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## TOPIC 9 <br> VECTOR ALGEBRA <br> SCHEMATIC DIAGRAM

| Topic | Concept | Degree of importance | Refrence <br> NCERT Text Book Edition 2007 |
| :---: | :---: | :---: | :---: |
| Vector algebra | (i)Vector and scalars | * | Q2 pg 428 |
|  | (ii)Direction ratio and direction cosines | * | Q 12,13 pg 440 |
|  | (iii)Unit vector | ** | Ex 6,8 Pg 436 |
|  | (iv)Position vector of a point and collinear vectors | ** | $\begin{aligned} & \text { Q } 15 \operatorname{Pg} 440, \text { Q } 11 \operatorname{Pg} 440, \text { Q } 16 \\ & \text { Pg } 448 \end{aligned}$ |
|  | (v)Dot product of two vectors | ** | Q6,13 Pg445 |
|  | (vi)Projection of a vector | *** | Ex 16 Pg 445 |
|  | (vii)Cross product of two vectors | ** | Q 12 Pg458 |
|  | (viii)Area of a triangle | * | Q 9 Pg 454 |
|  | (ix)Area of a parallelogram | * | Q 10 Pg 455 |

## SOME IMPORTANT RESULTS/CONCEPTS

* Position vector of point $A(x, y, z)=\overrightarrow{O A}=x \hat{i}+y \hat{j}+z \hat{k}$
* If $A\left(x_{1}, y_{1}, z_{1}\right)$ and point $B\left(x_{2}, y_{2}, z_{2}\right)$ then $\overrightarrow{A B}=\left(x_{2}-x_{1}\right) \hat{i}+\left(y_{2}-y_{1}\right) \hat{j}+\left(z_{2}-z_{1}\right) \hat{k}$
* If $\vec{a}=x \hat{i}+y \hat{j}+z \hat{k} \quad ;|\vec{a}|=\sqrt{x^{2}+y^{2}+z^{2}}$
* Unit vector parallel to $\vec{a}=\frac{\vec{a}}{|\vec{a}|}$
* Scalar Product (dot product) between two vectors: $\overrightarrow{\mathrm{a}} \cdot \overrightarrow{\mathrm{b}}=|\overrightarrow{\mathrm{a}}| \overrightarrow{\mathrm{b}} \mid \cos \theta ; \theta$ is angle between the vectors
$* \cos \theta=\frac{\overrightarrow{\mathrm{a}} \cdot \overrightarrow{\mathrm{b}}}{|\overrightarrow{\mathrm{a}}| \overrightarrow{\mathrm{b}} \mid}$
* If $\vec{a}=a_{1} \hat{i}+b_{1} \hat{j}+c_{1} \hat{k} \quad$ and $\quad \vec{b}=a_{2} \hat{i}+b_{2} \hat{j}+c_{2} \hat{k} \quad$ then $\vec{a} \cdot \vec{b}=a_{1} a_{2}+b_{1} b_{2}+c_{1} c_{2}$
* If $\vec{a}$ is perpendicular to $\vec{b}$ then $\vec{a} \cdot \vec{b}=0$
$* \vec{a} \cdot \vec{a}=|\vec{a}|^{2}$
* Projection of $\vec{a}$ on $\vec{b}=\frac{\vec{a} \cdot \vec{b}}{|\vec{b}|}$
* Vector product between two vectors:
$\overrightarrow{\mathrm{a}} \times \overrightarrow{\mathrm{b}}=|\overrightarrow{\mathrm{a}}| \overrightarrow{\mathrm{b}} \mid \sin \theta \hat{\mathrm{n}}$; $\hat{n}$ is the normal unit vector which is perpendicular to both $\overrightarrow{\mathrm{a}} \& \overrightarrow{\mathrm{~b}}$
* $\hat{n}=\frac{\vec{a} \times \vec{b}}{|\overrightarrow{\mathrm{a}} \times \overrightarrow{\mathrm{b}}|}$
* If $\vec{a}$ is parallel to $\vec{b}$ then $\vec{a} \times \vec{b}=0$
* Area of triangle (whose sides are given by $\overrightarrow{\mathrm{a}}$ and $\overrightarrow{\mathrm{b}}$ ) $=\frac{1}{2}|\overrightarrow{\mathrm{a}} \times \overrightarrow{\mathrm{b}}|$
* Area of parallelogram (whose adjacent sides are given by $\vec{a}$ and $\vec{b}$ ) $=|\vec{a} \times \vec{b}|$
* Area of parallelogram (whose diagonals are given by $\overrightarrow{\mathrm{a}}$ and $\overrightarrow{\mathrm{b}}$ ) $=\frac{1}{2}|\overrightarrow{\mathrm{a}} \times \overrightarrow{\mathrm{b}}|$


## ASSIGNMENTS

(i) Vector and scalars, Direction ratio and direction cosines\&Unit vector

## LEVEL I

1. If $\vec{a}=\hat{i}+\hat{j}-5 \hat{k}$ and $\vec{b}=\hat{i}-4 \hat{j}+3 \hat{k}$ find a unit vector parallel to $\vec{a}+\vec{b}$
2. Write a vector of magnitude 15 units in the direction of vector $\hat{\mathrm{i}}-2 \hat{\mathrm{j}}+2 \hat{\mathrm{k}}$
3. If $\vec{a}=\hat{\mathrm{i}}+\hat{\mathrm{j}}-\hat{\mathrm{k}} ; \vec{b}=\hat{\mathrm{i}}-\hat{\mathrm{j}}+\hat{\mathrm{k}} ; \vec{c}=-\hat{\mathrm{i}}+\hat{\mathrm{j}}+\hat{\mathrm{k}}$ find a unit vector in the direction of $\vec{a}+\vec{b}+\vec{c}$
4. Find a unit vector in the direction of the vector $\vec{a}=2 \hat{i}+\hat{j}+2 \hat{k}$ [CBSE 2011]
5. Find a vector in the direction of vector $\vec{a}=\hat{i}-2 \hat{j}$, whose magnitude is 7

## LEVEL II

1. Find a vector of magnitude 5 units, perpendicular to each of the vectors $(\vec{a}+\vec{b}),(\vec{a}-\vec{b})$ where

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$$
\overrightarrow{\mathrm{a}}=\hat{\mathrm{i}}+\hat{\mathrm{j}}+\hat{\mathrm{k}} \text { and } \overrightarrow{\mathrm{b}}=\hat{\mathrm{i}}+2 \hat{\mathrm{j}}+3 \hat{\mathrm{k}} .
$$

2. If the sum of two unit vectors is a unit vector, show that the magnitude of their difference is $\sqrt{3}$.
3. If $\vec{a}=\hat{i}+\hat{j}+\hat{k}, \vec{b}=4 \hat{i}-2 \hat{j}+3 \hat{k}$ and $\vec{c}=\hat{i}-2 \hat{j}+\hat{k}$, find a vector of magnitude 6 units which is parallel to the vector $2 \overrightarrow{\mathrm{a}}-\overrightarrow{\mathrm{b}}+3 \vec{c}$

## LEVEL - III

1. If a line make $\alpha, \beta, \gamma$ with the X - axis, Y - axis and Z - axis respectively, then find the value of $\sin ^{2} \alpha+\sin ^{2} \beta+\sin ^{2} \gamma$
2. For what value of $p$, is $(\hat{i}+\hat{j}+\hat{k}) p$ a unit vector?
3. What is the cosine of the angle which the vector $\sqrt{2} \hat{i}+\hat{j}+\hat{k}$ makes with Y-axis
4. Write the value of $p$ for which $\vec{a}=3 \hat{i}+2 \hat{j}+9 \hat{k}$ and $\vec{b}=\hat{i}+p \hat{j}+3 \hat{k}$ are parallel vectors.

## (ii)Position vector of a point and collinear vectors

## LEVEL - I

1. Find the position vector of the midpoint of the line segment joining the points $A(5 \hat{i}+3 \hat{j})$ and $B(3 \hat{i}-\hat{j})$.
2. In a triangle $A B C$, the sides $A B$ and $B C$ are represents by vectors $2 \hat{i}-\hat{j}+2 \hat{k}$,
$\hat{i}+3 \hat{j}+5 \hat{k}$ respectively. Find the vector representing CA.
3 . Show that the points $(1,0),(6,0),(0,0)$ are collinear.

## LEVEL - II

1. Write the position vector of a point R which divides the line joining the points P and Q whose position vectors are $\hat{i}+2 \hat{j}-\hat{k}$ and $-\hat{i}+\hat{j}+\hat{k}$ respectively in the ratio $2: 1$ externally.
2. Find the position vector of a point R which divides the line joining two points P and Q whose position vectors are $(2 \vec{a}+\vec{b})$ and $(\vec{a}-3 \vec{b})$ respectively, externally in the ratio 1:2. Also, show that P is the mid-point of the line segment RQ

## (iii) Dot product of two vectors

LEVEL - I
1.Find $\overrightarrow{\mathrm{a}} \cdot \overrightarrow{\mathrm{b}}$ if $\overrightarrow{\mathrm{a}}=3 \hat{\mathrm{i}}-\hat{\mathrm{j}}+2 \hat{\mathrm{k}}$ and $\overrightarrow{\mathrm{b}}=2 \hat{\mathrm{i}}+3 \hat{\mathrm{j}}+3 \hat{\mathrm{k}}$.
2.If $|\vec{a}|=\sqrt{3},|\vec{b}|=2$ and $\overrightarrow{\mathrm{a}} \cdot \overrightarrow{\mathrm{b}}=\sqrt{6}$. Then find the angle between $\overrightarrow{\mathrm{a}}$ and $\overrightarrow{\mathrm{b}}$.
3.Write the angle between two vectors $\vec{a}$ and $\vec{b}$ with magnitudes $\sqrt{3}$ and 2 respectively having $\vec{a} \cdot \vec{b}=\sqrt{6}$ [CBSE 2011]

## LEVEL - II

1. The dot products of a vector with the vectors $\hat{i}-3 \hat{j}, \hat{i}-2 \hat{j}$ and $\hat{i}+\hat{j}+4 \hat{k}$ are 0,5 and 8 respectively. Find the vectors.
2. If $\vec{a}$ and $\vec{b}$ are two vectors such that $|\vec{a} \cdot \vec{b}|=|\vec{a} \times \vec{b}|$, then what is the angle between $\vec{a}$ and $\vec{b}$.
3. If $\overrightarrow{\mathrm{a}}=2 \hat{\mathrm{i}}+2 \hat{\mathrm{j}}+3 \hat{\mathrm{k}}, \overrightarrow{\mathrm{b}}=-\hat{\mathrm{i}}+2 \hat{\mathrm{j}}+\hat{\mathrm{k}}$ and $\vec{c}=3 \hat{\mathrm{i}}+\hat{\mathrm{j}}$ are such that $\overrightarrow{\mathrm{a}}+\lambda \overrightarrow{\mathrm{b}}$ is perpendicular to $\vec{c}$, find the value of $\lambda$.

## LEVEL - III

1. If $\overrightarrow{\mathrm{a}} \& \overrightarrow{\mathrm{~b}}$ are unit vectors inclined at an angle $\theta$, prove that $\sin \frac{\theta}{2}=\frac{1}{2}|\overrightarrow{\mathrm{a}}-\overrightarrow{\mathrm{b}}|$.
2. If $|\vec{a}+\vec{b}|=|\vec{a}-\vec{b}|$, then find the angle between $\vec{a}$ and $\vec{b}$.
3. For what values of $\lambda$, vectors $\vec{a}=3 \hat{i}-2 \hat{j}+4 \hat{k}$ and $\vec{a}=\lambda \hat{i}-4 \hat{j}+8 \hat{k}$ are
(i) Orthogonal (ii) Parallel
4..Find $|\vec{x}|$, if for a unit vector $\vec{a},(\vec{x}-\vec{a}) \cdot(\vec{x}+\vec{a})=15$.
4. If $\vec{a}=5 \hat{i}-\hat{j}+7 \hat{k}$ and $\vec{b}=\hat{i}-\hat{j}+\mu \hat{k}$, find $\mu$, such that $\vec{a}+\vec{b}$ and $\vec{a}-\vec{b}$ are orthogonal.
5. Show that vector $2 \hat{i}-\hat{j}+\hat{k},-3 \hat{j}-5 \hat{k}$ and $3 \hat{i}-4 \hat{j}-4 \hat{k}$ form sides of a right angled triangle.
7.Let $\overrightarrow{\mathrm{a}}=\hat{\mathrm{i}}+4 \hat{\mathrm{j}}+2 \hat{\mathrm{k}}, \overrightarrow{\mathrm{b}}=3 \hat{\mathrm{i}}-2 \hat{\mathrm{j}}+7 \hat{\mathrm{k}}$ and $\vec{c}=2 \hat{\mathrm{i}}-\hat{\mathrm{j}}+4 \hat{\mathrm{k}}$. Find a vector $\overrightarrow{\mathrm{d}}$ which is perpendicular to both $\overrightarrow{\mathrm{a}}$ and $\overrightarrow{\mathrm{b}}$ and $\vec{c} \cdot \overrightarrow{\mathrm{~d}}=18$.
6. If $\overrightarrow{\mathrm{a}}, \overrightarrow{\mathrm{b}}, \vec{c}$ are three mutually perpendicular vectors of equal magnitudes, prove that $\overrightarrow{\mathrm{a}}+\overrightarrow{\mathrm{b}}+\vec{c}$ is equally inclined with the vectors $\overrightarrow{\mathrm{a}}, \overrightarrow{\mathrm{b}}, \vec{c}$.
7. Let $\overrightarrow{\mathrm{a}}, \overrightarrow{\mathrm{b}}, \vec{c}$ be three vectors such that $|\overrightarrow{\mathrm{a}}|=3,|\overrightarrow{\mathrm{~b}}|=4,|\overrightarrow{\mathrm{c}}|=5$ and each of them being perpendicular
to the sum of the other two, find $|\vec{a}+\vec{b}+\vec{c}|$.

## (iv) Projection of a vector

## LEVEL - I

1. Find the projection of $\overrightarrow{\mathrm{a}}$ on $\overrightarrow{\mathrm{b}}$ if $\overrightarrow{\mathrm{a}} \cdot \overrightarrow{\mathrm{b}}=8$ and $\overrightarrow{\mathrm{b}}=2 \hat{\mathrm{i}}+6 \hat{\mathrm{j}}+3 \hat{\mathrm{k}}$.
2. Write the projection of the vector $\hat{i}-\hat{j}$ on the vector $\hat{i}+\hat{j}$
[ CBSE 2011]
3. Find the angle between the vectors $\hat{\mathrm{i}}-2 \hat{\mathrm{j}}+3 \hat{\mathrm{k}}$ and $3 \hat{\mathrm{i}}-2 \hat{\mathrm{j}}+\hat{\mathrm{k}}$
4. Find the projection of the vector $\hat{\mathrm{i}}+3 \hat{\mathrm{j}}+7 \hat{\mathrm{k}}$ on the vector $7 \hat{\mathrm{i}}-\hat{\mathrm{j}}+8 \hat{\mathrm{k}}$

LEVEL - II
1.Three vertices of a triangle are $\mathrm{A}(0,-1,-2), \mathrm{B}(3,1,4)$ and $\mathrm{C}(5,7,1)$. Show that it is a right angled triangle. Also find the other two angles.
2.Show that the angle between any two diagonals of a cube is $\cos ^{-1}\left(\frac{1}{3}\right)$.
3.If $\overrightarrow{\mathrm{a}}, \overrightarrow{\mathrm{b}}, \vec{c}$ are non - zero and non - coplanar vectors, prove that $\overrightarrow{\mathrm{a}}-2 \overrightarrow{\mathrm{~b}}+3 \vec{c},-3 \overrightarrow{\mathrm{~b}}+5 \vec{c}$ and $-2 \overrightarrow{\mathrm{a}}+3 \overrightarrow{\mathrm{~b}}-4 \vec{c}$ are also coplanar

## LEVEL - III

1.If a unit vector $\overrightarrow{\text { a }}$ makes angles $\pi / 4$, with $\hat{i}, \pi / 3$ with $\hat{j}$ and an acute angle $\theta$ with $\hat{k}$, then find the component of $\vec{a}$ and angle $\theta$.
2. If $\overrightarrow{\mathrm{a}}, \overrightarrow{\mathrm{b}}, \vec{c}$ are three mutually perpendicular vectors of equal magnitudes, prove that $\overrightarrow{\mathrm{a}}+\overrightarrow{\mathrm{b}}+\vec{c}$ is equally inclined with the vectors $\overrightarrow{\mathrm{a}}, \overrightarrow{\mathrm{b}}, \vec{c}$.
3.If with reference to the right handed system of mutually perpendicular unit vectors $\hat{\mathrm{i}}, \hat{\mathrm{j}}$, and $\hat{\mathrm{k}}$, $\vec{\alpha}=3 \hat{i}-\hat{j}, \vec{\beta}=2 \hat{i}+\hat{j}-3 \hat{k}$ then express $\vec{\beta}$ in the form of $\vec{\beta}_{1}+\vec{\beta}_{2}$, where $\vec{\beta}_{1}$ is parallel to $\vec{\alpha}$ and $\vec{\beta}_{2}$ is perpendicular to $\vec{\alpha}$.
4.Show that the points $A, B, C$ with position vectors $\vec{a}=3 \hat{i}-4 \hat{j}-4 \hat{k}, \vec{b}=2 \hat{i}-\hat{j}+\hat{k}$ and $\vec{c}=\hat{\mathrm{i}}-3 \hat{\mathrm{j}}-5 \hat{\mathrm{k}}$ respectively form the vertices of a right angled triangle.
5. If $\vec{a} \& \vec{b}$ are unit vectors inclined at an angle $\theta$, prove that
(i) $\sin \frac{\theta}{2}=\frac{1}{2}|\vec{a}-\vec{b}|$ (ii) $\tan \frac{\theta}{2}=\frac{|\vec{a}-\vec{b}|}{|\vec{a}+\vec{b}|}$
(vii)Cross product of two vectors

## LEVEL - I

1. If $|\vec{a}|=3,|\vec{b}|=5$ and $\vec{a} \cdot \vec{b}=9$. Find $|\vec{a} \times \vec{b}|$
2.Find $|\vec{a} \times \vec{b}|$, if $\vec{a}=\hat{i}-7 \hat{j}+7 \hat{k}$ and $\vec{b}=3 \hat{i}+2 \hat{j}+2 \hat{k}$
2. Find $|\overrightarrow{\mathrm{x}}|$, if $\vec{p}$ is a unit vector and, $(\overrightarrow{\mathrm{x}}-\vec{p}) \cdot(\overrightarrow{\mathrm{x}}+\vec{p})=80$.
3. Find $p$, if $(2 \hat{i}+6 \hat{j}+27 \hat{k}) \times(\hat{i}+3 \hat{j}+p \hat{k})=\overrightarrow{0}$.

## LEVEL - II

1.Find $\lambda$, if $(2 \hat{i}+6 \hat{j}+14 \hat{k}) \times(\hat{i}-\lambda \hat{j}+7 \hat{k})=\overrightarrow{0}$.
2. Show that $(\vec{a}-\vec{b}) \times(\vec{a}+\vec{b})=2(\vec{a} \times \vec{b})$
3.Find the angle between two vectors $\vec{a}$ and $\vec{b}$ if $|\vec{a}|=3,|\vec{b}|=4$ and $|\vec{a} \times \vec{b}|=6$.
4.Let $\overrightarrow{\mathrm{a}}, \overrightarrow{\mathrm{b}}, \vec{c}$ be unit vectors such that $\overrightarrow{\mathrm{a}} \cdot \overrightarrow{\mathrm{b}}=\overrightarrow{\mathrm{a}} \cdot \vec{c}=0$ and the angle between $\overrightarrow{\mathrm{b}}$ and $\vec{c}$ is $\pi / 6$, prove that $\vec{a}= \pm 2(\vec{a} \times \vec{b})$.

## LEVEL - III

1.Find the value of the following: $\hat{i} \cdot(\hat{j} \times \hat{k})+\hat{i} \cdot(\hat{i} \times \hat{k})+\hat{k} .(\hat{i} \times \hat{j})$
2. Vectors $\overrightarrow{\mathrm{a}}$ and $\overrightarrow{\mathrm{b}}$ are such that $|\overrightarrow{\mathrm{a}}|=\sqrt{3},|\overrightarrow{\mathrm{~b}}|=\frac{2}{3}$, and $\overrightarrow{\mathrm{a}} \times \overrightarrow{\mathrm{b}}$ is a unit vector. Write the angle between $\overrightarrow{\mathrm{a}}$ and $\overrightarrow{\mathrm{b}}$
3.If $\overrightarrow{\mathrm{a}}=\hat{\mathrm{i}}+\hat{\mathrm{j}}+\hat{\mathrm{k}}$ and $\overrightarrow{\mathrm{b}}=\hat{\mathrm{j}}-\hat{\mathrm{k}}$, find a vector $\vec{c}$ such that $\overrightarrow{\mathrm{a}} \times \vec{c}=\overrightarrow{\mathrm{b}}$ and $\overrightarrow{\mathrm{a}} \cdot \vec{c}=3$.
4.If $\overrightarrow{\mathrm{a}} \times \overrightarrow{\mathrm{b}}=\vec{c} \times \overrightarrow{\mathrm{d}}$ and $\overrightarrow{\mathrm{a}} \times \vec{c}=\overrightarrow{\mathrm{b}} \times \overrightarrow{\mathrm{d}}$ show that $(\overrightarrow{\mathrm{a}}-\overrightarrow{\mathrm{d}})$ is parallel to $\overrightarrow{\mathrm{b}}-\overrightarrow{\mathrm{c}}$, where $\overrightarrow{\mathrm{a}} \neq \overrightarrow{\mathrm{d}}$ and $\overrightarrow{\mathrm{b}} \neq \vec{c}$.
5. Express $2 \hat{i}-\hat{j}+3 \hat{k}$ as the sum of a vector parellal and perpendicular to $2 \hat{i}+4 \hat{j}-2 \hat{k}$.

## (viii)Area of a triangle \& Area of a parallelogram

## LEVEL - I

1.Find the area of Parallelogram whose adjacent sides are represented by the vectors
$\vec{a}=3 \hat{i}+\hat{j}-2 \hat{k}$ and $\vec{b}=\hat{i}-3 \hat{j}+4 \hat{k}$.
2.If $\vec{a}$ and $\vec{b}$ represent the two adjacent sides of a Parallelogram, then write the area of parallelogram in terms of $\vec{a}$ and $\vec{b}$.
3. Find the area of triangle having the points $\mathrm{A}(1,1,1), \mathrm{B}(1,2,3)$ and $\mathrm{C}(2,3,1)$ as its vertices.

## LEVEL - II

1.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 $5 \sqrt{3}$ Sq units.
2. If $\overrightarrow{\mathrm{a}}, \overrightarrow{\mathrm{b}}, \vec{c}$ are the position vectors of the vertices of a $\triangle \mathrm{ABC}$, show that the area of the $\triangle \mathrm{ABC}$ is

$$
\frac{1}{2}|\overrightarrow{\mathrm{a}} \times \overrightarrow{\mathrm{b}}+\overrightarrow{\mathrm{b}} \times \overrightarrow{\mathrm{c}}+\overrightarrow{\mathrm{c}} \times \overrightarrow{\mathrm{a}}|
$$

3.Using Vectors, find the area of the triangle with vertices $\mathrm{A}(1,1,2), \mathrm{B}(2,3,5)$ and $\mathrm{C}(1,5,5)$
[ CBSE 2011]

## Questions for self evaluation

1.The scalar 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 $\lambda$.
2. If $\overrightarrow{\mathrm{a}}, \overrightarrow{\mathrm{b}}$ and $\vec{c}$ be three vectors such that $|\overrightarrow{\mathrm{a}}|=3,|\overrightarrow{\mathrm{~b}}|=4,|\overrightarrow{\mathrm{c}}|=5$ and each one of them being perpendicular to the sum of the other two, find $|\overrightarrow{\mathrm{a}}+\overrightarrow{\mathrm{b}}+\vec{c}|$.
3. If $|\vec{a}+\vec{b}|=|\vec{a}-\vec{b}|$, then find the angle between $\vec{a}$ and $\vec{b}$.
4. Dot product of a vector with $\hat{i}+\hat{j}-3 \hat{k}, \hat{i}+3 \hat{j}-2 \hat{k}$, and $2 \hat{i}+\hat{j}+4 \hat{k}$ are $0,5,8$ respectively. Find the vector.
5. Find the components of a vector which is perpendicular to the vectors $\hat{i}+2 \hat{j}-\hat{k}$ and $3 \hat{i}-\hat{j}+2 \hat{k}$.

