

WS-10 - Types of vectors

6th foundation +

①

Thank

①

Impulse, momentum both are vectors and dimensions

$$\text{are} = MLT^{-1}$$

Power, force $\rightarrow [Power] = ML^2T^{-3} \rightarrow \text{scalar}$

$[Force] = MLT^{-2} \rightarrow \text{vector}$

work, Energy $\rightarrow$ both are scalar $\rightarrow$ dimensions $= ML^2T^{-2}$

speed $\rightarrow$ scalar $\neq$ velocity $\rightarrow$ vector but dimensions

are same $= M^0LT^{-1} \rightarrow D$

④

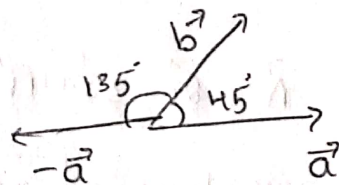
$$\text{Given } \vec{Q} = 10\hat{i} + 8\hat{j} + 6\hat{k}$$

$$\text{magnitude of } \vec{Q} \text{ in } yz \text{ plane} = \sqrt{y^2 + z^2} = \sqrt{8^2 + 6^2}$$

$$= \sqrt{100} = 10 \rightarrow B$$

⑤

Given angle between $\vec{a}$ and $\vec{b}$ is 45°



$\therefore$ angle between $\vec{a}$ and $-\vec{b}$ is

$135^\circ \rightarrow D$

⑥

Here for two vectors Tail-Tail connected.

so the angle between them is $120^\circ \rightarrow A$

8)

Given $\vec{A} = 3\hat{i} + 4\hat{j} + 5\hat{k}$

let it be a 3D vector

For any 3D vector

$$\vec{A} = A_x\hat{i} + A_y\hat{j} + A_z\hat{k}$$

$$|\vec{A}| = \sqrt{3^2 + 4^2 + 5^2}$$

$$= \sqrt{9 + 16 + 25}$$

$$= \sqrt{50}$$

$$= 5\sqrt{2} \rightarrow C$$

$$|\vec{A}| = \sqrt{A_x^2 + A_y^2 + A_z^2}$$

9)

Given

$$|2\hat{i} + y\hat{j} + 3\hat{k}| = 5$$

It is a 3D vector so its magnitude = $\sqrt{x^2 + y^2 + z^2}$

$$\Rightarrow \sqrt{2^2 + y^2 + 3^2} = 5$$

$$\Rightarrow (2^2 + y^2 + 3^2) = 5^2$$

$$\Rightarrow 4 + y^2 + 9 = 25 \Rightarrow y^2 = 25 - 13$$

$$\Rightarrow y = 12$$

$$y = \sqrt{12} = 2\sqrt{3} \rightarrow B$$

10)

let the vector be $\vec{A} = 2\hat{i} + 3\hat{j} + 4\hat{k}$

length of vector in xy-plane = $\sqrt{x^2 + y^2}$

$$= \sqrt{2^2 + 3^2}$$

$$= \sqrt{4 + 9}$$

$$= \sqrt{13} \rightarrow A$$



(2)

(12)

Electric current is a vector, because it does not follow laws of vector addition.

Any quantity is a vector if it has both magnitude, direction and follows laws of vector addition.

(13)

Given $\vec{A} = 3\hat{i} + 4\hat{j}$ and $\vec{B} = 12\hat{i} + 5\hat{j}$

$$\begin{aligned} |\vec{A}| &= \sqrt{3^2 + 4^2} \\ &= \sqrt{9 + 16} \\ &= \sqrt{25} \\ &= 5 \end{aligned}$$

$$\begin{aligned} |\vec{B}| &= \sqrt{12^2 + 5^2} \\ &= \sqrt{144 + 25} \\ &= \sqrt{169} \\ &= 13 \end{aligned}$$

B is not a unit vector.

unit vector of $\vec{A} = \frac{\vec{A}}{|\vec{A}|} = \frac{3\hat{i} + 4\hat{j}}{5}$

(14) (15) (16)

let $\vec{A} = 2\hat{i} + 2\hat{j}$ and $\vec{B} = 2\hat{i} - 4\hat{j}$.

magnitude of $\vec{B} = \sqrt{2^2 + (-4)^2} = \sqrt{4 + 16} = \sqrt{20} = 2\sqrt{5} \rightarrow A$

magnitude of $\vec{A} = \sqrt{2^2 + 2^2} = \sqrt{4 + 4} = 2\sqrt{2} \rightarrow B$

unit vector of $\vec{A} = \frac{\vec{A}}{|\vec{A}|} = \frac{2\hat{i} + 2\hat{j}}{2\sqrt{2}} = \frac{2\hat{i} + 2\hat{j}}{\sqrt{8}} \rightarrow A$

(17)

$$\text{let } \vec{a} = 3\hat{i} + 4\hat{j} \quad ; \quad \vec{b} = 2\hat{i} + 4\hat{j} + 6\hat{k}$$

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

$$|\vec{a}| = \sqrt{3^2 + 4^2} = \sqrt{9 + 16} = \sqrt{25} = 5$$

$$|\vec{b}| = \sqrt{2^2 + 4^2 + 6^2} = \sqrt{4 + 16 + 36} = \sqrt{56}$$

$$|\vec{c}| = \sqrt{2^2 + 2^2 + 1^2} = \sqrt{4 + 4 + 1} = 3$$

c, a, b is the increasing order.

LTASK (Jee mains level)

(1)

$$\text{let the vector be } \vec{A} = 3\hat{i} - 12\hat{j} - 4\hat{k}$$

It is a 3D vector whose magnitude = $\sqrt{x^2 + y^2 + z^2}$

$$\begin{aligned} \therefore |\vec{A}| &= \sqrt{3^2 + (-12)^2 + (-4)^2} = \sqrt{9 + 144 + 16} \\ &= \sqrt{169} = 13 \rightarrow A \end{aligned}$$

(2)

$$\text{let } \vec{A} = \frac{2}{3}\hat{i} - \frac{1}{3}\hat{j} + \frac{2}{3}\hat{k}$$

It is a 3D vector whose magnitude = $\sqrt{x^2 + y^2 + z^2}$

$$\begin{aligned} |\vec{A}| &= \sqrt{\left(\frac{2}{3}\right)^2 + \left(-\frac{1}{3}\right)^2 + \left(\frac{2}{3}\right)^2} \\ &= \sqrt{\frac{4}{9} + \frac{1}{9} + \frac{4}{9}} \\ &= \sqrt{\frac{9}{9}} = 1 \rightarrow B \end{aligned}$$

(3)

Given $\vec{A} = 5\hat{i} + p\hat{j} + 4\sqrt{2}\hat{k}$ is a unit vector.

It is a unit vector so its magnitude = $\sqrt{x^2 + y^2 + z^2}$

$$|\vec{A}| = 1$$

$$\Rightarrow \sqrt{5^2 + p^2 + (4\sqrt{2})^2} = 1$$

$$\Rightarrow 25 + p^2 + 32 = 1$$

$$\Rightarrow p^2 + 57 = 1 \Rightarrow p^2 = 1 - 57$$

$$\Rightarrow p^2 = -56$$

$$\Rightarrow p = \pm \sqrt{-56} \rightarrow \text{C}$$

(4)

Given that $0.5\hat{i} + 0.8\hat{j} + c\hat{k}$ is a unit vector.

$$\Rightarrow |0.5\hat{i} + 0.8\hat{j} + c\hat{k}| = 1$$

$$\Rightarrow \sqrt{(0.5)^2 + (0.8)^2 + c^2} = 1$$

$$\Rightarrow 0.25 + 0.64 + c^2 = 1$$

$$\Rightarrow 0.89 + c^2 = 1 \Rightarrow c^2 = 1 - 0.89$$

$$\Rightarrow c = \sqrt{0.11} \rightarrow \text{D}$$

(5)

Let the vector be $\vec{A} = 3\hat{i} + \hat{j} + 2\hat{k}$

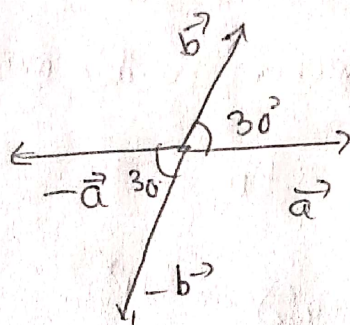
length of vector in xy plane = $\sqrt{x^2 + y^2}$

$$= \sqrt{3^2 + 1^2}$$

$$= \sqrt{10} \rightarrow \text{C}$$

(6)

Given angle between $\vec{a}$ and $\vec{b}$ is 30°

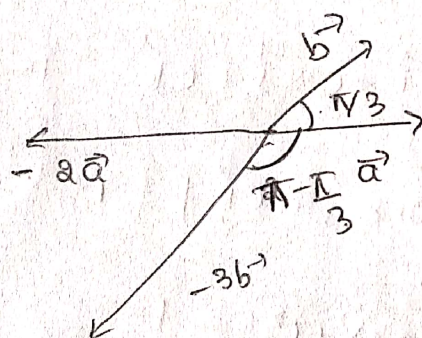


We can measure the angle between two vectors as the minimum angle between the two vectors which must have common starting point and common end point.

and common end point.

(7)

Given angle between $\vec{a}$ and $\vec{b}$ is $\frac{\pi}{3}$



The angle between $2\vec{a}$ and $-3\vec{b}$

$$\pi - \frac{\pi}{3} = \frac{2\pi}{3}$$

(8)

Given

$$|x\hat{i} - 3\hat{j} + 5\hat{k}| = \sqrt{98}$$

$$\Rightarrow \sqrt{x^2 + 3^2 + 5^2} = \sqrt{98} \quad \text{Squaring on both sides}$$

$$\Rightarrow \left[\frac{x^2 + 9 + 25}{1} \right]^{\frac{1}{2}} = [\sqrt{98}]^{\frac{1}{2}}$$

$$\Rightarrow x^2 + 34 = 98$$

$$\Rightarrow x^2 = 98 - 34 \Rightarrow 64$$

$$\Rightarrow x = \sqrt{64} = \pm 8$$



(9)

let $\vec{a} = 3\hat{i} + 2\hat{j} \Rightarrow \text{magnitude} = \sqrt{3^2 + 2^2} = \sqrt{9+4} = \sqrt{13}$

$\vec{b} = 2\hat{i} + 2\hat{j} + 6\hat{k} \Rightarrow \text{magnitude} = \sqrt{2^2 + 2^2 + 6^2} = \sqrt{44}$

$\vec{c} = \hat{i} + \hat{j} + \hat{k} \Rightarrow \text{magnitude} = \sqrt{1^2 + 1^2 + 1^2} = \sqrt{3}$

→ B

(10)

Given $\vec{A} = 2\hat{i} - 3\hat{j} + 4\hat{k}$

length in yz -plane = $\sqrt{y^2 + z^2} = \sqrt{(-3)^2 + 4^2}$
 $= \sqrt{9 + 16} = \sqrt{25} = 5$

length in zx -plane = $\sqrt{z^2 + x^2} = \sqrt{4^2 + 2^2} = \sqrt{20} = 2\sqrt{5}$

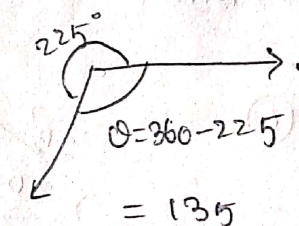
→ B

(12)

Electric current is a scalar because it does not follow laws of vector addition.

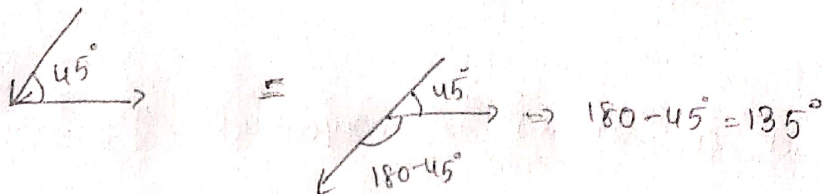
Any quantity is a vector if it has magnitude, direction and follows laws of vector addition.

(13)

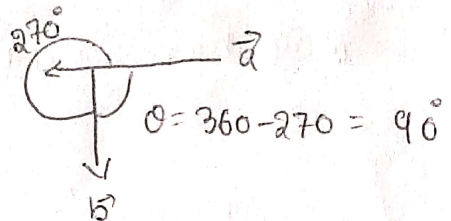


We have to take minimum angle between the vectors when they have common starting point (or) end point.

(14)

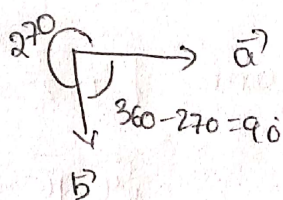


(15)



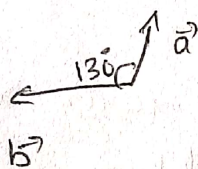
we have to take minimum angle between the vectors

(16)

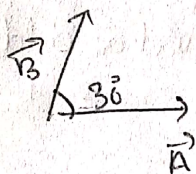


Even the two vectors are starting from same point, but we have to take minimum angle between them.

(17)

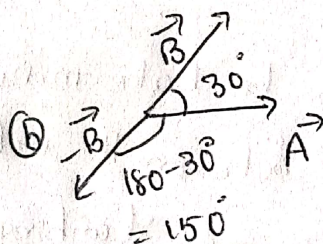


(18)

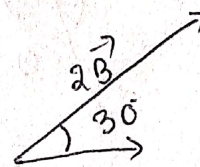


(a) $\vec{A}$ & $\vec{A}$ are Parallel so angle between them is 0°

(b) $\vec{A}$ and $-2\vec{A}$ are anti parallel then the angle $\theta = 180^\circ$



(c)



Here length of $\vec{B}$ is doubled but not direction. so angle is same.