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## MATHS

## BOOKS - CENGAGE MATHS (ENGLISH)

## VECTOR ALGEBRA

## Others

1. In a trapezium, the vector $B C=\lambda A D$. We will then find that $p=A C+B D$ is collinear with $A D . I p=\mu \mathrm{AD}$, then

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2. If the vectors $\vec{a} a n d \vec{b}$ are linearly idependent satisfying $(\sqrt{3} \tan \theta+1) \vec{a}+(\sqrt{3} \sec \theta-2) \vec{b}=0$, then the most general values of $\theta$
are $\quad$ a. $\quad n \pi-\frac{\pi}{6}, n \in Z \quad$ b. $\quad 2 n \pi \pm \frac{11 \pi}{6}, n \in Z \quad$ c. $\quad n \pi \pm \frac{\pi}{6}, n \in Z$ d. $2 n \pi+\frac{11 \pi}{6}, n \in Z$

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3. Given three non-zero, non-coplanar vectors $\vec{a}, \vec{b}$, and $\vec{c} . \vec{r}_{1}=p \vec{a}+q \vec{b}+\vec{c}$ and $\vec{r}_{2}=\vec{a}+p \vec{b}+q \vec{c} \quad$ If the vectors $\vec{r}_{1}+2 \vec{r}_{2}$ and $2 \vec{r}_{1}+\vec{r}_{2}$ are collinear, then $(P, q)$ is ${ }^{`}$

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4. Let $\vec{r}_{1}, \vec{r}_{2}, \vec{r}_{3}, \vec{r}_{n}$ be the position vectors of points $P_{1}, P_{2}, P_{3}, P_{n}$ relative to the origin $O$ If the vector equation $a_{1} \vec{r}_{1}+a_{2} \vec{r}_{2}++a_{n} \vec{r}_{n}=0$ hold, then a similar equation will also hold w.r.t. to any other origin provided a. $a_{1}+a_{2}++a_{n}=n$ b. $a_{1}+a_{2}++a_{n}=1$ c. $a_{1}+a_{2}++a_{n}=0$ d. $a_{1}=a_{2}=a_{3}+a_{n}=0$
5. In triangle $A B C, \angle A=30^{\circ}, H$ is the orthocenter and $D$ is the midpoint of $B C$. Segment $H D$ is produced to $T$ such that $H D=D T$ The length $A T$ is equal to
(a). $2 B C$
(b). $3 B C$
(c). $\frac{4}{2} B C$
(d). none of these

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6. If $\vec{\alpha}+\vec{\beta}+\vec{\gamma}=a \vec{\delta} a n d \vec{\beta}+\vec{\gamma}+\vec{\delta}=b \vec{\alpha}, \vec{\alpha}$ and $\vec{\delta}$ are non-colliner, then $\vec{\alpha}+\vec{\beta}+\vec{\gamma}+\vec{\delta}$ equals a. $a \vec{\alpha}$ b. $b \vec{\delta}$ c. 0 d. $(a+b) \vec{\gamma}$

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7. Given three vectors $\vec{a}=6 \hat{i}-3 \hat{j}, \vec{b}=2 \hat{i}-6 \hat{j} a n d \vec{c}=-2 \hat{i}+21 \hat{j}$ such that $\vec{\alpha}=\vec{a}+\vec{b}+\vec{c}$ Then the resolution of the vector $\vec{\alpha}$ into components with
respect to $\vec{a}$ and $\vec{b}$ is given by a. $3 \vec{a}-2 \vec{b}$ b. $3 \vec{b}-2 \vec{a}$ c. $2 \vec{a}-3 \vec{b}$ d. $\vec{a}-2 \vec{b}$

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8. Let us define the length of a vector $a \hat{i}+b \hat{j}+c \hat{k} a s|a|+|b|+|c|$ This definition coincides with the usual definition of length of a vector $a \hat{i}+b \hat{j}+c \hat{k}$ is and only if (a) $a=b=c=0$ (b) any two of $a, b, a n d c$ are zero (c) any one of $a, b, a n d c$ is zero (d) $a+b+c=0$

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9. Vectors $\vec{a}=-4 \hat{i}+3 \hat{k} ; \vec{b}=14 \hat{i}+2 \hat{j}-5 \hat{k}$ are laid off from one point. Vector $\hat{d}$, which is being laid of from the same point dividing the angle between vectors $\vec{a} a n d \vec{b}$ in equal halves and having the magnitude $\sqrt{6}$, is

$$
\text { a. } \hat{i}+\hat{j}+2 \hat{k} \text { b. } \hat{i}-\hat{j}+2 \hat{k} \text { c. } \hat{i}+\hat{j}-2 \hat{k} \text { d. } 2 \hat{i}-\hat{j}-2 \hat{k}
$$

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10. Vectors $\vec{a}=\hat{i}+2 \hat{j}+3 \hat{k}, \vec{b}=2 \hat{i}-\hat{j}+\hat{k}$ and $\vec{c}=3 \hat{i}+\hat{j}+4 \hat{k}$, are so placed that the end point of one vector is the starting point of the next vector. Then the vector are (A) not coplanar (B) coplanar but cannot form a triangle (C) coplanar and form a triangle (D) coplanar and can form a right angled triangle

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11. The position vectors of the vertices $A, B$, and $C$ of a triangle are $\hat{i}+\hat{j}, \hat{j}+\hat{k} a n d \hat{i}+\hat{k}$, respectively. Find the unite vector $\hat{r}$ lying in the plane of $A B C$ and perpendicular to $I A$, whereI is the incentre of the triangle.

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12. A ship is sailing towards the north at a speed of $1.25 \mathrm{~m} / \mathrm{s}$. The current is taking it towards the east at the rate of $1 \mathrm{~m} / \mathrm{s}$ and a sailor is climbing a vertical pole on the ship at the rate of $0.5 \mathrm{~m} / \mathrm{s}$. Find the velocity of the sailor in space.

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13. Given four points $P_{1}, P_{2}, P_{3}$ andP $P_{4}$ on the coordinate plane with origin
$O$ which satisfy the condition $(\overrightarrow{O P})_{n-1}+(\overrightarrow{O P})_{n+1}=\frac{3}{2} \overrightarrow{O P_{n}}$. If P1 and P2 lie on the curve $\mathrm{xy}=1$, then prove that P3 does not lie on the curve

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14. $A B C D$ is a tetrahedron and $O$ is any point. If the lines joining $O$ to the vertices meet the opposite faces at $P, Q$, RandS, prove that $\frac{O P}{A P}+\frac{O Q}{B Q}+\frac{O R}{C R}+\frac{O S}{D S}=1$.

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15. If $\vec{a}$ and $\vec{b}$ are non-collinear vectors and $\vec{A}=(p+4 q) \vec{a}+(2 p+q+1) \vec{b} a n d \vec{B}=(-2 p+q+2) \vec{a}+(2 p-3 q-1) \vec{b}, a \mathrm{n} \mathrm{d}$
if $3 \vec{A}=2 \vec{B}$, then determine p and q .

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16. If $\vec{a}$, $\vec{b}$ and $\vec{c}$ are any three non-coplanar vectors, then prove that points are collinear: $\vec{a}+\vec{b}+\vec{c}, 4 \vec{a}+3 \vec{b}, 10 \vec{a}+7 \vec{b}-2 \vec{c}$.

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17. If $\vec{a}$, $\vec{b}$ and $\vec{c}$ are three non-zero non-coplanar vectors, then the value of

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

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18. Let $a, b, c$ be distinct non-negative numbers an the vectors $a \hat{i}+a \hat{j}+c \hat{k}, \hat{i}+\hat{k}, c \hat{i}+c \hat{j}+b \hat{k}$ lie in a plane, then prove that the quadratic equation $a x^{2}+2 c x+b=0$ has equal roots
19. A pyramid with vertex at point $P$ has a regular hexagonal base $A B C D E F$, Position vector of points $A$ and $B$ are $\hat{i}$ and $\hat{i}+2 \hat{j}$ The centre of base has the position vector $\hat{i}+\hat{j}+\sqrt{3} \hat{k}$ Altitude drawn from $P$ on the base meets the diagonal $A D$ at point $G$ find the all possible position vectors of $G$ It is given that the volume of the pyramid is $6 \sqrt{3}$ cubic units and $A P$ is 5 units.

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20. $A B C D$ is a parallelogram. If $L$ and $M$ be the middle points of $B C$ and CD , respectively express $A L$ and $A M$ in terms of $A B$ and $A D$. Also show that $A L+A M=(3 / 2) A C$.

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21. $A, B, C$ and $D$ have position vectors $\vec{a}, \vec{b}, \vec{c} a n d \vec{d}$, respectively, such that $\vec{a}-\vec{b}=2(\vec{d}-\vec{c})$ Then a. ABandCD bisect each other b. BDandAC bisect each other c . $A B$ and $C D$ trisect each other d. BDandAC trisect each other

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22. If $\vec{a} a n d \vec{b}$ are two unit vectors and $\theta$ is the angle between them, then the unit vector along the angular bisector of $\vec{a}$ and $\vec{b}$ will be given by a.
$\frac{\vec{a}-\vec{b}}{\cos (\theta / 2)}$ b. $\frac{\vec{a}+\vec{b}}{2 \cos (\theta / 2)}$ c. $\frac{\vec{a}-\vec{b}}{2 \cos (\theta / 2)}$ d. none of these

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23. $A B C D$ is a quadrilateral. $E$ is the point of intersection of the line joining the midpoints of the opposite sides. If $O$ is any point and $\vec{O} A+\vec{O} B+\vec{O} C+\vec{O} D=x \vec{O} E$, thenx is equal to a. 3 b .9 c .7 d .4
24. If vectors $\vec{A} B=-3 \hat{i}+4 \hat{k} a n d \vec{A} C=5 \hat{i}-2 \hat{j}+4 \hat{k}$ are the sides of a $\triangle A B C$, then the length of the median through Ais a. $\sqrt{14}$ b. $\sqrt{18}$ c. $\sqrt{29}$ d. $\sqrt{5}$

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25. $A B C D$ parallelogram, and $A_{1} a n d B_{1}$ are the midpoints of sides $B C$ andCD, respectivley. If $\vec{A} A_{1}+\vec{A} B_{1}=\lambda \vec{A} C$, then $\lambda$ is equal to a. $\frac{1}{2}$ b. 1 c. $\frac{3}{2}$ d. 2 e. $\frac{2}{3}$

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26. The position vectors of the points PandQ with respect to the origin $O$ are $\vec{a}=\hat{i}+3 \hat{j}-2 \hat{k}$ and $\vec{b}=3 \hat{i}-\hat{j}-2 \hat{k}$, respectively. If $M$ is a point on $P Q$, such that $O M$ is the bisector of $\angle P O Q$, then $\overrightarrow{O M}$ is a. $2(\hat{i}-\hat{j}+\hat{k})$ b. $2 \hat{i}+\hat{j}-2 \hat{k} \mathrm{c} .2(-\hat{i}+\hat{j}-\hat{k})$ d. $2(\hat{i}+\hat{j}+\hat{k})$

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27. A point $O$ is the centre of a circle circumscribed about a triangleABC Then $\vec{O} A \sin 2 A+\vec{O} B \sin 2 B+\vec{O} C \sin 2 C$ is equal to

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28. If $G$ is the centroid of triangle $A B C$, then $\vec{G} A+\vec{G} B+\vec{G} C$ is equal to a. $\overrightarrow{0}$ b. $3 \vec{G} A$ c. $3 \vec{G} B$ d. $3 \vec{G} C$

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29. Let $A B C$ be triangle, the position vecrtors of whose vertices are respectively $\hat{i}+2 \hat{j}+4 \hat{k},-2 \hat{i}+2 \hat{j}+\hat{k} a n d 2 \hat{i}+4 \hat{j}-3 \hat{k}$. Then Delta $A B C$ is a. isosceles b. equilateral c. right angled d. none of these
30. If $|\vec{a}+\vec{b}|<|\vec{a}-\vec{b}|$, then the angle between $\vec{a} a n d \vec{b}$ can lie in the interval a. $(\pi / 2, \pi / 2)$ b. $(0, \pi)$ c. $(\pi / 2,3 \pi / 2)$ d. $(0,2 \pi)$

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31. ' $I$ ' is the incentre of triangle $A B C$ whose corresponding sides are $a, b, c$, rspectively. $a \vec{I} A+b \vec{I} B+c \vec{I} C$ is always equal to $a . \overrightarrow{0} \mathrm{~b}$. $(a+b+c) \vec{B} C$ c. $(\vec{a}+\vec{b}+\vec{c}) \vec{A} C$ d. $(a+b+c) \vec{A} B$

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32. Let $x^{2}+3 y^{2}=3$ be the equation of an ellipse in the $x-y$ plane. AandB are two points whose position vectors are $-\sqrt{3} \hat{i}$ and $-\sqrt{3} \hat{i}+2 \hat{k}$ Then the position vector of a point $P$ on the ellipse such that $\angle A P B=\pi / 4$ is a. $\pm \hat{j}$
b. $\pm(\hat{i}+\hat{j})$ c. $\pm \hat{i}$ d. none of these

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33. Locus of the point $P$, for which $O P$ represents a vector with direction $\operatorname{cosine} \cos \alpha=\frac{1}{2}$ (where O is the origin) is

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34. If $\vec{x} a n d \vec{y}$ are two non-collinear vectors and $A B C$ isa triangle with side lengths

$$
a, b, a n d c
$$ satisfying $(20 a-15 b) \vec{x}+(15 b-12 c) \vec{y}+(12 c-20 a)(\vec{x} \times \vec{y})=0$, then triangle $A B C$ is a. an acute-angled triangle b. an obtuse-angled triangle c. a right-angled triangle d. an isosceles triangle

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35. If $\hat{i}-3 \hat{j}+5 \hat{k}$ bisects the angle between âand $-\hat{i}+2 \hat{j}+2 \hat{k}$, whereâ is a unit vector, then a. $\hat{a}=\frac{1}{105}(41 \hat{i}+88 \hat{j}-40 \hat{k})$ b. $\hat{a}=\frac{1}{105}(41 \hat{i}+88 \hat{j}+40 \hat{k})$
c. $\hat{a}=\frac{1}{105}(-41 \hat{i}+88 \hat{j}-40 \hat{k})$ d. $\hat{a}=\frac{1}{105}(41 \hat{i}-88 \hat{j}-40 \hat{k})$
36. If $4 \hat{i}+7 \hat{j}+8 \hat{k}, 2 \hat{i}+3 \hat{j}+24 a n d 2 \hat{i}+5 \hat{j}+7 \hat{k}$ are the position vectors of the vertices $A$, BandC, respectively, of triangle $A B C$, then the position vecrtor of the point where the bisector of angle $A$ meets $B C$ is a. $\frac{2}{3}(-6 \hat{i}-8 \hat{j}-\hat{k})$ b. $\frac{2}{3}(6 \hat{i}+8 \hat{j}+6 \hat{k})$ c. $\frac{1}{3}(6 \hat{i}+13 \hat{j}+18 \hat{k})$ d. $\frac{1}{3}(5 \hat{j}+12 \hat{k})$

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37. If $\vec{b}$ is a vector whose initial point divides thejoin of $5 \hat{i}$ and $5 \hat{j}$ in the ratio $k: 1$ and whose terminal point is the origin and $|\vec{b}| \leq \sqrt{37}$, thenk lies in the interval a. [-6, -1/6] b. $(-\infty,-6] \cup[-1 / 6, \infty)$ c. [0, 6] d. none of these

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38. Find the value of $\lambda$ so that the points $P, Q, R$ and $S$ on the sides $O A, O B, O C$ and $A B$, respectively, of a regular tetrahedron $O A B C$ are
coplanar. It is given that $\frac{O P}{O A}=\frac{1}{3}, \frac{O Q}{O B}=\frac{1}{2}, \frac{O R}{O C}=\frac{1}{3}$ and $\frac{O S}{A B}=\lambda$.
$\lambda=\frac{1}{2}$ (B) $\lambda=-1$ (C) $\lambda=0$ (D) for no value of $\lambda$

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39. A uni-modular tangent vector on the curve
$x=t^{2}+2, y=4 t-5, z=2 t^{2}-6 t=2$ is a. $\frac{1}{3}(2 \hat{i}+2 \hat{j}+\hat{k})$ b. $\frac{1}{3}(\hat{i}-\hat{j}-\hat{k})$ c. $\frac{1}{6}(2 \hat{i}+\hat{j}+\hat{k})$ d. $\frac{2}{3}(\hat{i}+\hat{j}+\hat{k})$

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40. If $\vec{x}$ and $\vec{y}$ are two non-collinear vectors and $\mathrm{a}, \mathrm{b}$, and c represent the sides of a $A B C$ satisfying $(a-b) \vec{x}+(b-c) \vec{y}+(c-a)(\vec{x} \times \vec{y})=0$, then $A B C$ is (where $\vec{x} x \vec{y}$ is perpendicular to the plane of xandy) a. an acute-angled triangle b. an obtuse-angled triangle c. a right-angled triangle d. a scalene triangle
41. The position vectors of points $A a n d B$ w.r.t. the origin are $\vec{a}=\hat{i}+3 \hat{j}-2 \hat{k}$ , $\vec{b}=3 \hat{i}+\hat{j}-2 \hat{k}$ respectively. Determine vector $\vec{O} P$ which bisects angle $A O B$, where $P$ is a point on $A B$

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42. What is the unit vector parallel to $\vec{a}=3 \hat{i}+4 \hat{j}-2 \hat{k}$ ? What vector should be added to $\vec{a}$ so that the resultant is the unit vector $\hat{i}$ ?

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43. $A B C D$ is a quadrilateral and $E$ is the point of intersection of the lines joining the middle points of opposite side. Show that the resultant of $O A, O B, O C$ and $O D=4 \quad O E$ where $O$ is any point.
44. $A B C D$ is a parallelogram. If $L$ and $M$ be the middle points of $B C$ and $C D$, respectively express $A L$ and $A M$ in terms of $A B$ and $A D$. Also show that $\overrightarrow{A L}+\overrightarrow{A M}=(3 / 2) \overrightarrow{A C}$.

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45. If $\vec{a}, \vec{b}, \vec{c} a n d \vec{d}$ are four vectors in three-dimensional space with the same initial point and such that $3 \vec{a}-2 \vec{b}+\vec{c}-2 \vec{d}=0$, show that terminals A, B, CandD of these vectors are coplanar. Find the point at which ACandBD meet. Find the ratio in which $P$ divides $A$ CandBD

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46. Find the vector of magnitude 3, bisecting the angle between the vectors $\vec{a}=2 \hat{i}+\hat{j}-\hat{k}$ and $\vec{b}=\hat{i}-2 \hat{j}+\hat{k}$

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47. If $\vec{a} a n d \vec{b}$ are two vectors of magnitude 1 inclined at $120^{\circ}$, then find the angle between $\vec{b}$ and $\vec{b}-\vec{a}$

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48. If $\vec{r}_{1}, \vec{r}_{2}, \vec{r}_{3}$ are the position vectors of the collinear points and scalar pandq exist such that $\vec{r}_{3}=p \vec{r}_{1}+q \vec{r}_{2}$, then show that $p+q=1$.

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49. Examine the following vector for linear independence:
(1) $\vec{i}+\vec{j}+\vec{k}, 2 \vec{i}+3 \vec{j}-\vec{k},-\vec{i}-2 \vec{j}+2 \vec{k}$
(2) $3 \vec{i}+\vec{j}-\vec{k}, 2 \vec{i}-\vec{j}+7 \vec{k}, 7 \vec{i}-\vec{j}+13 \vec{k}$

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50. Show that the vectors $2 \vec{a}-\vec{b}+3 \vec{c}, \vec{a}+\vec{b}-2 \vec{c} a n d \vec{a}+\vec{b}-3 \vec{c}$ are noncoplanar vectors (where $\vec{a}, \vec{b}, \vec{c}$ are non-coplanar vectors)

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51. Let $\vec{a}$, $\vec{b}$ and $\vec{c}$ be three units vectors such that $2 \vec{a}+4 \vec{b}+5 \vec{c}=0$. Then which of the following statement is true? a. $\vec{a}$ is parallel to $\vec{b}$ b. $\vec{a}$ is perpendicular to $\vec{b}$ c. $\vec{a}$ is neither parallel nor perpendicular to $\vec{b}$ d. none of these

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52. Four non -zero vectors will always be a. linearly dependent b. linearly independent c. either a or b
d. none of
these
53. A boat moves in still water with a velocity which is $k$ times less than the river flow velocity. Find the angle to the stream direction at which the boat should be rowed to minimize drifting.

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54. In a triangle $P Q R$, SandT are points on $Q R a n d P R$, respectively, such that $Q S=3 S R a n d P T=4 T R$ Let $M$ be the point of intersection of PSandQT Determine the ratio QM: MT using the vector method .

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55. In a quadrilateral $P Q R S, \vec{P} Q=\vec{a}, \vec{Q} R=\vec{b}, \vec{S} P=\vec{a}-\vec{b}, M$ is the midpoint of $\vec{Q}$ Rand $X$ is a point on $S M$ such that $S X=\frac{4}{5} S M$ Prove that $P, X a n d R$ are collinear.

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56. solve the differential equation $\left(1+x^{2}\right) \frac{d y}{d x}=x$

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57. Sow that $x_{1} \hat{i}+y_{1} \hat{j}+z_{1} \hat{k}, x_{2} \hat{i}+y_{2} \hat{j}+z_{2} \hat{k}$, $\operatorname{andx}_{3} \hat{i}+y_{3} \hat{j}+z_{3} \hat{k}$, are noncoplanar if $\left|x_{1}\right|>\left|y_{1}\right|+\left|z_{1}\right|,\left|y_{2}\right|>\left|x_{2}\right|+\left|z_{2}\right|$ and $\left|z_{3}\right|>\left|x_{3}\right|+\left|y_{3}\right|$.

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58. The position vector of the points $P$ and $Q$ are $5 \hat{i}+7 \hat{j}-2 \hat{k}$ and $-3 \hat{i}+3 \hat{j}+6 \hat{k}$, respectively. Vector $\vec{A}=3 \hat{i}-\hat{j}+\hat{k}$ passes through point $P$ and vector $\vec{B}=-3 \hat{i}+2 \hat{j}+4 \hat{k}$ passes through point $Q$. A third vector
$2 \hat{i}+7 \hat{j}-5 \hat{k}$ intersects vectors $A$ and $B$ Find the position vectors of points of intersection.

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$\hat{i}+\cos (\beta-\alpha) \hat{j}+\cos (\gamma-\alpha) \hat{k}, \cos (\alpha-\beta) \hat{i}+\hat{j}+\cos (\gamma-\beta) \hat{k}$
$\cos (\alpha-\gamma) \hat{i}+\cos (\beta-\gamma) \hat{k}+a \hat{k} w h e r e \alpha, \beta$, and $\gamma$ are different angles. If these vectors are coplanar, show that $a$ is independent of $\alpha, \beta$ and $\gamma$

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60. If $\vec{a}$ and $\vec{b}$ are two unit vectors and $\theta$ is the angle between them, then the unit vector along the angular bisector of $\vec{a}$ and $\vec{b}$ will be given by

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61. The vectors $x \hat{i}+(x+1) \hat{j}+(x+2) \hat{k},(x+3) \hat{i}+(x+4) \hat{j}+(x+5) \hat{k}$ and $(x+6) \hat{i}+(x+7) \hat{j}+(x+8) \hat{k}$ are coplanar if $x$ is equal to a. 1 b. -3 c. 4 d. 0

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62. $\vec{A}$ is vector with direction cosines $\cos \alpha, \cos \beta a n d \cos \gamma$ Assuming the $y-z$ plane as a mirror, the direction cosines of the reflected image of $\vec{A}$ in the plane are a. $\cos \alpha, \cos \beta, \cos \gamma \mathrm{b} . \cos \alpha,-\cos \beta, \cos \gamma \mathrm{c} .-\cos \alpha, \cos \beta, \cos \gamma \mathrm{d}$. $-\cos \alpha,-\cos \beta,-\cos \gamma$

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63. The vector $\vec{a}$ has the components $2 p$ and 1 w.r.t. a rectangular

Cartesian system. This system is rotated through a certain angle about the origin in the counterclockwise sense. If, with respect to a new system, $\vec{a}$ has components $(p+1)$ and 1 , then $p$ is equal to
a. -4 b. $-1 / 3$
c. 1 d. 2

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64. The sides of a parallelogram are $2 \hat{i}+4 \hat{j}-5 \hat{k}$ and $\hat{i}+2 \hat{j}+3 \hat{k}$. The unit vector parallel to one of the diagonals is a. $\frac{1}{7}(3 \hat{i}+6 \hat{j}-2 \hat{k})$ b.
$\frac{1}{7}(3 \hat{i}-6 \hat{j}-2 \hat{k})$ c. $\frac{1}{\sqrt{69}}(\hat{i}+6 \hat{j}+8 \hat{k})$ d. $\frac{1}{\sqrt{69}}(-\hat{i}-2 \hat{j}+8 \hat{k})$

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65. If $\vec{a}, \vec{b}, \vec{c}$ are non-coplanar vector and $\lambda$ is a real number, then the vectors $\vec{a}+2 \vec{b}+3 \vec{c}, \lambda \vec{b}+\mu \vec{c}$ and $(2 \lambda-1) \vec{c}$ are coplanar when a. $\mu \in R$ b.
$\lambda=\frac{1}{2} c . \lambda=0 \mathrm{~d}$. no value of $\lambda$

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66. If points $\hat{i}+\hat{j}, \hat{i}-\hat{j}$ and $p \hat{i}+q \hat{j}+r \hat{k}$ are collinear, then
A. a. $p=1$
B. b. $r=0$
C. c. $q \in R$
D. d. $q \neq 1$

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67. If the vectors $\hat{i}-\hat{j}, \hat{j}+\hat{k}$ and $\vec{a}$ form a triangle, then $\vec{a}$ may be $-\hat{i}-\hat{k} \mathrm{~b}$. $\hat{i}-2 \hat{j}-\hat{k} \mathrm{c} \cdot 2 \hat{i}+\hat{j}+\hat{k} \mathrm{~d} . \hat{i}+\hat{k}$

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68. If the resultant of three forces
$\vec{F}_{1}=p \hat{i}+3 \hat{j}-\hat{k}, \vec{F}_{2}=6 \hat{i}-\hat{k} a n d \vec{F}_{3}=-5 \hat{i}+\hat{j}+2 \hat{k}$ acting on a parricle has magnitude equal to 5 units, then the value of $p$ is a. -6 b. -4 c. 2 d. 4

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69. $\vec{a}, \vec{b}, \vec{c}$ are unit vectors such that $\vec{a}+\vec{b}+\vec{c}=0$. then find the value of $\vec{a} \cdot \vec{b}+\vec{b} \cdot \vec{c}+\vec{c} \cdot \vec{a}$
70. The vector $\hat{i}+x \hat{j}+3 \hat{k}$ is rotated through an angle $\theta$ and doubled in magnitude, then it becomes $4 \hat{i}+(4 x-2) \hat{j}+2 \hat{k}$. Then value of $x$ are $-\frac{2}{3}$ (b) $\frac{1}{3}$ (c) $\frac{2}{3}$ (d) 2

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71. Prove that point $\hat{i}+2 \hat{j}-3 \hat{k}, 2 \hat{i}-\hat{j}+\hat{k}$ and $2 \hat{i}+5 \hat{j}-\hat{k}$ from a triangle in space.

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72. Show that the point $A, B$ and $C$ with position vectors $\vec{a}=3 \hat{i}-4 \hat{j}-4 \hat{k} \vec{b}=2$ $\hat{i} j+\hat{k}$ and $\vec{c}=\hat{i}-3 \hat{j}-5 \hat{k}$, respectively form the vertices of a right angled triangle.

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73. If $2 A C=3 C B$, then prove that $2 O A+3 O B=5 O C$ where $O$ is the origin.

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74. Find the unit vector in the direction of vector $P Q$, where $P$ and $Q$ are the points $(1,2,3)$ and $(4,5,6)$, respectively.

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75. For given vector, $\vec{a}=2 \hat{i} j+2 \hat{k}$ and $\vec{b}=-\hat{i}+\hat{j}-\hat{k}$, find the unit vector in the direction of the vector $\vec{a}+\vec{b}$.

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76. If the projections of vector $\vec{a}$ on $x-y$ - and $z$-axes are 2,1 and 2 units ,respectively, find the angle at which vector $\vec{a}$ is inclined to the $z$-axis.
77. Find a vector in the direction of the vector $5 \hat{i}-\hat{j}+2 \hat{k}$ which has magnitude 8 units.

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78. If $\vec{a}, \vec{b}, \vec{c}, \vec{d}$ are the position vector of point $A, B, C$ and $D$, respectively referred to the same origin $O$ such that no three of these point are collinear and $\vec{a}+\vec{c}=\vec{b}+\vec{d}$, than prove that quadrilateral $A B C D$ is a parallelogram.

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79. Show that the points $A(6,-7,0), B(16,-19,-4), C(0,3,-6)$ and $D(2,-5,10)$ are such that $A B$ and $C D$ intersect at the point $P(1,-1,2)$.
80. Statement 1: The direction cosines of one of the angular bisectors of two intersecting line having direction cosines as $l_{1}, m_{1}, n_{1} a n d l_{2}, m_{2}, n_{2}$ are proportional to $l_{1}+l_{2}, m_{1}+m_{2}, n_{1}+n_{2}$ Statement 2: The angle between the two intersection lines having direction cosines as $l_{1}, m_{1}, n_{1}$ andl $_{2}, m_{2}, n_{2}$ is given by $\cos \theta=l_{1} l_{2}+m_{1} m_{2}+n_{1} n_{2}$

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81. Statement 1: In $\triangle A B C, A B+B C+C A=0$

Statement 2: If $O A=\vec{a}, O B=\vec{b}$, then $A B=\vec{a}+\vec{b}$

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82. Statement 1: If $\vec{u} a n d \vec{v}$ are unit vectors inclined at angle $\alpha a n d \vec{x}$ is a unit vector bisecting the angle between them, then
$\vec{x}=(\vec{u}+\vec{v}) /(2 \sin (\alpha / 2)$ Statement 2: If DeltaABC is an isosceles triangle with $A B=A C=1$, then the vector representing the bisector of angel $A$ is given by $\vec{A} D=(\vec{A} B+\vec{A} C) / 2$.

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83. Statement 1: If $\cos \alpha, \cos \beta$, and $\cos \gamma$ are the direction cosines of any line segment, then $\cos ^{2} \alpha+\cos ^{2} \beta+\cos ^{2} \gamma=1$. Statement 2 : If $\cos \alpha, \cos \beta$, andcos $\gamma$ are the direction cosines of any line segment, then $\cos 2 \alpha+\cos 2 \beta+\cos 2 \gamma=1$.

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84. A vector has components $p$ and 1 with respect to a rectangular Cartesian system. The axes are rotated through an angle $\alpha$ about the origin in the anticlockwise sense.

Statement 1: If the vector has component $p+2$ and 1 with respect to the new system, then $p=-1$.

Statement 2: Magnitude of the original vector and new vector remains the same.

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85. Statement 1 : If three point $P, Q$ and $R$ have position vectors $\vec{a}, \vec{b}$ and $\vec{c}$, respectively, and $2 \vec{a}+3 \vec{b}-5 \vec{c}=0$, then the point $\mathrm{P}, \mathrm{Q}$ and R must be collinear.

Statement 2 : If for three points $\mathrm{A}, \mathrm{B}$ and $\mathrm{C}, A B=\lambda A C$, then points $\mathrm{A}, \mathrm{B}$ and C must be collinear.

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86. In a four-dimensional space where unit vectors along the axes are $\hat{i}, \hat{j}, \hat{k}$ and $\hat{l}$, and $\vec{a}_{1}, \vec{a}_{2}, \vec{a}_{3}, \vec{a}_{4}$ are four non-zero vectors such that no vector can be expressed as a linear combination of others and $(\lambda-1)\left(\vec{a}_{1}-\vec{a}_{2}\right)+\mu\left(\vec{a}_{2}+\vec{a}_{3}\right)+\gamma\left(\vec{a}_{3}+\vec{a}_{4}-2 \vec{a}_{2}\right)+\vec{a}_{3}+\delta \vec{a}_{4}=0$, then
A. a. $\lambda=1$
B. b. $\mu=-2 / 3$
C. c. $y=2 / 3$
D. d. $\delta=1 / 3$

## Answer: null

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87. Let $A B C$ be a triangle, the position vectors of whose vertices are $-10 \hat{i}+10 \hat{k},-\hat{i}+6 \hat{j}+6 \hat{k}$ and $-4 \hat{i}+9 \hat{j}+6 \hat{k}$. Then $\triangle A B C$ is a. isosceles b . equilateral c. right angled d. none of these

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88. If non-zero vectors $\vec{a}$ and $\vec{b}$ are equally inclined to coplanar vector $\vec{c}$,
then $\vec{c}$ can be a. $\frac{|\vec{a}|}{|\vec{a}|+2|\vec{b}|} a+\frac{|\vec{b}|}{|\vec{a}|+|\vec{b}|} \vec{b}$ b. $\frac{|\vec{b}|}{|\vec{a}|+|\vec{b}|} a+\frac{|\vec{a}|}{|\vec{a}|+|\vec{b}|} \vec{b}$
$\frac{|\vec{a}|}{|\vec{a}|+2|\vec{b}|} a+\frac{|\vec{b}|}{|\vec{a}|+2|\vec{b}|} \vec{b}$ d. $\frac{|\vec{b}|}{2|\vec{a}|+|\vec{b}|} a+\frac{|\vec{a}|}{2|\vec{a}|+|\vec{b}|} \vec{b}$

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89. If $A(-4,0,3)$ and $B(14,2,-5)$, then which one of the following points lie on the bisector of the angle between $\vec{O} A$ and $\vec{O} B(O$ is the origin of reference )? a. $(2,2,4)$ b. $(2,11,5)$ c. ( $-3,-3,-6)$ d. $(1,1,2)$

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90. Prove that the sum of three vectors determined by the medians of a triangle directed from the vertices is zero.

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91. Prove that the resultant of two forces acting at point O and represented by $\vec{O} B$ and $\vec{O} C$ is given by $2 \vec{O} D$, where $D$ is the midpoint of

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92. Two forces $\vec{A} B$ and $\vec{A} D$ are acting at vertex $A$ of a quadrilateral $A B C D$ and two forces $\vec{C} B$ and $\vec{C} D$ at $C$ prove that their resultant is given by $4 \vec{E} F$ , where E and F are the midpoints of AC and BD , respectively.

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93. $A B C$ is a triangle and $P$ any point on $B C$. If $P Q$ is the sum of $A P+P B+P C$, show that ABQC is a parallelogram and Q , therefore, is a fixed point.

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94. If vector $\vec{a}+\vec{b}$ bisects the angle between $\vec{a}$ and $\vec{b}$, then prove that $|\vec{a}|$
$=|\vec{b}|$.

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95. ABCDE is a pentagon. Prove that the resultant of force $\vec{A} B, \vec{A} E, \vec{B} C, \vec{D} C$ , $\vec{E} D$ and $\vec{A} C$, is $3 \vec{A} C$.

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$\rightarrow \quad \rightarrow \quad \rightarrow$
96. if $A O+O B=B O+O C$, than prove that $B$ is the midpoint of $A C$.

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97. A unit vector of modulus 2 is equally inclined to $x$ - and $y$-axes at an angle $\pi / 3$. Find the length of projection of the vector on the $z$-axis.
98. Find the equation of the normal to the curve $y=x^{3}+2 x+6$ which are parallel to the line $x+14 y+4=0 \cdot x^{3}+y^{3}=8 x y$ at the point where it meets the curve $y^{2}=4 x$ other than the origin.

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99. Let $\vec{a}, \vec{b}$ and $\vec{c}$ be unit vectors such that $\vec{a}+\vec{b}-\vec{c}=0$. If the area of triangle formed by vectors $\vec{a}$ and $\vec{b}$ is $A$, then what is the value of $4 A^{2}$ ?

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100. 

If the
resultant of three
forces
$\vec{F}_{1}=p \hat{i}+3 \hat{j}-\hat{k}, \vec{F}_{2}=6 \hat{i}-\hat{k}$ and $\vec{F}_{3}=-5 \hat{i}+\hat{j}+2 \hat{k}$ acting on a parricle has magnitude equal to 5 units, then the value of $p$ is a. $-6 \mathrm{~b} .-4 \mathrm{c} .2 \mathrm{~d} .4$

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101. Let $\vec{a}, \vec{b}, \vec{c}, \vec{d}$ be the position vectors of the four distinct points $A, B, C, D$ if $\vec{b}-\vec{a}=\vec{c}-\vec{d}$, then show that $A B C D$ is parallelogram.

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102. Statement 1:Let $A(\vec{a}), B(\vec{b}) a n d C(\vec{c})$ be three points such that $\vec{a}=2 \hat{i}+\hat{k}, \vec{b}=3 \hat{i}-\hat{j}+3 \hat{k} a n d \vec{c}=-\hat{i}+7 \hat{j}-5 \hat{k}$ Then $O A B C$ is a tetrahedron. Statement 2: Let $A(\vec{a}), B(\vec{b})$ andC $(\vec{c})$ be three points such that vectors $\vec{a}, \vec{b} a n d \vec{c}$ are non-coplanar. Then $O A B C$ is a tetrahedron where $O$ is the origin.

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103. Statement 1: If $|\vec{a}+\vec{b}|=|\vec{a}-\vec{b}|$, then $\vec{a}$ and $\vec{b}$ are perpendicular to each other. Statement 2: If the diagonal of a parallelogram are equal magnitude, then the parallelogram is a rectangle. Which of the following Statements is/are correct ?
104. Statement 1: $\vec{a}=3 \vec{i}+p \vec{j}+3 \vec{k}$ and $\vec{b}=2 \vec{i}+3 \vec{j}+q \vec{k}$ are parallel vectors if $p=9 / 2 a n d q=2 . \quad$ Statement $2:$ if $\vec{a}=a_{1} \vec{i}+a_{2} \vec{j}+a_{3} \vec{k}$ and $\vec{b}=b_{1} \vec{i}+b_{2} \vec{j}+b_{3} \vec{k} \quad$ are parallel, then $\frac{a_{1}}{b_{1}}=\frac{a_{2}}{b_{2}}=\frac{a_{3}}{b_{3}}$ Which of the following Statements is/are correct ?

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105. The position vectors of the vertices $A$, Band $C$ of a triangle are three unit vectors $\vec{a}, \vec{b}$, and $\vec{c}$, respectively. A vector $\vec{d}$ is such that $\vec{a}=\vec{b}$ and $\vec{d}=\lambda(\vec{b}+\vec{c})$ Then triangle $A B C$ is a. acute angled b. obtuse angled c. right angled d. none of these

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106. aandb form the consecutive sides of a regular hexagon $A B C D E F$ Column I, Column II If $\vec{C} D=x \vec{a}+y \vec{b}$, then, p. $x=-2$ If $\vec{C} E=x \vec{a}+y \vec{b}$, then, q $x=-1$ If $\vec{A} E=x \vec{a}+y \vec{b}$, then, r. $y=1 \vec{A} D=-x \vec{b}$, then, s. $y=2$

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107. Column I, Column II Collinear vectors, p. $\vec{a}$ Coinitial vectors, q. $\vec{b}$ Equal vectors, r. $\vec{c}$ Unlike vectors (same intitial point), s. $\vec{d}$

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108. Statement $1: \quad|\vec{a}|=3,|\vec{b}|=4$ and $|\vec{a}+\vec{b}|=5$, then $|\vec{a}-\vec{b}|=5$.

Statement 2: The length of the diagonals of a rectangle is the same.
109. A man travelling towards east at $8 \mathrm{~km} / \mathrm{h}$ finds that the wind seems to blow directly from the north On doubling the speed, he finds that it appears to come from the north-east. Find the velocity of the wind.

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110. OABCDE is a regular hexagon of side 2 units in the $X Y$-plane in the first quadrant. O being the origin and OA taken along the $x$-axis. A point $P$ is taken on a line parallel to the $z$-axis through the centre of the hexagon at a distance of 3 unit from $O$ in the positive $Z$ direction. Then find vector AP.

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111. If $\vec{a}=7 \hat{i}-4 \hat{j}-4 \hat{k}$ and $\vec{b}=-2 \hat{i}-\hat{j}+2 \hat{k}$, determine vector $\vec{c}$ along the internal bisector of the angle between of the angle between vectors $\vec{a}$ and $\vec{b}$ such that $|\vec{c}|=5 \sqrt{6}$
112. Find a unit vector $\vec{c}$ if $\overrightarrow{-i}+\vec{j}-\vec{k}$ bisects the angle between $\vec{c}$ and $3 \vec{i}+4 \vec{j}$.

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113. The vectors $2 i+3 \hat{j}, 5 \hat{i}+6 \hat{j}$ and $8 \hat{i}+\lambda \hat{j}$ have initial points at $(1,1)$. Find the value of $\lambda$ so that the vectors terminate on one straight line.

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114. If $\vec{a}, \vec{b}$ and $\vec{c}$ are three non-zero vectors, no two of which are collinear, $\vec{a}+2 \vec{b}$ is collinear with $\vec{c}$ and $\vec{b}+3 \vec{c}$ is collinear with $\vec{a}$, then find the value of $|\vec{a}+2 \vec{b}+6 \vec{c}|$.
115. i. Prove that the points $\vec{a}-2 \vec{b}+3 \vec{c}, 2 \vec{a}+3 \vec{b}-4 \vec{c}$ and $-7 \vec{b}+10 \vec{c}$ are are collinear, where $\vec{a}, \vec{b}, \vec{c}$ are non-coplanar. ii. Prove that the points $A(1,2,3), B(3,4,7)$, and $C(-3,-2,-5)$ are collinear. find the ratio in which point $C$ divides $A B$.

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116. Check whether the given three vectors are coplanar or non-coplanar.
$-2 \hat{i}-2 \hat{j}+4 \hat{k},-2 \hat{i}+4 \hat{j}, 4 \hat{i}-2 \hat{j}-2 \hat{k}$

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117. Prove that the four points $6 \hat{i}-7 \hat{j}, 16 \hat{i}-19 \hat{j}-4 \hat{k}, 3 \hat{j}-6 \hat{k}$ and $2 \hat{i}+5 \hat{j}+10 \hat{k}$ form a tetrahedron in space.

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118. If $\vec{a}$ and $\vec{b}$ are two non-collinear vectors, show that points
$l_{1} \vec{a}+m_{1} \vec{b}, l_{2} \vec{a}+m_{2} \vec{b}$ and $l_{3} \vec{a}+m_{3} \vec{b}$ are collinear if $\left|\begin{array}{ccc}l_{1} & l_{2} & l_{3} \\ m_{1} & m_{2} & m_{3} \\ 1 & 1 & 1\end{array}\right|=0$.

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119. Show, by vector methods, that the angularbisectors of a triangle are concurrent and find an expression for the position vector of the point of concurrency in terms of the position vectors of the vertices.

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120. Let $\vec{A}(t)=f_{1}(t) \hat{i}+f_{2}(t) \hat{j}$ and $\vec{B}(t)=g(t) \hat{i}+g_{2}(t) \hat{j}, t \in[0,1], f_{1}, f_{2}, g_{1} g_{2}$ are continuous functions. If $\vec{A}(t)$ and $\vec{B}(t)$ are non-zero vectors for all $t$ and $\vec{A}(0)=2 \hat{i}+3 \hat{j}, \vec{A}(1)=6 \hat{i}+2 \hat{j}, \vec{B}(0)=3 \hat{i}+2 \hat{i}$ and $\vec{B}(1)=2 \hat{i}+6 \hat{j}$ Then,show that $\vec{A}(t)$ and $\vec{B}(t)$ are parallel for some $t$.
121. Find the least positive integral value of $x$ for which the angle between vectors $\vec{a}=x \hat{i}-3 \hat{j}-\hat{k}$ and $\vec{b}=2 x \hat{i}+x \hat{j}-\hat{k}$ is acute.

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122. If vectors $\vec{a}=\hat{i}+2 \hat{j}-\hat{k}, \vec{b}=2 \hat{i}-\hat{j}+\hat{k}$ and $\vec{c}=\lambda \hat{i}+\hat{j}+2 \hat{k}$ are coplanar, then find the value of $(\lambda-4)$.

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123. Find the values of $\lambda$ such that $x, y, z \neq(0,0,0)$ and $(\hat{i}+\hat{j}+3 \hat{k}) x+(3 \hat{i}-3 \hat{j}+\hat{k}) y+(-4 \hat{i}+5 \hat{j}) z=\lambda(x \hat{i}+y \hat{j}+z \hat{k})$, where $\hat{i}, \hat{j}, \hat{k}$ are unit vector along coordinate axes.

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124. A vector has component $A_{1}, A_{2} a n d A_{3}$ in a right -handed rectangular

Cartesian coordinate system $O X Y Z$ The coordinate system is rotated about the $x$-axis through an angel $\pi / 2$. Find the component of $A$ in the new coordinate system in terms of $A_{1}, A_{2}$, and $A_{3}$

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125. The position vectors of the point $A, B, C$ and $D$ are $3 \hat{i}-2 \hat{j}-\hat{k}, 2 \hat{i}+3 \hat{j}-4 \hat{k},-\hat{i}+\hat{j}+2 \hat{k}$ and $4 \hat{i}+5 \hat{j}+\lambda \hat{k}$, respectively. If the points $A, B, C$ and $D$ lie on a plane, find the value of $\lambda$.

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126. Let $O A C B$ be a parallelogram with $O$ at the origin and $O C$ a diagonal.

Let $D$ be the midpoint of $O A$ using vector methods prove that $B D a n d C O$ intersect in the same ratio. Determine this ratio.
127. In a triangle $A B C$, DandE are points on BCandAC, respectivley, such that $B D=2 D$ CandAE $=3 E C$ Let $P$ be the point of intersection of $A D a n d B E$ Find $B P / P E$ using the vector method.

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128. Prove by vector method that the line segment joining the mid-points of the diagonals of a trapezium is parallel to the parallel sides and equal to half of their difference.

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129. If the resultant of two forces is equal in magnitude to one of the components and perpendicular to it direction, find the other components using the vector method.
130. The axes of coordinates are rotated about the $z$-axis through an angle of $\pi / 4$ in the anticlockwise direction and the components of a vector are $2 \sqrt{2}, 3 \sqrt{2}, 4$. Prove that the components of the same vector in the original system are $-1,5,4$.

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131. Three coinitial vectors of magnitudes a, 2a and 3a meet at a point and their directions are along the diagonals if three adjacent faces if a cube.

Determined their resultant R. Also prove that the sum of the three vectors determinate by the diagonals of three adjacent faces of a cube passing through the same corner, the vectors being directed from the corner, is twice the vector determined by the diagonal of the cube.

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132. If two side of a triangle are $\hat{i}+2 \hat{j}$ and $\hat{i}+\hat{k}$, then find the length of the third side.

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133. If in parallelogram $A B C D$, diagonal vectors are $\vec{A} C=2 \hat{i}+3 \hat{j}+4 \hat{k}$ and $\vec{B} D=-6 \hat{i}+7 \hat{j}-2 \hat{k}$, then find the adjacent side vectors $\rightarrow A B$ and $\vec{A} D$

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134. Find the resultant of vectors $\vec{a}=\hat{i}-\hat{j}+2 \hat{k}$ and $\vec{b}=\hat{i}+2 \hat{j}-4 \hat{k}$ Find the unit vector in the direction of the resultant vector.

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135. Check whether the three vectors $2 \hat{i}+2 \hat{j}+3 \hat{k},-3 \hat{i}+3 \hat{j}+2 \hat{k} a n d 3 \hat{i}+4 \hat{k}$ from a triangle or not
136. The midpoint of two opposite sides of a quadrilateral and the midpoint of the diagonals are the vertices of a parallelogram. Prove that using vectors.

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137. Prove that the lines joining the vertices of a tetrahedron to the centroids of opposite faces are concurrent.

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138. Find the angle of vector $\vec{a}=6 \hat{i}+2 \hat{j}-3 \hat{k}$ with $x$-axis.

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139. If the vectors $\vec{\alpha}=a \hat{i}+a \hat{j}+c \hat{k}, \vec{\beta}=\hat{i}+\hat{k}$ and $\vec{\gamma}=c \hat{i}+c \hat{j}+b \hat{k}$ are coplanar, then prove that $c$ is the geometric mean of $a$ and $b$.

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140. The points with position vectors $60 i+3 j, 40 i-8 j$, $a i-52 j$ are collinear if a. $a=-40 \mathrm{~b} . a=40 \mathrm{c} . a=20 \mathrm{~d}$. none of these

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141. Let $\alpha, \beta$ and $\gamma$ be distinct real numbers. The points whose position vector's are $\alpha \hat{i}+\beta \hat{j}+\gamma \hat{k} ; \beta \hat{i}+\gamma \hat{j}+\alpha \hat{k}$ and $\gamma \hat{i}+\alpha \hat{j}+\beta \hat{k}$ a. are collinear. b . forms an equilateral triangle. c. forms a scalene triangle. d. forms a right angled triangle.

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142. 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 $y$

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143. In the $\triangle O A B, M$ is the mid-point of $A B, C$ is a point on $O M$, such that $20 C=C M . X$ is a point on the side $O B$ such that $O X=2 X B$. The line $X C$ is produced to meet $O A$ in $Y$. then, $\frac{O Y}{Y A}$ is equal to

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144. If $\vec{a}, \vec{b}$ are two non-collinear vectors, prove that the points with position vectors $\vec{a}+\vec{b}, \vec{a}-\vec{b}$ and $\vec{a}+\lambda \vec{b}$ are collinear for all real values of $\lambda$
145. If $\vec{a}=\hat{i}+\hat{j}+\hat{k}, \vec{b}=4 \hat{i}+3 \hat{j}+4 \hat{k}$ and $\vec{c}=\hat{i}+\alpha \hat{j}+\beta \hat{k}$ are linearly dependent vectors \& $|\vec{c}|=\sqrt{3}$, then ordered pair $(\alpha, \beta)$ is $(\mathrm{a})(1,1)$ (b) $(1,-1)(c)(-1,1)(d)(-1,-1)$

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146. The number of distinct real values of $\lambda$, for which the vectors $-\lambda^{2} \hat{i}+\hat{j}+k, \hat{i}-\lambda^{2} \hat{j}+\hat{k}$ and $\hat{i}+\hat{j}-\lambda^{2} \hat{k}$ are coplanar is a. zero b . one c . two d . three

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147. If $\vec{A} O+\vec{O} B=\vec{B} O+\vec{O} C$, then $A, B$ and $C$ are (where $O$ is the origin) a. coplanar b. collinear c. non-collinear d. none of these

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148. Find a vector magnitude 5 units, and parallel to the resultant of the vectors $\vec{a}=2 \hat{i}+3 \hat{j}-\hat{k}$ and $\vec{b}=\hat{i}-2 \hat{j}+\hat{k}$

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149. 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 $A C$

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150. The position vectors of PandQ are $5 \hat{i}+4 \hat{j}+a \hat{k}$ and $-\hat{i}+2 \hat{j}-2 \hat{k}$, respectively. If the distance between them is 7, then find the value of $a$

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151. Given three points are $A(-3,-2,0), B(3,-3,1) \operatorname{and} C(5,0,2)$ Then find a vector having the same direction as that of $\vec{A} B$ and magnitude equal to

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152. Let $A B C D$ be a p[arallelogram whose diagonals intersect at $P$ and let
$O$ be the origin. Then prove that $\vec{O} A+\vec{O} B+\vec{O} C+\vec{O} D=4 \overrightarrow{O P}$

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153. If $A B C D$ is quadrilateral and EandF are the mid-points of ACandBD respectively, prove that $\vec{A} B+\vec{A} D+\vec{C} B+\vec{C} D=4 \vec{E} F$

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154. If $A B C D$ is a rhombus whose diagonals cut at the origin $O$, then proved that $\vec{O} A+\vec{O} B+\vec{O} C+\vec{O} D=0$
155. Let $D$, EandF be the middle points of the sides $B C, C A a n d A B$, respectively of a triangle $A B C$ Then prove that $\vec{A} D+\vec{B} E+\vec{C} F=\overrightarrow{0}$.

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156. Consider the set of eight vectors $V[a \hat{i}+b \hat{j}+c \hat{k}: a, b, c \in\{1-1\}]$. Three non-coplanar vectors cann be chosen from V in $2^{p}$ ways, then p is

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157. Find the direction cosines of the vector joining the points $A(1,2,-3) a \cap B(-1-2,1)$ directed from $A \rightarrow B$

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158. Find the direction cosines of the vector $\hat{i}+2 \hat{j}+3 \hat{k}$
159. The median $A D$ of the triangle $A B C$ is bisected at $E$ and $B E$ meets $A C$ at F . Find $\mathrm{AF}: \mathrm{FC}$.

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160. Vectors $\vec{a}$ and $\vec{b}$ are non-collinear. Find for what value of $n$ vectors $\vec{c}=(n-2) \vec{a}+\vec{b}$ and $\vec{d}=(2 n+1) \vec{a}-\vec{b}$ are collinear?

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161. i. If vec a , vec b a n d vec c arenon - coplanar $\vec{\rightarrow} r s$, provet $\overrightarrow{\vec{\beta}} r$ rs3veca -7 vecb -4 vecc ,3 veca -2 vecb + vecc and veca + vecb +2 vecc ` are coplanar.

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162. Prove that a necessary and sufficient condition for three vectors $\vec{a}, \vec{b}$ and $\vec{c}$ to be coplanar is that there exist scalars $l, m, n$ not all zero simultaneously such that $l \vec{a}+m \vec{b}+n \vec{c}=\overrightarrow{0}$

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163. If $\vec{a}, \vec{b}, \vec{c}$ and $\vec{d}$ are distinct vectors such that $\vec{a} \times \vec{c}=\vec{b} \times \vec{d}$ and $\vec{a} \times \vec{b}=\vec{c} \times \vec{d}$, prove that $(\vec{a}-\vec{d}) .(\vec{b}-\vec{c}) \neq 0$,

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164. If $\vec{a}, \vec{b} a n d \vec{c}$ are non-coplanar vectors, prove that the four points $2 \vec{a}+3 \vec{b}-\vec{c}, \vec{a}-2 \vec{b}+3 \vec{c}, 3 \vec{a}+4 \vec{b}-2 \vec{c}$ and $\vec{a}-6 \vec{b}+6 \vec{c}$ are coplanar.

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165. Find the unit vector in the direction of vector $\vec{a}=\hat{i}+\hat{j}+2 \hat{k}$.
166. let $P$ an interioer point of a triangle $A B C$ and $A P, B P, C P$ meets the sides $B C, C A, A B$ in $D, E, F$, respectively, Show that $\frac{A P}{P D}=\frac{A F}{F B}+\frac{A E}{E C}$.

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167. Let $\vec{a}, \vec{b}$ and $\vec{c}$ be unit vectors, such that
$\vec{a}+\vec{b}+\vec{c}=\vec{x}, \vec{a} \vec{x}=1, \vec{b} \vec{x}=\frac{3}{2},|\vec{x}|=2$. Then find the angel between
$c$ and x

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168. Let $\vec{A}$ and $\vec{B}$ be two non-parallel unit vectors in a plane. If $(\alpha \vec{A}+\vec{B})$ bisects the internal angle between $\vec{A}$ and $\vec{B}$, then find the value of $\alpha$
169. If the vectors $3 \vec{p}+\vec{q} ; 5 p-3 \vec{q}$ and $2 \vec{p}+\vec{q} ; 4 \vec{p}-2 \vec{q}$ are pairs of mutually perpendicular vectors, then find the angle between vectors $\vec{p}$ and $\vec{q}$

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170. $P(1,0,-1), Q(2,0,-3), R(-1,2,0)$ andS(, $-2,-1)$, then find the projection length of $\vec{P}$ Qon $\vec{R} S$

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171. $A, B, C, D$ are any four points, prove that
$\vec{A} B \vec{C} D+\vec{B} C \vec{A} D+\vec{C} A \vec{B} D=4($ Area of $\triangle A B C)$.

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172. Let $u=\hat{i}+\hat{j}, v=\hat{i}-\hat{j}$ and $w=\hat{i}+2 \hat{j}+3 \hat{k}$. If $\hat{n}$ is a unit vector such that $u \cdot \hat{n}=0$ and $v \cdot \hat{n}=0$, then $|w \cdot \hat{n}|$ is

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173. If the angel between unit vectors $\vec{a} a n d \vec{b} 60^{\circ}$, then find the value of $|\vec{a}-\vec{b}|$

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174. $\vec{a}+\vec{b}+\vec{c}=\overrightarrow{0},|\vec{a}|=3,|\vec{b}|=5,|\vec{c}|=9$,find the angle between $\vec{a}$ and $\vec{c}$.

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175. Constant forces $P_{1}=\hat{i}+\hat{j}+\hat{k}, P_{2}=-\hat{i}+2 \hat{j}-\hat{k} a n d P_{3}=-\hat{j}-\hat{k}$ act on a particle at a point $A$ Determine the work done when particle is displaced from position $A(4 \hat{i}-3 \hat{j}-2 \hat{k})$ to $B(6 \hat{i}+\hat{j}-3 \hat{k})^{\text {. }}$
176. If $\vec{a}$, and $\vec{b}$ are unit vectors, then find the greatest value of $|\vec{a}+\vec{b}|+|\vec{a}-\vec{b}|$

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177. Let $G_{1}, G_{2} a n d G_{3}$ be the centroids of the triangular faces $O B C, O C A a n d O A B$, respectively, of a tetrahedron $O A B C$ If $V_{1}$ denotes the volumes of the tetrahedron $O A B C a n d V_{2}$ that of the parallelepiped with $O G_{1}, O G_{2} a n d O G_{3}$ as three concurrent edges, then prove that $4 V_{1}=9 V_{2}$

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178. Prove that $\hat{i} \times(a+\hat{i})+\hat{j} \times(a \times \hat{j})+\hat{k} \times(a \times \hat{k})=2 a$

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179. If $\hat{i} \times[(\vec{a}-\hat{j}) \times \hat{i}]+\hat{j} \times[(\vec{a}-\hat{k}) \times \hat{j}]+\hat{k} \times[(\vec{a}-\hat{i}) \times \hat{k}]=0$, then find vector $\vec{a}$

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180. Let $\vec{a}, \vec{b}$, and $\vec{c}$ be any three vectors, then prove that [ $\vec{a} \times \vec{b} \vec{b} \times \vec{c} \vec{c} \times \vec{a}]=[\vec{a} \vec{b} \vec{c}]^{2}$

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181. If $[\vec{a} \vec{b} \vec{c}]=2$, then find the value of
$[(\vec{a}+2 \vec{b}-\vec{c})(\vec{a}-\vec{b})(\vec{a}-\vec{b}-\vec{c})]$

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182. If $\vec{a}, \vec{b}, \vec{c}$ are mutually perpendicular unit vectors, find $|2 \vec{a}+\vec{b}+\vec{c}|$
183. If $a$, bandc are three non-copOlanar vector, non-zero vectors then the value of $(\vec{a} \cdot \vec{a}) \vec{b} \times \vec{c}+(\vec{a} \cdot \vec{b}) \vec{c} \times \vec{a}+(\vec{a} \cdot \vec{c}) \vec{a} \times \vec{b}$.

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184. Prove that vectors $\vec{u}=\left(a l+a_{1} l_{1}\right) \hat{i}+\left(a m+a_{1} m_{1}\right) \hat{j}+\left(a n+a_{1} n_{1}\right) \hat{k}$ $\vec{v}=\left(b l+b_{1} l_{1}\right) \hat{i}+\left(b m+b_{1} m_{1}\right) \hat{j}+\left(b n+b_{1} n_{1}\right) \hat{k}$
$\vec{w}=\left(c l+c_{1} l_{1}\right) \hat{i}+\left(c m+c_{1} m_{1}\right) \hat{j}+\left(c n+c_{1} n_{1}\right) \hat{k}$ are coplanar.

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185. For any four vectors, prove that
$(\vec{a} \times \vec{b}) \times(\vec{c} \times \vec{d})=[\vec{a} \vec{c} \vec{d}] \vec{b}-[\vec{b} \vec{c} \vec{d}] \vec{a}$

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186. If $\vec{b}$ and $\vec{c}$ are two-noncollinear vectors such that $\vec{a}|\mid(\vec{b} \times \vec{c})$, then prove that $(\vec{a} \times \vec{b}) \cdot(\vec{a} \times \vec{c})$ is equal to $|\vec{a}|^{2}(\vec{b} \vec{c})$.

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187. If the vertices $A, B, C$ of a triangle $A B C$ are $(1,2,3),(-1,0,0),(0,1,2)$, respectively, then find $\angle A B C$.

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188. Let $\vec{a}, \vec{b}$ and $\vec{c}$ be pairwise mutually perpendicular vectors, such that $|\vec{a}|=1,|\vec{b}|=2,|\vec{c}|=2$. Then find the length of $\vec{a}+\vec{b}+\vec{c}$

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189. Show that $|\vec{a}| \vec{b}+|\vec{b}| \vec{a}$ is a perpendicular to $|\vec{a}| \vec{b}-|\vec{b}| \vec{a}$, for any two non-zero vectors $\vec{a} a n d \vec{b}$

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190. If $|\vec{a}|=3,|\vec{b}|=4$ and the angle between $\vec{a}$ and $\vec{b} i s 120^{\circ}$. Then find the value of $|4 \vec{a}+3 \vec{b}|$

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191. If $\vec{a}, \vec{b}$, and $\vec{c}$ be three non-coplanar vector and $p, q, r$ constitute the reciprocal system of vectors, then $(l a+m b+n c)$. $(l p+m q+n r)$. is equals to

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192. Find $|\rightarrow a|$ and $|\rightarrow b|$, if $(\rightarrow a+\rightarrow b) \rightarrow a-\rightarrow b=8$ and $|\rightarrow a|=8|\rightarrow b|$

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193. Let $\vec{a}, \vec{b}$, and $\vec{c}$ and $\vec{a}^{\prime}, \vec{b}^{\prime}, \vec{c}^{\prime}$ are reciprocal system of vectors, then prove that $\vec{a}^{\prime} \times \vec{b}^{\prime}+\vec{b}^{\prime} \times \vec{c}^{\prime}+\vec{c}^{\prime} \times \vec{a}^{\prime}=\frac{\vec{a}+\vec{b}+\vec{c}}{[\vec{a} \vec{c}]}$.

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

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194. If $\vec{a}, \vec{b}$ and $\vec{c}$ are three non-coplanar vectors, then $(\vec{a}+\vec{b}+\vec{c}) \cdot[(\vec{a}+\vec{b}) \times(\vec{a}+\vec{c})]$ equals a. 0 b. $[\vec{a} \vec{b} \vec{c}]$ c. $2[\vec{a} \vec{b} \vec{c}]$
d. $-[\vec{a} \vec{b} \vec{c}]$
195. Find the vector equation of the plane passing through the points having position vectors $\hat{i}+\hat{j}-2 \hat{k}, 2 i-\hat{j}+\hat{k} a n d \hat{i}+2 \hat{j}+\hat{k}$

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196. If $\vec{a} \times \vec{b}=\vec{b} \times \vec{c} \neq 0$, where $\vec{a}, \vec{b}$, and $\vec{c}$ are coplanar vectors, then for some scalar $k$ prove that $\vec{a}+\vec{c}=k \vec{b}$

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197. If $\vec{a}=2 \vec{i}+3 \vec{j}-\vec{k}, \vec{b}=-\vec{i}+2 \vec{j}-4 \vec{k}$ and $\vec{c}=\vec{i}+\vec{j}+\vec{k}$, then find thevalue of $(\vec{a} \times \vec{b}) \vec{a} \times \vec{c}$

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198. If the vectors $\vec{c}, \vec{a}=x \hat{i}+y \hat{j}+z \hat{k}$ and $\vec{b}=\hat{j}$ are such that $\vec{a}, \vec{c}$ and $\vec{b}$ form a right-handed system, then find $\vec{c}$

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199. Given that $\vec{a} \vec{b}=\vec{a} \vec{c}, \vec{a} \times \vec{b}=\vec{a} \times \vec{c}$ and $\vec{a}$ is not a zero vector. Show that $\vec{b}=\vec{c}$

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200. If $|\vec{a}|=5,|\vec{a}-\vec{b}|=8$ and $|\vec{a}+\vec{b}|=10$, then find $|\vec{b}|$

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201. If $A, B, C, D$ are four distinct point in space such that $A B$ is not
$\overrightarrow{A B} \cdot \overrightarrow{C D}=k\left(|\overrightarrow{A D}|^{2}+|\overrightarrow{B C}|^{2}-|\overrightarrow{A C}|^{2}-|\overrightarrow{B D}|^{2}\right)$, then find the value of $k$

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202. If $\vec{a}=2 \hat{i}+3 \hat{j}-5 \hat{k}, \vec{b}=m \hat{i}+n \hat{j}+12 \hat{k}$ and $\vec{a} \times \vec{b}=\overrightarrow{0}$, then find ( $m, n$ )

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203. If $|\vec{a}|=2|\vec{b}|=5$ and $|\vec{a} \times \vec{b}|=8$, then find the value of $\vec{a}$. $\vec{b}$

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204. Prove that $(\vec{a}-\vec{b}) \times(\vec{a}+\vec{b})=2(\vec{a} \times \vec{b})$ and interpret it geometrically.
205. $\vec{a}$, $\vec{b}$ and $\vec{c}$ are unit vectors such that $|\vec{a}+\vec{b}+3 \vec{c}|=4$. Angle between $\vec{a} a n d \vec{b} i s \theta_{1}$, between $\vec{b}$ and $\vec{c}$ is $\theta_{2}$ and between $\vec{a} a n d \vec{c}$ varies $[\pi / 6,2 \pi / 3]$ Then the maximum of $\cos \theta_{1}+3 \cos \theta_{2}$ is 3 b. 4 c. $2 \sqrt{2}$ d. 6

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206. Prove that $\left[\begin{array}{lll}\vec{a}+\vec{b} & \vec{b}+\vec{c} & \vec{c}+\vec{a}\end{array}\right]=2\left[\begin{array}{lll}\vec{a} & \vec{b} & \vec{c}\end{array}\right]$

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207. Let $A, B, C$ be three unit vectors and $A . B=A . C=0$. If the angel between $B$ and $C$ is $\frac{\pi}{6}$, then $A$ is equals to

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208. The position vectors of the four angular points of a tetrahedron are $A(\hat{j}+2 \hat{k}), B(3 \hat{i}+\hat{k}), C(4 \hat{i}+3 \hat{j}+6 \hat{k}) \operatorname{andD}(2 \hat{i}+3 \hat{j}+2 \hat{k})$ Find the volume
of the tetrahedron $A B C D$

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209. If the vectors $2 \hat{i}-3 \hat{j}, \hat{i}+\hat{j}-\hat{k}$ and $3 \hat{i}-\hat{k}$ form three concurrent edges of a parallelepiped, then find the volume of the parallelepiped.

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210. If $\vec{u}, \vec{v}$ and $\vec{w}$ are three non-coplanar vectors, then prove that $(\vec{u}+\vec{v}-\vec{w}) \cdot[[(\vec{u}-\vec{v}) \times(\vec{v}-\vec{w})]]=\vec{u} \cdot \vec{v} \times \vec{w}$

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211. Find the value of $a$ so that the volume of the parallelepiped formed by vectors $\hat{i}+a \hat{j}+k, \hat{j}+a \hat{k} a n d a \hat{i}+\hat{k}$ becomes minimum.
212. If $\vec{a}=2 \hat{i}+3 \hat{j}-5 \hat{k}, \vec{b}=m \hat{i}+n \hat{j}+12 \hat{k}$ and $\vec{a} \times \vec{b}=\overrightarrow{0}$, then find $(m, n)$

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213. Prove that $[\vec{l} \vec{m} \vec{n}][\vec{a} \vec{b} \vec{c}]=\left|\begin{array}{lll}\vec{l} \cdot \vec{a} & \vec{l} \cdot \vec{b} & \vec{l} \cdot \vec{c} \\ \vec{m} . \vec{a} & \vec{m} \cdot \vec{b} & \vec{m} \cdot \vec{c} \\ \vec{n} \cdot \vec{a} & \vec{n} \cdot \vec{b} & \vec{n} \cdot \vec{c}\end{array}\right|$.

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214. Find the altitude of a parallelepiped whose three coterminous edtges are vectors $\vec{A}=\hat{i}+\hat{j}+\hat{k}, \vec{B}=2 \hat{i}+4 \hat{j}-\hat{k} a n d \vec{C}=\hat{i}+\hat{j}+3 \hat{k} w i t h \vec{A}$ and $\vec{B}$ as the sides of the base of the parallepiped.

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215. If $\vec{a}$ and $\vec{b}$ are two vectors such that $|\vec{a}|=2,|\vec{b}|=3$ and $(\vec{a} . \vec{b})=4$ then find $|(\vec{a}-\vec{b})|^{`}$

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216. 

Prove
that
$\vec{R}+\frac{[\vec{R} \vec{\beta} \times(\vec{\beta} \times \vec{\alpha})] \vec{\alpha}}{|\vec{\alpha} \times \vec{\beta}|^{2}}+\frac{[\vec{R} \vec{\alpha} \times(\vec{\alpha} \times \vec{\beta})] \vec{\beta}}{|\vec{\alpha} \times \vec{\beta}|^{2}}=\frac{[\vec{R} \vec{\alpha} \vec{\beta}](\vec{\alpha} \times \vec{\beta})}{|\vec{\alpha} \times \vec{\beta}|^{2}}$

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217. If $\vec{a}, \vec{b}$, and $\vec{c}$ are non-coplanar unit vectors such that
$\vec{a} \times(\vec{b} \times \vec{c})=\frac{\vec{b}+\vec{c}}{\sqrt{2}}, \vec{b}$ and $\vec{c}$ are non-parallel, then prove that the angel between $\vec{a}$ and $\vec{b}, i s 3 \pi / 4$.

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218. 

$\vec{r} . \vec{a}=0, \vec{r} . \vec{b}=1$ and $\left[\begin{array}{ccc}\vec{r} & \vec{a} & \vec{b}\end{array}\right]=1, \vec{a} \vec{b} \neq 0,(\vec{a} \vec{b})^{2}-|\vec{a}|^{2}|\vec{b}|^{2}=-1$, then find $\vec{r}$ in terms of $\vec{a}$ and $\vec{b}$.

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219. If $\vec{a}$ and $\vec{b}$ are two given vectors and $k$ is any scalar, then find the vector $\vec{r}$ satisfying $\vec{r} \times \vec{a}+k \vec{r}=\vec{b}$.

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220. $\vec{a}$, $\vec{b}$ and $\vec{c}$ are three non-coplanar ,non-zero vectors and $\vec{r}$ is any vector in space, then
$(\vec{a} \times \vec{b}) \times(\vec{r} \times \vec{c})+(\vec{b} \times \vec{c}) \times(\vec{r} \times \vec{a})+(\vec{c} \times \vec{a}) \times(\vec{r} \times \vec{b})$ is equal to

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$$
\vec{a} \times(\overrightarrow{d x x \vec{c}})
$$

$\vec{x}=\lambda \vec{a}+\vec{a} \times \longrightarrow$, then find the value of $\lambda$

$$
(\vec{a} \vec{c})|\vec{a}|^{2}
$$

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222. Let $\hat{a}, \hat{b}$, and $\hat{c}$ be the non-coplanar unit vectors. The angle between $\hat{b}$ and $\hat{c}$ is $\alpha$, between $\hat{c}$ and $\hat{a}$ is $\beta$ and between $\hat{a}$ and $\hat{b}$ is $\gamma$. If $A(\hat{a} \cos \alpha, 0), B(\hat{b} \cos \beta, 0)$ and $C(\hat{c} \cos \gamma, 0)$, then show that in triangle $A B C, \frac{|\hat{a} \times(\hat{b} \times \hat{c})|}{\sin A}=\frac{|\hat{b} \times(\hat{c} \times \hat{a})|}{\sin B}=\frac{|\hat{c} \times(\hat{a} \times \hat{b})|}{\sin C}$

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223. Find the vector of length 3 unit which is perpendicular to $\hat{i}+\hat{j}+\hat{k}$ and lies in the plane of $\hat{i}+\hat{j}+\hat{k} a n d 2 \hat{i}-3 \hat{j}$.

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224. If $\vec{b}$ is not perpendicular to $\vec{c}$, then find the vector $\vec{r}$ satisfying the equyation $\vec{r} \times \vec{b}=\vec{a} \times \vec{b}$ and $\vec{r} . \vec{c}=0$.

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225. If $\vec{a}, \vec{b}$ and $\vec{c}$ are three non coplanar vectors, then $(\vec{a}+\vec{b}+\vec{c})[(\vec{a}+\vec{b}) \times(\vec{a}+\vec{c})]$ is :

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226. Let $\vec{a}, \vec{b}$ and $\vec{c}$ be three non-zero vectors such that $\vec{a}+\vec{b}+\vec{c}=0$ and $\lambda \vec{b} \times \vec{a}+\vec{b} \times \vec{c}+\vec{c} \times \vec{a}=0$, then find the value of $\lambda$
227. Prove that $(\vec{a} . \hat{i})(\vec{a} \times \hat{i})+(\vec{a} . j)(\vec{a} \times \hat{j})+(\vec{a} . \hat{k})(\vec{a} \times \hat{k})=0$.

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228. If $(\vec{a} \times \vec{b})^{2}+(\vec{a} \cdot \vec{b})^{2}=144$ and $|\vec{a}|=4$, then find the value of $|\vec{b}|$

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229. A particle has an angular speed of $3 \mathrm{rad} / \mathrm{s}$ and the axis of rotation passes through the points $(1,1,2)$ and $(1,2,-2)$ Find the velocity of the particle at point $P(3,6,4)$

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230. Find the moment of $\vec{F}$ about point (2, -1, 3), where force $\vec{F}=3 \hat{i}+2 \hat{j}-4 \hat{k}$ is acting on point $(1,-1,2)$.
231. Given $|\vec{a}|=|\vec{b}|=1$ and $|\vec{a}+\vec{b}|=\sqrt{3}$. If $\vec{c}$ is a vector such that $\vec{c}-\vec{a}-2 \vec{b}=3(\vec{a} \times \vec{b})$, then find the value of $\vec{c} \cdot \vec{b}$

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232. Let $\vec{a}=a_{1} \hat{i}+a_{2} \hat{j}+a_{3} \hat{k}, \vec{b}=b_{1} \hat{i}+b_{2} \hat{j}+b_{3} \hat{k}$ and $\vec{c}=c_{1} \hat{i}+c_{2} \hat{j}+c_{3} \hat{k}$ be three non-zero vectors such that $\vec{c}$ is a unit vector perpendicular to both $\vec{a}$ and $\vec{b}$. If the angle between $a$ and $b$ is $\frac{\pi}{6}$, then prove that

$$
\left|\begin{array}{lll}
a_{1} & a_{2} & a_{3} \\
b_{1} & b_{2} & b_{3} \\
c_{1} & c_{2} & c_{3}
\end{array}\right|^{2}=\frac{1}{4}\left(a_{1}^{2}+a_{2}^{2}+a_{3}^{2}\right)\left(b_{1}^{2}+b_{2}^{2}+b_{3}^{2}\right)
$$

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233. Statement 1: $\vec{a}, \vec{b}$, and $\vec{c}$ are three mutually perpendicular unit vectors and $\vec{d}$ is a vector such that $\vec{a}, \vec{b}, \vec{c}$ and $\vec{d}$ are non-coplanar. If
$[\vec{d} \vec{b} \vec{c}]=[\vec{d} \vec{a} \vec{b}]=[\vec{d} \vec{c} \vec{a}]=1$, thend $=\vec{a}+\vec{b}+\vec{~}$
$[\vec{d} \vec{b} \vec{c}]=[\vec{d} \vec{a} \vec{b}]=[\vec{d} \vec{c} \vec{a}] \vec{d}$

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234. If the volume of a parallelepiped whose adjacent edges are $\vec{a}=2 \hat{i}+3 \hat{j}+4 \hat{k}, \vec{b}=\hat{i}+\alpha \hat{j}+2 \hat{k}, \vec{c}=\hat{i}+2 \hat{j}+\alpha \hat{k}$ is 15 , then find the value of $\alpha$ if $(\alpha>0)$

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235. Prove that $[\vec{l} \vec{m} \vec{n}][\vec{a} \vec{b} \vec{c}]=\left|\begin{array}{lll}\vec{l} \cdot \vec{a} & \vec{l} \cdot \vec{b} & \vec{l} \cdot \vec{c} \\ \vec{m} \cdot \vec{a} & \vec{m} \cdot \vec{b} & \vec{m} \cdot \vec{c} \\ \vec{n} \cdot \vec{a} & \vec{n} \cdot \vec{b} & \vec{n} \cdot \vec{c}\end{array}\right|$.
236. Using dot product of vectors, prove that a parallelogram, whose diagonals are equal, is a rectangle

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237. If $a+2 b+3 c=4$, then find the least value of $a^{2}+b^{2}+c^{2}$

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238. In any triangle $A B C$, prove the projection formula $a=b \cos C+c \cos B$ using vector method.

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239. Prove that an angle inscribed in a semi-circle is a right angle using vector method.
240. If $\vec{a} \cdot \hat{i}=\vec{a} .(\hat{i}+\hat{j})=\vec{a} \cdot(\hat{i}+\hat{j}+\hat{k})$, then find the unit vector $\vec{a}$

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241. Prove by vector method that $\cos (A+B)=\cos A \cos B-\sin A \sin B$

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242. If the scalar projection of vector $x \hat{i}-\hat{j}+\hat{k}$ on vector $2 \hat{i}-\hat{j}+5 \hat{k}$, is $\frac{1}{\sqrt{30}}$ ,then find the value of $x$

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243. If $\vec{a}=x \hat{i}+(x-1) \hat{j}+\hat{k}$ and $\vec{b}=(x+1) \hat{i}+\hat{j}+a \hat{k}$ make an acute angle $\forall x \in R$, then find the values of $a$
244. A unit vector a makes an angle $\frac{\pi}{4}$ with z -axis. If $a+i+j$ is a unit vector, then a can be equal to

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245. if $\vec{a}, \vec{b}$ and $\vec{c}$ are there mutually perpendicular unit vectors and $\vec{a}$ ia a unit vector then find the value of $|2 \vec{a}+\vec{b}+\vec{c}|^{2}$

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246. If $\vec{a}, \vec{b}$, and $\vec{c}$ be non-zero vectors such that no two are collinear or $(\vec{a} \times \vec{b}) \times \vec{c}=\frac{1}{3}|\vec{b}||\vec{c}| \vec{a}$ if $\theta$ is the acute angle between vectors $\vec{b}$ and $\vec{c}$, then find the value of $\sin \theta$

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247. If $\vec{p}, \vec{q}, \vec{r}$ denote vector $\vec{b} \times \vec{c}, \vec{c} \times \vec{a}, \vec{a} \times \vec{b}$, respectively, show that $\vec{a}$ is parallel to $\vec{q} \times \vec{r}, \vec{b}$ is parallel $\vec{r} \times \vec{p}, \vec{c}$ is parallel to $\vec{p} \times \vec{q}$.

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248. If $\vec{a}$ and $\vec{b}$ be two non-collinear unit vector such that $\vec{a} \times(\vec{a} \times \vec{b})=\frac{1}{2} \vec{b}$, then find the angle between $\vec{a}$ and $\vec{b}$.

## D Watch Video Solution

249. Show that $(\vec{a}-\vec{b}) \times(\vec{a}+\vec{b})=2(\vec{a} \times \vec{b}) \cdot$

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250. Prove that $(\vec{a} .(\vec{b} \times \hat{i})) \hat{i}+(\vec{a} \cdot(\vec{b} \times \hat{j})) \hat{j}+(\vec{a} .(\vec{b} \times \hat{k})) \hat{k}=\vec{a} \times \vec{b}$.

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251. For any four vectors, $\vec{a}, \vec{b}, \vec{c}$ and $\vec{d}$ prove that $\vec{d} .(\vec{a} \times(\vec{b} \times(\vec{c} \times \vec{d})))=(\vec{b} \cdot \vec{d})[\vec{a} \vec{c} \vec{d}]$.

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252. If $\vec{a}, \vec{b}$, and $\vec{c}$ are three vectors such that $\vec{a} \times \vec{b}=\vec{c}, \vec{b} \times \vec{c}=\vec{a}, \vec{c} \times \vec{a}=\vec{b}$, then prove that $|\vec{a}|=|\vec{b}|=|\vec{c}|$.

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

253. If $\vec{a}=\vec{p}+\vec{q}, \vec{p} \times \vec{b}=0$ and $\vec{q} \vec{b}=0$, then prove that $\quad=\vec{q}$ $\vec{b} \vec{b}$

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254. If $\vec{a}=\hat{i}+\hat{j}+\hat{k}$ and $\vec{b}=\hat{i}-2 \hat{j}+\hat{k}$, then find vector $\vec{c}$ such that $\vec{a} \cdot \vec{c}=2$ and $\vec{a} \times \vec{c}=\vec{b}$

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255. If non-zero vectors $\vec{a}$ and $\vec{b}$ are perpendicular to each other, then the solution of the equation $\vec{r} \times \vec{a}=\vec{b}$ is given by

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256. If $\vec{a}, \vec{b}$, and $\vec{c}$ are mutually perpendicular vectors of equal magnitudes, then find the angle between vectors $\vec{a}$ and $\vec{a}+\vec{b}+\vec{c}$

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257. If $\vec{a}, \vec{b}$, and $\vec{c}$ are unit vectors such that $\vec{a}+\vec{b}+\vec{c}=0$, then find the value of $\vec{a} \cdot \vec{b}+\vec{b} \cdot \vec{c}+\vec{c} \cdot \vec{a}$

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258. If three unit vectors $\vec{a}, \vec{b}$, and $\vec{c}$ satisfy $\vec{a}+\vec{b}+\vec{c}=0$, then find the angle between $\vec{a}$ and $\vec{b}$

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259. If $|\vec{a}|+|\vec{b}|=|\vec{c}|$ and $\vec{a}+\vec{b}=\vec{c}$, then find the angle between $\vec{a}$ and $\vec{b}$

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260. Find the angle between the vectors $\hat{i}-2 \hat{j}+3 \hat{k}$ and $3 \hat{i}-2 \hat{j}+\hat{k}$

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261. If $\vec{r} . \hat{i}=\vec{r} . \hat{j}=\vec{r} . \hat{k}$ and $|\vec{r}|=3$, then find the vector $\vec{r}$

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262. If $\vec{a}, \vec{b}$, and $\vec{c}$ are non-zero vectors such that $\vec{a} . \vec{b}=\vec{a}$. $\vec{c}$, then find the geometrical relation between the vectors.

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263. Find the projection of vector $\hat{i}+3 \hat{j}+7 \hat{k}$ on the vector $7 \hat{i}-\hat{j}+8 \hat{k}$

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264. If $\theta$ is th angle between the unit vectors $a$ and $b$, then prove that
$\cos \left(\frac{\theta}{2}\right)=\frac{1}{2}|\vec{a}+\vec{b}|$,and $\sin \left(\frac{\theta}{2}\right)=\frac{1}{2}|\vec{a}-\vec{b}|$
265. Let $\vec{a}, \vec{b}$, and $\vec{c}$ be three non-coplanar unit vectors such that the angle between every pair of them is $\mathrm{pi} / 3$. If veca $\times$ vecb + vecb $\times$ vecc $=p$ veca $+q$ vecb $+r$ vecc, where $p, q$ and $r$ are scalars, then the value of $p 2$ $+2 q 2+r 2 / q 2$ is

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266. Given unit vectors $\hat{m}$, $\hat{\text { and }}$ d $\hat{p}$ such that angel between $\hat{m} a n d \hat{n}$ is $\alpha$ and angle between $\hat{p}$ and $(\hat{m} \times \hat{n})$ is also $\alpha$, then $[\hat{n} \hat{p} \hat{m}]=$

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267. Let $\vec{a}, \vec{b}$, and $\vec{c}$ be non-coplanar vectors and let the equation $\vec{a}^{\prime}, \vec{b}^{\prime}, \vec{c}^{\prime}$ are reciprocal system of vector $\vec{a}, \vec{b}, \vec{c}$, then prove that $\vec{a} \times \vec{a}^{\prime}+\vec{b} \times \vec{b}^{\prime}+\vec{c} \times \vec{c}^{\prime}$ is a null vector.

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268. Vector $\vec{O} A=\hat{i}+2 \hat{j}+2 \hat{k}$ turns through a right angle passing through the positive x -axis on the way. Show that the vector in its new position is $\frac{4 \hat{i}-\hat{j}-\hat{k}}{\sqrt{2}}$

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269. The base of the pyramid $A O B C$ is an equilateral triangle $O B C$ with each side equal to $4 \sqrt{2}, O$ is the origin of reference, $A O$ is perpendicualar to the plane of $O B C$ and $|\vec{A} O|=2$. Then find the cosine of the angle between the skew straight lines, one passing though $A$ and the midpoint of $O B a n d$ the other passing through $O$ and the mid point of $B C$

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270. Find $|\vec{a} \times \vec{b}|$, if $\vec{a}=\hat{i}-7 \hat{j}+7 \hat{k}$ and $\vec{b}=3 \hat{i}-2 \hat{j}+2 \hat{k}$
271. Let the vectors $\vec{a}$ and $\vec{b}$ be such that $|\vec{a}|=3$ and $|\vec{b}|=\frac{\sqrt{2}}{3}$, then, $\vec{a} \times \vec{b}$ is a unit vector, if the angel between $\vec{a}$ and $\vec{b}$ is?

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272. Show that $(\vec{a}-\vec{b}) \times(\vec{a}+\vec{b})=2(\vec{a} \times \vec{b})$

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273. 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 $\vec{c}, \vec{d}=15$.

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274. If $A, B a n d C$ are the vetices of a triangle $A B C$, then prove sine rule $\frac{a}{\sin A}=\frac{b}{\sin B}=\frac{c}{\sin C}$.

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275. Using cross product of vectors , prove that $(\sin A+B)-\sin A \cos B+\cos A \sin B$.

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276. Find a unit vector perpendicular to the plane determined by the points (1, - 1,2$),(2,0,-1)$ and $(0,2,1)$

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277. If $\vec{a}$ and $\vec{b}$ are two vectors, then prove that $(\vec{a} \times \vec{b})^{2}=\left|\begin{array}{ll}\vec{a} \cdot \vec{a} & \vec{a} \cdot \vec{b} \\ \vec{b} \cdot \vec{a} & \vec{b} \cdot \vec{b}\end{array}\right|$.
278. In isosceles triangles $A B C,|\vec{A} B|=|\vec{B} C|=8$, a point $E$ divides $A B$ internally in the ratio $1: 3$, then find the angle between $\vec{C}$ Eand $\vec{C} A($ where $|\vec{C} A|=12$ ).

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279. Prove that in a tetrahedron if two pairs of opposite edges are perpendicular , then the third pair is also perpendicular.

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280. Let $\vec{a}, \vec{b}$, and $\vec{c}$ are vectors such that $|\vec{a}|=3,|\vec{b}|=4$ and $|\vec{c}|=5$, and $(\vec{a}+\vec{b})$ is perpendicular to $\vec{c},(\vec{b}+\vec{c})$ is perpendicular to $\vec{a}$ and $(\vec{c}+\vec{a})$ is perpendicular to $\vec{b}$ Then find the value of $|\vec{a}+\vec{b}+\vec{c}|$.
281. If $|\vec{a}|=|\vec{b}|=|\vec{a}+\vec{b}|=1$, then find the value of $|\vec{a}-\vec{b}|$

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282. If $\vec{A}=4 \hat{i}+6 \hat{j} a n d \vec{B}=3 \hat{j}+4 \hat{k}$, then find the component of $\vec{A} B$

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283. A particle acted by constant forces $4 \hat{i}+\hat{j}-3 \hat{k}$ and $3 \hat{i}+\hat{9} j-\hat{k}$ is displaced from point $\hat{i}+2 \hat{j}+3 \hat{k}$ to point $5 \hat{i}+4 \hat{j}+\hat{k}$ find the total work done by the forces in units.

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284. If $\vec{a}, \vec{b}, \vec{c}$ are three mutually perpendicular unit vectors, then prove that $|\vec{a}+\vec{b}+\vec{c}|=\sqrt{3}$

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285. Let $\vec{a}=x \hat{i}+12 \hat{j}-\hat{k}, \vec{b}=2 \hat{i}+2 x \hat{j}+\hat{k}$ and $\vec{c}=\hat{i}+\hat{k}$ If the ordered set $[\vec{b} \vec{c} \vec{a}]$ is left handed, then find the values of $x$

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286. If $\vec{a}, \vec{b}$, and $\vec{c}$ are three non-coplanar vectors, then find the value of
$\frac{\vec{a} \vec{b} \times \vec{c}}{.}+\frac{\vec{b} \vec{c} \times \vec{a}}{}+\frac{\vec{c} \vec{b} \times \vec{a} .}{}$.
$\vec{b} \vec{c} \times \vec{a} \quad \vec{c} \vec{a} \times \vec{b} \quad \vec{a} \vec{b} \times \vec{c}$

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287. If $\vec{a}, \vec{b}, \vec{c}$ and $\vec{d}$ are the position vectors of the vertices of a cyclic quadrilateral $A B C D$, prove that

$$
\underline{|\vec{a} \times \vec{b}+\vec{b} \times \vec{d}+\vec{d} \times \vec{a}|}+\frac{|\vec{b} \times \vec{c}+\vec{c} \times \vec{d}+\vec{d} \times \vec{b}|}{}=0
$$

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

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288. The position vectors of the vertices of a quadrilateral with $A$ as origin are $B(\vec{b}), D(\vec{d}) \operatorname{andC}(\vec{l} \vec{b}+m \vec{d})$ Prove that the area of the quadrialeral is $\frac{1}{2}(l+m)|\vec{b} \times \vec{d}|$

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289. If $\vec{a} \times \vec{b}=\vec{c} \times \vec{d}$ and $\vec{a} \times \vec{c}=\vec{b} \times \vec{d}$, then show that $\vec{a}-\vec{d}$, is paralelto $\vec{b}-\vec{c}$
290. Show by a numerical example and geometrically also that $\vec{a} \times \vec{b}=\vec{a} \times \vec{c}$ does not imply $\vec{b}=\vec{c}$

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291. In triangle $A B C$,points $D$, EandF are taken on the sides $B C, C A a n d A B$, respectively, such that $\frac{B D}{D C}=\frac{C E}{E A}=\frac{A F}{F B}=n$. Prove that $\triangle D E F=\frac{n^{2}-n+1}{(n+1)^{2}} \triangle(A B C)$

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292. Let $A, B, C$ be points with position vectors
$2 \hat{i}-\hat{j}+\hat{k}, \hat{i}+2 \hat{j}+3 \hat{k}$ and $3 \hat{i}+\hat{j}+2 \hat{k}$ respectively. Find the shortest distance between point $B$ and plane $O A C$

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293. Let $\vec{a}$ and $\vec{b}$ be unit vectors such that $|\vec{a}+\vec{b}|=\sqrt{3}$. Then find the value of $(2 \vec{a}+5 \vec{b}) \cdot((3 \vec{a}+\vec{b}+\vec{a} \times \vec{b}))$

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294. If $u$ and $v$ are two non-collinear unit vectors such that $|\vec{u} \times \vec{v}|=\left|\frac{\vec{u}-\vec{v}}{2}\right|$, then the value of $|\vec{u} \times(\vec{u} \times \vec{v})|^{2}$ is equal to

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295. A rigid body is spinning about a fixed point ( $3,-2,-1$ ) with an angular velocity of $4 \mathrm{rad} / \mathrm{s}$, the axis of rotation being in the direction of $(1,2,-2)$.

Find the velocity of the particle at point $(4,1,1)$.

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296. $\vec{r} \times \vec{a}=\vec{b} \times \vec{a} ; \vec{r} \times \vec{b}=\vec{a} \times \vec{b} ; \vec{a} \neq \overrightarrow{0} ; \vec{b} \neq \overrightarrow{0} ; \vec{a} \neq \lambda \vec{b}$, and $\vec{a}$ is not perpendicular to $\vec{b}$, then find $\vec{r}$ in terms of $\vec{a} a n d \vec{b}$

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297. If $|\vec{a}|=2$, then find the value of $|\vec{a} \times \hat{i}|^{2}+|\vec{a} \times \hat{j}|^{2}+|\vec{a} \times \hat{k}|^{2}$

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298. If $\vec{a}, \vec{b}, \vec{c}$ are position vectors of the vertices $\mathrm{A}, \mathrm{B}, \mathrm{C}$ of a triangle ABC , show that the area of the triangle $\operatorname{ABC}$ is $\frac{1}{2}[\vec{a} \times \vec{b}+\vec{b} \times \vec{c}+\vec{c} \times \vec{a}]$. Also deduce the condition for collinearity of the points $A, B$ and $C$.

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299. $A, B, C a n d D$ are any four points in the space, then prove that
$|\vec{A} B \times \vec{C} D+\vec{B} C \times \vec{A} D+\vec{C} A \times \vec{B} D|=4$ (area of $A B C$.

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300. Find the area of the parallelogram whose adjacent sides are determined by the vectors $\vec{a}=\hat{i}-\hat{j}+3 \hat{k} a n d \vec{b}=2 \hat{i}-7 \hat{j}+\hat{k}$

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301. Using vectors, find the area of the triangle with vertices $A(1,1,2), B(2$, $3,5)$ and $C(1,5,5)$.

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302. Let $\vec{a}$, $\vec{b}$ and $\vec{c}$ be three verctors such that $\vec{a} \neq 0,|\vec{a}|=|\vec{c}|=1,|\vec{b}|=4$ and $|\vec{b} \times \vec{c}|=\sqrt{15}$ If $\vec{b}-2 \vec{c}=\lambda \vec{a}$, then find the value of $\lambda$

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303. Find the area a parallelogram whose diagonals are $\vec{a}=3 \hat{i}+\hat{j}-2 \hat{k}$ and $\vec{b}=\hat{i}-3 \hat{j}+4 \hat{k}$

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304. If $\vec{a}$ and $\vec{b}$ are unit vectors such that $(\vec{a}+\vec{b}) \cdot[(2 \vec{a}+3 \vec{b}) \times(3 \vec{a}-2 \vec{b})]=0$, then angle between $\vec{a}$ and $\vec{b}$ is a. 0 b. $\pi / 2 \mathrm{c} . \pi \mathrm{d}$. indeterminate

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305. If $\vec{a} a n d \vec{b}$ are any two unit vectors, then find the greatest positive integer in the range of $\frac{3|\vec{a}+\vec{b}|}{2}+2|\vec{a}-\vec{b}|$.

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306. If the vectors $\vec{a}, \vec{b}$, and $\vec{c}$ form the sides $B C, C A a n d A B$, respectively, of triangle $A B C$, then $\begin{array}{llll}\text { (a) } \vec{a} \vec{b}+\vec{b} \vec{c}+\vec{c} \vec{a}=0 & \text { (b) } \vec{a} \times \vec{b}=\vec{b} \times \vec{c}=\vec{c} \times \vec{a} & \text { (c). }\end{array}$
$\vec{a} \vec{b}=\vec{b} \vec{c}=\vec{c} \vec{a}(\mathrm{~d}) . \vec{a} \times \vec{b}+\vec{b} \times \vec{c}+\vec{c} \times \vec{a}=0$

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307. Let $\vec{u}$ be a vector on rectangular coordinate system with sloping angle $60^{\circ}$ Suppose that $|\vec{u}-\hat{i}|$ is geometric mean of $|\vec{u}|$ and $|\vec{u}-2 \hat{i}|$, where $\hat{i}$ is the unit vector along the $x$-axis. Then find the value of $(\sqrt{2}+1)|\vec{u}|$

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308. Two adjacent sides of a parallelogram $A B C D$ are given by $\vec{A} B=2 \hat{i}+10 \hat{j}+11 \hat{k}$ and $\vec{A} D=-\hat{i}+2 \hat{j}+2 \hat{k}$ The side $A D$ is rotated by an acute angle $\alpha$ in the plane of the parallelogram so that $A D$ becomes $A D^{\prime}$

If $A D^{\prime}$ makes a right angle with the side $A B$, then the cosine of the angel $\alpha$ is given by $\frac{8}{9}$ b. $\frac{\sqrt{17}}{9}$ c. $\frac{1}{9}$ d. $\frac{4 \sqrt{5}}{9}$

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309. Let $\vec{a}, \vec{b}$, and $\vec{c}$ be non-coplanar unit vectors, equally inclined to one another at an angle $\theta$ then $[\vec{a} \vec{b} \vec{c}]$ in terms of $\theta$ is equal to :

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310. Volume of parallelepiped formed by vectors
$\vec{a} \times \vec{b}, \vec{b} \times \vec{c} a n d \vec{c} \times \vec{a} i s 36 s q$ units. Column \|Column II Volume of parallelepiped formed by vectors $\vec{a}, \vec{b}$, and $\vec{c}$ is $\mid \mathrm{p}$. Osq.units Volume of tetrahedron formed by vectors $\vec{a}, \vec{b}$, and $\vec{c}$ is $\mid q$. 12 sq. units Volume of parallelepiped formed by vectors $\vec{a}+\vec{b}, \vec{b}+\vec{c}$ and $\vec{c}+\vec{a}$ is|r. 6 sq. units Volume of parallelepiped formed by vectors $\vec{a}-\vec{b}, \vec{b}-\vec{c} a n d \vec{c}-\vec{a}$ is $\mid \mathrm{s}$. 1 sq. units
311. Given three vectors $\vec{a}, \vec{b}$, and $\vec{c}$ two of which are non-collinear. Further if $(\vec{a}+\vec{b})$ is collinear with $\vec{c},(\vec{b}+\vec{c})$ is collinear with $\vec{a},|\vec{a}|=|\vec{b}|=|\vec{c}|=\sqrt{2}$ Find the value of $\vec{a} \cdot \vec{b}+\vec{b} \cdot \vec{c}+\vec{c} \cdot \vec{a}$ a. $3 \mathrm{~b} \cdot-3 \mathrm{c} .0 \mathrm{~d}$. cannot be evaluated

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312. The value of $a$ so that the volume of parallelepiped formed by $\hat{i}+a \hat{j}+\hat{k}, \hat{j}+a \hat{k}$ and $a \hat{i}+\hat{k}$ is minimum is a. -3 b. 3 c. $1 / \sqrt{3}$ d. $\sqrt{3}$

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313. $A_{1}, A_{2}, \ldots, A_{n}$ are the vertices of a regular plane polygon with n sides and O as its centre. Show that $\sum_{i=1}^{n} \overrightarrow{O A}_{i} \times \overrightarrow{O A}_{i+1}=(1-n)\left(\overrightarrow{O A_{2}} \times \overrightarrow{O A_{1}}\right)$
314. If $c$ is a given non-zero scalar, and $\vec{A}$ and $\vec{B}$ are given non-zero vector such that $\vec{A} \perp \vec{B}$, then find vector $\vec{X}$ which satisfies the equation
$\vec{A} \vec{X}=c$ and $\vec{A} \times \vec{X}=\vec{B}$

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315. $A, B, C a n d D$ are any four points in the space, then prove that
$|\vec{A} B \times \vec{C} D+\vec{B} C \times \vec{A} D+\vec{C} A \times \vec{B} D|=4$ (area of $A B C$. )

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316. $[\vec{a}+\vec{b} \vec{b}+\vec{c} \vec{c}+\vec{a}]=[\vec{a} \vec{b} \vec{c}]$, then

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317. Let $\vec{A}=2 \vec{i}+\vec{k}, \vec{B}=\vec{i}+\vec{j}+\vec{k} \vec{C}=4 \hat{i}-3 \hat{j}+7 \hat{k}$ Determine a vector $\vec{R}$ satisfying $\vec{R} \times \vec{B}=\vec{C} \times \vec{B}$ and $\vec{R} \cdot \vec{A}=0$.

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318. Determine the value of $c$ so that for all real $x$, vectors $c x \hat{i}-6 \hat{j}-3 \hat{k}$ and $x \hat{i}+2 \hat{j}+2 c x \hat{k}$ make an obtuse angle with each other.

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319. If $\vec{r}=x_{1}(\vec{a} \times \vec{b})+x_{2}(\vec{b} \times \vec{a})+x_{3}(\vec{c} \times \vec{a})$ and $4[\vec{a} \vec{b} \vec{c}]=1$, then $x_{1}+x_{2}+x_{3}$ is equal to (A) $\frac{1}{2} \vec{r} \cdot(\vec{a}+\vec{b}+\vec{c})$ (B) $\frac{1}{4} \vec{r} \cdot(\vec{a}+\vec{b}+\vec{c})$
$2 \vec{r} .(\vec{a}+\vec{b}+\vec{c})$ (D) $4 \vec{r} .(\vec{a}+\vec{b}+\vec{c})$

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320. $[(\vec{a} \times \vec{b}) \times(\vec{b} \times \vec{c})(\vec{b} \times \vec{c}) \times(\vec{c} \times \vec{a})(\vec{c} \times \vec{a}) \times(\vec{a} \times \vec{b})]$ is equal to (where $\vec{a}, \vec{b}$ and $\vec{c}$ are nonzero non-coplanar vector) $[\vec{a} \vec{b} \vec{c}]^{2} \mathrm{~b}$. $[\vec{a} \vec{b} \vec{c}]^{3} \mathrm{c}$. $[\vec{a} \vec{b} \vec{c}]^{4}$ d. $[\vec{a} \vec{b} \vec{c}]$

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321. If $V$ be the volume of a tetrahedron and $V^{\prime}$ be the volume of another tetrahedran formed by the centroids of faces of the previous tetrahedron and $V=K V^{\prime}$, then $K$ is equal to a. 9 b. 12 c. 27 d. 81

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322. Let $\vec{a}, \vec{b}$ and $\vec{c}$ be three non-coplanar vecrors and $\vec{r}$ be any arbitrary vector. Then $(\vec{a} \times \vec{b}) \times(\vec{r} \times \vec{c})+(\vec{b} \times \vec{c}) \times(\vec{r} \times \vec{a})+(\vec{c} \times \vec{a}) \times(\vec{r} \times \vec{b})$ is always equal to $[\vec{a} \vec{b} \vec{c}] \vec{r}$ b. $2[\vec{a} \vec{b} \vec{c}] \vec{r}$ c. $3[\vec{a} \vec{b} \vec{c}] \vec{r}$ d. none of these

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323. $A(\vec{a}), B(\vec{b}), C(\vec{c})$ are the vertices of the triangle $A B C$ and $R(\vec{r})$ is any point in the plane of triangle ABC , then $r .(\vec{a} \times \vec{b}+\vec{b} \times \vec{c}+\vec{c} \times \vec{a})$ is always equal to

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324. Let $\vec{a}$, $\vec{b}$ and $\vec{c}$ be three non-coplanar vectors and $\vec{p}$, $\vec{q} a n d \vec{r}$ the vectors
defined by the relation $\vec{p}=\frac{\vec{b} \times \vec{c}}{[\vec{a} \vec{c}]}, \overrightarrow{\vec{c} \times \vec{a}}$ and $\vec{r}=\frac{\vec{a} \times \vec{b}}{[\vec{a} \vec{c}]}$ Then the

$$
\left[\begin{array}{lll}
\vec{a} \vec{b} \vec{c}] \quad[\vec{a} \vec{b} \vec{c}] \quad[\vec{a} \vec{b} \vec{c}]
\end{array}\right.
$$

value of the expression $(\vec{a}+\vec{b}) \vec{p}+(\vec{b}+\vec{c}) \vec{q}+(\vec{c}+\vec{a}) \vec{r}$ is a. 0 b .1 c .2 d . 3

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325. Let $\vec{a}, \vec{b} a n d \vec{c}$ be three non-coplanar vecrors and $\vec{r}$ be any arbitrary vector. Then $(\vec{a} \times \vec{b}) \times(\vec{r} \times \vec{c})+(\vec{b} \times \vec{c}) \times(\vec{r} \times \vec{a})+(\vec{c} \times \vec{a}) \times(\vec{r} \times \vec{b})$ is always equal to $[\vec{a} \vec{b} \vec{c}] \vec{r}$ b. $2[\vec{a} \vec{b} \vec{c}] \vec{r}$ c. $3[\vec{a} \vec{b} \vec{c}] \vec{r}$ d. none of these
326. The position vectors of point $A, B$, and $C$ are $\hat{i}+\hat{j}+\hat{k}, \hat{i}+5 \hat{j}-\hat{k}$ and $2 \hat{i}+3 \hat{j}+5 \hat{k}$, respectively. Then greatest angel of triangle $A B C$ is $120^{\circ} \mathrm{b} \cdot 90^{0} \mathrm{c} \cdot \cos ^{-1}(3 / 4) \mathrm{d}$. none of these

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327. Let $\vec{a}(x)=(\sin x) \hat{i}+(\cos x) \hat{j} a n d \vec{b}(x)=(\cos 2 x) \hat{i}+(\sin 2 x \hat{j})$ be two variable vectors $(x \in R)$ Then $\vec{a}(x) a n d \vec{b}(x)$ are a. collinear for unique value of $x$ b. perpendicular for infinite values of $x$ c. zero vectors for unique value of $x$ d. none of these

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328. 

If
$\vec{a}=2 \hat{i}+\hat{j}+\hat{k}, \vec{b}=\hat{i}+2 \hat{j}+2 \hat{k}, \vec{c}=\hat{i}+\hat{j}+2 \hat{k} \operatorname{and}(1+\alpha) \hat{i}+\beta(1+\alpha) \hat{j}+\gamma(1+\alpha)(1$
are a. $-2,-4,-\frac{2}{3}$ b. $2,-4, \frac{2}{3}$ c. $-2,4, \frac{2}{3}$ d. $2,4,-\frac{2}{3}$

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329. If $\vec{a}, \vec{b}$ and $\vec{c}$ are unit vectors satisfying $|\vec{a}-\vec{b}|^{2}+|\vec{b}-\vec{c}|^{2}+|\vec{c}-\vec{a}|^{2}=9$, then $|2 \vec{a}+5 \vec{b}+5 \vec{c}|$ is.

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330. If $\vec{d}=\vec{a} \times \vec{b}+\vec{b} \times \vec{c}+\vec{c} \times \vec{a}$ is non-zero vector and
$|(\vec{d} \cdot \vec{c})(\vec{a} \times \vec{b})+(\vec{d} \cdot \vec{a})(\vec{b} \times \vec{c})+(\vec{d} \cdot \vec{b})(\vec{c} \times \vec{a})|=0$, then
a. $|\vec{a}|=|\vec{b}|=|\vec{c}|$
b. $|\vec{a}|+|\vec{b}|+|\vec{c}|=|d|$
c. $\vec{a}, \vec{b}$, and $\vec{c}$ are coplanar
d. none of these
331. The vector(s) which is/are coplanar with vectors $\hat{i}+\hat{j}+2 \hat{k}$ and $\hat{i}+2 \hat{j}+\hat{k}$, and perpendicular to vector $\hat{i}+\hat{j}+\hat{k}$, is/are a. $\hat{j}-\hat{k} b \cdot-\hat{i}+\hat{j}$
c. $\hat{i}-\hat{j}$ d. $-\hat{j}+\hat{k}$

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332. 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 $\vec{r} \times \vec{b}=\vec{c} \times \vec{d}$ and $\vec{r} \vec{a}=0$, then find the value of $\vec{r} \vec{b}$

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333. Let $\vec{a}, \vec{b}$, and $\vec{c}$ be vectors forming right-hand traid. Let $\vec{p}=\frac{\vec{b} \times \vec{c}}{[\vec{a} \vec{b} \vec{c}]}, \vec{q}=\frac{\vec{c} \times \vec{a}}{[\vec{a} \vec{b} \vec{c}]}$, and $\vec{r}=\frac{\vec{a} \times \vec{b}}{[\vec{a} \vec{b} \vec{c}]}$, If $x \in R^{+}$, then
a. $x[\vec{a} \vec{b} \vec{c}]+\frac{[\vec{p} \vec{q} \vec{r}]}{x}$ has least value $=2$. b. $x^{4}[\vec{a} \vec{b} \vec{c}]^{2}+\frac{[\vec{p} \vec{q} \vec{r}]}{x^{2}}$ has least value $=\left(\frac{3}{2}\right)^{2 / 3}$ c. $[\vec{p} \vec{q} \vec{r}]>0 \mathrm{~d}$. none of these

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334. From a point $O$ inside a triangle $A B C$, perpendiculars $O D$, OEandOf are drawn to rthe sides $B C, C A a n d A B$, respecrtively. Prove that the perpendiculars from $A, B$, andC to the sides $E F, F D a n d D E$ are concurrent.

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335. Find $\vec{a} \times \vec{b}$, if $\vec{a}=2 \hat{i}+\hat{k}$ and $\vec{b}=\hat{i}+\hat{j}+\hat{k}$

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336. Find the work done by the force $F=3 \hat{i}-\hat{j}-2 \hat{k}$ acrting on a particle such that the particle is displaced from point $A(-3,-4,1) \rightarrow B(-1,-1,-2)$

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337. Find the angle between the vectors $\vec{a}=\hat{i}+\hat{j}-\hat{k}$ and $\vec{b}=\hat{i}-\hat{j}+\hat{k}$

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338. $O A B C$ is regular tetrahedron in which $D$ is the circumcentre of $O A B$ and E is the midpoint of edge $A C$ Prove that $D E$ is equal to half the edge of tetrahedron.

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339. In the quadrilateral $A B C D$, the diagonals $A C$ and $B D$ are equal and perpendicular to each other. What type of a quadrilateral is $A B C D$ ?

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340. If $\vec{e}_{1}, \vec{e}_{2}, \vec{e}_{3}$ and $\vec{E}_{1}, \vec{E}_{2}, \vec{E}_{3}$ arwe two sets of vectors such that $\vec{e}_{1} \cdot \vec{E}_{j}=1$, if and $\vec{e}_{i} \cdot \vec{E}_{j}=0$ and $\quad$ if $i \neq j$, the prove that $\left[\vec{e}_{1} \vec{e}_{2} \vec{e}_{3}\right]\left[\vec{E}_{1} \vec{E}_{2} \vec{i}\right.$
341. Find the angle between the vectors $\vec{a}=\hat{i}+\hat{j}-\hat{k}$ and $\vec{b}=\hat{i}-\hat{j}+\hat{k}$

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342. Given the vectors $\vec{A}, \vec{B}$, and $\vec{C}$ form a triangle such that $\vec{A}=\vec{B}+\vec{C}$ find $a, b, c$, andd such that the area of the triangle is $5 \sqrt{6}$ where $\vec{A}=a \hat{i}+b \hat{j}+c \hat{k} \vec{B}=d \hat{i}+3 \hat{j}+4 \hat{k} \vec{C}=3 \hat{i}+\hat{j}-2 \hat{k}$

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343. If $\vec{a}$, $\vec{b}$ and $\vec{c}$ are three mutually perpendicular vectors, then the vector
which is equally inclined to these vectors is $\vec{a}+\vec{b}+\vec{c} \mathrm{~b} . \frac{\vec{a}}{|\vec{a}|}+\frac{\vec{b}}{|\vec{b}|}+\frac{\vec{c}}{|\vec{c}|}$
c. $\frac{\vec{a}}{|\vec{a}|^{2}}+\frac{\vec{b}}{|\vec{b}|^{2}}+\frac{\vec{c}}{|\vec{c}|^{2}}$ d. $|\vec{a}| \vec{a}-|\vec{b}| \vec{b}+|\vec{c}| \vec{c}$
344. Let a three dimensional vector $\vec{V}$ satisfy the condition, $2 \vec{V}+\vec{V} \times(\hat{i}+2 \hat{j})=2 \hat{i}+\hat{k}$ If $3|\vec{V}|=\sqrt{m}$ Then find the value of $m$

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345. If $\vec{a}=3 \hat{i}-\hat{j}-4 \hat{k}, \vec{b}=2 \hat{i}+4 \hat{j}-3 \hat{k}$ and $\vec{c}=\hat{i}+2 \hat{j}-\hat{k}$, find $|3 \vec{a}-2 \hat{b}+4 \hat{c}|$

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346. Let $\vec{O} A=\vec{a}, \hat{O} B=10 \vec{a}+2 \vec{b}$ and $\vec{O} C=\vec{b}$, where $O$, Aand $C$ are noncollinear points. Let $p$ denotes the areaof quadrilateral $O A C B$, and let $q$ denote the area of parallelogram with OAandOC as adjacent sides. If $p=k q$, then find $k$
347. If $\vec{a}, \vec{b}, \vec{c}$ are unit vectors such that $\vec{a} . \vec{b}=0=\vec{a}$. $\vec{c}$ and the angle between $\vec{b}$ and $\vec{c}$ is $\frac{\pi}{3}$, then find the value of $|\vec{a} \times \vec{b}-\vec{a} \times \vec{c}|$.

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348. If $\vec{x}, \vec{y}$ are two non-zero and non-collinear vectors satisfying $\left[(a-2) \alpha^{2}+(b-3) \alpha+c\right] \vec{x}+\left[(a-2) \beta^{2}+(b-3) \beta+c\right] \vec{y}+\left[(a-2) \gamma^{2}+(b-3) \gamma+c\right.$ are three distinct real numbers, then find the value of $\left(a^{2}+b^{2}+c^{2}-4\right)$

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349. Let $\vec{a}=\alpha \hat{i}+2 \hat{j}-3 \hat{k}, \vec{b}=\alpha \hat{i}+2 \alpha \hat{j}-2 \hat{k}$, and $\vec{c}=2 \hat{i}-\alpha \hat{j}+\hat{k}$ Find thevalue of $6 \alpha$, such that $\{(\vec{a} \times \vec{b}) \times(\vec{b} \times \vec{c})\} \times(\vec{c} \times \vec{a})=0$.

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350. Let $\vec{a}, \vec{b}$ and $\vec{c}$ be three vectors having magnitudes 1 , 5and 3 , respectively, such that the angel between $\vec{a} a n d \vec{b} i s \theta$ and $\vec{a} \times(\vec{a} \times \vec{b})=c$. Then $\tan \theta$ is equal to a. 0 b. $2 / 3$ c. $3 / 5 \mathrm{~d} .3 / 4$

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351. Two vectors in space are equal only if they have equal component in
a. a given direction
b. two given directions
c. three given directions
d. in any arbitrary direction

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352. Let $\vec{a}=\hat{i}-\hat{j}, \vec{b}=\hat{j}-\hat{k}$ and $\vec{c}=\hat{k}-\hat{i}$. If $\vec{d}$ is a unit vector such that $\vec{a} . \vec{d}=0=[\vec{b} \vec{c} \vec{d}]$, then $d$ equals a. $\pm \frac{\hat{i}+\hat{j}-2 \hat{k}}{\sqrt{6}}$ b. $\pm \frac{\hat{i}+\hat{j}-\hat{k}}{\sqrt{3}}$ c. $\pm \frac{\hat{i}+\hat{j}+\hat{k}}{\sqrt{3}}$ d. $\pm \hat{k}$
353. If vectors $\vec{a} a n d \vec{b}$ are two adjacent sides of a parallelogram, then the vector respresenting the altitude of the parallelogram which is the perpendicular to $a$ is a. $\vec{b}+\frac{\vec{b} \times \vec{a}}{|\vec{a}|^{2}}$ b. $\frac{\vec{a} \vec{b}}{|\vec{b}|^{2}}$ c. $\vec{b}-\frac{\vec{b} \vec{a}}{|\vec{a}|^{2}}$ d. $\frac{\vec{a} \times(\vec{b} \times \vec{a})}{|\vec{b}|^{2}}$

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354. If $\vec{a} \times(\vec{b} \times \vec{c})$ is perpendicular to $(\vec{a} \times \vec{b}) \times \vec{c}$, we may have a.

$$
(\vec{a} \cdot \vec{c})|\vec{b}|^{2}=(\vec{a} \cdot \vec{b})(\vec{b} \cdot \vec{c})(\vec{c} \cdot \vec{a}) \text { b. } \vec{a} \vec{b}=0 \text { c. } \vec{a} \vec{c}=0 \text { d. } \vec{b} \vec{c}=0
$$

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355. $[(\vec{a} \times \vec{b})(\vec{c} \times \vec{d})(\vec{e} \times \vec{f})]$ is equal to
(a) $[\vec{a} \vec{b} \vec{d}][\vec{c} \vec{e} \vec{f}]-[\vec{a} \vec{b} \vec{c}][\vec{d} \vec{e} \vec{f}]$
(b) $[\vec{a} \vec{b} \vec{e}][\vec{f} \vec{c} \vec{d}]-[\vec{a} \vec{b} \vec{f}][\vec{e} \vec{c} \vec{d}]$

(d) $[\vec{c} \vec{c} \vec{e}][\vec{b} \vec{d} \vec{f}]$

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356. $\vec{b}$ and $\vec{c}$ are non-collinear
$\vec{a} \times(\vec{b} \times \vec{c})+(\vec{a} \vec{b}) \vec{b}=(4-2 x-\sin y) \vec{b}+\left(x^{2}-1\right) \vec{c}$ and $(\vec{c} \vec{c}) \vec{a}=\vec{?}$ Then a. $x=1$ b. $x=-1$ c. $y=(4 n+1) \pi / 2, n \in I$ d. $y=(2 n+1) \pi / 2, n \in I$

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357. If $\vec{a}$ and $\vec{b}$ are unit vectors, then angle between $\vec{a}$ and $\vec{b}$ for
$\sqrt{3} \vec{a}-\mathrm{b}$ to be unit vector is
358. If $\vec{a} \perp \vec{b}$, then vector $\vec{v}$ in terms of $\vec{a} a n d \vec{b}$ satisfying the equation s
$\vec{v} \vec{a}=\operatorname{Oand} \vec{v} \vec{b}=1 \operatorname{and}[\vec{v} \vec{a} \vec{b}]=1$ is $\frac{\vec{b}}{|\vec{b}|^{2}}+\frac{\vec{a} \times \vec{b}}{|\vec{a} \times \vec{b}|^{2}}$ b. $\frac{\vec{b}}{|\vec{b}|^{\square}}+\frac{\vec{a} \times \vec{b}}{|\vec{a} \times \vec{b}|^{2}}$ c.
$\frac{\vec{b}}{|\vec{b}|^{2}}+\frac{\vec{a} \times \vec{b}}{|\vec{a} \times \vec{b}|^{\square}}$

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359. If $\vec{a}^{\prime}=\hat{i}+\hat{j}, \vec{b}^{\prime}=\hat{i}-\hat{j}+2 \hat{k}$ and $\vec{c}^{\prime}=2 \hat{i}+\hat{j}-\hat{k}$, then the altitude of the parallelepiped formed by the vectors $\vec{a}, \vec{b}$ and $\vec{c}$ having base formed by $\vec{b}$ and $\vec{c}$ is (where $\vec{a}^{\prime}$ is reciprocal vector $\vec{a}$ )

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360. If $\vec{a}=\hat{i}+\hat{j}, \vec{b}=\hat{j}+\hat{k}, \vec{c}=\hat{k}+\hat{i}$, then in the reciprocal system of vectors $\vec{a}, \vec{b}, \vec{c}$ reciprocal $\vec{a}$ of vector $\vec{a}$ is a. $\frac{\hat{i}+\hat{j}+\hat{k}}{2}$ b. $\frac{\hat{i}-\hat{j}+\hat{k}}{2}$ c. $\frac{-\hat{i}-\hat{j}+\hat{k}}{2}$ d. $\frac{\hat{i}+\hat{j}-\hat{k}}{2}$
361. If unit vectors $\vec{a} a n d \vec{b}$ are inclined at angle $2 \theta$ such that $|\vec{a}-\vec{b}|<1$ and $0 \leq \theta \leq \pi$, then $\theta$ lies in interval a.[0, $\pi / 6]$ b. $[5 \pi / 6, \pi]$ C.
$[\pi / 6, \pi / 2]$ d. $[\pi / 2,5 \pi / 6]$

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362. Let $\vec{a}, \vec{b}$ and $\vec{c}$ be three non-coplanar vectors and $\vec{p}$, $\vec{q} a n d \vec{r}$ the vectors
defined by the relation $\vec{p}=\frac{\vec{b} \times \vec{c}}{[\vec{a} \vec{b} \vec{c}]}, \vec{q}=\frac{\vec{c} \times \vec{a}}{[\vec{a} \vec{b} \vec{c}]}$ and $\vec{r}=\frac{\vec{a} \times \vec{b}}{[\vec{a} \vec{b} \vec{c}]}$. Then the
value of the expression $(\vec{a}+\vec{b}) \vec{p}+(\vec{b}+\vec{c}) \vec{q}+(\vec{c}+\vec{a}) \vec{r}$ is a. 0 b .1 c .2 d . 3

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363. Let $\vec{a}=a_{1} \hat{i}+a_{2} \hat{j}+a_{2} \hat{k}, \vec{b}=b_{1} \hat{i}+a_{2} \hat{j}+b_{2} \hat{k}$, and $\vec{c}=c_{1} \hat{i}+c_{2} \hat{j}+c_{2} \hat{k}$, be three non-zero vectors such that $\vec{c}$ is a unit vector perpendicular to both vectors $\vec{a}$ and $\vec{b}$. If the angle between $a$ and $b$ is $\pi / 6$, then

$$
\left|\begin{array}{lll}
a_{1} & a_{2} & a_{3} \\
b_{1} & b_{2} & b_{3} \\
c_{1} & c_{2} & c_{3}
\end{array}\right| \text { is equal to }
$$

A. (a) 0
B. (b) 1
C. (c) $\frac{1}{4}\left(a_{1}^{2}+a_{2}^{2}+a_{3}^{2}\right)\left(b_{1}^{2}+b_{2}^{2}+b_{3}^{2}\right)$
D. (d) $\frac{3}{4}\left(a_{1}^{2}+a_{2}^{2}+a_{3}^{2}\right)\left(b_{1}^{2}+b_{2}^{2}+b_{3}^{2}\right)\left(c_{1}^{2}+c_{2}^{2}+c_{3}^{2}\right)$

## Answer: null

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364. A, B, CandD are four points such that
$\vec{A} B=m(2 \hat{i}-6 \hat{j}+2 \hat{k}), \vec{B} C=(\hat{i}-2 \hat{j})$ and $\vec{C} D=n(-6 \hat{i}+15 \hat{j}-3 \hat{k}) \quad$ If $\quad C D$
intersects $A B$ at some point $E$, then a. $m \geq 1 / 2$ b. $n \geq 1 / 3$ c. $m=n$ d. $m<n$

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365. Let $\vec{a}=\hat{i}+\hat{j}+\hat{k}, \vec{b}=\hat{i}-\hat{j}+\hat{k}$ and $\vec{c}=\hat{i}-\hat{j}-\hat{k}$ be three vectors. A vector $\vec{v}$ in the plane of $\vec{a} a n d \vec{b}$, whose projection on $\vec{c}$ is $\frac{1}{\sqrt{3}}$ is given by a. $\hat{i}-3 \hat{j}+3 \hat{k}$ b. $-3 \hat{i}-3 \hat{j}+3 \hat{k} \mathrm{c} .3 \hat{i}-\hat{j}+3 \hat{k} \mathrm{~d} . \hat{i}+3 \hat{j}-3 \hat{k}$

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366. If $\hat{a}, \hat{b}$, and $\hat{c}$ are unit vectors, then $|\hat{a}+\hat{b}|^{2}+|\hat{b}-\hat{c}|^{2}+|\hat{c}-\hat{a}|^{2}$ does not exceed

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367. Which of the following expressions are meaningful? a. $\vec{u} .(\vec{v} \times \vec{w})$ b.
$\vec{u} \cdot \vec{v} \cdot \vec{w} \mathrm{c} \cdot(\vec{u} \vec{v}) \cdot \vec{w} \mathrm{~d} \cdot \vec{u} \times(\vec{v} \cdot \vec{w})$
368. Find the value of $\lambda$ if the volume of a tetrashedron whose vertices are with position vectors $\hat{i}-6 \hat{j}+10 \hat{k},-\hat{i}-3 \hat{j}+3 \hat{k}, 5 \hat{i}-\hat{j}+\lambda \hat{k} a n d 7 \hat{i}-4 \hat{j}+7 \hat{k}$ is 11 cubic unit.

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369. Let $\vec{a}=2 \hat{i}-\hat{j}+\hat{k}, \vec{b}=\hat{i}+2 \hat{j}=\hat{k} a n d \vec{c}=\hat{i}+\hat{j}-2 \hat{k}$ be three vectors. A vector in the plane of $\vec{b}$ and $\vec{c}$, whose projection on $\vec{a}$ is of magnitude $\sqrt{2 / 3}$, is a. $2 \hat{i}+3 \hat{j}-3 \hat{k}$ b. $2 \hat{i}-3 \hat{j}+3 \hat{k}$ c. $-2 \hat{i}-\hat{j}+5 \hat{k}$ d. $2 \hat{i}+\hat{j}+5 \hat{k}$

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370. If $(\vec{a} \times \vec{b}) \times(\vec{c} \times \vec{d}) \vec{a} \times \vec{d}=0$, then which of the following may be true? $\vec{a}, \vec{b}, \vec{c}$ and $\vec{d}$ are necessarily coplanar b. $\vec{a}$ lies in the plane of $\vec{c}$ and $\vec{d}$ c.
$\vec{b}$ lies in the plane of $\vec{a}$ and $\vec{d} \mathrm{~d} . \vec{c}$ lies in the plane of $\vec{a}$ and $\vec{d}$
371. Vector $\frac{1}{3}(2 i-2 j+k)$ is (A) a unit vector (B) makes an angle $\pi / 3$ with vector $(2 \hat{i}-4 \hat{j}+3 \hat{k})$ (C) parallel to vector $\left(-\hat{i}+\hat{j}-\frac{1}{2} \hat{k}\right)$ (D) perpendicular to vector $3 \hat{i}+2 \hat{j}-2 \hat{k}$

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372. Let $\vec{u}$ and $\vec{v}$ be unit vectors such that $\vec{u} \times \vec{v}+\vec{u}=\vec{w}$ and $\vec{w} \times \vec{u}=\vec{v}$.

Find the value of $[\vec{u} \vec{v} \vec{w}]$.

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373. The scalarslandm such that $l \vec{a}+m \vec{b}=\vec{c}$, where $\vec{a}$, $\vec{b}$ and $\vec{c}$ are given vectors, are equal to

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374. If $O A B C$ is a tetrahedron where $O$ is the orogin $\operatorname{anf} A, B$, and $C$ are the other three vertices with position vectors, $\vec{a}, \vec{b}$, and $\vec{c}$ respectively, then prove that the centre of the sphere circumscribing the tetrahedron is $a^{2}(\vec{b} \times \vec{c})+b^{2}(\vec{c} \times \vec{a})+c^{2}(\vec{a} \times \vec{b})$
given by position vector

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

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375. If $K$ is the length of any edge of a regular tetrahedron, then the distance of any vertex from the opposite face is

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376. In $\triangle A B C$, a point $P$ is taken on $A B$ such that $A P / B P=1 / 3$ and point $Q$ is taken on $B C$ such that $C Q / B Q=3 / 1$. If $R$ is the point of intersection of the lines $A Q a n d C P$, using vector method, find the area of
$A B C$ if the area of $B R C$ is 1 unit
377. Let $A B C D$ be a parallelogram whose diagonals intersect at $P$ and let $O$ be the origin. Then prove that $\vec{O} A+\vec{O} B+\vec{O} C+\vec{O} D=4 \vec{O} P$

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378. Find $\vec{a} \vec{b}$ when: $\vec{a}=\hat{j}-\hat{k}$ and $\vec{b}=2 \hat{i}+3 \hat{j}-2 \hat{k}$

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379. if $\vec{a}=2 \hat{i}-3 \hat{j}+\hat{k}$ and $\vec{b}=\hat{i}+2 \hat{j}-3 \hat{k}$ then $\vec{a} X \vec{b}$ is

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380. If $\vec{a}=x \hat{i}+y \hat{j}+z \hat{k}, \vec{b}=y \hat{i}+z \hat{j}+x \hat{k} \quad$ and $\vec{c}=x \hat{i}+x \hat{j}+y \hat{k}$, then $\vec{a} \times(\vec{b} \times \vec{c})$ is
A. (a) parallel to $(y-z) \hat{i}+(z-x) \hat{j}+(x-y) \hat{k}$
B. (b) orthogonal to $\hat{i}+\hat{j}+\hat{k}$
C. (c) orthogonal to $(y+z) \hat{i}+(z+x) \hat{j}+(x+y) \hat{k}$
D. (d) orthogonal to $x \hat{i}+y \hat{j}+z \hat{k}$

## Answer: null

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381. Find $|\rightarrow a \times \rightarrow b|$, if $\rightarrow a=2 \hat{i}+\hat{j}+3 \hat{k}$ and $\rightarrow b=3 \hat{i}+5 \hat{j}-2 \hat{k}$.

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382. find the value of $x, y$ and $z$ so that vectors $\vec{a}=x \hat{i}+2 \hat{j}+z \hat{k}$ and $\vec{b}=$ $2 \hat{i}+y \hat{j}+\hat{k}$ are equal

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383. The lengths of two opposite edges of a tetrahedron are $a$ and $b$; the shortest distane between these edges is $d$, and the angel between them is $\theta$ Prove using vectors that the volume of the tetrahedron is $\frac{a b d \sin \theta}{6}$.

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384. Volume of the parallelopiped whose adjacent edges are vectors $\vec{a}, \vec{b}, \vec{c}$ is

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385. If vectors $\vec{A}=2 \hat{i}+3 \hat{j}+4 \hat{k}, \vec{B}=\hat{i}+\hat{j}+5 \hat{k} a n d \vec{C}$ form a left-handed system, then $\vec{C}$ is a. $11 \hat{i}-6 \hat{j}-\hat{k}$ b. $-11 \hat{i}+6 \hat{j}+\hat{k}$ c. $11 \hat{i}-6 \hat{j}+\hat{k}$ d. $-11 \hat{i}+6 \hat{j}-\hat{k}$

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386. Let $a=2 i-j+k, b=i+2 j-k$ and $c=i+j-2 k$ be three vectors. $A$ vector in the plane of $b$ and $c$ whose projection on $a$ is of magnitude $\left(\frac{\sqrt{3}}{2}\right)$ is

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387. Vectors $\vec{A} a n d \vec{B}$ satisfying the vector equation
$\vec{A}+\vec{B}=\vec{a}, \vec{A} \times \vec{B}=\vec{b}$ and $\vec{A} \cdot \vec{a}=1$, where $\vec{a}$ and $\vec{b}$ are given vectors, are a.
$\vec{A}=\frac{(\vec{a} \times \vec{b})-\vec{a}}{a^{2}}$ b. $\quad \vec{B}=\frac{(\vec{b} \times \vec{a})+\vec{a}\left(a^{2}-1\right)}{a^{2}}$ c. $\vec{A}=\frac{(\vec{a} \times \vec{b})+\vec{a}}{a^{2}}$ d.
$\vec{B}=\frac{(\vec{b} \times \vec{a})-\vec{a}\left(a^{2}-1\right)}{a^{2}}$

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388. if $\left.\vec{\alpha}|\mid(\vec{\beta} \times \vec{\gamma})$, then $(\vec{\alpha} \times \beta) \cdot(\vec{\alpha} \times \vec{\gamma})$ equals to a. $| \vec{\alpha}\right|^{2}(\vec{\beta} \cdot \vec{\gamma})$ b. $|\vec{\beta}|^{2}(\vec{\gamma} \cdot \vec{\alpha})$ c. $|\vec{\gamma}|^{2}(\vec{\alpha} \cdot \vec{\beta})$ d. $|\vec{\alpha}||\vec{\beta}||\vec{\gamma}|$
389. Let $\vec{\alpha}=a \hat{i}+b \hat{j}+c \hat{k}, \vec{\beta}=b \hat{i}+c \hat{j}+a \hat{k} a n d \vec{\gamma}=c \hat{i}+a \hat{j}+b \hat{k}$ are three coplanar vectors with $a \neq b$, and $\vec{v}=\hat{i}+\hat{j}+\hat{k}$ Then $v$ is perpendicular to $\vec{\alpha}$ b. $\vec{\beta}$ c. $\vec{\gamma}$ d. none of these

## (D) Watch Video Solution

390. $a_{1}, a_{2}, a_{3}, \in R-\{0\}$ and $a_{1}+a_{2} \cos 2 x+a_{3} \sin ^{2} x=0$ for all $x \in R$, then
A. (a) vector $\vec{a}=a_{1} \hat{i}+a_{2} \hat{j}+a_{3} \hat{k}$ and $\vec{b}=4 \hat{i}+2 \hat{j}+\hat{k}$ are perpendicular to each other
B. (b) vector $\vec{a}=a_{1} \hat{i}+a_{2} \hat{j}+a_{3} \hat{k}$ and $\vec{b}=-\hat{i}+\hat{j}+2 \hat{k}$ are parallel to each other
C. (c) If vector $\vec{a}=a_{1} \hat{i}+a_{2} \hat{j}+a_{3} \hat{k}$ is of length $\sqrt{6}$ units, then one of the ordered triplet is $\left(a_{1}, a_{2}, a_{3}\right)=(1,-1,-2)$
D. (d) If $2 a_{1}+3 a_{2}+6 a_{3}=26$, then $\left|a_{1} \hat{i}+a_{2} \hat{j}+a_{3} \hat{k}\right|$ is $2 \sqrt{6}$

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391. If $P$ is any arbitrary point on the circumcircle of the equilateral triangle of side length $l$ units, then $|\vec{P} A|^{2}+|\vec{P} B|^{2}+|\vec{P} C|^{2}$ is always equal to $2 l^{2}$ b. $2 \sqrt{3} l^{2}$ c. $l^{2}$ d. $3 l^{2}$

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392. Let $\vec{a} a n d \vec{b}$ be two non-zero perpendicular vectors. A vecrtor $\vec{x}$ satisfying the equation $\vec{x} \times \vec{b}=\vec{a}$ is $\vec{x}=\beta \vec{b}-\frac{1}{|b|^{2}} \vec{a} \times \vec{b}$ then $\beta$ can be

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393. If $\vec{a} a n d \vec{b}$ are two vectors and angle between them is $\theta$, then
$|\vec{a} \times \vec{b}|^{2}+(\vec{a} \vec{b})^{2}=|\vec{a}|^{2}|\vec{b}|^{2} \quad|\vec{a} \times \vec{b}|=(\vec{a} \vec{b})$, if $\theta=\pi / 4$
$\vec{a} \times \vec{b}=(\vec{a} \vec{b}) \hat{n}$, (wheren is unit vector,) if $\theta=\pi / 4(\vec{a} \times \vec{b}) \vec{a}+\vec{b}=0$

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394. Let $\vec{r}$ be a unit vector satisfying
$\vec{r} \times \vec{a}=\vec{b}$, where $|\vec{a}|=\sqrt{3}$ and $|\vec{b}|=\sqrt{2}$. Then

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395. If vector $\vec{b}=(\tan \alpha,-1,2 \sqrt{\sin \alpha / 2}) \operatorname{and} \vec{c}=\left(\tan \alpha, \tan \alpha,-\frac{3}{\sqrt{\sin \alpha / 2}}\right)$ are orthogonal and vector $\vec{a}=(1,3, \sin 2 \alpha)$ makes an obtuse angle with the $z$-axis, then the value of $\alpha$ is
396. Let $\vec{a}, \vec{b}$, and $\vec{c}$ be non-zero vectors and $\vec{V}_{1}=\vec{a} \times(\vec{b} \times \vec{c}) \operatorname{and} \vec{V}_{2}=(\vec{a} \times \vec{b}) \times \vec{c}$. Vectors $\vec{V}_{1} a n d \vec{V}_{2}$ are equal. Then (a). $\vec{a} a n \vec{b}$ are orthogonal (b). $\vec{a} a n d \vec{c}$ are collinear (c). $\vec{b}$ and $\vec{c}$ are orthogonal (d). $\vec{b}=\lambda(\vec{a} \times \vec{c})$ when $\lambda$ is a scalar

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397. $\vec{a}=2 \hat{i}-\hat{j}+\hat{k}, \vec{b}=\hat{i}+2 \hat{j}-\hat{k}, \vec{c}=\hat{i}+\hat{j}-2 \hat{k} \quad$ A vector coplanar with $\vec{b}$ and $\vec{c}$ whose projectin on $\vec{a}$ is magnitude $\sqrt{\frac{2}{3}}$ is $2 \hat{i}+3 \hat{j}-3 \hat{k}$ b. $-2 \hat{i}-\hat{j}+5 \hat{k}$ c. $2 \hat{i}+3 \hat{j}+3 \hat{k}$ d. $2 \hat{i}+\hat{j}+5 \hat{k}$

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398. Let $\vec{P} R=3 \hat{i}+\hat{j}-2 \hat{k}$ and $\vec{S} Q=\hat{i}-3 \hat{j}-4 \hat{k}$ determine diagonals of a parallelogram PQRS, and $\vec{P} T=\hat{i}+2 \hat{j}+3 \hat{k}$ be another vector. Then the
volume of the parallelepiped determine by the vectors $\vec{P} T, \vec{P} Q$ and $\vec{P} S$ is 5 b. 20 c. 10 d. 30

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399. If in a right-angled triangle $A B C$, the hypotenuse $A B=p$,then
$\overrightarrow{A B} \cdot \overrightarrow{A C}+\overrightarrow{B C} \cdot \overrightarrow{B A}+\overrightarrow{C A} \cdot \overrightarrow{C B}$ is equal to $2 p^{2}$ b. $\frac{p^{2}}{2}$ c. $p^{2}$ d. none of these

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400. If $\vec{a}=(\hat{i}+\hat{j}+\hat{k})$, $\vec{a}$. $\vec{b}=$ and $\vec{a} \times \vec{b}=\hat{j}-\hat{k}$, then $\hat{b}$ is $\hat{i}-\hat{j}+\hat{k} \mathrm{~b} .2 \hat{j}-\hat{k}$ c. $\hat{i}$ d. $2 \hat{i}$

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401. If $\vec{a}$ satisfies $\vec{a} \times(\hat{i}+2 \hat{j}+\hat{k})=\hat{i}-\hat{k}$, then $\vec{a}$ is equal to a.

$$
\text { b. } \quad \lambda \hat{i}+(1-2 \lambda) \hat{j}+\lambda \hat{k}, \lambda \in R
$$

$$
\begin{aligned}
& \lambda \hat{i}+(2 \lambda-1) \hat{j}+\lambda \hat{k}, \lambda \in R \quad \text { b. } \quad \lambda \hat{i}+(1-2 \lambda) \\
& \lambda \hat{i}+(2 \lambda+1) \hat{j}+\lambda \hat{k}, \lambda \in R \text { d. } \lambda \hat{i}-(1+2 \lambda) \hat{j}+\lambda \hat{k}, \lambda \in R
\end{aligned}
$$

c.

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402. If $\vec{r} \vec{a}=\vec{r} \vec{b}=\vec{r} \vec{c}=0$, where $\vec{a}, \vec{b}$, and $\vec{c}$ are non-coplanar, then a.

$$
\vec{r} \perp(\vec{c} \times \vec{a}) \text { b. } \vec{r} \perp(\vec{a} \times \vec{b}) \text { c. } \vec{r} \perp(\vec{b} \times \vec{c}) \text { d. } \vec{r}=\overrightarrow{0}
$$

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403. The unit vector orthogonal to vector $-\hat{i}+\hat{j}+2 \hat{k}$ and making equal angles with the $x$ and $y$-axis a. $\pm \frac{1}{3}(2 \hat{i}+2 \hat{j}-\hat{k})$ b. $\pm \frac{1}{3}(\hat{i}+\hat{j}-\hat{k})$ c. $\pm \frac{1}{3}(2 \hat{i}-2 \hat{j}-\hat{k}) \mathrm{d}$. none of these

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404. Vectors $3 \vec{a}-5 \vec{b}$ and $2 \vec{a}+\vec{b}$ are mutually perpendicular. If $\vec{a}+4 \vec{b}$ and $\vec{b}-\vec{a}$ are also mutually perpendicular, then the cosine of the angle between $a$ and $b$ is a. $\frac{19}{5 \sqrt{43}}$ b. $\frac{19}{3 \sqrt{43}}$ c. $\frac{19}{2 \sqrt{45}}$ d. $\frac{19}{6 \sqrt{43}}$
405. If vectors $\vec{a}$ and $\vec{b}$ are two adjacent sides of a parallelogram, then the vector respresenting the altitude of the parallelogram which is the perpendicular to $\vec{a}$ is a. $\vec{b}+\frac{\vec{b} \times \vec{a}}{|\vec{a}|^{2}}$ b. $\frac{\vec{a} \cdot \vec{b}}{|\vec{b}|^{2}}$ c. $\vec{b}-\frac{(\vec{b} \cdot \vec{a}) \vec{a}}{|\vec{a}|^{2}}$ d. $\frac{\vec{a} \times(\vec{b} \times \vec{a})}{|\vec{b}|^{2}}$

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406. The value of $x$ for which the angle between $\vec{a}=2 x^{2} \hat{i}+4 x \hat{j}+\hat{k}$ and $\vec{b}=7 \hat{i}-2 \hat{j}+\hat{k}$ is obtuse and the angle between $b$ and the z -axis acute and less than $\pi / 6$ is given by

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407. Let $\vec{a} \cdot \vec{b}=0$, where $\vec{a} a n d \vec{b}$ are unit vectors and the unit vector $\vec{c}$ is inclined at an angle $\theta$ to both $\vec{a}$ and $\vec{b}$ If
$\vec{c}=m \vec{a}+n \vec{b}+p(\vec{a} \times \vec{b}),(m, n, p \in R)$, then a.- $\frac{\pi}{4} \leq \theta \leq \frac{\pi}{4}$ b. $\frac{\pi}{4} \leq \theta \leq \frac{3 \pi}{4}$
c. $0 \leq \theta \leq \frac{\pi}{4}$ d. $0 \leq \theta \leq \frac{3 \pi}{4}$

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408. 

A parallelogram
is constructed
on
$3 \vec{a}+\vec{b}$ and $\vec{a}-4 \vec{b}$, where $|\vec{a}|=6$ and $|\vec{b}|=8$, and $\vec{a} a n d \vec{b}$ are anti-parallel. Then the length of the longer diagonal is 40 b .64 c .32 d .48

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409. Let the position vectors of the points PandQ be $4 \hat{i}+\hat{j}+\lambda \hat{k}$ and $2 \hat{i}-\hat{j}+\lambda \hat{k}$, respectively. Vector $\hat{i}-\hat{j}+6 \hat{k}$ is perpendicular to the plane containing the origin and the points PandQ. Then $\lambda$ equals a $-1 / 2$ b. 1/2 c. 1 d. none of these

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410. If $a$ and $c$ are unit vectors and $|b|=4$. The angel between aandc is $\cos ^{-1}(1 / 4)$ and $a \times b=2 a \times c$ then, $b-2 c=\lambda a$ The value of $\lambda$ is

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411. If $\vec{d}=\vec{a} \times \vec{b}+\vec{b} \times \vec{c}+\vec{c} \times \vec{a}$ is non-zero vector and
$|(\vec{d} \cdot \vec{c})(\vec{a} \times \vec{b})+(\vec{d} \cdot \vec{a})(\vec{b} \times \vec{c})+(\vec{d} \cdot \vec{b})(\vec{c} \times \vec{a})|=0, \quad$ then $\quad$ a.
$|\vec{a}|=|\vec{b}|=|\vec{c}|$ b. $|\vec{a}|+|\vec{b}|+|\vec{c}|=|d|$ c. $\vec{a}, \vec{b}$, and $\vec{c}$ are coplanar d. none of these

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412. Let $\vec{a}, \vec{b}$, and $\vec{c}$ be three non-coplanar vectors and $\vec{d}$ be a non-zero vector, which is perpendicular to $(\vec{a}+\vec{b}+\vec{c})$ Now
$\vec{d}=(\vec{a} \times \vec{b}) \sin x+(\vec{b} \times \vec{c}) \cos y+2(\vec{c} \times \vec{a})$ Then $\quad$ a. $\frac{\vec{d} \vec{a}+\vec{c}}{[\vec{a} \vec{b} \vec{c}]}=2$
b.
 $[\vec{a} \vec{b} \vec{c}]$
$x^{2}+y^{2}$ is $5 \pi^{2} / 4$

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413. If $\vec{a}+2 \vec{b}+3 \vec{c}=0$, then $\vec{a} \times \vec{b}+\vec{b} \times \vec{c}+\vec{c} \times \vec{a}=$ a. $2(\vec{a} \times \vec{b})$ b. $6(\vec{b} \times \vec{c})$ c. $3(\vec{c} \times \vec{a})$ d. $\overrightarrow{0}$

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414. If $\vec{a}$ and $\vec{b}$ are two non-collinear unit vector, and $|\vec{a}+\vec{b}|=3$ then $(2 \vec{a}-5 \vec{b}) \cdot(3 \vec{a}+\vec{b})=$
415. The angles of triangle, two of whose sides are represented by vectors
$\sqrt{3}(\vec{a} \times \vec{b})$ and $\vec{b}-(\hat{a} \vec{b}) \hat{a}$, where $\vec{b}$ is a non zero vector and $\hat{a}$ is unit vector in the direction of $\vec{a}$, are

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416. $\vec{a}, \vec{b}$, and $\vec{c}$ are unimodular and coplanar. A unit vector $\vec{d}$ is perpendicular to then. If $(\vec{a} \times \vec{b}) \times(\vec{c} \times \vec{d})=\frac{1}{6} \hat{i}-\frac{1}{3} \hat{j}+\frac{1}{3} \hat{k}$, and the angel between $\vec{a}$ and $\vec{b}$ is $30^{0}$, then $\vec{c}$ is a. $(\hat{i}-2 \hat{j}+2 \hat{k}) / 3$ b. $(-\hat{i}+2 \hat{j}-2 \hat{k}) / 3$
c. $(2 \hat{i}+2 \hat{j}-\hat{k}) / 3$ d. $(-2 \hat{i}-2 \hat{j}+\hat{k}) / 3$

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417. Vectors perpendicular to $\hat{i}-\hat{j}-\hat{k}$ and in the plane of $\hat{i}+\hat{j}+\hat{k}$ and $-\hat{i}+\hat{j}+\vec{k}$ are $\hat{i}+\hat{k}$ b. $2 \hat{i}+\hat{j}+\hat{k}$ c. $3 \hat{i}+2 \hat{j}+\hat{k}$ d. $-4 \hat{i}-2 \hat{j}-2 \hat{k}$
418. If side $\vec{A} B$ of an equilateral strangle $A B C$ lying in the $x$-y plane $3 \hat{i}$, then side $\vec{C} B$ can be a. $-\frac{3}{2}(\hat{i}-\sqrt{3 \dot{j}})$ b. $-\frac{3}{2}(\hat{i}-\sqrt{3} \hat{j})$ c. $-\frac{3}{2}(\hat{i}+\sqrt{3} \hat{j})$ d. $\frac{3}{2}(\hat{i}+\sqrt{3} \hat{j})$

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419. 36. If $\vec{a}, \vec{b}, \vec{c}$ and $\vec{d}$ are unit vectors such that $(\vec{a} \times \vec{b}) \cdot \vec{c} \times \vec{d}=1$ and $\vec{a} . \vec{c}=\frac{1}{2}$ then a) $\vec{a}, \vec{b}$ and $\vec{c}$ are non-coplanar b) $\vec{b}, \vec{c}, \vec{d}$ are non -coplanar c) $\vec{b}, \vec{d}$ are non parallel d) $\vec{a}, \vec{d}$ are parallel and $\vec{b}, \vec{c}$ are parallel

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420. Let two non-collinear unit vector $\hat{a}$ a $\mathrm{n} d \hat{b}$ form an acute angle. A point $P$ moves so that at any time $t$, the position vector $O P$ (where $O$ is the origin) is given by a cost $+\hat{b} \operatorname{sintWhenP}$ is farthest from origin $O$, let $M$ be the length of OPandu be the unit vector along $O P$ Then (a)
$\hat{u}=\frac{\hat{a}+\hat{b}}{|\hat{a}+\hat{b}|} \operatorname{andM}=(1+\hat{a} \hat{b})^{1 / 2} \quad$ (b) $\hat{u}=\frac{\hat{a}-\hat{b}}{|\hat{a}-\hat{b}|}$ andM $=\left(1+\hat{a}^{\wedge}\right)^{1 / 2}$
$\hat{u}=\frac{\hat{a}+\hat{b}}{|\hat{a}+\hat{b}|} \operatorname{andM}=(1+2 \hat{a} \hat{b})^{1 / 2}$ (d) $\hat{u}=\frac{\hat{a}-\hat{b}}{|\hat{a}-\hat{b}|}$ andM $=(1+2 \hat{a} \hat{b})^{1 / 2}$

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421. Let $\vec{a}=\hat{i}+2 \hat{j}+\hat{k}, \vec{b}=\hat{i}-\hat{j}+\hat{k}$ and $\vec{c}=\hat{i}+\hat{j}-\hat{k}$ A vector in the plane of $\vec{a}$ and $\vec{b}$ whose projection of $c$ is $1 / \sqrt{3}$ is a. $4 \hat{i}-\hat{j}+4 \hat{k}$ b. $3 \hat{i}+\hat{j}+3 \hat{k}$ c. $2 \hat{i}+\hat{j}+2 \hat{k}$ d. $4 \hat{i}+\hat{j}-4 \hat{k}$

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422. If $\vec{a}, \vec{b}$ and $\vec{c}$ are three non-zero, non coplanar vector $\vec{b}_{1}=\vec{b}-\frac{\vec{b} \vec{a}}{|\vec{a}|^{2}} \vec{a}$,
$\vec{c}_{1}=\vec{c}-\frac{\vec{\cdot} \vec{a}}{|\vec{a}|^{2}} \vec{a}+\frac{\vec{b} \vec{c}}{|\vec{c}|^{2}} \vec{b}_{1} \quad, \quad, c_{2}=\vec{c}-\frac{\vec{\cdot} \vec{a}}{|\vec{a}|^{2}} \vec{a}-\frac{\vec{b} \vec{c}}{\left|\vec{b}_{1}\right|^{2}}$
$b_{1}, \vec{c}_{3}=\vec{c}-\frac{\vec{\cdot} \vec{a}}{|\vec{c}|^{2}} \vec{a}+\frac{\vec{b} \vec{c}}{|\vec{c}|^{2}} \vec{b}_{1}, \vec{c}_{4}=\vec{c}-\frac{\vec{a} \vec{a}}{|\vec{c}|^{2}} \vec{a}=\frac{\vec{b} \vec{c}}{|\vec{b}|^{2}} \vec{b}_{1}$ then the set of orthogonal vectors is $\left(\vec{a}, \vec{b}_{1}, \vec{c}_{3}\right)$ b. $\left(\vec{a}, \vec{b}_{1}, \vec{c}_{2}\right)$
c. $\left(\vec{a}, \vec{b}_{1}, \vec{c}_{1}\right) \mathrm{d}$. $\left(\vec{a}, \vec{b}_{2}, \vec{c}_{2}\right)$

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423. The unit vector which is orthogonal to the vector $3 \hat{j}+2 \hat{j}+6 \hat{k}$ and is coplanar with vectors $2 \hat{i}+\hat{j}+\hat{k}$ and $\hat{i}-\hat{j}+\hat{k}$ is $\frac{2 \hat{i}-6 \hat{j}+\hat{k}}{\sqrt{41}}$ b. $\frac{2 \hat{i}-3 \hat{j}}{\sqrt{13}}$ c. $\frac{3 \hat{j}-\hat{k}}{\sqrt{10}}$
d. $\frac{4 \hat{i}+3 \hat{j}-3 \hat{k}}{\sqrt{34}}$

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424. If $\vec{a}$ and $\vec{b}$ are unequal unit vectors such that $(\vec{a}-\vec{b}) \times[(\vec{b}+\vec{a}) \times(2 \vec{a}+\vec{b})]=\vec{a}+\vec{b}$, then angle $\theta$ between $\vec{a}$ and $\vec{b}$ is 0 b. $\pi / 2 \mathrm{c} . \pi / 4 \mathrm{~d} . \pi$
425. If $\vec{a}, \vec{b}, \vec{c}$ are 3 unit vectors such that $\vec{a} \times(\vec{b} \times \vec{c})=\frac{\vec{b}}{2}$ then $(\vec{b}$ and $\vec{c}$ being non parallel). (a)angle between $\vec{a} \& \vec{b}$ is $\frac{\pi}{3}$ (b)angle between $\vec{a}$ and $\vec{c}$ is $\frac{\pi}{3}$ (c)angle between $\vec{a}$ and $\vec{b}$ is $\frac{\pi}{2}$ (d)angle between $\vec{a}$ and $\vec{c}$ is $\frac{\pi}{2}$

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426. If in triangle $A B C, \vec{A} B=\frac{\vec{u}}{|\vec{u}|}-\frac{\vec{v}}{|\vec{v}|} \operatorname{and} \vec{A} C=\frac{2 \vec{u}}{|\vec{u}|}$, where $|\vec{u}| \neq|\vec{v}|$, then
a. $1+\cos 2 A+\cos 2 B+\cos 2 C=0$
b. $\sin A=\cos C$
c. projection of $A C$ on $B C$ is equal to $B C$
d. projection of $A B$ on $B C$ is equal to $A B$

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427. A vector $\vec{d}$ is equally inclined to three vectors $\vec{a}=\hat{i}+\hat{j}+\hat{k}, \vec{b}=2 \hat{i}+\hat{j}$ and $\vec{c}=3 \hat{j}-2 \hat{k}$ Let $\vec{x}, \vec{y}$, and $\vec{z}$ be three vectors in the plane of $\vec{a}, \vec{b} ; \vec{b}, \vec{c} ; \vec{c}, \vec{a}$, respectively. Then a. $\vec{x} . \vec{d}=-1$ b. $\vec{y} . \vec{d}=1$ C.
$\vec{z} \cdot \vec{d}=0 \mathrm{~d} \cdot \vec{r} \cdot \vec{d}=0$, where $\vec{r}=\lambda \vec{x}+\mu \vec{y}+\delta \vec{z}$

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428. If $a \times(b \times c)=(a \times b) \times c$, then $(\vec{c} \times \vec{a}) \times \vec{b}=\overrightarrow{0} b . \vec{c} \times(\vec{a} \times \vec{b})=\overrightarrow{0} c$. $\vec{b} \times(\vec{c} \times \vec{a})=0$ d. $(\vec{c} \times \vec{a}) \times \vec{b}=\vec{b} \times(\vec{c} \times \vec{a})=\overrightarrow{0}$

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429. If $\hat{a}, \hat{b}$, and $\hat{c}$ are three unit vectors inclined to each other at angle $\theta$, then the maximum value of $\theta$ is $\frac{\pi}{3}$ b. $\frac{\pi}{4}$ c. $\frac{2 \pi}{3}$ d. $\frac{5 \pi}{6}$

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430. Let the pairs $a, b$, and $c, d$ each determine a plane. Then the planes are parallel if a. $(\vec{a} \times \vec{c}) \times(\vec{b} \times \vec{d})=\overrightarrow{0} \quad$ b. $\quad(\vec{a} \times \vec{c}) \cdot(\vec{b} \times \vec{d})=\overrightarrow{0} \quad$ c. $(\vec{a} \times \vec{b}) \times(\vec{c} \times \vec{d})=\overrightarrow{0}$ d. $(\vec{a} \times \vec{b}) \cdot(\vec{c} \times \vec{d})=\overrightarrow{0}$

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431. $P(\vec{p})$ and $Q(\vec{q})$ are the position vectors of two fixed points and $R(\vec{r})$ is the position vectorvariable point. If R moves such that $(\vec{r}-\vec{p}) \times(\vec{r}-\vec{q})=0$ then the locus of R is

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432. Two adjacent sides of a parallelogram $A B C D$ are $2 \hat{i}+4 \hat{j}-5 \hat{k}$ and $\hat{i}+2 \hat{j}+3 \hat{k}$. Then the value of $|A C \times B D|$ is a. $20 \sqrt{5}$ b. $22 \sqrt{5}$ c. $24 \sqrt{5}$ d. $26 \sqrt{5}$

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433. If $\vec{a}$ and $\vec{b}$ are two unit vectors and $\theta$ is the angle between them, then the unit vector along the angular bisector of $\vec{a}$ and $\vec{b}$ will be given by

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434. If $\vec{a}, \vec{b}, \vec{c}$ are unit vectors such that $\vec{a} \vec{b}=0=\vec{a} \vec{c}$ and the angle between $\vec{b}$ and $\vec{c}$ is $\pi / 3$, then the value of $|\vec{a} \times \vec{b}-\vec{a} \times \vec{c}|$ is $1 / 2 \mathrm{~b} .1 \mathrm{c} .2 \mathrm{~d}$. none of these

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435. Let $\vec{a}=\hat{i}+\hat{j} ; \vec{b}=2 \hat{i}-\hat{k}$ Then vector $\vec{r}$ satisfying $\vec{r} \times \vec{a}=\vec{b} \times \vec{a}$ and $\vec{r} \times \vec{b}=\vec{a} \times \vec{b}$ then $\vec{r}$ is a. $\hat{i}-\hat{j}+\hat{k}$ b. $3 \hat{i}-\hat{j}+\hat{k}$ c. $3 \hat{i}+\hat{j}-\hat{k}$ d. $\hat{i}-\hat{j}-\hat{k}$

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436. If $\vec{a}$ and $\vec{b}$ are two vectors, such that $\vec{a} \cdot \vec{b}<0$ and $|\vec{a} \cdot \vec{b}|=|\vec{a} \times \vec{b}|$, then the angle between vectors $\vec{a}$ and $\vec{b}$ is a $\pi \mathrm{b} .7 \pi / 4 \mathrm{c} . \pi / 4 \mathrm{~d} .3 \pi / 4$

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437. $\vec{a}, \vec{b}$, and $\vec{c}$ are three vectors of equal magnitude. The angel between each pair of vectors is $\pi / 3$ such that $|\vec{a}+\vec{b}+\vec{c}|=\sqrt{6}$. Then $|\vec{a}|$ is equal to a.2 b. -1 c. 1 d. $\sqrt{6} / 3$

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438. If $\vec{a}, \vec{b}$ and $\vec{c}$ are three mutually perpendicular vectors, then the vector which is equally inclined to these vectors is a. $\vec{a}+\vec{b}+\vec{c}$ b. $\frac{\vec{a}}{|\vec{a}|}+\frac{\vec{b}}{|\vec{b}|}+\frac{\vec{c}}{|\vec{c}|}$ c. $\frac{\vec{a}}{|\vec{a}|^{2}}+\frac{\vec{b}}{|\vec{b}|^{2}}+\frac{\vec{c}}{|\vec{c}|^{2}}$ d. $|\vec{a}| \vec{a}-|\vec{b}| \vec{b}+|\vec{c}| \vec{c}$

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439. Let $\vec{a}$ and $\vec{b}$ be two non-collinear unit vector. If
$\vec{u}=\vec{a}-(\vec{a} \vec{b}) \vec{b}$ and $\vec{v}=\vec{a} \times \vec{b}$, then $|\vec{v}|$ is $|\vec{u}|$ b. $|\vec{u}|+|\vec{u} \vec{a}|$ c. $|\vec{u}|+|\vec{u} \vec{b}|$ d.
$|\vec{u}|+\hat{u}|\vec{a}+\vec{b}|$

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440. The vertex $A$ triangle $A B C$ is on the line $\vec{r}=\hat{i}+\hat{j}+\lambda \hat{k}$ and the vertices Band have respective position vectors $\hat{i} a n d \hat{j}$ Let Delta be the area of the triangle and Delta $[3 / 2, \sqrt{33} / 2]$. Then the range of values of $\lambda$ corresponding to $A$ is $a .[-8,4] \cup[4,8]$ b. $[-4,4]$
c. [-2, 2]
d. $[-4,-2] \cup[2,4]$

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441. If $a$ is real constant $A, B$ and $C$ are variable angles and $\sqrt{a^{2}-4} \tan A+a \tan B+\sqrt{a^{2}+4} \tan C=6 a$, then the least value of
$\tan ^{2} A+\tan ^{2} B+\tan ^{2} C$ is a. 6 b. 10 c. 12 d. 3

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442. The position vectors of the vertices $A$, BandC of a triangle are three unit vectors $\vec{a}, \vec{b}$, and $\vec{c}$, respectively. A vector $\vec{d}$ is such that $\vec{d} \vec{a}=\vec{d} \vec{b}=\vec{d} \vec{c}$ and $\vec{d}=\lambda(\vec{b}+\vec{c})$ Then triangle $A B C$ is a. acute angled $b$. obtuse angled c. right angled d. none of these

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443. Given that $\vec{a}, \vec{b}, \vec{p}, \vec{q}$ are four vectors such that $\vec{a}+\vec{b}=\mu \vec{p}, \vec{b} \cdot \vec{q}=0$ and $|\vec{b}|^{2}=1$, where $\mu \quad$ is a scalar. Then
$|(\vec{a} \vec{q}) \vec{p}-(\vec{p} \vec{q}) \vec{a}|$ is equal to (a) $2|\vec{p} \cdot \vec{q}|$ (b) (1/2) $|\vec{p} \cdot \vec{q}|$ (c) $|\vec{p} \times \vec{q}|$
$|\vec{p} \cdot \vec{q}|$
444. In AB, DE and GF are parallel to each other and AD, BG and EF ar parallel to each other. If $C D: C E=C G: C B=2: 1$ then the value of area ( $\triangle A E G$ ): area $(\triangle A B D$ ) is equal to (a) $7 / 2$ (b)3 (c)4 (d) $9 / 2$

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445. In a quadrilateral $A B C D, \vec{A} C$ is the bisector of $\vec{A} B a n d \vec{A} D$, angle between $\vec{A} B$ and $\vec{A} D$ is $2 \pi / 3,15|\vec{A} C|=3|\vec{A} B|=5|\vec{A} D|$ Then the angle between $\vec{B}$ Aand $\vec{C} D$ is $\frac{\cos ^{-1}(\sqrt{14})}{7 \sqrt{2}}$ b. $\frac{\cos ^{-1}(\sqrt{21})}{7 \sqrt{3}}$ c. $\frac{\cos ^{-1} 2}{\sqrt{7}}$ d. $\cos ^{-1}(2 \sqrt{7})$ 14

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446. Position vector $\hat{k}$ is rotated about the origin by angle $135^{\circ}$ in such a way that the plane made by it bisects the angle between $\hat{i}$ and $\hat{j}$. Then its new position is
A. a. $\pm \frac{\hat{i}}{\sqrt{2}} \pm \frac{\hat{j}}{\sqrt{2}}$
B. b. $\pm \frac{\hat{i}}{2} \pm \frac{\hat{j}}{2}-\frac{\hat{k}}{\sqrt{2}}$
C. c. $\frac{\hat{i}}{\sqrt{2}}-\frac{\hat{k}}{\sqrt{2}}$
D. d. none of these

## Answer: null

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447. A non-zero vector $\vec{a}$ is such that its projections along vectors
$\frac{\hat{i}+\hat{j}}{\sqrt{2}}, \frac{-\hat{i}+\hat{j}}{\sqrt{2}}$ and $\hat{k}$ are equal, then unit vector along $\vec{a}$ is a. $\frac{\sqrt{2} \hat{j}-\hat{k}}{\sqrt{3}}$ b.
$\frac{\hat{j}-\sqrt{2} \hat{k}}{\sqrt{3}}$ c. $\frac{\sqrt{2}}{\sqrt{3}} \hat{j}+\frac{\hat{k}}{\sqrt{3}}$ d. $\frac{\hat{j}-\hat{k}}{\sqrt{2}}$

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448. Let $\vec{a}=2 \hat{i}+\hat{j}+\hat{k}, \vec{b}=\hat{i}+2 \hat{j}-\hat{k}$ and a unit vector $\vec{c}$ be coplanar. If $\vec{c}$ is perpendicular to $\vec{a}$, then $\vec{c}$ is a. $\frac{1}{\sqrt{2}}(-\hat{j}+\hat{k})$ b. $\frac{1}{\sqrt{3}}(-\hat{i}-\hat{j}-\hat{k})$ C. $\frac{1}{\sqrt{5}}(-\hat{k}-2 \hat{j})$ d. $\frac{1}{\sqrt{3}}(\hat{i}-\hat{j}-\hat{k})$

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449. Let $\vec{a}=2 i+j-2 k a n d \vec{b}=i+j$ If $\vec{c}$ is a vector such that $\vec{a} . \vec{c}=|\vec{c}|,|\vec{c}-\vec{a}|=2 \sqrt{2}$ between $\vec{a} \times \vec{b}$ and $\vec{c}$ is $30^{0}$, then $|(\vec{a} \times \vec{b}) \times \vec{c}|$ । equal to a. $2 / 3 \mathrm{~b} .3 / 2 \mathrm{c} .2$ d. 3

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450. Let $A B C D$ be a tetrahedron such that the edges $A B, A C$ and $A D$ are mutually perpendicular. Let the area of triangles $A B C, A C D$ and $A D B$ be 3,4 and 5 sq. units, respectively. Then the area of triangle $B C D$ is a. $5 \sqrt{2}$
b. 5
c. $\frac{-}{2}$
d. $\frac{5}{2}$

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451. Vector $\vec{a}$ in the plane of $\vec{b}=2 \hat{i}+\hat{j}$ and $\vec{c}=\hat{i}-\hat{j}+\hat{k}$ is such that it equally inclined to $\vec{b}$ and $\vec{d}$ where $\vec{d}=\hat{j}+2 \hat{k}$ The value of $\vec{a}$ is a. $\frac{\hat{i}+\hat{j}+\hat{k}}{\sqrt{2}}$ b. $\frac{\hat{i}-\hat{j}+\hat{k}}{\sqrt{3}}$ c. $\frac{2 \hat{i}+\hat{j}}{\sqrt{5}}$ d. $\frac{2 \hat{i}+\hat{j}}{\sqrt{5}}$

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452. If $\vec{a}, \vec{b}$ and $\vec{c}$ are non-coplanar unit vectors such that $\vec{a} \times(\vec{b} \times \vec{c})=\frac{\vec{b}+\vec{c}}{\sqrt{2}}$, then the angle between $\vec{a}$ and $\vec{b}$ is a. $3 \pi / 4 \mathrm{~b} . \pi / 4 \mathrm{c}$. $\pi / 2$ d. $\pi$

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453. 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 $\vec{u} \cdot \vec{v}+\vec{v} \cdot \vec{w}+\vec{w} \cdot \vec{u}$ is a. 47 b. -25 c. 0 d. 25

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454. If $\vec{a}, \vec{b}$ and $\vec{c}$ are three non-coplanar vectors, then $(\vec{a}+\vec{b}+\vec{c}) \cdot[(\vec{a}+\vec{b}) \times(\vec{a}+\vec{c})]$ equals a. 0 b. $[\vec{a} \vec{b} \vec{c}]$ c. $2[\vec{a} \vec{b} \vec{c}]$
d. $-[\vec{a} \vec{b} \vec{c}]$

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455. Let $\vec{p}$ and $\vec{q}$ be any two orthogonal vectors of equal magnitude 4 each.

Let $\vec{a}, \vec{b}$, and $\vec{c}$ be any three vectors of lengths $7 \sqrt{15}$ and $2 \sqrt{33}$, mutually perpendicular to each other. Then find the distance of the vector

$$
(\vec{a} \vec{p}) \vec{p}+(\vec{a} \vec{q}) \vec{q}+(\vec{a} \vec{p} \times \vec{q})(\vec{p} \times \vec{q})+(\vec{b} \vec{p}) \vec{p}(\vec{b} \vec{q}) \vec{q}+(\vec{b} \vec{p} \times \vec{q})(\vec{p} \times \vec{q})+(
$$

from the origin.
456. Let $\vec{a}, \vec{b}$ and $\vec{c}$ be three non-coplanar vecrors and $\vec{r}$ be any arbitrary vector. Then $(\vec{a} \times \vec{b}) \times(\vec{r} \times \vec{c})+(\vec{b} \times \vec{c}) \times(\vec{r} \times \vec{a})+(\vec{c} \times \vec{a}) \times(\vec{r} \times \vec{b})$ is always equal to $[\vec{a} \vec{b} \vec{c}] \vec{r}$ b. $2[\vec{a} \vec{b} \vec{c}] \vec{r}$ c. $3[\vec{a} \vec{b} \vec{c}] \vec{r}$ d. none of these

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

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458. Consider three vectors $\vec{a}, \vec{b}$ and $\vec{c}$ Statement 1 $\vec{a} \times \vec{b}=((\hat{i} \times \vec{a}) \cdot \vec{b}) \hat{i}+((\hat{j} \times \vec{a}) \cdot \vec{b}) \hat{j}+((\hat{k} \times \vec{a}) \cdot \vec{b}) \hat{k} \quad$ Statement $\quad 2:$ $\vec{c}=(\hat{i} \cdot \vec{c}) \hat{i}+(\hat{j} \cdot \vec{c}) \hat{j}+(\hat{k} \cdot \vec{c}) \hat{k}$

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459. Column I, Column II The possible value of $\vec{a}$ if $\vec{r}=(\hat{i}+\hat{j})+\lambda(\hat{i}+2 \hat{i}-\hat{k})$ and $\vec{r}=(\hat{i}+2 \hat{j})+\mu(-\hat{i}+\hat{j}+a \hat{k})$ are not consistent, where $\lambda$ and $\mu$ are scalars, is, p. -4 The angel between vectors $\vec{a}=\lambda \hat{i}-3 \hat{j}-\hat{k} a n d \vec{b}=2 \lambda \hat{i}+\lambda \hat{j}-\hat{k}$ is acute, whereas vector $\vec{b}$ makes an obtuse angel with the axes of coordinates. Then $\lambda$ may be, q. -2 The possible value of $a$ such that $2 \hat{i}-\hat{j}+\hat{k}, \hat{i}+2 \hat{j}+(1+a) k a n d 3 \hat{i}+a \hat{j}+5 \hat{k}$ are coplanar is, r. 2 If $\vec{A}=2 \hat{i}+\lambda \hat{j}+3 \hat{k}, \vec{B}=2 \hat{i}+\lambda \hat{j}+\hat{k}, \vec{C}=3 \hat{i}+\hat{j} a n d \vec{A}+\lambda \vec{B}$ is perpendicular to $\vec{C}$ then $|2 \lambda|$ is, s. 3

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460. If $\vec{A}, \vec{B}$ and $\vec{C}$ are vectors such that $|\vec{B}|-|\vec{C}|$. Prove that $[(\vec{A}+\vec{B}) \times(\vec{A}+\vec{C})] \times(\vec{B}+\vec{C}) \cdot(\vec{B}+\vec{C})=0$

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$3 \vec{a}+\vec{b}$ and $\vec{a}-4 \vec{b}$, where $|\vec{a}|=6$ and $|\vec{b}|=8$, and $\vec{a} a n d \vec{b}$ are anti-parallel. Then the length of the longer diagonal is 40 b .64 c .32 d .48

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462. Statement 1 : Vector $\vec{c}=-5 \hat{i}+7 \hat{j}+2 \hat{k}$ is along the bisector of angel between $\vec{a}=\hat{i}+2 \hat{j}+2 \hat{k} a n d \vec{b}=8 \hat{i}+\hat{j}-4 \hat{k} \quad$ Statement $2: \quad \vec{c} \quad$ is equally inclined to $\vec{a} a n d \vec{b}$

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463. Statement 1: A component of vector $\vec{b}=4 \hat{i}+2 \hat{j}+3 \hat{k}$ in the direction perpendicular to the direction of vector $\vec{a}=\hat{i}+\hat{j}+\hat{k} i s \hat{i}-\hat{j}$ Statement 2 : A component of vector in the direction of $\vec{a}=\hat{i}+\hat{j}+\hat{k}$ is $2 \hat{i}+2 \hat{j}+2 \hat{k}$
464. Statement 1 : Points $A(1,0), B(2,3), C(5,3)$, and $D(6,0)$ are concyclic. Statement 2 : Points $A, B, C, a n d D$ form an isosceles trapezium or ABandCD meet at $E$ Then EAEB $=E C E D$

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465. Let $\vec{r}$ be a non-zero vector satisfying $\vec{r} \vec{a}=\vec{r} \vec{b}=\vec{r} \vec{c}=0$ for given non-zero vectors $\vec{a}, \vec{b}$ and $\vec{c}$ Statement 1: $\left.\begin{array}{lll}\vec{a}-\vec{b} & \vec{b}-\vec{c} & \vec{c}-\vec{a}\end{array}\right]=0$ Statement 2: $[\vec{a} \vec{b} \vec{c}]=0$

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466. Let $\vec{a}=a_{1} \hat{i}+a_{2} \hat{j}+a_{3} \hat{k} ; \vec{b}=b_{1} \hat{i}+b_{2} \hat{j}+b_{3} \hat{k} ; \vec{c}=c_{1} \hat{i}+c_{2} \hat{j}+c_{3} \hat{k}$ be three non-zero vectors such that $\vec{c}$ is a unit vector perpendicular to both
$\vec{a} \& \vec{b}$. If the angle between $\vec{a}$ and $\vec{b}$ is $\frac{\pi}{6}$, then $\left|\begin{array}{lll}a_{1} & b_{1} & c_{1} \\ a_{2} & b_{2} & c_{2} \\ a_{3} & b_{3} & c_{3}\end{array}\right|^{2}=$

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467. Statement-I $A=2 \hat{i}+3 \hat{j}+6 \hat{k}, B=\hat{i}+\hat{j}-2 \hat{k}$ and $C=\hat{i}+2 \hat{j}+\hat{k}$, then $|A \times(A \times(A \times B)) \cdot C|=243$

Statement-II $|A \times(A \times(A \times B)) \cdot C|=|A|^{2} 2|[A B C]|$

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468. If $\vec{a}$ and $\vec{b}$ and $\vec{c}$ are mutually perpendicular unit vectors, write the value of $|\vec{a}+\vec{b}+\vec{c}|$

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469. Let vectors $\vec{a}, \vec{b}, \vec{c}$, and $\vec{d}$ be such that $(\vec{a} \times \vec{b}) \times(\vec{c} \times \vec{d})=0$. Let $P_{1} a n d P_{2}$ be planes determined by the pair of vectors $\vec{a}, \vec{b}$, and $\vec{c}, \vec{d}$, respectively. Then the angle between $P_{1} a n d P_{2}$ is a. $0 \mathrm{~b} . \pi / 4 \mathrm{c} . \pi / 3 \mathrm{~d} . \pi / 2$
470. The number of vectors of unit length perpendicular to vectors $\vec{a}=(1,1,0)$ and $\vec{b}=(0,1,1)$ is a. one b. two c. three d. infinite

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471. For any two $\vec{a}$ and $\vec{b},(\vec{a} \times \hat{i}) \cdot(\vec{b} \times \hat{i})+(\vec{a} \times \hat{j}) \cdot(\vec{b} \times \hat{j})+(\vec{a} \times \hat{k}) \cdot(\vec{b} \times \hat{k})$ is always equal to a. $\vec{a}, \vec{b}$ b. $2 \vec{a}, \vec{b}$ c. zero d. none of these

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472. Let $f(t)=[t] \hat{i}+(t-[t]) \hat{j}+[t+1] \hat{k}$, where[.] denotes the greatest integer function. Then the vectors $f\left(\frac{5}{4}\right) \operatorname{andf}(t), 0<t<1$ are(a) parallel to
each other(b) perpendicular(c) inclined at $\cos ^{-1} 2\left(\sqrt{7\left(1-t^{2}\right)}\right)$ (d)inclined
at $\cos ^{-1}\left(\frac{8+t}{9 \sqrt{1+t^{2}}}\right)$;

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473. If $\vec{a}$ is parallel to $\vec{b} \times \vec{c}$, then $(\vec{a} \times \vec{b}) \vec{a} \times \vec{c}$ is equal to $|\vec{a}|^{2}(\vec{b} \vec{c}) b$. $|\vec{b}|^{2}\binom{\vec{a} \vec{c}}{)}$ c. $|\vec{c}|^{2}(\vec{a} \vec{b})$ d. none of these

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474. The three vectors $\hat{i}+\hat{j}, \hat{j}+\hat{k}, \hat{k}+\hat{i}$ taken two at a time form planes, The three unit vectors drawn perpendicular to these planes form a parallelopiped of volume:

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475. If $\vec{d}=\vec{a} \times \vec{b}+\vec{b} \times \vec{c}+\vec{c} \times \vec{a}$ is non-zero vector and
$|(\vec{d} \cdot \vec{c})(\vec{a} \times \vec{b})+(\vec{d} \cdot \vec{a})(\vec{b} \times \vec{c})+(\vec{d} \cdot \vec{b})(\vec{c} \times \vec{a})|=0, \quad$ then $\quad$ a.
$|\vec{a}|=|\vec{b}|=|\vec{c}|$ b. $|\vec{a}|+|\vec{b}|+|\vec{c}|=|d|$ c. $\vec{a}, \vec{b}$, and $\vec{c}$ are coplanar d. none of these

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476. If $|a|=2 a n d|b|=3$ and $a b=0$, then $(a \times(a \times(a \times(a \times b))))$ is equal to $48 \hat{b}$ b. -48 b c. $48 a ̂$ d. $-48 \hat{a}$

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477. If the two diagonals of one its faces are $6 \hat{i}+6 \hat{k} a n d 4 \hat{j}+2 \hat{k}$ and of the edges not containing the given diagonals is $c=4 \hat{j}-8 \hat{k}$, then the volume of a parallelepiped is a. 60 b .80 c .100 d .120

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478. The volume of a tetrahedron formed by the coterminous edges $\vec{a}, \vec{b}$, and $\vec{c}$ is 3 . Then the volume of the parallelepiped formed by the coterminous edges $\vec{a}+\vec{b}, \vec{b}+\vec{c}$ and $\vec{c}+\vec{a}$ is 6 b .18 c .36 d .9

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479. If $\vec{a}, \vec{b}$, and $\vec{c}$ are three mutually orthogonal unit vectors, then the triple product $[\vec{a}+\vec{b}+\vec{c} \vec{a}+\vec{b} \vec{b}+\vec{c}]$ equals: (a.) 0 (b.) 1 or -1 (c.) 1 (d.) 3

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480. Vector $\vec{c}$ is perpendicular to vectors $\vec{a}=(2,-3,1)$ and $\vec{b}=(1,-2,3)$ and satisfies the condition $\vec{\cdot}(\hat{i}+2 \hat{j}-7 \hat{k})=10$. Then vector $\vec{c}$ is equal to a. $(7,5,1)$ b. $-7,-5,-1$ c. 1, 1, -1 d. none of these

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481. Given $\vec{a}=x \hat{i}+y \hat{j}+2 \hat{k}, \vec{b}=\hat{i}-\hat{j}+\hat{k}, \vec{c}=\hat{i}+2 \hat{j} ; \vec{a} \perp \vec{b}, \vec{a} \vec{c}=4$. Then $[\vec{a} \vec{b} \vec{c}]^{2}=|\vec{a}| \mathrm{b} .[\vec{a} \vec{b} \vec{c}]^{=}|\vec{a}| c .[\vec{a} \vec{b} \vec{c}]^{=} 0$ d. $[\vec{a} \vec{b} \vec{c}]^{=}|\vec{a}|^{2}$

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482. $\vec{a} a n d \vec{b}$ are two unit vectors that are mutually perpendicular. A unit vector that is equally inclined to $\vec{a}$, $\vec{b}$ and $\vec{a} \times \vec{b}$ is a. $\frac{1}{\sqrt{2}}(\vec{a}+\vec{b}+\vec{a} \times \vec{b})$ b. $\frac{1}{2}(\vec{a} \times \vec{b}+\vec{a}+\vec{b})$ c. $\frac{1}{\sqrt{3}}(\vec{a}+\vec{b}+\vec{a} \times \vec{b})$ d. $\frac{1}{3}(\vec{a}+\vec{b}+\vec{a} \times \vec{b})$

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483. If $\vec{r}$ and $\vec{s}$ are non-zero constant vectors and the scalar $b$ is chosen such that $|\vec{r}+b \vec{s}|$ is minimum, then the value of $|b \vec{s}|^{2}+|\vec{r}+b \vec{s}|^{2}$ is equal to a.2 $|\vec{r}|^{2}$ b. $|\vec{r}|^{2} / 2$ c. $3|\vec{r}|^{2}$ d. $|r|^{2}$

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484. 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

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485. The volume of he parallelepiped whose sides are given by $\vec{O} A=2 i-2 j, \vec{O} B=i+j-k a n d \vec{O} C=3 i-k$ is a. $\frac{4}{13}$ b. 4 c. $\frac{2}{7}$ d. 2

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486. For non-zero vectors $\vec{a}, \vec{b}$, and $\vec{c},|(\vec{a} \times \vec{b}) \vec{c}|=|\vec{a}||\vec{b}||\vec{c}|$ holds if and only if a. $\vec{a} \cdot \vec{b}=0, \vec{b} \cdot \vec{c}=0 \mathrm{~b} . \vec{b} \cdot \vec{c}=0, \vec{c} \cdot \vec{a}=0 \mathrm{c} . \vec{c} \cdot \vec{a}=0, \vec{a} \cdot \vec{b}=0 \mathrm{~d}$. $\vec{a} \cdot \vec{b}=0, \vec{b} \cdot \vec{c}=0, \vec{c} \cdot \vec{a}=0$

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487. For three vectors $\vec{u}, \vec{v} a n d \vec{w}$ which of the following expressions is not equal to any of the remaining three ? a. $\vec{u} \vec{v} \times \vec{w} \mathrm{~b} .(\vec{v} \times \vec{w}) \vec{u} \mathrm{c} . \vec{v} \vec{u} \times \vec{w} \mathrm{~d}$. $(\vec{u} \times \vec{v}) \vec{w}$

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488. Let $\vec{A}$ be a vector parallel to the line of intersection of planes $P_{1}$ and $P_{2}$ Plane $P_{1}$ is parallel to vectors $2 \hat{j}+3 \hat{k}$ and $4 \hat{j}-3 k a n d P_{2}$ is parallel to $\hat{j}-\hat{k}$ and $3 \hat{i}+3 \hat{j}$ Then the angle betweenvector $\vec{A}$ and a given vector $2 \hat{i}+\hat{j}-2 \hat{k}$ is a. $\pi / 2$ b. $\pi / 4$ c. $\pi / 6$ d. $3 \pi / 4$

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489. If $\vec{a} \vec{b}=\beta$ and $\vec{a} \times \vec{b}=\vec{c}$, then $\vec{b}$ is $\frac{(\beta \vec{a}-\vec{a} \times \vec{c})}{|\vec{a}|^{2}}$ b. $\frac{(\beta \vec{a}+\vec{a} \times \vec{c})}{|\vec{a}|^{2}}$ c.
$\frac{(\beta \vec{c}-\vec{a} \times \vec{c})}{|\vec{a}|^{2}}$ d. $\frac{(\beta \vec{a}+\vec{a} \times \vec{c})}{|\vec{a}|^{2}}$
490. Let $\vec{a}, \vec{b}$ and $\vec{c}$ be three non-coplanar vecrors and $\vec{r}$ be any arbitrary vector. Then $(\vec{a} \times \vec{b}) \times(\vec{r} \times \vec{c})+(\vec{b} \times \vec{c}) \times(\vec{r} \times \vec{a})+(\vec{c} \times \vec{a}) \times(\vec{r} \times \vec{b})$ is always equal to $[\vec{a} \vec{b} \vec{c}] \vec{r}$ b. $2[\vec{a} \vec{b} \vec{c}] \vec{r}$ c. $3[\vec{a} \vec{b} \vec{c}] \vec{r}$ d. none of these

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491. Let $\vec{a} a n d \vec{b}$ be mutually perpendicular unit vectors. Then for any arbitrary

$$
\begin{equation*}
\text { a. } \quad \vec{r}=(\dot{\vec{r}} \dot{\hat{a}}) \hat{a}+(\vec{r} \hat{b}) \hat{b}+(\vec{r} \hat{a} \times \hat{b})(\hat{a} \times \hat{b}) \tag{b.}
\end{equation*}
$$

$\vec{r}=(\dot{\vec{r}} \dot{a})-(\dot{r} \hat{b}) \hat{b}-(\vec{r} \hat{a} \times \hat{b})(\hat{a} \times \hat{b})$
C.
$\vec{r}=(\stackrel{\rightharpoonup}{r} \dot{a}) \hat{a}-(\vec{r} \hat{b}) \hat{b}+(\vec{r} \hat{a} \times \hat{b})(\hat{a} \times \hat{b})$ none of these

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492. Value of $[\vec{a} \times \vec{b} \vec{a} \times \vec{c} \vec{d}]$ is always equal to $(\vec{a} \vec{d})[\vec{a} \vec{b} \vec{c}]$ b. $\left(\begin{array}{c}\vec{a} \vec{c}\end{array}\right)[\vec{a} \vec{b} \vec{d}]$ c. $\left(\begin{array}{c}\vec{a} \vec{b}\end{array}\right)[\vec{a} \vec{b} \vec{d}]$ d. none of these

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493. Let $\vec{a} a n d \vec{b}$ be unit vectors that are perpendicular to each other. Then $[\vec{a}+(\vec{a} \times \vec{b}) \vec{b}+(\vec{a} \times \vec{b}) \vec{a} \times \vec{b}]$ will always be equal to 1 b. 0 c. -1 d. none of these

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494. Let $\vec{r}, \vec{a}, \vec{b}$ and $\vec{c}$ be four nonzero vectors such that $\vec{r} \vec{a}=0,|\vec{r} \times \vec{b}|=|\vec{r}||\vec{b}|$ and $|\vec{r} \times \vec{c}|=|\vec{r}||\vec{c}|$ Then $[a b c]$ is equal to $|a||b||c|$ b. $-|a||b||c| c .0$ d. none of these
495. Let $\vec{a}=a_{1} \hat{i}+a_{2} \hat{j}+a_{3} \hat{k}, \vec{b}=b_{1} \hat{i}+b_{2} \hat{j}+b_{3} \hat{k}$ and $\vec{c}=c_{1} \hat{i}+c_{2} \hat{j}+c_{3} \hat{k}$ be three nonzero vectors such that $\vec{c}$ is a unit vector perpendicular to both $\vec{a} a n d \vec{b}$ If the angle between $\vec{a} a n d \vec{b}$ is $\pi / 6$, then the value of
$\left|a_{1} b_{1} c_{1} a_{2} b_{2} c_{2} a_{3} b_{3} c_{3}\right|^{2}$ is a. 0
b. 1
c. $\frac{1}{4}\left(a 1^{2}+a 2^{2}+a 3^{2}\right)\left(b 1^{2}+b 2^{2}+b 3^{2}\right)$
d. $\frac{3}{4}\left(a 1^{2}+a 2^{2}+a 3^{2}\right)\left(b 1^{2}+b 2^{2}+b 3^{2}\right)$

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496. If $4 \vec{a}+5 \vec{b}+9 \vec{c}=0$, then $(\vec{a} \times \vec{b}) \times[(\vec{b} \times \vec{c}) \times(\vec{c} \times \vec{a})]$ is equal to a vector perpendicular to the plane of $a, b, c \mathrm{~b}$. a scalar quantity $\mathrm{c} . \overrightarrow{0} \mathrm{~d}$. none of these

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497. If $\vec{a}, \vec{b}$, and $\vec{c}$ are such that $[\vec{a} \vec{b} \vec{c}]=1, \vec{c}=\lambda \vec{a} \times \vec{b}$, angle, between $\vec{a} a n d \vec{b}$ is $\frac{2 \pi}{3},|\vec{a}|=\sqrt{2},|\vec{b}|=\sqrt{3} a n d|\vec{c}|=\frac{1}{\sqrt{3}}$, then the angel between
$\vec{a}$ and $\vec{b}$ is $\frac{\pi}{6}$ b. $\frac{\pi}{4}$ c. $\frac{\pi}{3}$ d. $\frac{\pi}{2}$

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498. A vector of magnitude $\sqrt{2}$ coplanar with the vecrtor $\vec{a}=\hat{i}+\hat{j}+2 \hat{k} a n d \vec{b}=\hat{i}+2 \hat{j}+\hat{k}, \quad$ and perpendicular to the vector $\vec{c}=\hat{i}+\hat{j}+\hat{k}$, is a $.-\hat{j}+\hat{k}$ b. $\hat{i}-\hat{k}$ c. $\hat{i}-\hat{j}$ d. $\hat{i}-\hat{j}$

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499. Let $P$ be a point interior to the acute triangle $A B C$ If $P A+P B+P C$ is a null vector, then w.r.t traingel $A B C$, point $P$ is its a. centroid b. orthocentre c. incentre d. circumcentre

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500. $G$ is the centroid of triangle $A B C a n d A_{1}$ and $B_{1}$ are rthe midpoints of sides $A B a n d A C$, respectively. If Delta $_{1}$ is the area of quadrilateral
$G A_{1} A B_{1}$ andDelta is the area of triangle $A B C$, then Delta/Delta ${ }_{1}$ is equal to a. $\frac{3}{2}$ b. 3 c. $\frac{1}{3}$ d. none of these

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501. Points $\vec{a}, \vec{b}, \vec{c}$, and $\vec{d}$ are coplanar and
$(\sin \alpha) \vec{a}+(2 \sin 2 \beta) \vec{b}+(3 \sin 3 \gamma) \vec{c}-\vec{d}=0$. Then the least value of $\sin ^{2} \alpha+\sin ^{2} 2 \beta+\sin ^{2} 3$ yis a. $\frac{1}{14}$ b. 14 c. 6 d. $1 / \sqrt{6}$

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502. If $\vec{a} a n d \vec{b}$ are any two vectors of magnitudes 1 and 2 , respectively, and
$(1-3 \vec{a} \vec{b})^{2}+|2 \vec{a}+\vec{b}+3(\vec{a} \times \vec{b})|^{2}=47$, then the angel between $\vec{a}$ and $\vec{b}$
is $\pi / 3 \mathrm{~b} \cdot \pi-\cos ^{-1}(1 / 4)$ c. $\frac{2 \pi}{3}$ d. $\cos ^{-1}(1 / 4)$

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503. If $\vec{a}$ and $\vec{b}$ are any two vectors of magnitudes 2 and 3 , respectively, such that $|2(\vec{a} \times \vec{b})|+|3(\vec{a} \cdot \vec{b})|=k$, then the maximum value of $k$ is a. $\sqrt{13}$ b. $2 \sqrt{13}$ c. $6 \sqrt{13}$ d. $10 \sqrt{13}$

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504. If $\vec{a}$ and $\vec{b}$ are two vectors such that $|\vec{a} \times \vec{b}|=3$ and $\vec{a} \vec{b}=1$, find the angle between $\vec{a}$ and $\vec{b}$.

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505. If the vector product of a constant vector $\overrightarrow{O A}$ with a variable vector $\vec{O} B$ in a fixed plane $O A B$ be a constant vector, then the locus of $B$ is a. a straight line perpendicular to $\overrightarrow{O A} \mathrm{~b}$. a circle with centre $O$ and radius equal to $|\vec{O} A|$ c. a straight line parallel to $\overrightarrow{O A} A$ d. none of these
506. Let $\vec{u}, \vec{v}$ and $\vec{w}$ be such that $|\vec{u}|=1,|\vec{v}|=2$ and $|\vec{w}|=3$. If the projection of $\vec{v}$ along $\vec{u}$ is equal to that of $\vec{w}$ along $\vec{u}$ and vectors $\vec{v} a n d \vec{w}$ are perpendicular to each other, then $|\vec{u}-\vec{v}+\vec{w}|$ equals 2 b. $\sqrt{7}$ c. $\sqrt{14} \mathrm{~d}$. 14
A. 2
B. $\operatorname{sqrt}(7)^{\prime}$
C. $\operatorname{sqrt}(14)^{\text { }}$
D. 14`

## Answer: 3

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507. If the two adjacent sides of two rectangles are represented by vectors

$$
\vec{p}=5 \vec{a}-3 \vec{b} ; \vec{q}=-\vec{a}-2 \vec{b} \text { and } \vec{r}=-4 \vec{a}-\vec{b} ; \vec{s}=-\vec{a}+\vec{b},
$$

respectively, then the angel between the vector
$\vec{x}=\frac{1}{3}(\vec{p}+\vec{r}+\vec{s})$ and $\quad \vec{y}=\frac{1}{5}(\vec{r}+\vec{s}) \quad$ is $\quad$ a. $-\cos ^{-1}\left(\frac{19}{5 \sqrt{43}}\right)$
$\cos ^{-1}\left(\frac{19}{5 \sqrt{43}}\right)$ c. $\pi-\cos ^{-1}\left(\frac{19}{5 \sqrt{43}}\right)$ d. cannot be evaluate

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508. Let $P, Q, R$ and $S$ be the points on the plane with position vectors $-2 i-j, 4 i, 3 i+3 j a n d-3 j+2 j$, respectively. The quadrilateral $P Q R S$ must be a Parallelogram, which is neither a rhombus nor a rectangle Square Rectangle, but not a square Rhombus, but not a square

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509. $\vec{u}, \vec{v}$ and $\vec{w}$ are three non-coplanar unit vecrtors and $\alpha, \beta$ and $\gamma$ are the angles between $\vec{u}$ and $\vec{v}, \vec{v}$ and $\vec{w}$, and $\vec{w}$ and $\vec{u}$, respectively, and $\vec{x}, \vec{y}$ and $\vec{z}$ are unit vectors along the bisectors of the angles $\alpha, \beta a n d \gamma$, respectively. Prove that

$$
[\vec{x} \times \vec{y} \vec{y} \times \vec{z} \vec{z} \times \vec{x}]=\frac{1}{16}[\vec{u} \vec{v} \vec{w}]^{2} \sec ^{2}\left(\frac{\alpha}{2}\right) \sec ^{2}\left(\frac{\beta}{2}\right) \sec ^{2}\left(\frac{\gamma}{2}\right) .
$$

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510. If $\vec{a}=a_{1} \hat{i}+a_{2} \hat{j}+a_{3} \hat{k} ; \vec{b}=b_{1} \hat{i}+b_{2} \hat{j}+b_{3} \hat{k}, . \vec{c}=c_{1} \hat{i}+c_{2} \hat{j}+c_{3} \hat{k}$ and $[3 \vec{a}+\vec{b} 3 \vec{b}+\vec{c} 3 \vec{c}+\vec{a}]=\lambda[\vec{a} \vec{b} \vec{c}]$, then find the value of $\frac{\lambda}{4}$.

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511. Find the absolute value of parameter $t$ for which the area of the triangle whose vertices the $A(-1,1,2) ; B(1,2,3)$ and $C(t, 1,1)$ is minimum.

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512. The condition for equations $\vec{r} \times \vec{a}=\vec{b}$ and $\vec{r} \times \vec{c}=\vec{d}$ to be consistent is $\vec{b} \vec{c}=\vec{a} \vec{d}$ b. $\vec{a} \vec{b}=\vec{c} \vec{d}$ c. $\vec{b} \vec{c}+\vec{a} \vec{d}=0$ d. $\vec{a} \vec{b}+\vec{c} \vec{d}=0$

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513. If aandb are nonzero non-collinear vectors, then $[\vec{a} \vec{b} \hat{i}] \hat{i}+[\vec{a} \vec{b} \hat{j}] \hat{j}+[\vec{a} \vec{b} \hat{b}] \hat{k}$ is equal to a. $\vec{a} \times \vec{b}$ b. $\vec{a}+\vec{b}$ c. $\vec{a}-\vec{b}$ d. $\vec{b} \times \vec{a}$

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514. $(\vec{a}+\vec{b}) \vec{b}+\vec{c} \times(\vec{a}+\vec{b}+\vec{c})=[\vec{a} \vec{b} \vec{c}]$
b. $\backslash 0 \backslash$
c. $2[\vec{a} \vec{b} \vec{c}]$
d.
$-[\vec{a} \vec{b} \vec{c}]$

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515. A vector of magnitude 10 along the normal to the curve $3 x^{2}+8 x y+2 y^{2}-3=0$ at its point $P(1,0)$ can be (A) $6 \hat{i}+8 \hat{j}$ (B) $-8 \hat{i}+3 \hat{j}$ (C)
$6 \hat{i}-8 \hat{j}$ (D) $8 \hat{i}+6 \hat{j}$

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516. If $a(\vec{\alpha} \times \vec{\beta})+b(\vec{\beta} \times \vec{\gamma})+c(\vec{\gamma} \times \vec{\alpha})=0$ and at least one of $a$, bandc is nonzero, then vectors $\vec{\alpha}, \vec{\beta}$ and $\vec{\gamma}$ are a. parallel b. coplanar c. mutually perpendicular d. none of these

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517. If $(\vec{a} \times \vec{b}) \times(\vec{b} \times \vec{c})=\vec{b}$, where $\vec{a}, \vec{b}$, and $\vec{c}$ are nonzero vectors, then 1 . $\vec{a}, \vec{b}$, and $\vec{c}$ can be coplanar 2. $\vec{a}, \vec{b}$, and $\vec{c}$ must be coplanar $3 . \vec{a}, \vec{b}$, and $\vec{c}$ cannot be coplanar 4.none of these

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518. If $\vec{a}, \vec{b}, \vec{c}$ are any three noncoplanar vector, then $(\vec{a}+\vec{b}+\vec{c})[(\vec{a}+\vec{b}) \times(\vec{a}+\vec{c})]$ is :

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519. If $\vec{x}+\vec{c} \times \vec{y}=\vec{a}$ and $\vec{y}+\vec{c} \times \vec{x}=\vec{b}$, where $\vec{c}$ is a nonzero vector, then

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

which of the following is not correct? a. $\vec{x}=$
b.

$$
1+\vec{c} \vec{c}
$$

$$
\vec{c} \times \vec{b}+\vec{b}+\left(\begin{array}{c}
\vec{c} \vec{a}) \vec{c} \quad \vec{a} \times \vec{c}+\vec{b}+(\vec{c} \vec{b}) \vec{c}+\vec{v}-\vec{r}
\end{array}\right.
$$

$\vec{x}=$
c. $\vec{y}=$

$$
1+\vec{c} \vec{c}
$$

d. none of these

$$
1+\vec{c} \vec{c}
$$

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520. If $\vec{a} a n d \vec{b}$ are two unit vectors incline at angle $\pi / 3$, then
$\{\vec{a} \times(\vec{b}+\vec{a} \times \vec{b})\} \vec{b}$ is equal to $\frac{-3}{4}$ b. $\frac{1}{4}$ c. $\frac{3}{4}$ d. $\frac{1}{2}$

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521. If $\vec{a}$ and $\vec{b}$ are orthogonal unit vectors, then for a vector $\vec{r}$ noncoplanar with $\vec{a}$ and $\vec{b}, \vec{r} \times \vec{a}$ is equal to
a. $[\vec{r} \vec{a} \vec{b}] \vec{b}-(\vec{r} \cdot \vec{b})(\vec{b} \times \vec{a})$
b. $[\vec{r} \vec{a} \vec{b}](\vec{a}+\vec{b})$
c. $[\vec{r} \vec{a} \vec{b}] \vec{a}-(\vec{r} \cdot \vec{a}) \vec{a} \times \vec{b}$
d. none of these

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522. Let V be the volume of the parallelepiped formed by the vectors
$\vec{a}=a_{i} \hat{i}+a_{2} \hat{j}+a_{3} \hat{k}$ and $\vec{b}=b_{1} \hat{i}+b_{2} \hat{j}+b_{3} \hat{k}$ and $\vec{c}=c_{1} \hat{i}+c_{2} \hat{j}+c_{3} \hat{k}$. If
$a_{r}, b_{r}$ and $c r$, where $r=1,2,3$, are non-negative real numbers and 3
$\sum_{r=1}\left(a_{r}+b_{r}+c_{r}\right)=3 L$ show that $V \leq L^{3}$

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523. Find 3-dimensional vectors $\vec{v}_{1}, \vec{v}_{2}, \vec{v}_{3} \quad$ satisfying
$\vec{v}_{1} \cdot \vec{v}_{1}=4, \vec{v}_{1} \cdot \vec{v}_{2}=-2, \vec{v}_{1} \cdot \vec{v}_{3}=6$,
$\vec{v}_{2} \cdot \vec{v}_{2}=2, \vec{v}_{2} \cdot \vec{v}_{3}=-5, \vec{v}_{3} \cdot \vec{v}_{3}=29$
524. Let $\vec{u} a n d \vec{v}$ be unit vectors such that $\vec{u} \times \vec{v}+\vec{u}=\vec{w}$ and $\vec{w} \times \vec{u}=\vec{v}$ Find the value of [ $\vec{u} \vec{v} \vec{w}$ ]

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525. For any two vectors $\vec{u} a n d \vec{v}$ prove that $(\vec{u} \cdot \vec{v})^{2}+|\vec{u} \times \vec{v}|^{2}=|\vec{u}|^{2}|\vec{v}|^{2}$

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526. If the incident ray on a surface is along the unit vector $\vec{v}$, the reflected ray is along the unit vector $\vec{w}$ and the normal is along the unit vector $\vec{a}$ outwards, express $\vec{w}$ in terms of $\vec{a}$ and $\vec{v}$

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527. $P_{1} n d P_{2}$ are planes passing through origin $L_{1}$ and $L_{2}$ are two lines on $P_{1}$ and $P_{2}$, respectively, such that their intersection is the origin. Show that there exist points $A, B a n d C$, whose permutation $A^{\prime}, B^{\prime}$ andC', respectively, can be chosen such that $A$ is on $L_{1}$, BonP $_{1}$ but not on $L_{1}$ andC not on $P_{1}$; $A^{\prime}$ is on $L_{2}, B^{\prime}$ on $P_{2}$ but not on $L_{2}$ and $C^{\prime}$ not on $P_{2}$

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528. If $\vec{a}, \vec{b}, \vec{c}$ and $\vec{d}$ are distinct vectors such that $\vec{a} \times \vec{c}=\vec{b} \times \vec{d}$ and $\vec{a} \times \vec{b}=\vec{c} \times \vec{d}$, prove that $(\vec{a}-\vec{d}) .(\vec{b}-\vec{c}) \neq 0$,

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529. Given two vectors $\vec{a}=-\hat{i}+2 \hat{j}+2 \hat{k}$ and $\vec{b}=-2 \hat{i}+\hat{j}+2 \hat{k}$ Column I, Column II A vector coplanar with $\vec{a} a n d \vec{b}, \mathrm{p} .-3 \hat{i}+3 \hat{j}+4 \hat{k} \mathrm{~A}$ vector which is perpendicular to both $\vec{a}$ and $\vec{b}$, q. $2 \hat{i}-2 \hat{j}+3 \hat{k} \mathrm{~A}$ vector which is equally
inclined to $\vec{a} a n d \vec{b}$, r. $\hat{i}+\hat{j}$ A vector which forms a triangle with $\vec{a} a n d \vec{b}$, s. $\hat{i}-\hat{j}+5 \hat{k}$

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530. Let $\vec{V}=2 \hat{i}+\hat{j}-\hat{k}$ and $\vec{W}=\hat{i}+3 \hat{k}$ If $\vec{U}$ is a unit vector, then the maximum value of the scalar triple product [UVW] is a.-1 b. $\sqrt{10}+\sqrt{6} c$. $\sqrt{59}$ d. $\sqrt{60}$

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531. If the vectors $\vec{a}, \vec{b}, \vec{c}$ are non-coplanar and I,m,n are distinct real numbers, then $[(l \vec{a}+m \vec{b}+n \vec{c})(l \vec{b}+m \vec{c}+n \vec{a})(l \vec{c}+m \vec{a}+n \vec{b})]=0$, implies
(A) $|m+m n+n|=0$
(B) $l+m+n=0$ (C) $l^{2}+m^{2}+n^{2}=0$
532. If $\vec{a}$, $\vec{b}$ and $\vec{c}$ are unit coplanar vectors, then the scalar triple product

$$
[2 \vec{a}-\vec{b} 2 \vec{b}-\vec{c} 2 \vec{c}-\vec{a}] \text { is } 0 \text { b. } 1 \text { c. }-\sqrt{3} \text { d. } \sqrt{3}
$$

