vec{r} = 2$ and $\vec{c}.\vec{r} = 5$

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7. If $\vec{\alpha}$ and $\vec{\beta}$ are perpendicular to each other, show that $\left|\vec{\alpha} + \vec{\beta}\right|^2 = \left|\vec{a}\right|^2 + \left|\vec{\beta}\right|^2$

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8. If $\vec{\alpha}$ and $\vec{\beta}$ are perpendicular to each other , show that $\left|\vec{\alpha}+\vec{\beta}\right|^2=\left|\vec{\alpha}-\vec{\beta}\right|^2$

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9. $A(p,1,-1), B(2p,0,2)$ and $C(2+2p,p,p)$ are three points . Find the value of p so that the vectors $\overrightarrow{AB}$ and $\overrightarrow{BC}$ are perpendicular to each other .

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10. If $\vec{a}=\hat{i}+2\hat{j}-3\hat{k}$ and $\vec{\beta}=3\hat{i}-\hat{j}+2\hat{k}$, find the cosine of the angle between the vectors $\left(2\vec{\alpha}+\vec{\beta}\right)$ and $\left(\vec{\alpha}+2\vec{\beta}\right)$

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11. Show that the vector $\vec{a}$ is perpendicular to the vector $\vec{b} - \frac{\vec{a} \cdot \vec{b}}{\left|\vec{a}\right|^2} \vec{a}$

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12. For any two vectors $\vec{a}$ and $\vec{b}$, show that $\left|\vec{a} \cdot \vec{b}\right| \leq \left|\vec{a}\right| \left|\vec{b}\right|$

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13. If $\vec{a}, \vec{b}, \vec{c}$ are non - coplanar vectors $\vec{r} \cdot \vec{a} = \vec{r} \cdot \vec{b} = \vec{r} \cdot \vec{c} = 0$, show that $\vec{r}$ is a zero vector .

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14. For the vector $\vec{a}$ and $\vec{b}$ if $\left|\vec{a} + \vec{b}\right| = \left|\vec{a} - \vec{b}\right|$, show that $\vec{a}$ and $\vec{b}$ are perpendicular

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15. Prove that $\left(\vec{a}+\vec{b}\right).\left(\vec{a}+\vec{b}\right)=\left|\vec{a}\right|^2+\left|\vec{b}\right|^2$, if and only if $\vec{a}$, $\vec{b}$ are perpendicular , given $\vec{a}1=\vec{0}$, $\vec{b}\neq\vec{0}$

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16. If $\hat{i}$, $\hat{j}$ and $\hat{k}$ are unit vectors along three mutuaaly perpendicular axes and

$\vec{a}=a_1\hat{i}+a_2\hat{j}+a_3\hat{k}$, $\vec{b}=b_1\hat{i}+b_2\hat{j}+b_3\hat{k}$ and $\vec{c}=c_1\hat{i}+c_2\hat{j}+c_3\hat{k}$

prove that

$\vec{a}.\left(\vec{b}+\vec{c}\right)=\vec{a}.\vec{b}+\vec{a}.\vec{c}$

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17. If $\hat{i}$, $\hat{j}$ and $\hat{k}$ are unit vectors along three mutuaaly perpendicular axes and

$\vec{a}=a_1\hat{i}+a_2\hat{j}+a_3\hat{k}$, $\vec{b}=b_1\hat{i}+b_2\hat{j}+b_3\hat{k}$ and $\vec{c}=c_1\hat{i}+c_2\hat{j}+c_3\hat{k}$

prove that

$$\left(\vec{b}+\vec{c}\right)\times\vec{a}=\vec{b}\times\vec{a}+\vec{c}\times\vec{a}$$

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18. Let $\vec{a}=2\hat{i}-2\hat{j}+\hat{k}$, $\vec{b}=\hat{j}-\hat{k}$ and $\vec{c}=-\hat{i}+3\hat{j}+2\hat{k}$ be three given vectors .Find

$$\vec{a}\times\vec{b}$$

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19. Let $\vec{a}=2\hat{i}-2\hat{j}+\hat{k}$, $\vec{b}=\hat{j}-\hat{k}$ and $\vec{c}=-\hat{i}+3\hat{j}+2\hat{k}$ be three given vectors .Find

$$\vec{c}\times\left(-\vec{a}\right)$$

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20. Let $\vec{a} = 2\hat{i} - 2\hat{j} + \hat{k}$, $\vec{b} = \hat{j} - \hat{k}$ and $\vec{c} = -\hat{i} + 3\hat{j} + 2\hat{k}$ be three given vectors .Find

$\left(\vec{a} - 2\vec{b}\right) \times \vec{c}$

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21. Let $\vec{a} = 2\hat{i} - 2\hat{j} + \hat{k}$, $\vec{b} = \hat{j} - \hat{k}$ and $\vec{c} = -\hat{i} + 3\hat{j} + 2\hat{k}$ be three given vectors .Find

$\left(\vec{a} + \vec{b}\right) \times \left(\vec{b} - \vec{c}\right)$

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22. Let $\vec{a} = 2\hat{i} - 2\hat{j} + \hat{k}$, $\vec{b} = \hat{j} - \hat{k}$ and $\vec{c} = -\hat{i} + 3\hat{j} + 2\hat{k}$ be three given vectors .Find

angle between $\vec{a}$ and $\vec{b}$

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23. Let $\vec{a} = 2\hat{i} - 2\hat{j} + \hat{k}$, $\vec{b} = \hat{j} - \hat{k}$ and $\vec{c} = -\hat{i} + 3\hat{j} + 2\hat{k}$ be three given vectors .Find

sine of the angle $\vec{a}$ and $\vec{c}$

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24. In each of the following find a unit a vector perpendicular to both $\vec{a}$ and $\vec{b}$

$\vec{A} = \hat{i} + \hat{j}$ and $\vec{b} = -\hat{i} + \hat{k}$

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25. In each of the following find a unit a vector perpendicular to both $\vec{a}$ and $\vec{b}$

$\vec{a} = 2\hat{i} + \hat{j}$ and $\vec{b} = -\hat{i} + \hat{k}$

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26. In each of the following find a unit a vector perpendicular to both $\vec{a}$ and $\vec{b}$

$\vec{a} = 2\hat{i} - 2\hat{j} + \hat{k}$ and $\vec{b} = \hat{i} + 2\hat{j} - 2\hat{k}$

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27. In each of the following find a unit a vector perpendicular to both $\vec{a}$ and $\vec{b}$

$\vec{a} = (2, 1, 1)$ and $\vec{b} = (1, -1, 2)$

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28. If $\vec{a} = \hat{i} + \hat{j} - \hat{k}$, $\vec{b} = 2\hat{i} - 2\hat{j} + \hat{k}$ and $\vec{c} = 3\hat{i} + 2\hat{j} - 2\hat{k}$ show that ,

$\vec{a} . \left(\vec{b} + \vec{c}\right) = \vec{a} . \vec{b} + \vec{a} . \vec{c}$

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29. If $\vec{a} = \hat{i} + \hat{j} - \hat{k}$, $\vec{b} = 2\hat{i} - 2\hat{j} + \hat{k}$ and $\vec{c} = 3\hat{i} + 2\hat{j} - 2\hat{k}$ show that ,

$$\vec{a} \times \left(\vec{b} + \vec{c} \right) = \vec{a} \times \vec{b} + \vec{a} \times \vec{c}$$

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30. Be vector method show that the points $(2, -3, 4), (-2, 1, 0)$ and $(1, -2, 3)$ are collinear

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31. If $\vec{\alpha} = 2\hat{i} + \hat{j} - 3\hat{k}$ and $\vec{\beta} = \hat{i} - 2\hat{j} + \hat{k}$, find a vector of magnitude 5 perpendicular to both $\vec{\alpha}$ and $\vec{\beta}$

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32. If $\vec{a} + \vec{b} + \vec{c} = \vec{0}$ and $\left|\vec{a}\right| = 6, \left|\vec{b}\right| = 4$ and $\left|\vec{c}\right| = 3$ find the cosine of the angle between the vectors $\vec{b}$ and $\vec{c}$

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33. Prove that ,

$$\left(\vec{a}-\vec{b}\right)\times\left(\vec{a}+\vec{b}\right)=2\left(\vec{a}\times\vec{b}\right)$$

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34. Prove that ,

$$\left(\vec{a}\times\vec{b}\right)^2+\left(\vec{a}.\vec{b}\right)^2=\left|\vec{a}\right|^2\left|\vec{b}\right|^2$$

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35. Prove that ,

$$\vec{a}\times\left(\vec{b}+\vec{c}\right)+\vec{b}\times\left(\vec{c}+\vec{a}\right)+\vec{c}\times\left(\vec{a}+\vec{b}\right)=\vec{0}$$

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36. Given that $\vec{a}.\vec{b}=0$ and $\vec{a}\times\vec{b}=\vec{0}$. What can you conclude abut the vector $\vec{a}$ and $\vec{b}$?

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37. If $\vec{a}+\vec{b}+\vec{c}=\vec{0}$, show that $\vec{a}\times\vec{b}=\vec{b}\times\vec{c}=\vec{c}\times\vec{a}$

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38. Find the value of $\left[\left(\hat{k}\times\hat{j}\right).\hat{i}+\hat{j}.\hat{k}\right]$

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39. The three vertices of the triangle ABC are A(2,3,5) B(3,5,8) and C(2,7,8) : using vector method find the area of the triangle ABC.

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

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41. Find a unit vector perpendicular to each of the vectors $\vec{a} + \vec{b}$ and $\vec{a} - \vec{b}$ where $\vec{a} = 3\hat{i} + 2\hat{j} + 2\hat{k}$ and $\vec{b} = \hat{i} + 2\hat{j} - 2\hat{k}$.

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Exercise 2 A Long Answer Type Questions

1. Applying vectors , show that

$$(a_1b_1 + a_2b_2 + a_3b_3)^2 \leq \left(a_1^2 + a_2^2 + a_3^2\right)\left(b_1^2 + b_2^2 + b_3^2\right)$$

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2. By vector method show that ,

an angle inscribed in a semi - circle is a right angle ,

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3. By vector method show that ,

the parallelogram whose diagonals are equal is a rectangle ,

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4. By vector method show that ,

the perpendicular bsectors of the sides of a triangle are concurrent .

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5. By vector method show that ,

median to the base of an isocales triangle is perpendicular to the base .

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6. $A(3, -1, 2), B(2, -3, 3)$ and $C(1, -2, 1)$ are three given points . Find the angle between the vectors $\overrightarrow{BA}$ and $\overrightarrow{BC}$.

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7. Three vectors $\vec{a}, \vec{b}, \vec{c}$ are such that $\vec{a} + \vec{b} + \vec{c} = \vec{0}$, if $|\vec{a}| = 1|\vec{b}| = 4$ and $|\vec{c}| = 2$, then find the value of $\mu = \left(\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a}\right)$

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8. The scaler product of the vector $\hat{i} + \hat{j} + \hat{k}$ with the unit vector along the sum of vectors $2\hat{i} + 4\hat{j} - 5\hat{k}$ and $\lambda\hat{i} + 2\hat{j} + 3\hat{k}$ is equal to one . Find the value of λ

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9. Let $\vec{a} = 2\hat{i} + 2\hat{j} + 3\hat{k}$, $\vec{b} = -\hat{i} + 2\hat{j} + \hat{k}$ and $\vec{c} = 3\hat{i} + \hat{j}$ be three given vectors , if $\vec{a} + \lambda \vec{b}$ and $\vec{c}$ are perpendicular to each other , find λ

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10. Let $\vec{a} = 2\hat{i} + 2\hat{j} + 2\hat{k}$, $\vec{b} = -\hat{i} + 2\hat{j} + \hat{k}$ and $\vec{c} = 3\hat{i} + \hat{j}$ be three given vectors , if $\vec{a} + \lambda \vec{b}$ and $\vec{c}$ are perpendicular to each other , find lambda .

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11. If $\hat{i} + \hat{j} + \hat{k}, 2\hat{i} + 5\hat{j}, 3\hat{i} + 2\hat{j} - 3\hat{k}$ and $\vec{i} - 6\hat{j} - \hat{k}$ are the position vectors find the angle between $\overrightarrow{AB}$ and $\overrightarrow{CD}$. Deduce that $\overrightarrow{AB}$ and $\overrightarrow{CD}$ are collinear .

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12. Express the vector $\vec{a} = 5\hat{i} - 2\hat{j} + 5\hat{k}$ as sum of two vectors such that one is parallel to the vector $\vec{b} = 3\hat{i} + \hat{k}$ and the other is perpendicular to $\vec{b}$

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13. If $\vec{a} = \vec{0}$ or $\vec{b} = \vec{0}$ then $\vec{a} . \vec{b} = 0,$ show by an example that the converse of this statement is not always true .

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14. If $\vec{a} = 3\hat{i} + 4\hat{j} - \hat{k}, \vec{b} = \hat{i} - 3\hat{j} + 4\hat{k}$ and $\vec{c} = 5\hat{i} - 6\hat{j} + 4\hat{k}$, find the vector $\vec{r}$ which is perpendicular to both $\vec{a}$ and $\vec{b}$ and which satisfies the relation $\vec{r} . \vec{c} = 91$

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15. Let $\vec{a}, \vec{b}, \vec{c}$ be the positions vectors of the vertices of a triangle , prove that the area of the triangle is $\frac{1}{2}\left|\vec{a} \times \vec{b} + \vec{b} \times \vec{c} + \vec{c} \times \vec{a}\right|$

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16. Given $\vec{a} = 4\hat{i} + 5\hat{j} - \hat{k}, \vec{b} = \hat{i} - 4\hat{j} + 5\hat{k}$ If $\left|\vec{c}\right| = 21$ and $\vec{c}$ is perpendicular to $\vec{a}$ and $\vec{b}$, find in component form the vector $\vec{c}$

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Exercise 2 B Short Answer Type Questions

1. If $\vec{a} = \hat{i} + \hat{j}, \vec{b} = \hat{i} - \hat{j}$ and $\vec{c} = 5\hat{i} + 2\hat{j} + 3\hat{k}$, find the value of $\left[\vec{b}\,\vec{c}\,\vec{a}\right]$

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2. If $\vec{\alpha} = \hat{i} - 2\hat{j} + 3\hat{k}, \vec{\beta} = 2\hat{i} - 3\hat{j} + \hat{k}$ and $\vec{\gamma} = 3\hat{i} + \hat{j} - 2\hat{k}$, find $\vec{\alpha}.\left(\vec{\beta} \times \vec{\gamma}\right)$.

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3. If $\vec{\alpha} = -\hat{i} + 2\hat{j} + \hat{k}, \vec{b} = 3\hat{i} + \hat{j} + 2\hat{k}$ and $\vec{c} = 2\hat{i} + \hat{j} + 3\hat{k}$, find $\left[\vec{c}\,\vec{a}\,\vec{b}\right]$

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4. The vectors which determine the sides of the parallelopiped are given below :

$\hat{i} + \hat{j} + \hat{k}, \hat{k}, 3\hat{i} - \hat{j} + 2\hat{k}$

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5. The vectors which determine the sides of the parallelopiped are given below :

$\hat{i}+\hat{j}+\hat{k}, \hat{i}+2\hat{j}+2\hat{k}, \hat{i}-2\hat{j}+4\hat{k}$

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6. In each of the following show that the given vectors are coplanar:

$4\hat{i}+2\hat{j}+\hat{k}, 2\hat{i}-\hat{j}+3\hat{k}, 8\hat{i}+7\hat{k}$

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7. In each of the following show that the given vectors are coplanar:

$\vec{a}=\hat{i}+\hat{j}-6\hat{k}, \vec{b}=\hat{i}+3\hat{j}+4\hat{k}, \vec{c}=2\hat{i}+5\hat{j}+3\hat{k}$

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8. If $\vec{a} = -2\hat{i} - 2\hat{j} + 4\hat{k}$, $\vec{b} = -2\hat{i} + 4\hat{j} - 2\hat{k}$ and $\vec{c} = 4\hat{i} - 2\hat{j} - 2\hat{k}$, find $\vec{a}.\left(\vec{b} \times \vec{c}\right)$ and interpret the result

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9. If the vectors $x\hat{i} - 4\hat{j} + 5\hat{k}$, $\hat{i} + 2\hat{j} + \hat{k}$ and $2\hat{i} - \hat{j} + \hat{k}$ are coplanar , find the value x

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10. If the vectors $\vec{a} = 2\hat{i} - \hat{j} + \hat{k}$, $\vec{b} = \hat{i} + 2\hat{j} - 3\hat{k}$ and $\vec{c} = 3\hat{i} + \lambda\hat{j} + 5\hat{k}$ are coplanar , find the value of λ

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11. The position vectors of four points A,B,C and D are given below . In each case , using vector method prove that the four points A,B,C and D are coplanar .

$6\hat{i} - 4\hat{j} + 10\hat{k},\ -5\hat{i} + 3\hat{j} - 10\hat{k}, 4\hat{i} - 6\hat{j} - 10\hat{k}, 2\hat{j} + 10\hat{k}$

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12. The position vectors of four points A,B,C and D are given below . In each case , using vector method prove that the four points A,B,C and D are coplanar .

$4\hat{i} + 8\hat{j} + 12\hat{k}, 2\hat{i} + 4\hat{j} + 6\hat{k}, 3\hat{i} + 5\hat{j} + 4\hat{k}, 5\hat{i} + 8\hat{j} + 5\hat{k}$

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13. If the vectors $-4\hat{i} - 6\hat{j} - 2\hat{k},\ -\hat{i} + 4\hat{j} + 3\hat{k}$ and $-8\hat{i} - \hat{j} + \lambda\hat{k}$ are coplanar , then find the value of λ

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14. If the vectors $\vec{a} = 2\hat{i} - \lambda\hat{j} + 3\hat{k}$, $\vec{b} = 3\hat{i} + 2\hat{k} - \mu\hat{k}$ and $\vec{c} = \hat{i} + \hat{j} + \hat{k}$ are coplanar , find μ in terms of λ

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15. Prove that :

$$\left(\vec{a} + \vec{b}\right).\left\{\left(\vec{b} + \vec{c}\right) \times \left(\vec{c} + \vec{a}\right)\right\} = 2\vec{a}.\left(\vec{b} \times \vec{c}\right)$$

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16. Prove that :

$$\vec{a}.\left\{\vec{b} \times \left(\vec{c} + \vec{d}\right)\right\} = \vec{a}.\left(\vec{b} \times \vec{c}\right) + \vec{a}.\left(\vec{b} \times \vec{d}\right)$$

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17.

$\vec{\alpha} = \lambda\hat{i} + \hat{j} + 3\hat{k}$, $\vec{\beta} = -\hat{i} + 2\hat{j} + \hat{k}$, $\vec{\gamma} = 3\hat{i} + \hat{j} + 2\hat{k}$ and $\left[\vec{\alpha}\ \vec{\beta}\right.$

then find the value of λ

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18. If the vectors $a\hat{i}+a\hat{j}+c\hat{k}, \hat{i}+\hat{k}$ and $c\hat{i}+c\hat{j}+b\hat{k}$ be coplanar, show that $c^2=ab$

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19. Let $\vec{a}=\hat{i}+\hat{j}+\hat{k}, \vec{b}=\hat{i}$ and $\vec{c}=c_1\hat{i}+c_2\hat{j}+c_3\hat{k}$ then , if $c_1=1$ and $c_2=2$, find c_3 which makes $\vec{a}, \vec{b}$ and $\vec{c}$ coplanar .

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20. Find x such that the four points $A(3,2,1), B(4,x,5), C(4,2,-2)$ and $D(6,5,-1)$ are coplanar .

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Sample Questions For Competitive Examination Multiple Correct Answers Type

1. f $\vec{a}$ is any vector , then -

A. $\left(\vec{a}.\hat{i}\right)\hat{i}+\left(\vec{a}.\hat{j}\right)\hat{j}+\left(\vec{a}.\hat{k}\right)\hat{k}=\vec{a}$

B. $\left(\vec{a}.\hat{i}\right)^2+\left(\vec{a}.\hat{j}\right)^2+\left(\vec{a}.\hat{k}\right)^2=\left|\vec{a}\right|^2$

C. $\hat{i}\times\left(\vec{a}\times\hat{j}\right)+\hat{j}\times\left(\vec{a}\times\hat{j}\right)+\hat{k}\times\left(\vec{a}\times\vec{k}\right)=2\vec{a}$

D. all of the above

Answer: A,B,C,D

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2. The vector $\vec{a}=\lambda\hat{i}+\hat{j}+2\hat{k},\ \vec{b}=\hat{i}+\lambda\hat{j}-\hat{k}$ and $\vec{c}=2\hat{i}-\hat{i}-\hat{j}+\lambda\hat{k}$ are coplanar if -

A. $\lambda=-2$

B. $\lambda = \sqrt{3} + 1$

C. $\lambda = 1 - \sqrt{3}$

D. $\lambda = 2$

Answer: A,B,C

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3. If $\vec{a}, \vec{b}, \vec{c}$ are any vectors, then which the following is equal to $\vec{a} \times \vec{b} + \vec{b} \times \vec{c} + \vec{c} \times \vec{a}$?

A. $\left(\vec{a} - \vec{b}\right) \times \left(\vec{b} - \vec{c}\right)$

B. $\left(\vec{c} - \vec{b}\right) \times \left(\vec{a} - \vec{c}\right)$

C. $\left(\vec{a} - \vec{b}\right) \times \left(\vec{a} - \vec{c}\right)$

D. $\frac{1}{2}\left\{\vec{a} \times \left(\vec{b} - \vec{c}\right) + \vec{b} \times \left(\vec{c} - \vec{a}\right) + \vec{c} \times \left(\vec{a} - \vec{b}\right)\right\}$

Answer: A,B,C,D

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4. If $\alpha = 2\vec{i} + 3\vec{j} - 5\vec{k}$ and $\beta = \vec{i} - \vec{j}$, then find the value of $\alpha \times \beta$

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5. The vectors $\vec{a}, \vec{b}, \vec{c}$ are of same magnitude and taken pariwise , they contain equal angles. If $\vec{a} = \hat{i} + \hat{j}, \vec{b} = \hat{j} + \hat{k}$ then the vector $\vec{c}$ =

A. $\hat{i} + \hat{k}$

B. $\hat{i} + 2\hat{j} + 3\hat{k}$

C. $-\hat{i} + \hat{j} + 2\hat{k}$

D. $-\frac{1}{3}i + \frac{4}{3}\hat{j} - \frac{1}{3}\hat{k}$

Answer: A,D

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Sample Questions For Competitive Examination Integar Answer Type

1. Let $\vec{a} = -\hat{i} - \hat{k}$, $\vec{b} = -\hat{i} + \hat{j}$ and $\vec{c} = \hat{i} + 2\hat{j} + 3\hat{k}$ be three given vectors . If $\vec{r}$ is a vector such that $\vec{r} \times \vec{b} = \vec{c} \times \vec{b}$ and $\vec{r} . \vec{a} = 0$ then the value of $\vec{r} . \vec{b}$ is -

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2. If $\vec{a}$ and $\vec{b}$ are two vectors in space given by $\vec{a} = \frac{\hat{i} - 2\hat{j}}{\sqrt{5}}$ and $\vec{b} = \frac{2\hat{i} + \hat{j} + 3\hat{k}}{\sqrt{14}}$ then the value of

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3. If a vector $\vec{v}$ is such that $2\vec{v} + \vec{v} \times \left[\hat{i} + 2\hat{j}\right] = 2\hat{i} + \hat{k}$ and $\left|\vec{v}\right| = \frac{1}{3}\sqrt{m}$, then m is equal to -

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4. If $\vec{a} = 3\alpha\hat{i} + 2\hat{j} - 3\hat{k}$, $\vec{b} = \hat{i} + 6\alpha\hat{j} - 2\hat{k}$ and $\hat{c} = 2\hat{i} - 3\alpha\hat{j} + \hat{k}$ be such that $\left\{\left(\vec{a} \times \vec{b}\right) \times \left(\vec{b} \times \vec{c}\right)\right\} \times \left(\vec{c} \times \vec{a}\right) = \vec{O}$, then the value of 9α is -

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5. A median drawn from the vertex from the A of a triangle ABC is bisected at E . BE meets AC in F such that AF:AC = 1 : n where n is-

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Sample Questions For Competitive Examination Matrix Match Type

1. Match the following Column I and Column II

1.	Column I		Column II
(A)	For any vector $\vec{a}$, $\vec{a} \times \vec{a}$ is equal to	(p)	$(\vec{a})^2$
(B)	For any vector $\vec{a}$, $\vec{a} \cdot \vec{a}$ is equal to	(q)	$\vec{0}$
(C)	For any vector $\vec{a}$, $(\vec{a} \cdot \hat{i})\hat{i} + (\vec{a} \cdot \hat{j})\hat{j} + (\vec{a} \cdot \hat{k})\hat{k} =$	(r)	$-2\vec{a}$
(D)	For any vector $\vec{a}$, $(\vec{a} \times \hat{i}) \times \hat{i} + (\vec{a} \times \hat{j}) \times \hat{j} + (\vec{a} \times \hat{k}) \times \hat{k} =$	(s)	$\vec{a}$
		(t)	$\lvert\vec{a}\rvert^2$

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2. If $\alpha = 2\vec{i} + 3\vec{j} - 5\vec{k}$ and $\beta = \vec{i} - \vec{j}$, then find the value of $\alpha . \beta$

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Sample Questions For Competitive Examination Comprehension Type

1. Let $\vec{a}, \vec{b}, \vec{c}$ be unit such that $\hat{a} + \hat{b} + \hat{c} = \vec{\alpha}$ and $\hat{a} . \hat{b} = \hat{b} . \hat{c} = \hat{c} . \hat{a} = \frac{1}{2}$

Magnitude of vector $\vec{\alpha}$ is equal to -

A. 3

B. $\sqrt{3}$

C. $\sqrt{6}$

D. 6

Answer: c

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2. Let $\vec{a}, \vec{b}, \vec{c}$ be unit such that $\hat{a} + \hat{b} + \hat{c} = \vec{\alpha}$ and $\hat{a}.\hat{b} = \hat{b}.\hat{c} = \hat{c}.\hat{a} = \frac{1}{2}$

Which of the following is not a unit vector ?

A. $\vec{a} - \vec{b}$

B. $\vec{b} - \vec{c}$

C. $\vec{c} - \vec{a}$

D. none of these

Answer: d

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3. Let $\vec{a}, \vec{b}, \vec{c}$ be unit such that $\hat{a} + \hat{b} + \hat{c} = \vec{\alpha}$ and $\hat{a}.\hat{b} = \hat{b}.\hat{c}.\hat{a} = \frac{1}{2}$

$\left|\left(\hat{a} \times \hat{b}\right) \times \hat{c}\right|$ is equal to -

A. 0

B. $\frac{1}{2}$

C. 1

D. 2

Answer: b

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4. If $\alpha = 9\vec{i} - \vec{j} + 2\vec{k}$ and $\beta = \vec{i} + 2\vec{k}$, then find the value of $\alpha . \beta$

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5. If $\alpha = 9\vec{i} - \vec{j} + 2\vec{k}$ and $\beta = \vec{i} + 2\vec{k}$, then find the value of $\alpha \times \beta$

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6. If $\alpha = 5\vec{i} - 3\vec{k}$ and $\beta = 2\vec{i} - \vec{j} + 2\vec{k}$, then find the value of $\alpha \times \beta$

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Sample Questions For Competitive Examination Assertion Reason Type

1. Let $\vec{a} = \hat{i} + \hat{j} - 3\hat{k}$ and $\vec{b} = 2\hat{i} + \hat{j} + \hat{k}$

Statement - I: Vectors $\vec{a}$ and $\vec{b}$ are perpendicular to each other

Statement - II: $\vec{a} . \vec{b} = 0$

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2. If $\alpha = 5\vec{i} - 3\vec{k}$ and $\beta = 2\vec{i} - \vec{j} + 2\vec{k}$, then find the value of $\alpha . \beta$

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