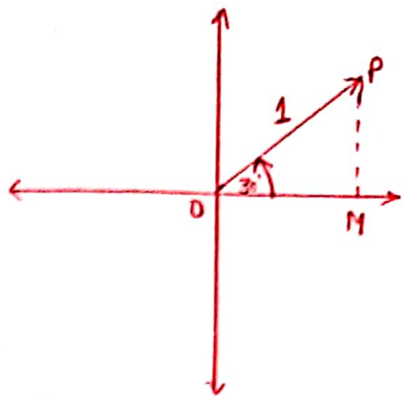
MISCELLANEOUS EXERCISE - VECTOR ALGEBRA.

Q No 1 Write down a unit vector in XY-plane, making an angle of 30° with +ve direction of x-axis.

Sol. Let $\vec{OP}$ be required unit vector in XOY plane, so that $\angle XOP = 30^\circ$

Let M be the foot of $\perp$r from P on X'OX.



$$\frac{OM}{|OP|} = \cos 30^\circ$$

$$\Rightarrow OM = |OP| \cos 30^\circ = 1 \cos 30^\circ = \frac{\sqrt{3}}{2} \qquad [\because |\vec{OP}| = 1]$$

Also $\frac{MP}{|OP|} = \sin 30^\circ \Rightarrow MP = 1 \sin 30^\circ = \frac{1}{2}$.

$\therefore$ Required Unit Vector $\vec{OP} = \frac{\sqrt{3}}{2}\hat{i} + \frac{1}{2}\hat{j}$

Q No 2. Find the scalar component and magnitude of the vector joining the points $P(x_1, y_1, z_1)$ and $Q(x_2, y_2, z_2)$

Sol. Here $\vec{OP}$ = P.V. of P $= x_1\hat{i} + y_1\hat{j} + z_1\hat{k}$

and $\vec{OQ}$ = P.V. of Q $= x_2\hat{i} + y_2\hat{j} + z_2\hat{k}$

Now $\vec{PQ} = \vec{OQ} - \vec{OP} = (x_2\hat{i} + y_2\hat{j} + z_2\hat{k}) - (x_1\hat{i} + y_1\hat{j} + z_1\hat{k})$

$$= (x_2 - x_1)\hat{i} + (y_2 - y_1)\hat{j} + (z_2 - z_1)\hat{k}$$

$\therefore$ Scalar Components of Vector $\vec{PQ}$ are $x_2 - x_1$, $y_2 - y_1$, $z_2 - z_1$

and Magnitude $|\vec{PQ}| = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}$

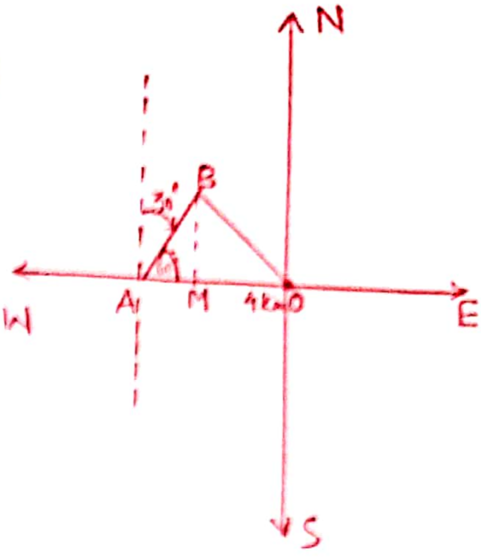
Q No. 3 A girl walks 4 km towards west, then she walks 3 km in a direction 30° east of north and stops. Determine the girl's displacement from her initial point of departure.

Sol. Let $|OA| = 4$ km and $|AB| = 3$ km as shown in fig.

then $\angle OAB = 90^\circ - 30^\circ = 60^\circ$

Girl's displacement from initial point O

$= \vec{OB} = x\hat{i} + y\hat{j}$ (say)



$|x| = OM = |OA| - |MA|$

$= 4 - (|AB| \cos 60^\circ)$

$= 4 - 3 \times \frac{1}{2} = 4 - \frac{3}{2} = \frac{5}{2}$

$\therefore \; x = -\frac{5}{2}$

and $y = MP = |AB| \sin 60^\circ = 3 \times \frac{\sqrt{3}}{2}$

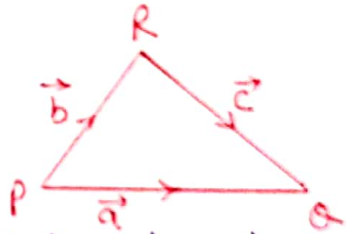
$\therefore \; \vec{OB} = x\hat{i} + y\hat{j} = -\frac{5}{2}\hat{i} + \frac{3\sqrt{3}}{2}\hat{j}$

Distance of B from initial point $|OB| = |\vec{OB}|$

$= \left|-\frac{5}{2}\hat{i} + \frac{3\sqrt{3}}{2}\hat{j}\right| = \sqrt{\left(-\frac{5}{2}\right)^2 + \left(\frac{3\sqrt{3}}{2}\right)^2} = \sqrt{\frac{25}{4} + \frac{27}{4}} = \sqrt{\frac{52}{4}} = \sqrt{13}$ km.

QNo 4. If $\vec{a} = \vec{b} + \vec{c}$, then is it true that $|\vec{a}| = |\vec{b}| + |\vec{c}|$. Justify your answer.

Sol When $\vec{a} = \vec{b} + \vec{c}$ then $\vec{a}, \vec{b}, \vec{c}$ form a triangle as shown.



Now since the sum of two sides of a triangle is always greater than the third side

$\therefore \quad |PR| + |RQ| > |PQ|$

i.e $\quad |\vec{b}| + |\vec{c}| > |\vec{a}|$

or $\quad |\vec{a}| < |\vec{b}| + |\vec{c}|$

Thus in general $\vec{a} = \vec{b} + \vec{c}$ does not imply $|\vec{a}| = |\vec{b}| + |\vec{c}|$

QNo 5. Find value of x for which $x(\hat{i} + \hat{j} + \hat{k})$ is a unit vector.

Sol ATQ $\quad |x(\hat{i} + \hat{j} + \hat{k})| = 1$

i.e $\quad |x\hat{i} + x\hat{j} + x\hat{k}| = 1$

$\Rightarrow \quad \sqrt{x^2 + x^2 + x^2} = 1$

$\sqrt{3x^2} = 1$ or $3x^2 = 1$

$\Rightarrow x^2 = \frac{1}{3} \Rightarrow x = \pm\frac{1}{\sqrt{3}}$

Q No. 6. Find a vector of magnitude 5 units and parallel to the resultant of the vectors $\vec{a} = 2\hat{i}+3\hat{j}-\hat{k}$ $\vec{b} = \hat{i}-2\hat{j}+\hat{k}$

Sol. Resultant of vectors $\vec{a}$ and $\vec{b}$ $= \vec{a}+\vec{b}$

$= (2\hat{i}+3\hat{j}-\hat{k})+(\hat{i}-2\hat{j}+\hat{k}) = 3\hat{i}+\hat{j}+0\hat{k}$

Let $\vec{c}$ be the required vector parallel to $\vec{a}+\vec{b}$ and having magnitude 5.

Then $\vec{c} = \lambda(\vec{a}+\vec{b})$, λ is any real No.

$= \lambda(3\hat{i}+\hat{j}+0k) = 3\lambda\hat{i}+\lambda\hat{j}+0\hat{k}$

and $|\vec{c}| = 5$

$\Rightarrow |3\lambda\hat{i}+\lambda\hat{j}+0\hat{k}| = 5$

$\Rightarrow \sqrt{(3\lambda)^2+(\lambda)^2+(0)^2} = 5$

$\Rightarrow \sqrt{9\lambda^2+\lambda^2} = 5$

$\Rightarrow \sqrt{10\lambda^2} = 5$

$\Rightarrow 10\lambda^2 = 25 \Rightarrow \lambda^2 = \frac{25}{10} = \frac{5}{2}$

$\Rightarrow \lambda = \pm\sqrt{\frac{5}{2}}$

Hence the required Vector is

either $\sqrt{\frac{5}{2}}(3\hat{i}+\hat{j})$ or $-\sqrt{\frac{3}{2}}(3\hat{i}+\hat{j})$

Q No 7. If $\vec{a} = \hat{i}+\hat{j}+\hat{k}$, $\vec{b} = 2\hat{i}-\hat{j}+3k$ and $\vec{c} = \hat{i}-2\hat{j}+\hat{k}$, find a unit vector parallel to $2\vec{a}-\vec{b}+3\vec{c}$.

Sol. Let $\vec{V} = 2\vec{a}-\vec{b}+3\vec{c}$

$= 2(\hat{i}+\hat{j}+k)-(2\hat{i}-\hat{j}+3\hat{k})+3(\hat{i}-2\hat{j}+\hat{k})$

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

Now $|\vec{V}| = |3\hat{i}-3\hat{j}+2\hat{k}| = \sqrt{(3)^2+(-3)^2+(2)^2} = \sqrt{9+9+4} = \sqrt{22}$

$\therefore$ Unit Vector parallel to $\vec{V} = \pm\frac{\vec{V}}{|\vec{V}|} = \pm\frac{1}{\sqrt{22}}(3\hat{i}-3\hat{j}+2\hat{k})$

Q No 8. Show that the points A(1, -2, -8), B(5, 0, -2) and C(11, 3, 7) are collinear and find the ratio in which B divides AC.

Sol. A, B and C will be collinear if B divides AC in ratio k:1 for unique value of k.

Now P.V of A = $\vec{a} = \hat{i} - 2\hat{j} - 8\hat{k}$

P.V of B = $\vec{b} = 5\hat{i} + 0\hat{j} - 2\hat{k}$

P.V of C = $\vec{c} = 11\hat{i} + 3\hat{j} + 7\hat{k}$

Now B divides $\bar{AC}$ in ratio k:1

if $\vec{b} = \dfrac{k\vec{c} + 1.\vec{a}}{k+1}$ for unique value of k

ie if $5\hat{i} + 0\hat{j} - 2\hat{k} = \dfrac{k(11\hat{i} + 3\hat{j} + 7\hat{k}) + 1(\hat{i} - 2\hat{j} - 8\hat{k})}{k+1}$

ie if $5\hat{i} + 0\hat{j} - 2\hat{k} = \left(\dfrac{11k+1}{k+1}\right)\hat{i} + \left(\dfrac{3k-2}{k+1}\right)\hat{j} + \left(\dfrac{7k-8}{k+1}\right)\hat{k}$

ie if $\dfrac{11k+1}{k+1} = 5$, $\dfrac{3k-2}{k+1} = 0$, $\dfrac{7k-8}{k+1} = -2$

if $11k + 1 = 5k + 5$, $3k - 2 = 0$, $7k - 8 = -2k - 2$

if $6k = 4$, $3k = 2$, $9k = 6$

if $k = \frac{4}{6}$, $k = \frac{2}{3}$, $k = \frac{6}{9}$

if $k = \frac{2}{3}$, $k = \frac{2}{3}$, $k = \frac{2}{3}$

Hence A, B, C are collinear and B divides AC in ratio $\frac{2}{3}:1$ ie 2:3.

Q No 9 Find the position Vector of a point R which divides the line joining the two points P and Q whose position vectors are $(2\vec{a}+\vec{b})$ and $(\vec{a}-3\vec{b})$ externally in ratio 1:2. Also show that P is the mid point of RQ.

Sol. Since R divides PQ in Ratio 1:2 externally

$$\therefore \text{P.V of } R = \frac{1(\text{P.V of } Q) - 2(\text{P.V. of } P)}{1-2} \quad [\text{Section formula}]$$

$$= \frac{1(\vec{a}-3\vec{b}) - 2(2\vec{a}+\vec{b})}{1-2}$$

$$= \frac{\vec{a}-3\vec{b}-4\vec{a}-2\vec{b}}{-1} = \frac{-3\vec{a}-5\vec{b}}{-1} = 3\vec{a}+5\vec{b}$$

Now P.V of mid point of RQ $= \frac{\text{P.V of } R + \text{P.V of } Q}{2}$

$$= \frac{(3\vec{a}+5\vec{b})+(\vec{a}-3\vec{b})}{2} = \frac{4\vec{a}+2\vec{b}}{2} = 2\vec{a}+\vec{b}$$

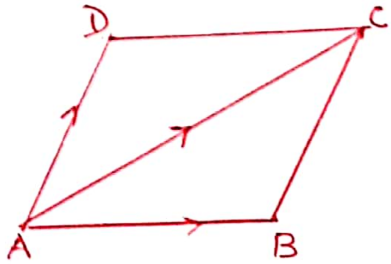
$$= \text{P.V. of } P.$$

$\therefore$ P is the mid point of RQ.

Q No 10 The two adjacent sides of a ||gm are $2\hat{i}-4\hat{j}+5\hat{k}$ and $\hat{i}-2\hat{j}-3\hat{k}$. Find the unit vector || to diagonal. Also find its Area.

Sol. Let ABCD be the ||gm with

$$\vec{AB} = 2\hat{i}-4\hat{j}+5\hat{k}$$
$$\vec{AD} = \hat{i}-2\hat{j}-3\hat{k}$$



By ||gm Law of addition of Vectors

$$\vec{AC} = \vec{AB} + \vec{AD}$$
$$= (2\hat{i}-4\hat{j}+5\hat{k}) + (\hat{i}-2\hat{j}-3\hat{k}) = 3\hat{i}-6\hat{j}+2\hat{k}$$

Hence a unit Vector parallel to $\vec{AC} = \frac{\vec{AC}}{|\vec{AC}|} = \frac{3\hat{i}-6\hat{j}+2\hat{k}}{\sqrt{(3)^2+(-6)^2+(2)^2}}$

$$= \frac{3\hat{i}-6\hat{j}+2\hat{k}}{\sqrt{9+36+4}} = \frac{1}{7}(3\hat{i}-6\hat{j}+2\hat{k})$$

$= \frac{3}{7}\hat{i} - \frac{6}{7}\hat{j} + \frac{2}{7}\hat{k}$

Area of parallelogram ABCD $= |\vec{AB} \times \vec{AD}|$

Now $\vec{AB} \times \vec{AD} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & -4 & 5 \\ 1 & -2 & -3 \end{vmatrix}$

$= \hat{i}(+12+10) - \hat{j}(-6-5) + \hat{k}(-4+4)$

$= 22\hat{i} + 11\hat{j} + 0\hat{k}$

$\therefore |\vec{AB} \times \vec{AD}| = \sqrt{(22)^2 + (11)^2 + (0)^2} = \sqrt{11^2 \times 2^2 + 11^2} = \sqrt{11^2(4+1)} = 11\sqrt{5}$

$\therefore$ Area of ||gm $= 11\sqrt{5}$ square units.

Q No 11 Show that the direction cosines of a vector equally inclined to the axes OX, OY and OZ are $\frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}}$

Sol. Let a vector $\vec{v}$ be equally inclined to OX, OY and OZ

Let $\vec{v}$ makes angle α with all the three axes.

Then unit vector in direction of $\vec{v}$ is

$\hat{v} = (\cos\alpha)\hat{i} + (\cos\alpha)\hat{j} + (\cos\alpha)\hat{k}$

$\Rightarrow \quad 1 = \sqrt{\cos^2\alpha + \cos^2\alpha + \cos^2\alpha}$

$\Rightarrow \quad 1 = \sqrt{3\cos^2\alpha}$

$\Rightarrow \quad (1)^2 = \left(\sqrt{3\cos^2\alpha}\right)^2 \Rightarrow 1 = 3\cos^2\alpha \Rightarrow \cos^2\alpha = \frac{1}{3}$

$\Rightarrow \quad \cos\alpha = \frac{1}{\sqrt{3}}$ (Taking only +ve value)

$\Rightarrow \quad \therefore$ Direction Cosines of $\vec{v}$ are $\left\langle \frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}} \right\rangle$

Q No. 12 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 $\vec{c} \cdot \vec{d} = 15$.

Sol. The vector which is perpendicular to both $\vec{a}$ and $\vec{b}$ must be parallel to $\vec{a} \times \vec{b}$

Now $\vec{a} \times \vec{b} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & 4 & 2 \\ 3 & -2 & 7 \end{vmatrix} = (28+4)\hat{i} - (7-6)\hat{j} + (-2-12)\hat{k}$

$= 32\hat{i} - \hat{j} - 14\hat{k}$

Since $\vec{d}$ is $\parallel$ to $\vec{a}\times\vec{b}$

Let $\vec{d} = \lambda(\vec{a}\times\vec{b}) = \lambda(32\hat{i}-\hat{j}-14\hat{k}) = 32\lambda\hat{i}-\lambda\hat{j}-14\lambda\hat{k}$

Now $\vec{c}\cdot\vec{d} = 15$

$\Rightarrow (2\hat{i}-\hat{j}+4\hat{k})\cdot(32\lambda\hat{i}-\lambda\hat{j}-14\lambda\hat{k}) = 15$

$\Rightarrow (2)(32\lambda)+(-1)(-\lambda)+(4)(-14\lambda) = 15$

$\Rightarrow 64\lambda+\lambda-56\lambda = 15$

$\Rightarrow 9\lambda = 15 \Rightarrow \lambda = \frac{15}{9} = \frac{5}{3}$

$\therefore$ Required Vector $\vec{d} = \frac{5}{3}(32\hat{i}-\hat{j}-14\hat{k})$

Q No 13. The scalar product of the vector $\hat{i}+\hat{j}+\hat{k}$ with a 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.

Sol. Let $\vec{a} = \hat{i}+\hat{j}+\hat{k}$

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

$\vec{c} = \lambda\hat{i}+2\hat{j}+3\hat{k}$

Now $\vec{b}+\vec{c} = (2+\lambda)\hat{i}+6\hat{j}-2\hat{k}$

$\therefore$ Unit Vector along $\vec{b}+\vec{c} = \dfrac{(2+\lambda)\hat{i}+6\hat{j}-2\hat{k}}{\sqrt{(2+\lambda)^2+(6)^2+(-2)^2}} = \vec{v}$ (say)

It is given that $\vec{a}\cdot\vec{v} = 1$

ie $(\hat{i}+\hat{j}+\hat{k})\cdot\dfrac{(2+\lambda)\hat{i}+6\hat{j}-2\hat{k}}{\sqrt{(2+\lambda)^2+(6)^2+(-2)^2}} = 1$

ie $\dfrac{(2+\lambda)(1)+(6)(1)+(-2)(1)}{\sqrt{4+\lambda^2+4\lambda+36+4}} = 1$

ie $\dfrac{2+\lambda+6-2}{\sqrt{\lambda^2+4\lambda+44}} = 1$

ie $\lambda+6 = \sqrt{\lambda^2+4\lambda+44}$.

ie $\lambda^2+36+12\lambda = \lambda^2+4\lambda+44$

ie $8\lambda = 8$ ie $\lambda = 1$.

Q.No. 14. If $\vec{a}, \vec{b}, \vec{c}$ are mutually perpendicular vectors of equal magnitude, show that the vectors $\vec{a}+\vec{b}+\vec{c}$ is equally inclined to $\vec{a}, \vec{b}$ and $\vec{c}$.

Sol. Since $\vec{a}, \vec{b}$ and $\vec{c}$ are mutually perpendicular

$\therefore \quad \vec{a}\cdot\vec{b} = \vec{b}\cdot\vec{c} = \vec{c}\cdot\vec{a} = 0 \quad \cdots (1)$

Let $\quad \vec{a}+\vec{b}+\vec{c} = \vec{v}$

Let $\vec{v}$ makes angles α, β and γ with $\vec{a}, \vec{b}$ and $\vec{c}$ resp.

Then $\cos\alpha = \dfrac{\vec{v}\cdot\vec{a}}{|\vec{v}||\vec{a}|} = \dfrac{(\vec{a}+\vec{b}+\vec{c})\cdot\vec{a}}{|\vec{v}||\vec{a}|} = \dfrac{\vec{a}\cdot\vec{a}+\vec{b}\cdot\vec{a}+\vec{c}\cdot\vec{a}}{|\vec{v}||\vec{a}|} = \dfrac{\vec{a}\cdot\vec{a}+0+0}{|\vec{v}||\vec{a}|}$

$= \dfrac{|\vec{a}|^2}{|\vec{v}||\vec{a}|} \quad [\because \text{ of } (1)]$

$= \dfrac{|\vec{a}|}{|\vec{v}|}$.

Illy we get $\cos\beta = \dfrac{|\vec{b}|}{|\vec{v}|}$ and $\cos\gamma = \dfrac{|\vec{c}|}{|\vec{v}|}$.

Now since it is given that $|\vec{a}| = |\vec{b}| = |\vec{c}|$

$\therefore \quad \cos\alpha = \cos\beta = \cos\gamma$

$\Rightarrow \quad \alpha = \beta = \gamma$.

$\therefore \quad \vec{a}+\vec{b}+\vec{c}$ is equally inclined to $\vec{a}, \vec{b}$ and $\vec{c}$.

Q.No 15. Prove that $(\vec{a}+\vec{b})\cdot(\vec{a}+\vec{b}) = |\vec{a}|^2+|\vec{b}|^2$ if and only if $\vec{a}$ and $\vec{b}$ are perpendicular, given $\vec{a}\neq\vec{0}, \vec{b}\neq\vec{0}$

Sol. $\quad (\vec{a}+\vec{b})\cdot(\vec{a}+\vec{b}) = |\vec{a}|^2+|\vec{b}|^2$

iff $\quad \vec{a}\cdot(\vec{a}+\vec{b}) + \vec{b}\cdot(\vec{a}+\vec{b}) = |\vec{a}|^2+|\vec{b}|^2$

iff $\quad \vec{a}\cdot\vec{a}+\vec{a}\cdot\vec{b}+\vec{b}\cdot\vec{a}+\vec{b}\cdot\vec{b} = |\vec{a}|^2+|\vec{b}|^2$

iff $\quad |\vec{a}|^2+\vec{a}\cdot\vec{b}+\vec{a}\cdot\vec{b}+|\vec{b}|^2 = |\vec{a}|^2+|\vec{b}|^2 \quad [\because \vec{a}\cdot\vec{b} = \vec{b}\cdot\vec{a}]$

iff $\quad |\vec{a}|^2+2\vec{a}\cdot\vec{b}+|\vec{b}|^2 = |\vec{a}|^2+|\vec{b}|^2$

iff $\quad \vec{a}\cdot\vec{b} = 0$

iff $\quad \vec{a}$ and $\vec{b}$ are perpendicular vectors.

Choose the correct answer in questions 16 to 19. 14.

QNo.16 If θ is the angle between two vectors $\vec{a}$ and $\vec{b}$, then $\vec{a}\cdot\vec{b} \geq 0$ only when (A) $0<\theta<\pi/2$ (B) $0\leq\theta\leq\frac{\pi}{2}$ (C) $0<\theta<\pi$ (D) $0\leq\theta\leq\pi$.

Sol. $\vec{a}\cdot\vec{b} \geq 0$ iff $|\vec{a}||\vec{b}|\cos\theta \geq 0$

ie only if $\cos\theta \geq 0$ ie only if $0\leq\theta\leq\pi/2$.

$\therefore$ (B) is the correct option.

QNo.17 Let $\vec{a}$ and $\vec{b}$ be two unit vectors and θ is the angle between them. Then $\vec{a}+\vec{b}$ is unit vector if

(A) $\theta=\frac{\pi}{4}$ (B) $\theta=\frac{\pi}{3}$ (C) $\theta=\frac{\pi}{2}$ (D) $\theta=2\pi/3$

Sol

$$|\vec{a}+\vec{b}|=1$$

iff $|\vec{a}+\vec{b}|^2=1$

iff $(\vec{a}+\vec{b})\cdot(\vec{a}+\vec{b})=1$

iff $|\vec{a}|^2+|\vec{b}|^2+2\vec{a}\cdot\vec{b}=1$ [As in Q.No 15]

iff $1+1+2\vec{a}\cdot\vec{b}=1$

iff $1+1+2\times1\times1\cdot\cos\theta=1$

iff $2\cos\theta=1-2$

iff $\cos\theta=-1/2$

iff $\theta=2\pi/3$.

$\therefore$ (D) is correct option.

QNo.18. The value of $\hat{i}\cdot(\hat{j}\times\hat{k})+\hat{j}\cdot(\hat{i}\times\hat{k})+\hat{k}\cdot(\hat{i}\times\hat{j})$ is

(A) 0 (B) -1 (C) 1 (D) 3

Sol.

$$\hat{i}\cdot(\hat{j}\times\hat{k})+\hat{j}\cdot(\hat{i}\times\hat{k})+\hat{k}(\hat{i}\times\hat{j})$$

$$=\hat{i}\cdot(\hat{i})+\hat{j}\cdot(-\hat{j})+\hat{k}(\hat{k})$$

$$=|\hat{i}|^2-|\hat{j}|^2+|\hat{k}|^2$$

$$=1^2-1^2+1^2=1.$$

$\therefore$ (C) is correct option.

Q No 19 If θ is the angle between any two vectors $\vec{a}$ and $\vec{b}$, then $|\vec{a}\cdot\vec{b}| = |\vec{a}\times\vec{b}|$ when θ is equal to

(A) 0 (B) $\pi/4$ (C) $\pi/2$ (D) π.

Sol..

$$|\vec{a}\cdot\vec{b}| = |\vec{a}\times\vec{b}|$$

iff $\;||\vec{a}||\vec{b}|\cos\theta| = ||\vec{a}||\vec{b}|\sin\theta\,\hat{n}|$.

iff $\;(\cos\theta)^2 = (\sin\theta)^2$

iff $\;\tan^2\theta = 1$

iff $\;\theta = \pi/4, \frac{3\pi}{4}$

$\therefore$ (B) is correct option..

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