NDA 2 2024

LIVE

MATHS

VECTOR ALGEBRA

CLASS 2

NAVJYOTI SIR

Crack EXAMS

PROPERTIES OF VECTOR PRODUCT

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

(x) Moment

(a) **About a point** Moment $= \mathbf{r} \times \mathbf{F}$

Where $\mathbf{r}$ be the position vector of any point P and $\mathbf{F}$ be the force about the point O.

(b) **About a line** The moment of a force $\mathbf{F}$ acting at a point P about a line L is a scalar given by $(\mathbf{r} \times \mathbf{F}) \cdot \hat{\mathbf{a}}$.

Where, $\hat{\mathbf{a}}$ is a unit vector in the direction of the line, and $\mathbf{OR} = \mathbf{R}$, where O is any point on the line.

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. Consider the following in respect of moment of a force :

1. The moment of force about a point is independent of point of application of force.

2. The moment of a force about a line is a vector quantity.

Which of the statements given above is/are correct ?

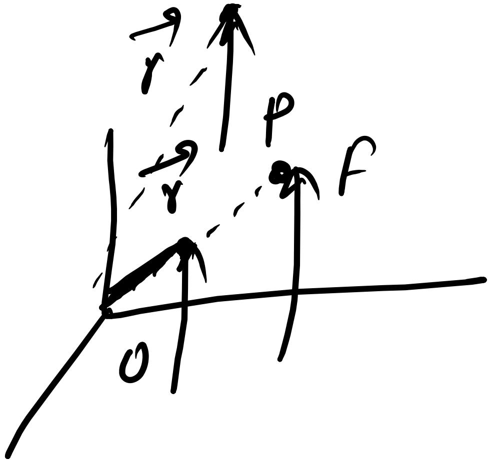
(a) 1 only

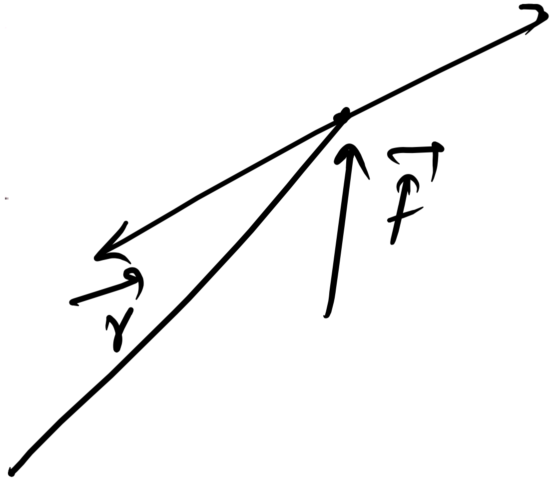
(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

Moment = $\vec{r} \times \vec{F}$





$(\vec{r} \times \vec{F})$.

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SCALAR TRIPLE PRODUCT

The scalar triple product of three vectors **a**, **b** and **c** is [**a b c**].

$\vec{a} \cdot (\vec{b} \times \vec{c})$

or $[\mathbf{a}\ \mathbf{b}\ \mathbf{c}] = \mathbf{a} \cdot (\mathbf{b} \times \mathbf{c})$ ≡ scalar

If $\mathbf{a} = a_1\mathbf{i} + a_2\mathbf{j} + a_3\mathbf{k}$, $\mathbf{b} = b_1\mathbf{i} + b_2\mathbf{j} + b_3\mathbf{k}$

and $\mathbf{c} = c_1\mathbf{i} + c_2\mathbf{j} + c_3\mathbf{k}$, then

$$[\mathbf{a}\ \mathbf{b}\ \mathbf{c}] = \begin{vmatrix} a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \\ c_1 & c_2 & c_3 \end{vmatrix} = +a_1(b_2c_3 - b_3c_2) - a_2(b_1c_3 - b_3c_1) + a_3(b_1c_2 - b_2c_1)$$

(determinant)

PROPERTIES OF SCALAR TRIPLE PRODUCT

(i) The value of scalar triple product does not depend upon the position of dot and cross.

$$\mathbf{a}\cdot(\mathbf{b}\times\mathbf{c})=(\mathbf{a}\times\mathbf{b})\cdot\mathbf{c}$$

(ii) If $\mathbf{a}$, $\mathbf{b}$, $\mathbf{c}$ are cyclically permuted the value of scalar product remains same.

The change of cyclic order of vectors in scalar triple product changes the sign of the scalar but not the magnitude.

i.e., $[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]=[\mathbf{b}\ \mathbf{c}\ \mathbf{a}]=[\mathbf{c}\ \mathbf{a}\ \mathbf{b}]$

and $[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]=-[\mathbf{b}\ \mathbf{a}\ \mathbf{c}]=-[\mathbf{c}\ \mathbf{b}\ \mathbf{a}]$

$=-[\mathbf{a}\ \mathbf{c}\ \mathbf{b}]$

(iii) The scalar triple product of three vectors is zero, if any two of them are equal.

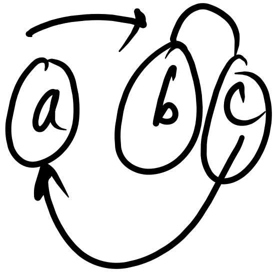
(iv) The scalar triple product of three vectors is zero, if two of them are parallel or collinear.

$[a\ b\ c]$

$\vec{a}\cdot(\vec{b}\times\vec{c})$

$=\vec{b}\cdot(\vec{c}\times\vec{a})$ $[b\ c\ a]$

$=\vec{c}\cdot(\vec{a}\times\vec{b})$ $[c\ a\ b]$



$\vec{a}\cdot(\vec{b}\times\vec{a})=0$

PROPERTIES OF SCALAR TRIPLE PRODUCT

(v) If three vectors **a**, **b** and **c** are collinear, then

$$[\mathbf{a}\ \mathbf{b}\ \mathbf{c}] = 0.$$

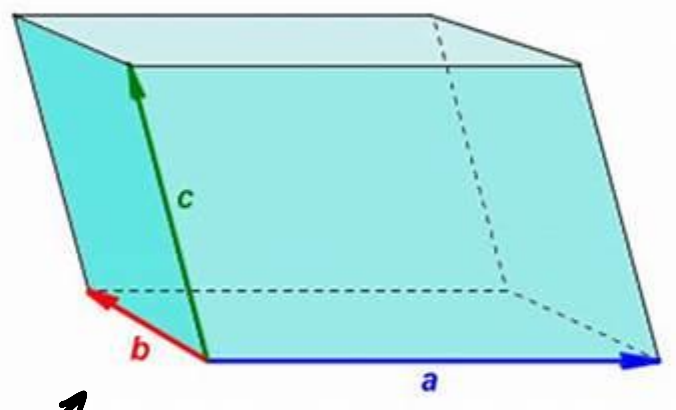
(vi) $[\mathbf{a}\ \ \mathbf{b}\ \mathbf{c} + \mathbf{d}] = [\mathbf{a}\ \mathbf{b}\ \mathbf{c}] + [\mathbf{a}\ \mathbf{b}\ \mathbf{d}]$

(vii) $[\mathbf{a} + \mathbf{b}\ \mathbf{b} + \mathbf{c}\ \mathbf{c} + \mathbf{a}] = 2\,[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]$

(viii) $[\mathbf{a} - \mathbf{b}\ \mathbf{b} - \mathbf{c}\ \mathbf{c} - \mathbf{a}] = 0$

(ix) $[\mathbf{a} \times \mathbf{b}\ \mathbf{b} \times \mathbf{c}\ \mathbf{c} \times \mathbf{a}] = [\mathbf{a}\ \mathbf{b}\ \mathbf{c}]^2$

(x) Volume of parallelopiped = $[\mathbf{a}\ \mathbf{b}\ \mathbf{c}]$ where **a**, **b** and **c** are adjacent sides of parallelopiped.

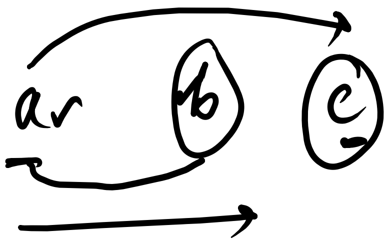


$|\vec{a} \times \vec{b}|$ = area of parallellogram

VECTOR TRIPLE PRODUCT

If $\mathbf{a}, \mathbf{b}$ and $\mathbf{c}$ are three vector quantities, then $\mathbf{a} \times (\mathbf{b} \times \mathbf{c})$ represents the vector triple product and is given by

$$\mathbf{a} \times (\mathbf{b} \times \mathbf{c}) = (\mathbf{a} \cdot \mathbf{c})\mathbf{b} - (\mathbf{a} \cdot \mathbf{b})\,\mathbf{c}$$



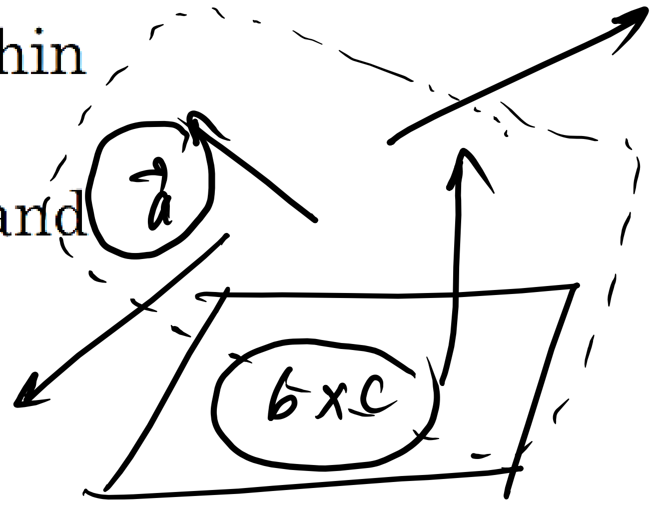
PROPERTIES OF VECTOR TRIPLE PRODUCT

(i) The vector triple product $\mathbf{a} \times (\mathbf{b} \times \mathbf{c})$ is a linear combination of those two vectors, which are within brackets.

(ii) The vector $\mathbf{r} = \mathbf{a} \times (\mathbf{b} \times \mathbf{c})$ is perpendicular to $\mathbf{a}$ and lies in the plane of $\mathbf{b}$ and $\mathbf{c}$.

(iii) Vector triple product is a vector quantity.

(iv) $\mathbf{a} \times (\mathbf{b} \times \mathbf{c}) \neq (\mathbf{a} \times \mathbf{b}) \times \mathbf{c}$



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Q) If $\vec{r}_1 = \lambda\hat{i} + 2\hat{j} + \hat{k}$, $\vec{r}_2 = \hat{i} + (2-\lambda)\hat{j} + 2\hat{k}$ are such that $|\vec{r}_1| > |\vec{r}_2|$, then λ satisfies which one of the following?

(a) $\lambda = 0$ only (b) $\lambda = 1$

(c) $\lambda < 1$ (d) $\lambda > 1$ ✓

$\vec{r}_1 = \lambda\hat{i} + 2\hat{j} + \hat{k}$

$|\vec{r}_1| = \sqrt{\lambda^2 + 4 + 1^2} = \sqrt{\lambda^2 + 5}$

$|\vec{r}_2| = \sqrt{1^2 + (2-\lambda)^2 + 2^2} = \sqrt{1 + 4 - 4\lambda + \lambda^2 + 4}$

$= \sqrt{\lambda^2 - 4\lambda + 9}$

$|\vec{r}_1| > |\vec{r}_2|$

$|\vec{r}_1|^2 > |\vec{r}_2|^2$

$\lambda^2 + 5 > \lambda^2 - 4\lambda + 9$

$5 > -4\lambda + 9$

$-4 > -4\lambda$

$\lambda > 1$ ✓

Q) If $\vec{r}_1 = \lambda\hat{i} + 2\hat{j} + \hat{k}$, $\vec{r}_2 = \hat{i} + (2-\lambda)\hat{j} + 2\hat{k}$ are such that $|\vec{r}_1| > |\vec{r}_2|$, then λ satisfies which one of the following?

(a) $\lambda = 0$ only

(b) $\lambda = 1$

(c) $\lambda < 1$

(d) $\lambda > 1$

Ans: (D)

Q) If $|\vec{a}| = 2, |\vec{b}| = 5$ and $|\vec{a} \times \vec{b}| = 8$, then what is the value of $\vec{a} \cdot \vec{b}$?

(a) 4 (b) 6

(c) 8 (d) 10

$\vec{a} \cdot \vec{b} = ab\cos\theta$

$|\vec{a} \times \vec{b}| = ab\sin\theta$

$(\vec{a} \cdot \vec{b})^2 + |\vec{a} \times \vec{b}|^2 = a^2b^2\cos^2\theta + a^2b^2\sin\theta$

$= a^2b^2$

$a = |\vec{a}|$

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

$(\vec{a} \cdot \vec{b})^2 + 8^2 = 2^2 \times 5^5$

$(\vec{a} \cdot \vec{b})^2 = 100 - 64 = 36$

$\vec{a} \cdot \vec{b} = 6$

Q) If $|\vec{a}| = 2, |\vec{b}| = 5$ and $|\vec{a} \times \vec{b}| = 8$, then what is the value of $\vec{a} \cdot \vec{b}$?

(a) 4 (b) 6

(c) 8 (d) 10

Ans: (B)

Q) Let $\vec{a}$ and $\vec{b}$ be two unit vectors and α be the angle between them. If $(\vec{a}+\vec{b})$ is also the unit vectors, then what is the value of α?

(a) $\frac{\pi}{4}$ (b) $\frac{\pi}{3}$

(c) $\frac{2\pi}{3}$ ✓ (d) $\frac{\pi}{2}$

$\vec{a}\cdot\vec{b} = ab\cos\theta$

$\vec{a}\cdot\vec{b} = 1\times 1\cos\alpha$

$\cos\alpha = \vec{a}\cdot\vec{b}$

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

$1^2 = 1^2 + 1^2 + 2\cos\alpha$

$\frac{-1}{2} = \cos\alpha$

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

Q) Let $\vec{a}$ and $\vec{b}$ be two unit vectors and α be the angle between them. If $(\vec{a}+\vec{b})$ is also the unit vectors, then what is the value of α?

(a) $\frac{\pi}{4}$

(b) $\frac{\pi}{3}$

(c) $\frac{2\pi}{3}$

(d) $\frac{\pi}{2}$

Ans: (C)

Q) If $x\hat{i} + y\hat{j} + z\hat{k}$ is a unit vector and $x : y : z = \sqrt{3} : 2 : 3$, then what is the value of z ?

(a) $\frac{3}{16}$ (b) 3

(c) $\frac{3}{4}$ (d) 2

$\sqrt{x^2+y^2+z^2} = 1$

$x^2+y^2+z^2 = 1$

$x : y : z = \sqrt{3} : 2 : 3$

$x = \sqrt{3}k$

$y = 2k$

$z = 3k$

$(\sqrt{3}k)^2 + (2k)^2 + (3k)^2 = 1$

$3k^2 + 4k^2 + 9k^2 = 1$

$16k^2 = 1$

$k = \frac{1}{4} \,/\, -\frac{1}{4}$

$z = 3k$

$\frac{3}{4} \,/\, -\frac{3}{4}$

Q) If $x\hat{\mathbf{i}} + y\hat{\mathbf{j}} + z\hat{\mathbf{k}}$ is a unit vector and $x : y : z = \sqrt{3} : 2 : 3$, then what is the value of z ?

(a) $\frac{3}{16}$ (b) 3

(c) $\frac{3}{4}$ (d) 2

Ans: (C)

Q) Which one of the following is the unit vector perpendicular to the vectors $4\hat{i}+2\hat{j}$ and $-3\hat{i}+2\hat{j}$?

(a) $\frac{\hat{i}+\hat{j}}{\sqrt{2}}$

(b) $\frac{\hat{i}-\hat{j}}{\sqrt{2}}$

(c) $\hat{k}$

(d) $\frac{\hat{i}+\hat{j}+\hat{k}}{\sqrt{3}}$

$\vec{a} = x\hat{i} + y\hat{j} + z\hat{k}$ (Let)

$\vec{a} \cdot (4\hat{i} + 2\hat{j}) = 0$

$\vec{a} \cdot (-3\hat{i} + 2\hat{j}) = 0$

$4x + 2y = 0$

$-3x + 2y = 0$

$x = 0$; $y = 0$

$\vec{a} = z\hat{k}$

Q) Which one of the following is the unit vector perpendicular to the vectors $4\hat{\mathbf{i}}+2\hat{\mathbf{j}}$ and $-3\hat{\mathbf{i}}+2\hat{\mathbf{j}}$?

(a) $\dfrac{\hat{\mathbf{i}}+\hat{\mathbf{j}}}{\sqrt{2}}$

(b) $\dfrac{\hat{\mathbf{i}}-\hat{\mathbf{j}}}{\sqrt{2}}$

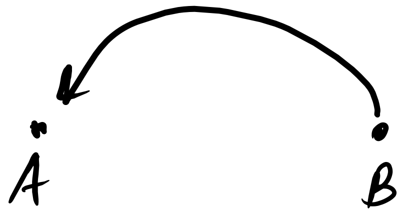
(c) $\hat{\mathbf{k}}$

(d) $\dfrac{\hat{\mathbf{i}}+\hat{\mathbf{j}}+\hat{\mathbf{k}}}{\sqrt{3}}$

Ans: (C)

Q) A force $\vec{F} = \hat{i} + 3\hat{j} + 2\hat{k}$ acts on a particle to displace it from the point $A(\hat{i} + 2\hat{j} - 3\hat{k})$ to the point $B(3\hat{i} - \hat{j} + 5\hat{k})$. The work done by the force will be

(a) 5 units (b) 7 units (c) 9 units (d) 10 units



displacement $= (3\hat{i} - \hat{j} + 5\hat{k}) - (\hat{i} + 2\hat{j} - 3\hat{k})$

$= 2\hat{i} - 3\hat{j} + 8\hat{k}$

Work done $= \vec{F} \cdot \vec{r}$

$= (\hat{i} + 3\hat{j} + 2\hat{k}) \cdot (2\hat{i} - 3\hat{j} + 8\hat{k}) = 2 - 9 + 16$

$= -7 + 16 = 9$ units

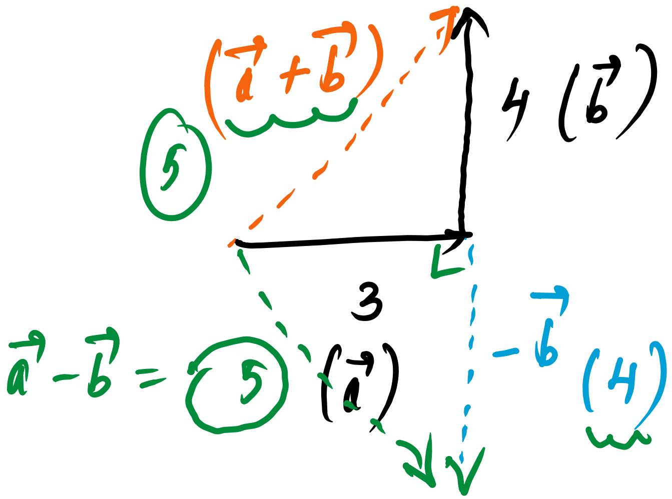
Q) A force $\vec{F} = \hat{i} + 3\hat{j} + 2\hat{k}$ acts on a particle to displace it from the point $A(\hat{i} + 2\hat{j} - 3\hat{k})$ to the point $B(3\hat{i} - \hat{j} + 5\hat{k})$. The work done by the force will be

(a) 5 units (b) 7 units (c) 9 units (d) 10 units

Ans: (c)

Q) If $|\vec{\mathbf{a}}| = 3$, $|\vec{\mathbf{b}}| = 4$ and $|\vec{\mathbf{a}} - \vec{\mathbf{b}}| = 5$, then what is the value of $|\vec{\mathbf{a}} + \vec{\mathbf{b}}|$?

(a) 8 (b) 6 (c) $5\sqrt{2}$ (d) 5



Q) If $|\vec{a}| = 3$, $|\vec{b}| = 4$ and $|\vec{a} - \vec{b}| = 5$, then what is the value of $|\vec{a} + \vec{b}|$?

(a) 8 (b) 6 (c) $5\sqrt{2}$ (d) 5

Ans: (d)

Q) If the magnitude of the sum of two non-zero vectors is equal to the magnitude of their difference, then which one of the following is correct?

(a) The vectors are parallel
(b) The vectors are perpendicular
(c) The vectors are anti-parallel
(d) The vectors must be unit vectors

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

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

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

$$4(\vec{a}\cdot\vec{b}) = 0$$

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

$$\Rightarrow \vec{a} \perp \vec{b}$$

Q) If the magnitude of the sum of two non-zero vectors is equal to the magnitude of their difference, then which one of the following is correct?

(a) The vectors are parallel
(b) The vectors are perpendicular
(c) The vectors are anti-parallel
(d) The vectors must be unit vectors

Ans: (b)

Q) If $|\vec{a}| = 4, |\vec{b}| = 2$ and the angle between $\vec{a}$ and $\vec{b}$ is $\pi/6$ then $|\vec{a} \times \vec{b}|^2$ is equal to

(a) 48 (b) 16

(c) $\vec{a}$ (d) none of these

$|\vec{a} \times \vec{b}|^2 = (ab\sin\theta)^2$

$= a^2b^2\sin^2\left(\frac{\pi}{6}\right)$

$= 4^2 \times 2^2 \times \frac{1}{4} = 16$

Q) If $|\vec{a}| = 4, |\vec{b}| = 2$ and the angle between $\vec{a}$ and $\vec{b}$ is $\pi/6$ then $(\vec{a} \times \vec{b})^2$ is equal to

(a) 48

(b) 16

(c) $\vec{a}$

(d) none of these

Ans: (b)

Q)If $\vec{\mathbf{r}} = x\hat{i} + y\hat{j} + z\hat{k}$, then what is $\vec{\mathbf{r}} \cdot (\hat{i} + \hat{j} + \hat{k})$ equal to ?

(a) x (b) $x + y$ (c) $-(x + y + z)$ (d) $(x + y + z)$

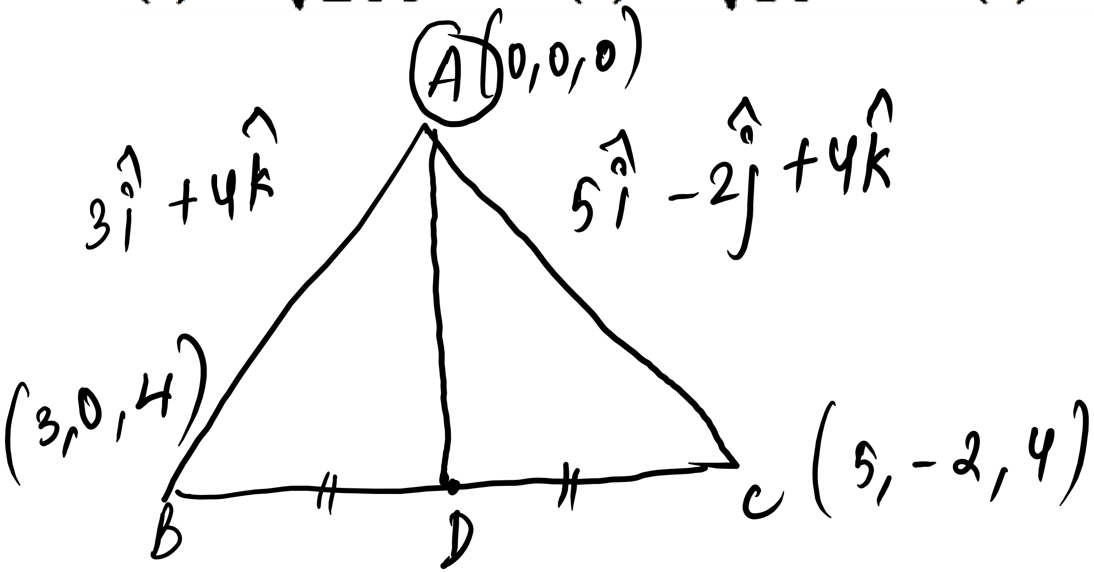
Q) If $\vec{\mathbf{r}} = x\hat{i} + y\hat{j} + z\hat{k}$, then what is $\vec{\mathbf{r}} \cdot (\hat{i} + \hat{j} + \hat{k})$ equal to ?

(a) x (b) $x + y$ (c) $-(x + y + z)$ (d) $(x + y + z)$

Ans: (d)

Q) The vectors $\overrightarrow{AB} = 3\hat{i} + 4\hat{k}$ & $\overrightarrow{AC} = 5\hat{i} - 2\hat{j} + 4\hat{k}$ are the sides of a triangle ABC. The length of the median through A is

(a) $\sqrt{288}$ (b) $\sqrt{18}$ (c) $\sqrt{72}$ (d) $\sqrt{33}$



Median length $= |\overrightarrow{AD}|$

$D \rightarrow \left(\frac{3+5}{2}, \frac{0-2}{2}, \frac{4+4}{2}\right)$

$\rightarrow (4, -1, 4) \Rightarrow \overrightarrow{AD} = 4\hat{i} - \hat{j} + 4\hat{k}$

$\sqrt{4^2 + (-1)^2 + 4^2} = \sqrt{33}$

Q) The vectors $\overrightarrow{AB} = 3\hat{i} + 4\hat{k}$ & $\overrightarrow{AC} = 5\hat{i} - 2\hat{j} + 4\hat{k}$ are the sides of a triangle ABC. The length of the median through A is

(a) $\sqrt{288}$ (b) $\sqrt{18}$ (c) $\sqrt{72}$ (d) $\sqrt{33}$

Ans: (d)

Q) The volume of the parallelopiped whose sides are given by

$\overrightarrow{OA} = 2i - 2j,\ \overrightarrow{OB} = i + j - k,\ \overrightarrow{OC} = 3i - k$, is

$\vec{a}$ $\vec{b}$ $\vec{c}$

(a) $\frac{4}{13}$ (b) 4

(c) $\frac{2}{7}$ (d) none of these

$[a\ b\ c]$

$= \vec{a} \cdot (\vec{b} \times \vec{c})$

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

$= -2 + 4 + 0$

$= (2)$

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

$$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & 1 & -1 \\ 3 & 0 & -1 \end{vmatrix} = \hat{i}(1 \times -1 - 0) - \hat{j}(1 \times -1 - (-1) \times 3) + \hat{k}(1 \times 0 - 1 \times 3) = -\hat{i} - 2\hat{j} - 3\hat{k}$$

Q) The volume of the parallelopiped whose sides are given by

$\overrightarrow{OA} = 2i - 2j,\ \overrightarrow{OB} = i + j - k,\ \overrightarrow{OC} = 3i - k,$ is

(a) $\frac{4}{13}$

(b) 4

(c) $\frac{2}{7}$

(d) none of these

Ans: (d)

Q) If $\vec{a}$ and $\vec{b}$ are two unit vectors such that $\vec{a}+2\vec{b}$ and $5\vec{a}-4\vec{b}$ are perpendicular to each other then the angle between $\vec{a}$ and $\vec{b}$ is

(a) $45°$ (b) $60°$

(c) $\cos^{-1}\left(\frac{1}{3}\right)$ (d) $\cos^{-1}\left(\frac{2}{7}\right)$

$a=1$

$b=1$

$\vec{A} \perp \vec{B}$

$\vec{A}\cdot\vec{B}=0$

$(\vec{a}+2\vec{b})\cdot(5\vec{a}-4\vec{b})=0$

$5\vec{a}\cdot\vec{a}-4(\vec{a}\cdot\vec{b})+10(\vec{b}\cdot\vec{a})-8(\vec{b}\cdot\vec{b})=0$

$5a^2+6\vec{a}\cdot\vec{b}-8b^2=0$

$\vec{a}\cdot\vec{b}=\frac{8b^2-5a^2}{6}$

$\vec{a}\cdot\vec{b}=\frac{8(1)-5(1)}{6}$

$\vec{a}\cdot\vec{b}=\frac{3}{6}=\frac{1}{2}$

$ab\cos\theta=\frac{1}{2}$

$1.1\cos\theta=\frac{1}{2}$

$\cos\theta=\frac{1}{2}$

$\theta=60°$

Q) If $\vec{a}$ and $\vec{b}$ are two unit vectors such that $\vec{a}+2\vec{b}$ and $5\vec{a}-4\vec{b}$ are perpendicular to each other then the angle between $\vec{a}$ and $\vec{b}$ is

(a) 45°

(b) 60°

(c) $\cos^{-1}\left(\frac{1}{3}\right)$

(d) $\cos^{-1}\left(\frac{2}{7}\right)$

Ans: (b)

Q) Let $\vec{u}, \vec{v}$ and $\vec{w}$ be vectors such that $\vec{u} + \vec{v} + \vec{w} = 0$. If $|\vec{u}| = 3, |\vec{v}| = 4$ and $|\vec{w}| = 5$, then $\vec{u}.\vec{v} + \vec{v}.\vec{w} + \vec{w}.\vec{u}$ is

(a) 47 (b) -25 (c) 0 (d) 25

Q) Let $\vec{u}, \vec{v}$ and $\vec{w}$ be vectors such that $\vec{u}+\vec{v}+\vec{w}=0$. If $|\vec{u}|=3, |\vec{v}|=4$ and $|\vec{w}|=5$, then $\vec{u}.\vec{v}+\vec{v}.\vec{w}+\vec{w}.\vec{u}$ is

(a) 47 (b) -25 (c) 0 (d) 25

Ans: (b)

Q) If **a** and **b** are unit vectors and θ is the angle between them, then what is $\sin^2\left(\frac{\theta}{2}\right)$ equal to?

(a) $\frac{|\mathbf{a}+\mathbf{b}|^2}{4}$

(b) $\frac{|\mathbf{a}-\mathbf{b}|^2}{4}$

(c) $\frac{|\mathbf{a}+\mathbf{b}|^2}{2}$

(d) $\frac{|\mathbf{a}-\mathbf{b}|^2}{2}$

Q) If **a** and **b** are unit vectors and θ is the angle between them, then what is $\sin^2\left(\frac{\theta}{2}\right)$ equal to?

(a) $\frac{|a+b|^2}{4}$ (b) $\frac{|a-b|^2}{4}$

(c) $\frac{|a+b|^2}{2}$ (d) $\frac{|a-b|^2}{2}$

Ans: (b)

Q) The scalar $\vec{A}.(\vec{B}+\vec{C})\times(\vec{A}+\vec{B}+\vec{C})$ equals :

(a) 0

(b) $[\vec{A}\ \vec{B}\ \vec{C}]+[\vec{B}\ \vec{C}\ \vec{A}]$

(c) $[\vec{A}\ \vec{B}\ \vec{C}]$

(d) None of these

Q) The scalar $\vec{A}.(\vec{B}+\vec{C})\times(\vec{A}+\vec{B}+\vec{C})$ equals :

(a) 0

(b) $[\vec{A}\ \vec{B}\ \vec{C}]+[\vec{B}\ \vec{C}\ \vec{A}]$

(c) $[\vec{A}\ \vec{B}\ \vec{C}]$

(d) None of these

Ans: (a)

Q) What is the moment about the point $\hat{i}+2\hat{j}+3\hat{k}$, of a force represented by $\hat{i}+\hat{j}+\hat{k}$, acting through the point $-2\hat{i}+3\hat{j}+\hat{k}$?

(a) $2\hat{i}+\hat{j}+2\hat{k}$

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

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

(d) $3\hat{i}+\hat{j}-4\hat{k}$

Q) What is the moment about the point $\hat{i}+2\hat{j}+3\hat{k}$, of a force represented by $\hat{i}+\hat{j}+\hat{k}$, acting through the point $-2\hat{i}+3\hat{j}+\hat{k}$?

(a) $2\hat{i}+\hat{j}+2\hat{k}$

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

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

(d) $3\hat{i}+\hat{j}-4\hat{k}$

Ans: (d)

Q) If the vectors $\alpha\hat{i}+\alpha\hat{j}+\gamma\hat{k}, \hat{i}+\hat{k}$ and $\gamma\hat{i}+\gamma\hat{j}+\beta\hat{k}$ lie on a plane, where α, β and γ are distinct non-negative numbers, then γ is

(a) Arithmetic mean of α and β

(b) Geometric mean of α and β

(c) Harmonic mean of α and β

(d) None of the above

Q) If the vectors $\alpha\hat{i}+\alpha\hat{j}+\gamma\hat{k}, \hat{i}+\hat{k}$ and $\gamma\hat{i}+\gamma\hat{j}+\beta\hat{k}$ lie on a plane, where α, β and γ are distinct non-negative numbers, then γ is

(a) Arithmetic mean of α and β

(b) Geometric mean of α and β

(c) Harmonic mean of α and β

(d) None of the above

Ans: (b)

Q) If $|\vec{a}| = 3, |\vec{b}| = 4$, then for what value of l is $(\vec{a} + \lambda\vec{b})$ perpendicular to $(\vec{a} - \lambda\vec{b})$?

(a) $\frac{3}{4}$

(b) $\frac{4}{3}$

(c) $\frac{9}{16}$

(d) $\frac{3}{5}$

Q) If $|\vec{a}| = 3, |\vec{b}| = 4$, then for what value of l is $(\vec{a} + \lambda\vec{b})$ perpendicular to $(\vec{a} - \lambda\vec{b})$?

(a) $\frac{3}{4}$

(b) $\frac{4}{3}$

(c) $\frac{9}{16}$

(d) $\frac{3}{5}$

Ans: (a)

Q) If the vectors $\vec{\mathbf{K}}$ and $\vec{\mathbf{A}}$ are parallel to each other, then what is $k\vec{\mathbf{K}} \times \vec{\mathbf{A}}$ equal to ?

(a) $k^2\vec{\mathbf{A}}$ (b) $\vec{\mathbf{0}}$ (c) $-k^2\vec{\mathbf{A}}$ (d) $\vec{\mathbf{A}}$

Q) If the vectors $\vec{K}$ and $\vec{A}$ are parallel to each other, then what is $k\vec{K} \times \vec{A}$ equal to ?

(a) $k^2\vec{A}$ (b) $\vec{0}$ (c) $-k^2\vec{A}$ (d) $\vec{A}$

Ans: (b)

Q) If the vectors $-\hat{i}-2x\hat{j}-3y\hat{k}$ and $\hat{i}-3x\hat{j}-2y\hat{k}$ are orthogonal to each other, then what is the locus of the point (x, y)?

(a) a straight line
(b) an ellipse
(c) a parabola
(d) a circle

Q) If the vectors $-\hat{i} - 2x\hat{j} - 3y\hat{k}$ and $\hat{i} - 3x\hat{j} - 2y\hat{k}$ are orthogonal to each other, then what is the locus of the point (x, y)?

(a) a straight line
(b) an ellipse
(c) a parabola
(d) a circle

Ans: (d)

Q) If the magnitudes of two vectors a and b are equal then which one of the following is correct?

(a) $(\vec{a}+\vec{b})$ is parallel to $(\vec{a}-\vec{b})$

(b) $(\vec{a}+\vec{b}) \bullet (\vec{a}-\vec{b}) = 1$

(c) $(\vec{a}+\vec{b})$ is perpendicular to $(\vec{a}-\vec{b})$

(d) None of the above

Q) If the magnitudes of two vectors a and b are equal then which one of the following is correct?

(a) $(\vec{a}+\vec{b})$ is parallel to $(\vec{a}-\vec{b})$

(b) $(\vec{a}+\vec{b})\bullet(\vec{a}-\vec{b})=1$

(c) $(\vec{a}+\vec{b})$ is perpendicular to $(\vec{a}-\vec{b})$

(d) None of the above

Ans: (c)

Q) If $\vec{\beta}$ is perpendicular to both $\vec{\alpha}$ and $\vec{\gamma}$ where $\vec{\alpha} = \vec{k}$ and $\vec{\gamma} = 2\hat{i} + 3\hat{j} + 4\hat{k}$, then what is $\vec{\beta}$ equal to?

(a) $3\hat{i} + 2\hat{j}$

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

(c) $2\hat{i} - 3\hat{j}$

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

Q) If $\vec{\beta}$ is perpendicular to both $\vec{\alpha}$ and $\vec{\gamma}$ where $\vec{\alpha} = \vec{k}$ and $\vec{\gamma} = 2\hat{i} + 3\hat{j} + 4\hat{k}$, then what is $\vec{\beta}$ equal to?

(a) $3\hat{i} + 2\hat{j}$ (b) $-3\hat{i} + 2\hat{j}$

(c) $2\hat{i} - 3\hat{j}$ (d) $-2\hat{i} + 3\hat{j}$

Ans: (b)

Q) If the magnitude of $\vec{a} \times \vec{b}$ equals to $\vec{a} . \vec{b}$, then which one of the following is correct?

(a) $\vec{a} = \vec{b}$

(b) The angle between $\vec{a}$ and $\vec{b}$ is 45°

(c) $\vec{a}$ is parallel to $\vec{b}$

(d) $\vec{a}$ is perpendicular to $\vec{b}$

Q) If the magnitude of $\vec{a} \times \vec{b}$ equals to $\vec{a}.\vec{b}$, then which one of the following is correct?

(a) $\vec{a} = \vec{b}$

(b) The angle between $\vec{a}$ and $\vec{b}$ is 45°

(c) $\vec{a}$ is parallel to $\vec{b}$

(d) $\vec{a}$ is perpendicular to $\vec{b}$

Ans: (b)

Q) A force $\vec{F} = 3\hat{i} + 4\hat{j} - 3\hat{k}$ is applied at the point P, whose position vector is $\vec{r} = \widehat{2i} - 2\hat{j} - 3\hat{k}$. What is the magnitude of the moment of the force about the origin?

(a) 23 units

(b) 19 units

(c) 18 units

(d) 21 units

Q) A force $\vec{F} = 3\hat{i} + 4\hat{j} - 3\hat{k}$ is applied at the point P, whose position vector is $\vec{r} = 2\hat{i} - 2\hat{j} - 3\hat{k}$. What is the magnitude of the moment of the force about the origin?

(a) 23 units (b) 19 units

(c) 18 units (d) 21 units

Ans: (a)

Q) If two unit vectors $\vec{p}$ and $\vec{q}$ make an angle $\frac{\pi}{3}$ with each other, what is the magnitude of $\vec{p}-\frac{1}{2}\vec{q}$?

(a) 0

(b) $\frac{\sqrt{3}}{2}$

(c) 1

(d) $\frac{1}{\sqrt{2}}$

Q) If two unit vectors $\vec{p}$ and $\vec{q}$ make an angle $\frac{\pi}{3}$ with each other, what is the magnitude of $\vec{p} - \frac{1}{2}\vec{q}$?

(a) 0

(b) $\frac{\sqrt{3}}{2}$

(c) 1

(d) $\frac{1}{\sqrt{2}}$

Ans: (b)

Q) The points with position vectors $60i + 3j$, $40i - 8j$, $ai - 52j$ are collinear if

(a) $a = -40$

(b) $a = 40$

(c) $a = 20$

(d) none of these

Q) The points with position vectors $60i + 3j$, $40\,i - 8\,j$, $ai - 52$ j are collinear if

(a) $a = -40$

(b) $a = 40$

(c) $a = 20$

(d) none of these

Ans: (a)

Q) Let $\vec{p}$ and $\vec{q}$ be the position vectors of P and Q respectively, with respect to O and $|\vec{p}| = p$, $|\vec{q}| = q$. The points R and S divide PQ internally and externally in the ratio 2 : 3 respectively. If OR and OS are perpendicular then

(a) $9q^2 = 4q^2$ (b) $4p^2 = 9q^2$

(c) $9p = 4q$ (d) $4p = 9q$

Q) Let $\overrightarrow{p}$ and $\overrightarrow{q}$ be the position vectors of P and Q respectively, with respect to O and $|\overrightarrow{p}| = p$, $|\overrightarrow{q}| = q$. The points R and S divide PQ internally and externally in the ratio 2 : 3 respectively. If OR and OS are perpendicular then

(a) $9q^2 = 4q^2$ (b) $4p^2 = 9q^2$

(c) $9p = 4q$ (d) $4p = 9q$

Ans: (a)

Q) Let α, β, γ be distinct real numbers. The points with position vectors $\alpha\hat{i} + \beta\hat{j} + \gamma\hat{k}, \beta\hat{i} + \gamma\hat{j} + \alpha\hat{k}, \gamma\hat{i} + \alpha\hat{j} + \beta\hat{k}$

(a) are collinear
(b) form an equilateral triangle
(c) form a scalene triangle
(d) form a right angled triangle

Q) Let α, β, γ be distinct real numbers. The points with position vectors $\alpha\hat{i} + \beta\hat{j} + \gamma\hat{k}, \beta\hat{i} + \gamma\hat{j} + \alpha\hat{k}, \gamma\hat{i} + \alpha\hat{j} + \beta\hat{k}$

(a) are collinear
(b) form an equilateral triangle
(c) form a scalene triangle
(d) form a right angled triangle

Ans: (b)

Q) What are the values of x for which the two vectors $(x^2-1)\hat{i}+(x+2)\hat{j}+x^2\hat{k}$ and $2\hat{i}-x\hat{j}+3\hat{k}$ are orthogonal?

(a) No real value of x

(b) $x=\frac{1}{2}$ and $x=-1$

(c) $x=-\frac{1}{2}$ and $x=1$

(d) $x=-1$ and $x=2$

Q) What are the values of x for which the two vectors $(x^2-1)\hat{i}+(x+2)\hat{j}+x^2\hat{k}$ and $2\hat{i}-x\hat{j}+3\hat{k}$ are orthogonal?

(a) No real value of x

(b) $x=\frac{1}{2}$ and $x=-1$

(c) $x=-\frac{1}{2}$ and $x=1$

(d) $x=-1$ and $x=2$

Ans: (c)

Q) Let $\vec{u}, \vec{v}$ and $\vec{w}$ be vectors such that $\vec{u} + \vec{v} + \vec{w} = 0$. If $|\vec{u}| = 3, |\vec{v}| = 4$ and $|\vec{w}| = 5$, then $\vec{u}.\vec{v} + \vec{v}.\vec{w} + \vec{w}.\vec{u}$ is

(a) 47 (b) -25 (c) 0 (d) 25

Q) Let $\vec{u}, \vec{v}$ and $\vec{w}$ be vectors such that $\vec{u} + \vec{v} + \vec{w} = 0$. If $|\vec{u}| = 3, |\vec{v}| = 4$ and $|\vec{w}| = 5$, then $\vec{u}.\vec{v} + \vec{v}.\vec{w} + \vec{w}.\vec{u}$ is

(a) 47 (b) -25 (c) 0 (d) 25

Ans: (b)

Q) If $\vec{a}$, $\vec{b}$ and $\vec{c}$ are three non coplanar vectors, then

$(\vec{a} + \vec{b} + \vec{c}).[(\vec{a} + \vec{b}) \times (\vec{a} + \vec{c})]$ equals

(a) 0

(b) $[\vec{a}\ \vec{b}\ \vec{c}]$

(c) $2[\vec{a}\ \vec{b}\ \vec{c}]$

(d) $-[\vec{a}\ \vec{b}\ \vec{c}]$

Q) If $\vec{a}$, $\vec{b}$ and $\vec{c}$ are three non coplanar vectors, then

$(\vec{a} + \vec{b} + \vec{c}).[(\vec{a} + \vec{b}) \times (\vec{a} + \vec{c})]$ equals

(a) 0

(b) $[\vec{a}\ \vec{b}\ \vec{c}]$

(c) $2\,[\vec{a}\ \vec{b}\ \vec{c}]$

(d) $-[\vec{a}\ \vec{b}\ \vec{c}]$

Ans: (d)

Q) If the vectors $\vec{a}, \vec{b}$ and $\vec{c}$ form the sides BC, CA and AB respectively of a triangle ABC, then

(a) $\vec{a}.\vec{b}+\vec{b}.\vec{c}+\vec{c}.\vec{a}=0$

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

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

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

Q) If the vectors $\vec{a}, \vec{b}$ and $\vec{c}$ form the sides BC, CA and AB respectively of a triangle ABC, then

(a) $\vec{a}.\vec{b}+\vec{b}.\vec{c}+\vec{c}.\vec{a}=0$

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

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

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

Ans: (b)

Q) Let $\vec{a} = \vec{i} - \vec{k}$, $\vec{b} = x\vec{i} + \vec{j} + (1-x)\vec{k}$ and $\vec{c} = y\vec{i} + x\vec{j} + (1+x-y)\vec{k}$. Then $[\vec{a}\ \vec{b}\ \vec{c}]$ depends on

(a) only x

(b) only y

(c) Neither x Nor y

(d) both x and y

Q) Let $\vec{a} = \vec{i} - \vec{k}$, $\vec{b} = x\vec{i} + \vec{j} + (1-x)\vec{k}$ and $\vec{c} = y\vec{i} + x\vec{j} + (1+x-y)\vec{k}$. Then $\left[\vec{a}\,\vec{b}\,\vec{c}\right]$ depends on

(a) only x

(b) only y

(c) Neither x Nor y

(d) both x and y

Ans: (c)

Q) If $\vec{a}$ and $\vec{b}$ are two unit vectors such that $\vec{a}+2\vec{b}$ and $5\vec{a}-4\vec{b}$ are perpendicular to each other then the angle between $\vec{a}$ and $\vec{b}$ is

(a) 45° (b) 60°

(c) $\cos^{-1}\left(\frac{1}{3}\right)$ (d) $\cos^{-1}\left(\frac{2}{7}\right)$

Q) If $\vec{a}$ and $\vec{b}$ are two unit vectors such that $\vec{a}+2\vec{b}$ and $5\vec{a}-4\vec{b}$ are perpendicular to each other then the angle between $\vec{a}$ and $\vec{b}$ is

(a) 45°

(b) 60°

(c) $\cos^{-1}\left(\frac{1}{3}\right)$

(d) $\cos^{-1}\left(\frac{2}{7}\right)$

Ans: (b)

Q) If $\vec{a} = (\hat{i} + \hat{j} + \hat{k}), \vec{a}.\vec{b} = 1$ and $\vec{a} \times \vec{b} = \hat{j} - \hat{k}$, then $\vec{b}$ is

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

(b) $2\hat{j} - \hat{k}$

(c) $\hat{i}$

(d) $2\hat{i}$

Q) If $\vec{a} = (\hat{i} + \hat{j} + \hat{k}), \vec{a}.\vec{b} = 1$ and $\vec{a} \times \vec{b} = \hat{j} - \hat{k}$, then $\vec{b}$ is

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

(b) $2\hat{j} - \hat{k}$

(c) $\hat{i}$

(d) $2\hat{i}$

Ans: (c)

Q) If $|\vec{a}| = 4, |\vec{b}| = 2$ and the angle between $\vec{a}$ and $\vec{b}$ is $\pi/6$ then $(\vec{a} \times \vec{b})^2$ is equal to

(a) 48

(b) 16

(c) $\vec{a}$

(d) none of these

Q) If $|\vec{a}| = 4, |\vec{b}| = 2$ and the angle between $\vec{a}$ and $\vec{b}$ is $\pi/6$ then $(\vec{a} \times \vec{b})^2$ is equal to

(a) 48 (b) 16

(c) $\vec{a}$ (d) none of these

Ans: (b)

Q) The vectors $\overrightarrow{AB} = 3\hat{i} + 4\hat{k}$ & $\overrightarrow{AC} = 5\hat{i} - 2\hat{j} + 4\hat{k}$ are the sides of a triangle ABC. The length of the median through A is

(a) $\sqrt{288}$ (b) $\sqrt{18}$ (c) $\sqrt{72}$ (d) $\sqrt{33}$

Q) The vectors $\overrightarrow{AB} = 3\hat{i} + 4\hat{k}$ & $\overrightarrow{AC} = 5\hat{i} - 2\hat{j} + 4\hat{k}$ are the sides of a triangle ABC. The length of the median through A is

(a) $\sqrt{288}$ (b) $\sqrt{18}$ (c) $\sqrt{72}$ (d) $\sqrt{33}$

Ans: (d)

Q) If $\vec{a}$ and $\vec{b}$ are unit vectors inclined at an angle of $30°$ to each other, then which one of the following is correct ?

(a) $|\vec{a}+\vec{b}|>1$

(b) $1<|\vec{a}+\vec{b}|<2$

(c) $|\vec{a}+\vec{b}|=2$

(d) $|\vec{a}+\vec{b}|>2$

Q) If $\vec{a}$ and $\vec{b}$ are unit vectors inclined at an angle of 30° to each other, then which one of the following is correct ?

(a) $|\vec{a}+\vec{b}|>1$

(b) $1<|\vec{a}+\vec{b}|<2$

(c) $|\vec{a}+\vec{b}|=2$

(d) $|\vec{a}+\vec{b}|>2$

Ans: (b)

Q) If $\vec{a}$ is a position vector of a point (1, – 3) and A is another point (– 1, 5), then what are the coordinates of the point B such that $\overrightarrow{AB} = \vec{a}$?

(a) (2, 0)   (b) (0, 2)

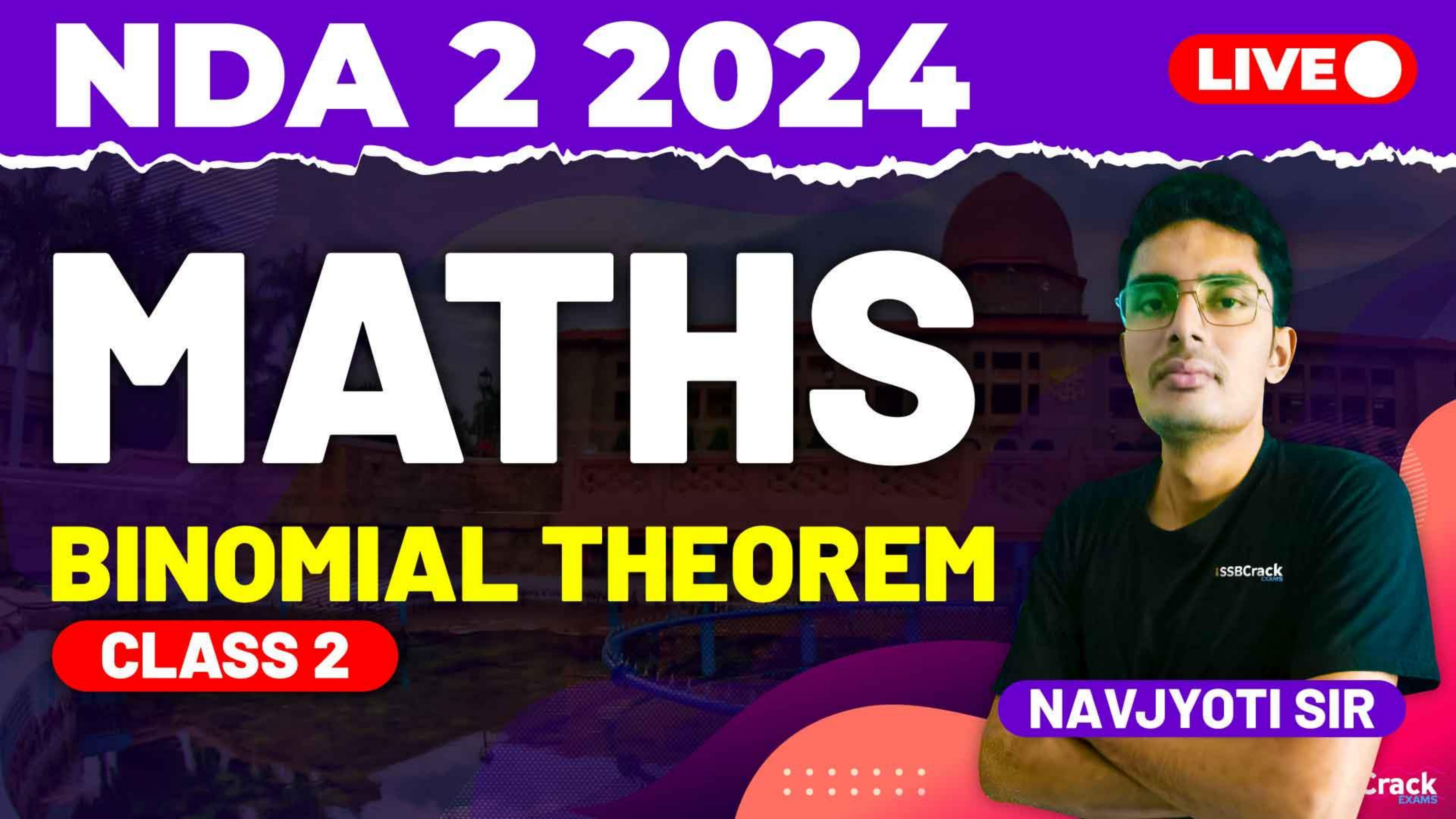
(c) (–2, 0)   (d) (0, –2)

Q) If $\vec{a}$ is a position vector of a point $(1, -3)$ and A is another point $(-1, 5)$, then what are the coordinates of the point B such that $\overrightarrow{AB} = \vec{a}$?

(a) $(2, 0)$ (b) $(0, 2)$

(c) $(-2, 0)$ (d) $(0, -2)$

Ans: (b)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