



MATHS

BOOKS - CENGAGE MATHS (ENGLISH)

VECTOR ALGEBRA

Others

1. In a trapezium, the vector $BC = \lambda AD$. We will then find that $p = AC + BD$ is collinear with AD . If $p = \mu AD$, then



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2. If the vectors \vec{a} and \vec{b} are linearly independent satisfying $(\sqrt{3}\tan\theta + 1)\vec{a} + (\sqrt{3}\sec\theta - 2)\vec{b} = 0$, then the most general values of θ

are a. $n\pi - \frac{\pi}{6}, n \in Z$ b. $2n\pi \pm \frac{11\pi}{6}, n \in Z$ c. $n\pi \pm \frac{\pi}{6}, n \in Z$ d. $2n\pi + \frac{11\pi}{6}, n \in Z$

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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 $\vec{r}_2 = \vec{a} + p\vec{b} + q\vec{c}$. 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 $\vec{r}_1, \vec{r}_2, \vec{r}_3, \dots, \vec{r}_n$ be the position vectors of points $P_1, P_2, P_3, \dots, P_n$ relative to the origin O . If the vector equation $a_1\vec{r}_1 + a_2\vec{r}_2 + \dots + a_n\vec{r}_n = \vec{0}$ hold, then a similar equation will also hold w.r.t. to any other origin provided a. $a_1 + a_2 + \dots + a_n = n$ b. $a_1 + a_2 + \dots + a_n = 1$ c. $a_1 + a_2 + \dots + a_n = 0$ d. $a_1 = a_2 = a_3 = \dots + a_n = 0$

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5. In triangle ABC , $\angle A = 30^\circ$, H is the orthocenter and D is the midpoint of BC . Segment HD is produced to T such that $HD = DT$. The length AT is equal to

(a). $2BC$

(b). $3BC$

(c). $\frac{4}{2}BC$

(d). none of these



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6. If $\vec{\alpha} + \vec{\beta} + \vec{\gamma} = a\vec{\delta}$ and $\vec{\beta} + \vec{\gamma} + \vec{\delta} = b\vec{\alpha}$, $\vec{\alpha}$ and $\vec{\delta}$ are non-collinear, 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 $\vec{a} = 6\hat{i} - 3\hat{j}$, $\vec{b} = 2\hat{i} - 6\hat{j}$ and $\vec{c} = -2\hat{i} + 21\hat{j}$ 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 $a\hat{i} + b\hat{j} + c\hat{k}$ as $|a| + |b| + |c|$. 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 $a, b,$ and c are zero (c) any one of $a, b,$ and 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 \vec{d} , which is being laid off from the same point dividing the angle between vectors \vec{a} and \vec{b} in equal halves and having the magnitude $\sqrt{6}$, is a. $\hat{i} + \hat{j} + 2\hat{k}$ b. $\hat{i} - \hat{j} + 2\hat{k}$ c. $\hat{i} + \hat{j} - 2\hat{k}$ 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 $\hat{i} + \hat{j}, \hat{j} + \hat{k}$ and $\hat{i} + \hat{k}$, respectively. Find the unite vector \hat{r} lying in the plane of ABC and perpendicular to IA , where I is the incentre of the triangle.



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



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13. Given four points P_1, P_2, P_3 and P_4 on the coordinate plane with origin

O which satisfy the condition $\left(\vec{OP}\right)_{n-1} + \left(\vec{OP}\right)_{n+1} = \frac{3}{2}\vec{OP}_n$. If P_1 and P_2

lie on the curve $xy=1$, then prove that P_3 does not lie on the curve



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14. $ABCD$ is a tetrahedron and O is any point. If the lines joining O to the vertices meet the opposite faces at P, Q, R and S , prove that

$$\frac{OP}{AP} + \frac{OQ}{BQ} + \frac{OR}{CR} + \frac{OS}{DS} = 1.$$



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15. If \vec{a} and \vec{b} are non-collinear vectors and

$$\vec{A} = (p + 4q)\vec{a} + (2p + q + 1)\vec{b} \text{ and } \vec{B} = (-2p + q + 2)\vec{a} + (2p - 3q - 1)\vec{b}, \text{ a n d}$$

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 and the vectors $a\hat{i} + a\hat{j} + c\hat{k}, \hat{i} + \hat{k}, c\hat{i} + \hat{j} + b\hat{k}$ lie in a plane, then prove that the quadratic equation $ax^2 + 2cx + b = 0$ has equal roots



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19. A pyramid with vertex at point P has a regular hexagonal base $ABCDEF$, 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 AD 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 AP is 5 units.

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20. $ABCD$ is a parallelogram. If L and M be the middle points of BC and CD , respectively express \vec{AL} and \vec{AM} in terms of \vec{AB} and \vec{AD} . Also show that $\vec{AL} + \vec{AM} = (3/2)\vec{AC}$.

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



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22. If \vec{a} and \vec{b} are two unit vectors and θ 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. $ABCD$ 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 $\vec{OA} + \vec{OB} + \vec{OC} + \vec{OD} = x\vec{OE}$, then x is equal to a. 3 b. 9 c. 7 d. 4



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24. If vectors $\vec{AB} = -3\hat{i} + 4\hat{k}$ and $\vec{AC} = 5\hat{i} - 2\hat{j} + 4\hat{k}$ are the sides of a $\triangle ABC$, then the length of the median through A is a. $\sqrt{14}$ b. $\sqrt{18}$ c. $\sqrt{29}$ d. $\sqrt{5}$



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25. $ABCD$ parallelogram, and A_1 and B_1 are the midpoints of sides BC and CD , respectively. If $\vec{AA}_1 + \vec{AB}_1 = \lambda \vec{AC}$, then λ 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 P and Q 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 PQ , such that OM is the bisector of $\angle POQ$, then \vec{OM} is a. $2(\hat{i} - \hat{j} + \hat{k})$ b. $2\hat{i} + \hat{j} - 2\hat{k}$ 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 triangle ABC .

Then $\vec{OA}\sin 2A + \vec{OB}\sin 2B + \vec{OC}\sin 2C$ is equal to



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28. If G is the centroid of triangle ABC , then $\vec{GA} + \vec{GB} + \vec{GC}$ is equal to a. $\vec{0}$

b. $3\vec{GA}$ c. $3\vec{GB}$ d. $3\vec{GC}$



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29. Let ABC be triangle, the position vectors of whose vertices are

respectively $\hat{i} + 2\hat{j} + 4\hat{k}$, $-2\hat{i} + 2\hat{j} + \hat{k}$ and $2\hat{i} + 4\hat{j} - 3\hat{k}$. Then ΔABC is a.

isosceles b. equilateral c. right angled d. none of these



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30. If $|\vec{a} + \vec{b}| < |\vec{a} - \vec{b}|$, then the angle between \vec{a} and \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 ABC whose corresponding sides are a, b, c , respectively. $a\vec{IA} + b\vec{IB} + c\vec{IC}$ is always equal to a. $\vec{0}$ b. $(a + b + c)\vec{BC}$ c. $(\vec{a} + \vec{b} + \vec{c})\vec{AC}$ d. $(a + b + c)\vec{AB}$

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32. Let $x^2 + 3y^2 = 3$ be the equation of an ellipse in the $x - y$ plane. A and B 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 $\angle APB = \pi/4$ 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 \vec{OP} represents a vector with direction cosine $\cos\alpha = \frac{1}{2}$ (where O is the origin) is

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34. If \vec{x} and \vec{y} are two non-collinear vectors and ABC is a triangle with side lengths $a, b,$ and c satisfying

$$(20a - 15b)\vec{x} + (15b - 12c)\vec{y} + (12c - 20a)(\vec{x} \times \vec{y}) = 0, \text{ then triangle } ABC \text{ is}$$

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 \hat{a} and $-\hat{i} + 2\hat{j} + 2\hat{k}$, where \hat{a} 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. $\hat{a} = \frac{1}{105}(41\hat{i} - 88\hat{j} - 40\hat{k})$

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36. If $4\hat{i} + 7\hat{j} + 8\hat{k}$, $2\hat{i} + 3\hat{j} + 24\hat{k}$ and $2\hat{i} + 5\hat{j} + 7\hat{k}$ are the position vectors of the vertices A , B and C , respectively, of triangle ABC , then the position vector of the point where the bisector of angle A meets BC 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 the join of $5\hat{i}$ and $5\hat{j}$ in the ratio $k:1$ and whose terminal point is the origin and $|\vec{b}| \leq \sqrt{37}$, then k 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 λ so that the points P, Q, R and S on the sides OA, OB, OC and AB , respectively, of a regular tetrahedron $OABC$ are

coplanar. It is given that $\frac{OP}{OA} = \frac{1}{3}$, $\frac{OQ}{OB} = \frac{1}{2}$, $\frac{OR}{OC} = \frac{1}{3}$ and $\frac{OS}{AB} = \lambda$ (A)

$\lambda = \frac{1}{2}$ (B) $\lambda = -1$ (C) $\lambda = 0$ (D) for no value of λ



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39. A uni-modular tangent vector on the curve

$x = t^2 + 2, y = 4t - 5, z = 2t^2 - 6t = 2$ 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 a, b, and c represent the

sides of a ABC satisfying $(a - b)\vec{x} + (b - c)\vec{y} + (c - a)(\vec{x} \times \vec{y}) = 0$, then ABC

is (where $\vec{x} \times \vec{y}$ is perpendicular to the plane of x and y) a. an acute-angled

triangle b. an obtuse-angled triangle c. a right-angled triangle d. a scalene

triangle



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41. The position vectors of points A and 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{OP} which bisects angle AOB , where P is a point on AB .

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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. $ABCD$ 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 \vec{OA} , \vec{OB} , \vec{OC} and $\vec{OD} = 4\vec{OE}$, where O is any point.

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44. $ABCD$ is a parallelogram. If L and M be the middle points of BC and

CD , respectively express \vec{AL} and \vec{AM} in terms of \vec{AB} and \vec{AD} . Also show

that $\vec{AL} + \vec{AM} = \frac{3}{2}\vec{AC}$.



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45. If $\vec{a}, \vec{b}, \vec{c}$ and \vec{d} are four vectors in three-dimensional space with the

same initial point and such that $3\vec{a} - 2\vec{b} + \vec{c} - 2\vec{d} = \vec{0}$, show that terminals

A, B, C and D of these vectors are coplanar. Find the point at which

AC and BD meet. Find the ratio in which P divides AC and BD .



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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} and \vec{b} are two vectors of magnitude 1 inclined at 120° , 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 p and q 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 $2\vec{a} - \vec{b} + 3\vec{c}$, $\vec{a} + \vec{b} - 2\vec{c}$ and $\vec{a} + \vec{b} - 3\vec{c}$ are non-coplanar 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

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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 PQR , S and T are points on QR and PR , respectively, such that $QS = 3SR$ and $PT = 4TR$. Let M be the point of intersection of PS and QT . Determine the ratio $QM:MT$ using the vector method.

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55. In a quadrilateral $PQRS$, $\vec{PQ} = \vec{a}$, $\vec{QR} = \vec{b}$, $\vec{SP} = \vec{a} - \vec{b}$, M is the midpoint of \vec{QR} and X is a point on SM such that $SX = \frac{4}{5}SM$. Prove that P , X and R are collinear.

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56. solve the differential equation $(1 + x^2) \frac{dy}{dx} = x$

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57. Show that $x_1\hat{i} + y_1\hat{j} + z_1\hat{k}$, $x_2\hat{i} + y_2\hat{j} + z_2\hat{k}$, and $x_3\hat{i} + y_3\hat{j} + z_3\hat{k}$, are non-coplanar if $|x_1| > |y_1| + |z_1|$, $|y_2| > |x_2| + |z_2|$ and $|z_3| > |x_3| + |y_3|$.

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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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59. Consider the vectors $\hat{i} + \cos(\beta - \alpha)\hat{j} + \cos(\gamma - \alpha)\hat{k}$, $\cos(\alpha - \beta)\hat{i} + \hat{j} + \cos(\gamma - \beta)\hat{k}$ and $\cos(\alpha - \gamma)\hat{i} + \cos(\beta - \gamma)\hat{k} + a\hat{k}$ where α , β , and γ are different angles. If these vectors are coplanar, show that a is independent of α , β and γ

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60. If \vec{a} and \vec{b} are two unit vectors and θ 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 a vector with direction cosines $\cos\alpha, \cos\beta$ and $\cos\gamma$. Assuming the $y-z$ plane as a mirror, the direction cosines of the reflected image of \vec{A} in the plane are a. $\cos\alpha, \cos\beta, \cos\gamma$ b. $\cos\alpha, -\cos\beta, \cos\gamma$ c. $-\cos\alpha, \cos\beta, \cos\gamma$ d. $-\cos\alpha, -\cos\beta, -\cos\gamma$

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63. The vector \vec{a} has the components $2p$ 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.

$$\frac{1}{7}(3\hat{i} - 6\hat{j} - 2\hat{k}) \quad \text{c. } \frac{1}{\sqrt{69}}(\hat{i} + 6\hat{j} + 8\hat{k}) \quad \text{d. } \frac{1}{\sqrt{69}}(-\hat{i} - 2\hat{j} + 8\hat{k})$$



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65. If $\vec{a}, \vec{b}, \vec{c}$ are non-coplanar vector and λ 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. $\lambda = 0$ d. no value of λ



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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. $q \neq 1$

Answer: null



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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 a. $-\hat{i} - \hat{k}$ b.

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



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68. If the resultant of three forces

$\vec{F}_1 = p\hat{i} + 3\hat{j} - \hat{k}, \vec{F}_2 = 6\hat{i} - \hat{k}$ and $\vec{F}_3 = -5\hat{i} + \hat{j} + 2\hat{k}$ acting on a particle 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

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



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70. The vector $\hat{i} + x\hat{j} + 3\hat{k}$ is rotated through an angle θ and doubled in magnitude, then it becomes $4\hat{i} + (4x - 2)\hat{j} + 2\hat{k}$. 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 $2\hat{i} + 5\hat{j} - \hat{k}$ form a triangle in space.



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72. Show that the point A, B and C with position vectors $\vec{a} = 3\hat{i} - 4\hat{j} - 4\hat{k}$, $\vec{b} = 2\hat{i} + \hat{j} + \hat{k}$ 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 $2\vec{AC} = 3\vec{CB}$, then prove that $2\vec{OA} + 3\vec{OB} = 5\vec{OC}$ where O is the origin.



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74. Find the unit vector in the direction of vector \vec{PQ} , 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.



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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 $\vec{a} + \vec{c} = \vec{b} + \vec{d}$, then prove that quadrilateral $ABCD$ 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 AB and CD intersect at the point $P(1, -1, 2)$.



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80. Statement 1: The direction cosines of one of the angular bisectors of two intersecting lines having direction cosines as l_1, m_1, n_1 and 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 intersecting lines having direction cosines as l_1, m_1, n_1 and l_2, m_2, n_2 is given by $\cos\theta = l_1l_2 + m_1m_2 + n_1n_2$.

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81. Statement 1: In ΔABC , $\vec{AB} + \vec{BC} + \vec{CA} = \vec{0}$

Statement 2: If $\vec{OA} = \vec{a}$, $\vec{OB} = \vec{b}$, then $\vec{AB} = \vec{a} + \vec{b}$

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82. Statement 1: If \vec{u} and \vec{v} are unit vectors inclined at an angle α and \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 ΔABC is an isosceles triangle with $AB = AC = 1$, then the vector representing the bisector of angle A is given by $\vec{AD} = (\vec{AB} + \vec{AC})/2$.

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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 $\cos\alpha$, $\cos\beta$, and $\cos\gamma$ 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 α 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 P, Q and R must be collinear.

Statement 2 : If for three points A, B and C, $\vec{AB} = \lambda\vec{AC}$, then points A, 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 $(\lambda - 1)(\vec{a}_1 - \vec{a}_2) + \mu(\vec{a}_2 + \vec{a}_3) + \gamma(\vec{a}_3 + \vec{a}_4 - 2\vec{a}_2) + \vec{a}_3 + \delta\vec{a}_4 = 0$, then

A. a. $\lambda = 1$

B. b. $\mu = -2/3$

C. c. $\gamma = 2/3$

D. d. $\delta = 1/3$

Answer: null

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87. Let ABC 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 ΔABC 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. $\frac{|\vec{a}|}{|\vec{a}| + 2|\vec{b}|} \vec{a} + \frac{|\vec{b}|}{|\vec{a}| + |\vec{b}|} \vec{b}$ b. $\frac{|\vec{b}|}{|\vec{a}| + |\vec{b}|} \vec{a} + \frac{|\vec{a}|}{|\vec{a}| + |\vec{b}|} \vec{b}$ c.

$$\frac{|\vec{a}|}{|\vec{a}| + 2|\vec{b}|} \vec{a} + \frac{|\vec{b}|}{|\vec{a}| + 2|\vec{b}|} \vec{b} \quad \text{d.} \quad \frac{|\vec{b}|}{2|\vec{a}| + |\vec{b}|} \vec{a} + \frac{|\vec{a}|}{2|\vec{a}| + |\vec{b}|} \vec{b}$$

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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{OA} and \vec{OB} (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{OB} and \vec{OC} is given by $2\vec{OD}$, where D is the midpoint of

BC.



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



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93. ABC is a triangle and P any point on BC. If \vec{PQ} is the sum of $\vec{AP} + \vec{PB} + \vec{PC}$, 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{AB} , \vec{AE} , \vec{BC} , \vec{DC} , \vec{ED} and \vec{AC} , is $3\vec{AC}$.

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96. if $\vec{AO} + \vec{OB} = \vec{BO} + \vec{OC}$, then prove that B is the midpoint of AC .

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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.

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98. Find the equation of the normal to the curve $y = x^3 + 2x + 6$ which are parallel to the line $x + 14y + 4 = 0$. $x^3 + y^3 = 8xy$ at the point where it meets the curve $y^2 = 4x$ 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 $4A^2$?

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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 particle has magnitude equal to 5 units, then the value of p is a. -6 b. -4 c. 2 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 $ABCD$ is parallelogram.

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102. Statement 1: Let $A(\vec{a}), B(\vec{b})$ and $C(\vec{c})$ be three points such that $\vec{a} = 2\hat{i} + \hat{k}, \vec{b} = 3\hat{i} - \hat{j} + 3\hat{k}$ and $\vec{c} = -\hat{i} + 7\hat{j} - 5\hat{k}$. Then $OABC$ is a tetrahedron.

Statement 2: Let $A(\vec{a}), B(\vec{b})$ and $C(\vec{c})$ be three points such that vectors \vec{a}, \vec{b} and \vec{c} are non-coplanar. Then $OABC$ 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 ?



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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 $p = 9/2$ and $q = 2$. Statement 2: if

$\vec{a} = a_1\vec{i} + a_2\vec{j} + a_3\vec{k}$ and $\vec{b} = b_1\vec{i} + b_2\vec{j} + b_3\vec{k}$ 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, B and 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 ABC is a. acute angled b. obtuse angled c. right angled d. none of these



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106. \vec{a} and \vec{b} form the consecutive sides of a regular hexagon $ABCDEF$

Column I, Column II If $\vec{CD} = x\vec{a} + y\vec{b}$, then, p. $x = -2$ If $\vec{CE} = x\vec{a} + y\vec{b}$,

then, q. $x = -1$ If $\vec{AE} = x\vec{a} + y\vec{b}$, then, r. $y = 1$ $\vec{AD} = -x\vec{b}$, 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 initial point), s. \vec{d}



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108. Statement 1: $|\vec{a}| = 3$, $|\vec{b}| = 4$ 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.



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109. A man travelling towards east at 8km/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 XY-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 $|\vec{c}| = 5\sqrt{6}$



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112. Find a unit vector \vec{c} if $-\vec{i} + \vec{j} - \vec{k}$ bisects the angle between \vec{c} and $3\vec{i} + 4\vec{j}$.

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113. The vectors $2\hat{i} + 3\hat{j}$, $5\hat{i} + 6\hat{j}$ and $8\hat{i} + \lambda\hat{j}$ have initial points at $(1, 1)$. Find the value of λ 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 $|\vec{a} + 2\vec{b} + 6\vec{c}|$.

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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 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 AB.

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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

$$l_1\vec{a} + m_1\vec{b}, l_2\vec{a} + m_2\vec{b} \text{ and } l_3\vec{a} + m_3\vec{b} \text{ are collinear if } \begin{vmatrix} l_1 & l_2 & l_3 \\ m_1 & m_2 & m_3 \\ 1 & 1 & 1 \end{vmatrix} = 0.$$



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119. Show, by vector methods, that the angular bisectors 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 $\vec{A}(0) = 2\hat{i} + 3\hat{j}, \vec{A}(1) = 6\hat{i} + 2\hat{j}, \vec{B}(0) = 3\hat{i} + 2\hat{j}$ 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 .



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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 $\vec{b} = 2x\hat{i} + x\hat{j} - \hat{k}$ 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 λ 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 and A_3 in a right-handed rectangular Cartesian coordinate system $OXYZ$. The coordinate system is rotated about the x -axis through an angle $\pi/2$. 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 λ .



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126. Let $OACB$ be a parallelogram with O at the origin and OC a diagonal. Let D be the midpoint of OA . Using vector methods prove that BD and CO intersect in the same ratio. Determine this ratio.



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127. In a triangle ABC , D and E are points on BC and AC , respectively, such that $BD = 2DC$ and $AE = 3EC$. Let P be the point of intersection of AD and BE . Find BP/PE 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 its direction, find the other components using the vector method.

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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 of three adjacent faces of a cube. Determine their resultant R . Also prove that the sum of the three vectors determined 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 ABCD, diagonal vectors are $\vec{AC} = 2\hat{i} + 3\hat{j} + 4\hat{k}$ and $\vec{BD} = -6\hat{i} + 7\hat{j} - 2\hat{k}$, then find the adjacent side vectors \vec{AB} and \vec{AD}

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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 $2\hat{i} + 2\hat{j} + 3\hat{k}$, $-3\hat{i} + 3\hat{j} + 2\hat{k}$ and $3\hat{i} + 4\hat{k}$ form a triangle or not



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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 $60i + 3j$, $40i - 8j$, $ai - 52j$ are collinear if a. $a = -40$ b. $a = 40$ c. $a = 20$ d. none of these

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141. Let α, β and γ 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 ΔOAB , M is the mid-point of AB , C is a point on OM , such that $2OC=CM$. X is a point on the side OB such that $OX=2XB$. The line XC is produced to meet OA in Y . then, $\frac{OY}{YA}$ 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 λ .



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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 (α, β) is (a)(1, 1) (b) (1, - 1) (c) (- 1, 1) (d) (- 1, - 1)



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146. The number of distinct real values of λ , 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 $\vec{AO} + \vec{OB} = \vec{BO} + \vec{OC}$, 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 AC

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150. The position vectors of P and Q 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 $A(-3, -2, 0)$, $B(3, -3, 1)$ and $C(5, 0, 2)$. Then find a vector having the same direction as that of \vec{AB} and magnitude equal to

$$|\vec{AC}|$$



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152. Let $ABCD$ be a parallelogram whose diagonals intersect at P and let O be the origin. Then prove that $\vec{OA} + \vec{OB} + \vec{OC} + \vec{OD} = 4\vec{OP}$



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153. If $ABCD$ is a quadrilateral and E and F are the mid-points of AC and BD respectively, prove that $\vec{AB} + \vec{AD} + \vec{CB} + \vec{CD} = 4\vec{EF}$



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154. If $ABCD$ is a rhombus whose diagonals cut at the origin O , then prove that $\vec{OA} + \vec{OB} + \vec{OC} + \vec{OD} = 0$



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155. Let D, E and F be the middle points of the sides BC, CA and AB , respectively of a triangle ABC . Then prove that $\vec{AD} + \vec{BE} + \vec{CF} = \vec{0}$.

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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 can 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 $A(1, 2, -3)$ and $B(-1, -2, 1)$ directed from $A \rightarrow B$.

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158. Find the direction cosines of the vector $\hat{i} + 2\hat{j} + 3\hat{k}$.



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159. The median AD of the triangle ABC is bisected at E and BE meets AC at F . Find $AF : FC$.

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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 $\vec{d} = (2n + 1)\vec{a} - \vec{b}$ are collinear?

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161. i. If \vec{a}, \vec{b} and \vec{c} are non-coplanar $\vec{r} = x\vec{a} + y\vec{b} + z\vec{c}$, prove that $3x\vec{a} - 7y\vec{b} - 4z\vec{c}, 3x\vec{a} - 2y\vec{b} + z\vec{c}$ and $x\vec{a} + y\vec{b} + 2z\vec{c}$ 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 $l\vec{a} + m\vec{b} + n\vec{c} = \vec{0}$

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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 $(\vec{a} - \vec{d}) \cdot (\vec{b} - \vec{c}) \neq 0$,

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164. If \vec{a}, \vec{b} and \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 the vector $\vec{a} = \hat{i} + \hat{j} + 2\hat{k}$.

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166. let P an interior point of a triangle ABC and AP, BP, CP meets the sides BC, CA, AB in D, E, F , respectively, Show that $\frac{AP}{PD} = \frac{AF}{FB} + \frac{AE}{EC}$.

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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 α

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169. If the vectors $3\vec{p} + \vec{q}$; $5\vec{p} - 3\vec{q}$ 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. $P(1, 0, -1)$, $Q(2, 0, -3)$, $R(-1, 2, 0)$ and $S(-2, -1)$, then find the projection length of \vec{PQ} on \vec{RS} .

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171. A, B, C, D are any four points, prove that $\vec{AB}\vec{CD} + \vec{BC}\vec{AD} + \vec{CA}\vec{BD} = 4(\text{Area of } \triangle ABC)$.

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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 angle between unit vectors \vec{a} and \vec{b} is 60° , then find the value of

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



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



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175. Constant forces $P_1 = \hat{i} + \hat{j} + \hat{k}$, $P_2 = -\hat{i} + 2\hat{j} - \hat{k}$ and $P_3 = -\hat{j} - \hat{k}$ 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 $B(6\hat{i} + \hat{j} - 3\hat{k})$.



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176. If \vec{a} , \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 and G_3 be the centroids of the triangular faces OBC, OCA and OAB , respectively, of a tetrahedron $OABC$. If V_1 denotes the volume of the tetrahedron $OABC$ and V_2 that of the parallelepiped with OG_1, OG_2 and OG_3 as three concurrent edges, then prove that

$$4V_1 = 9V_2$$



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



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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 $|2\vec{a} + \vec{b} + \vec{c}|$



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183. If a, b, c are three non-coplanar vectors, 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 $\vec{u} = (al + a_1l_1)\hat{i} + (am + a_1m_1)\hat{j} + (an + a_1n_1)\hat{k}$
 $\vec{v} = (bl + b_1l_1)\hat{i} + (bm + b_1m_1)\hat{j} + (bn + b_1n_1)\hat{k}$
 $\vec{w} = (cl + c_1l_1)\hat{i} + (cm + c_1m_1)\hat{j} + (cn + c_1n_1)\hat{k}$ 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 $\vec{a} \perp (\vec{b} \times \vec{c})$, then prove that $(\vec{a} \times \vec{b}) \cdot (\vec{a} \times \vec{c})$ is equal to $|\vec{a}|^2 (\vec{b} \cdot \vec{c})$.

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

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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 perpendicular to $|\vec{a}|\vec{b} - |\vec{b}|\vec{a}$, for any two non-zero vectors \vec{a} and \vec{b} .



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190. If $|\vec{a}| = 3$, $|\vec{b}| = 4$ and the angle between \vec{a} and \vec{b} is 120° . 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 $(la + mb + nc) \cdot (lp + mq + nr)$ is equals to



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192. Find $|\vec{a}|$ and $|\vec{b}|$, if $(\vec{a} + \vec{b}) \cdot \vec{a} - \vec{b} = 8$ and $|\vec{a}| = 8|\vec{b}|$

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193. Let $\vec{a}, \vec{b},$ and \vec{c} and $\vec{a}', \vec{b}', \vec{c}'$ are reciprocal system of vectors, then

prove that $\vec{a}' \times \vec{b}' + \vec{b}' \times \vec{c}' + \vec{c}' \times \vec{a}' = \frac{\vec{a} + \vec{b} + \vec{c}}{[\vec{a}\vec{b}\vec{c}]}$.

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

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195. Find the vector equation of the plane passing through the points having position vectors $\hat{i} + \hat{j} - 2\hat{k}$, $2\hat{i} - \hat{j} + \hat{k}$ and $\hat{i} + 2\hat{j} + \hat{k}$

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

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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 \vec{AB} is not perpendicular to \vec{CD} and satisfies

$\vec{AB} \cdot \vec{CD} = k \left(\left| \vec{AD} \right|^2 + \left| \vec{BC} \right|^2 - \left| \vec{AC} \right|^2 - \left| \vec{BD} \right|^2 \right)$, 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 $\vec{a} \times \vec{b} = \vec{0}$, 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 $\vec{a} \cdot \vec{b}$

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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.

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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} and \vec{b} is θ_1 , between \vec{b} and \vec{c} is θ_2 and between \vec{a} and \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 $[\vec{a} + \vec{b} \quad \vec{b} + \vec{c} \quad \vec{c} + \vec{a}] = 2[\vec{a} \quad \vec{b} \quad \vec{c}]$

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

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

of the tetrahedron $ABCD$



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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 $\hat{i} + a\hat{j} + k, \hat{j} + a\hat{k}$ and $\hat{i} + \hat{k}$ becomes minimum.



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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 $\vec{a} \times \vec{b} = \vec{0}$, then find (m, n)

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213. Prove that
$$\begin{bmatrix} \vec{l} \cdot \vec{a} & \vec{l} \cdot \vec{b} & \vec{l} \cdot \vec{c} \\ \vec{m} \cdot \vec{a} & \vec{m} \cdot \vec{b} & \vec{m} \cdot \vec{c} \\ \vec{n} \cdot \vec{a} & \vec{n} \cdot \vec{b} & \vec{n} \cdot \vec{c} \end{bmatrix} = \begin{bmatrix} \vec{l} \cdot \vec{a} & \vec{l} \cdot \vec{b} & \vec{l} \cdot \vec{c} \\ \vec{m} \cdot \vec{a} & \vec{m} \cdot \vec{b} & \vec{m} \cdot \vec{c} \\ \vec{n} \cdot \vec{a} & \vec{n} \cdot \vec{b} & \vec{n} \cdot \vec{c} \end{bmatrix}.$$

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

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

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216. Prove that

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

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217. If \vec{a} , \vec{b} , and \vec{c} are non-coplanar unit vectors such that

$$\vec{a} \times (\vec{b} \times \vec{c}) = \frac{\vec{b} + \vec{c}}{\sqrt{2}}, \vec{b} \text{ and } \vec{c} \text{ are non-parallel, then prove that the angle}$$

between \vec{a} and \vec{b} , is $3\pi/4$.

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218.

If

$$\vec{r} \cdot \vec{a} = 0, \vec{r} \cdot \vec{b} = 1 \text{ and } [\vec{r} \ \vec{a} \ \vec{b}] = 1, \vec{a} \cdot \vec{b} \neq 0, \left(\vec{a} \cdot \vec{b} \right)^2 - |\vec{a}|^2 |\vec{b}|^2 = -1,$$

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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221. If vector \vec{x} satisfying $\vec{x} \times \vec{a} + \left(\vec{x} \times \vec{b} \right) \vec{c} = \vec{d}$ is given

$$\vec{x} = \lambda \vec{a} + \vec{a} \times \frac{\vec{a} \times \left(\vec{d} \times \vec{c} \right)}{\left(\vec{a} \cdot \vec{c} \right) |\vec{a}|^2}, \text{ then find the value of } \lambda$$

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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 α , between \hat{c} and \hat{a} is β and between \hat{a} and \hat{b} is γ . 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

$$ABC, \frac{|\hat{a} \times (\hat{b} \times \hat{c})|}{\sin A} = \frac{|\hat{b} \times (\hat{c} \times \hat{a})|}{\sin B} = \frac{|\hat{c} \times (\hat{a} \times \hat{b})|}{\sin C}$$

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



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



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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 λ



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227. Prove that $(\vec{a} \cdot \hat{i})(\vec{a} \times \hat{i}) + (\vec{a} \cdot \hat{j})(\vec{a} \times \hat{j}) + (\vec{a} \cdot \hat{k})(\vec{a} \times \hat{k}) = 0$.



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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 rad/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 $(1, -1, 2)$.



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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

$$\begin{vmatrix} a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \\ c_1 & c_2 & c_3 \end{vmatrix}^2 = \frac{1}{4} (a_1^2 + a_2^2 + a_3^2) (b_1^2 + b_2^2 + b_3^2)$$

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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

$[\vec{d}\vec{b}\vec{c}] = [\vec{d}\vec{a}\vec{b}] = [\vec{d}\vec{c}\vec{a}] = 1$, then $\vec{d} = \vec{a} + \vec{b} + \vec{c}$. Statement 2:

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

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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

α if ($\alpha > 0$)

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235. Prove that $[\vec{l}\vec{m}\vec{n}][\vec{a}\vec{b}\vec{c}] = \begin{vmatrix} \vec{l} \cdot \vec{a} & \vec{l} \cdot \vec{b} & \vec{l} \cdot \vec{c} \\ \vec{m} \cdot \vec{a} & \vec{m} \cdot \vec{b} & \vec{m} \cdot \vec{c} \\ \vec{n} \cdot \vec{a} & \vec{n} \cdot \vec{b} & \vec{n} \cdot \vec{c} \end{vmatrix}$.

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236. Using dot product of vectors, prove that a parallelogram, whose diagonals are equal, is a rectangle

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

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238. In any triangle ABC , 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.

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240. If $\vec{a} \cdot \hat{i} = \vec{a} \cdot (\hat{i} + \hat{j}) = \vec{a} \cdot (\hat{i} + \hat{j} + \hat{k})$, 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



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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 three mutually perpendicular unit vectors and \vec{a} is 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 θ 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} .

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

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

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

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

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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 $\vec{r} \cdot \hat{i} = \vec{r} \cdot \hat{j} = \vec{r} \cdot \hat{k}$ 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 $\vec{a} \cdot \vec{b} = \vec{a} \cdot \vec{c}$, 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 θ is the angle between the unit vectors \vec{a} and \vec{b} , then prove that

$$\cos\left(\frac{\theta}{2}\right) = \frac{1}{2}|\vec{a} + \vec{b}|, \text{ and } \sin\left(\frac{\theta}{2}\right) = \frac{1}{2}|\vec{a} - \vec{b}|$$

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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 $\pi/3$. If $\text{veca} \times \text{vecb} + \text{vecb} \times \text{vecc} = p \text{veca} + q \text{vecb} + r \text{vecc}$, where p, q and r are scalars, then the value of $p^2 + 2q^2 + r^2/q^2$ is

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266. Given unit vectors \hat{m} , \hat{n} and \hat{p} such that angle between \hat{m} and \hat{n} is α and angle between \hat{p} and $(\hat{m} \times \hat{n})$ is also α , 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}' , \vec{b}' , \vec{c}' are reciprocal system of vector \vec{a} , \vec{b} , \vec{c} , then prove that $\vec{a} \times \vec{a}' + \vec{b} \times \vec{b}' + \vec{c} \times \vec{c}'$ is a null vector.

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268. Vector $\vec{OA} = \hat{i} + 2\hat{j} + 2\hat{k}$ 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 $AOBC$ is an equilateral triangle OBC with each side equal to $4\sqrt{2}$, O is the origin of reference, AO is perpendicular to the plane of OBC and $|\vec{AO}| = 2$. Then find the cosine of the angle between the skew straight lines, one passing through A and the midpoint of OB and the other passing through O and the midpoint of BC .

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270. Find $|\vec{a} \times \vec{b}|$, if $\vec{a} = \hat{i} - 7\hat{j} + 7\hat{k}$ and $\vec{b} = 3\hat{i} - 2\hat{j} + 2\hat{k}$.

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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 angle 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 $\vec{c} \cdot \vec{d} = 15$.

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274. If A, B and C are the vertices of a triangle ABC , 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 $(\vec{a} \times \vec{b})^2 = \begin{vmatrix} \vec{a} \cdot \vec{a} & \vec{a} \cdot \vec{b} \\ \vec{b} \cdot \vec{a} & \vec{b} \cdot \vec{b} \end{vmatrix} .$

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278. In isosceles triangles ABC , $|\vec{AB}| = |\vec{BC}| = 8$, a point E divides AB internally in the ratio $1:3$, then find the angle between \vec{CE} and \vec{CA} (where $|\vec{CA}| = 12$)

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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 $|\vec{a} + \vec{b} + \vec{c}|$.

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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 $\vec{A} = 4\hat{i} + 6\hat{j}$ and $\vec{B} = 3\hat{j} + 4\hat{k}$, then find the component of \vec{A} along \vec{B}

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283. A particle acted by constant forces $4\hat{i} + \hat{j} - 3\hat{k}$ and $3\hat{i} + 9\hat{j} - \hat{k}$ 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

$$\text{that } \left| \vec{a} + \vec{b} + \vec{c} \right| = \sqrt{3}$$



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285. Let $\vec{a} = x\hat{i} + 12\hat{j} - \hat{k}$, $\vec{b} = 2\hat{i} + 2x\hat{j} + \hat{k}$ 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

$$\frac{\vec{a}\vec{b} \times \vec{c}}{\vec{b}\vec{c} \times \vec{a}} + \frac{\vec{b}\vec{c} \times \vec{a}}{\vec{c}\vec{a} \times \vec{b}} + \frac{\vec{c}\vec{b} \times \vec{a}}{\vec{a}\vec{b} \times \vec{c}}$$



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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 $ABCD$, prove that

$$\frac{|\vec{a} \times \vec{b} + \vec{b} \times \vec{d} + \vec{d} \times \vec{a}|}{(\vec{b} - \vec{a}) \cdot \vec{d} - \vec{a}} + \frac{|\vec{b} \times \vec{c} + \vec{c} \times \vec{d} + \vec{d} \times \vec{b}|}{(\vec{b} - \vec{c}) \cdot \vec{d} - \vec{c}} = 0$$

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288. The position vectors of the vertices of a quadrilateral with A as origin are $B(\vec{b}), D(\vec{d})$ and $C(l\vec{b} + m\vec{d})$. Prove that the area of the quadrilateral 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 parallel to $\vec{b} - \vec{c}$.

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290. Show by a numerical example and geometrically also that

$$\vec{a} \times \vec{b} = \vec{a} \times \vec{c} \text{ does not imply } \vec{b} = \vec{c}$$

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291. In triangle ABC , points D, E and F are taken on the sides BC, CA and AB , respectively, such that $\frac{BD}{DC} = \frac{CE}{EA} = \frac{AF}{FB} = n$. Prove that

$$\Delta DEF = \frac{n^2 - n + 1}{(n + 1)^2} \Delta (ABC)$$

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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 OAC .

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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 rad/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. $\vec{r} \times \vec{a} = \vec{b} \times \vec{a}$; $\vec{r} \times \vec{b} = \vec{a} \times \vec{b}$; $\vec{a} \neq \vec{0}$; $\vec{b} \neq \vec{0}$; $\vec{a} \neq \lambda \vec{b}$, and \vec{a} is not perpendicular to \vec{b} , then find \vec{r} in terms of \vec{a} and \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 A, B, C of a triangle ABC, show that the area of the triangle 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 and D are any four points in the space, then prove that

$$|\vec{AB} \times \vec{CD} + \vec{BC} \times \vec{AD} + \vec{CA} \times \vec{BD}| = 4 (\text{area of } ABC)$$



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



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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 vectors 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 λ



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303. Find the area a parallelogram whose diagonals are

$$\vec{a} = 3\hat{i} + \hat{j} - 2\hat{k} \text{ and } \vec{b} = \hat{i} - 3\hat{j} + 4\hat{k}$$

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304. If \vec{a} and \vec{b} are unit vectors such that

$$(\vec{a} + \vec{b}) \cdot [(2\vec{a} + 3\vec{b}) \times (3\vec{a} - 2\vec{b})] = 0, \text{ then angle between } \vec{a} \text{ and } \vec{b} \text{ is a.0}$$

b. $\pi/2$ c. π d. indeterminate

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305. If \vec{a} and \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 BC , CA and AB , respectively, of triangle ABC , then (a) $\vec{a}\vec{b} + \vec{b}\vec{c} + \vec{c}\vec{a} = 0$ (b) $\vec{a} \times \vec{b} = \vec{b} \times \vec{c} = \vec{c} \times \vec{a}$ (c). $\vec{a}\vec{b} = \vec{b}\vec{c} = \vec{c}\vec{a}$ (d). $\vec{a} \times \vec{b} + \vec{b} \times \vec{c} + \vec{c} \times \vec{a} = 0$

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307. Let \vec{u} be a vector on rectangular coordinate system with sloping angle 60° . 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 $ABCD$ are given by $\vec{AB} = 2\hat{i} + 10\hat{j} + 11\hat{k}$ and $\vec{AD} = -\hat{i} + 2\hat{j} + 2\hat{k}$. The side AD is rotated by an acute angle α in the plane of the parallelogram so that AD becomes AD' .

If AD' makes a right angle with the side AB , then the cosine of the angle

α 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 θ then $[\vec{a}\vec{b}\vec{c}]$ in terms of θ is equal to :

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310. Volume of parallelepiped formed by vectors $\vec{a} \times \vec{b}$, $\vec{b} \times \vec{c}$ and $\vec{c} \times \vec{a}$ is $36sq$ units. Column I | Column II
 Volume of parallelepiped formed by vectors \vec{a} , \vec{b} , and \vec{c} is | p. 0 sq. units
 Volume of tetrahedron formed by vectors \vec{a} , \vec{b} , and \vec{c} is | 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 $\vec{a} - \vec{b}$, $\vec{b} - \vec{c}$ and $\vec{c} - \vec{a}$ is | s. 1 sq. units

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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 b. -3 c. 0 d. cannot be evaluated

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312. The value of a so that the volume of parallelepiped formed by $\hat{i} + \hat{a}\hat{j} + \hat{k}$, $\hat{j} + a\hat{k}$ 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, \dots, A_n are the vertices of a regular plane polygon with n sides

and O as its centre. Show that $\sum_{i=1}^n \vec{OA}_i \times \vec{OA}_{i+1} = (1 - n) \left(\vec{OA}_2 \times \vec{OA}_1 \right)$

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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

$$\vec{A}\vec{X} = c \text{ and } \vec{A} \times \vec{X} = \vec{B}$$

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315. A, B, C and D are any four points in the space, then prove that

$$\left| \vec{AB} \times \vec{CD} + \vec{BC} \times \vec{AD} + \vec{CA} \times \vec{BD} \right| = 4 \text{ (area of } ABC \text{.)}$$

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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 $cx\hat{i} - 6\hat{j} - 3\hat{k}$ and $x\hat{i} + 2\hat{j} + 2cx\hat{k}$ 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) $\frac{1}{4}\vec{r} \cdot (\vec{a} + \vec{b} + \vec{c})$ (C) $2\vec{r} \cdot (\vec{a} + \vec{b} + \vec{c})$ (D) $4\vec{r} \cdot (\vec{a} + \vec{b} + \vec{c})$



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320. $\left[(\vec{a} \times \vec{b}) \times (\vec{b} \times \vec{c}) (\vec{b} \times \vec{c}) \times (\vec{c} \times \vec{a}) (\vec{c} \times \vec{a}) \times (\vec{a} \times \vec{b}) \right]$ is equal to
 (where \vec{a} , \vec{b} and \vec{c} are nonzero non-coplanar vector) $[\vec{a}\vec{b}\vec{c}]^2$ b. $[\vec{a}\vec{b}\vec{c}]^3$ 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' be the volume of another tetrahedron formed by the centroids of faces of the previous tetrahedron and $V = KV'$, 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 vectors 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 ABC and $R(\vec{r})$ is any point in the plane of triangle ABC, then $r \cdot (\vec{a} \times \vec{b} + \vec{b} \times \vec{c} + \vec{c} \times \vec{a})$ 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} and \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 $(\vec{a} + \vec{b}) \cdot \vec{p} + (\vec{b} + \vec{c}) \cdot \vec{q} + (\vec{c} + \vec{a}) \cdot \vec{r}$ is a. 0 b. 1 c. 2 d.

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325. Let \vec{a}, \vec{b} and \vec{c} be three non-coplanar vectors 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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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 angle of triangle ABC is 120° b. 90° c. $\cos^{-1}(3/4)$ d. none of these

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327. Let $\vec{a}(x) = (\sin x)\hat{i} + (\cos x)\hat{j}$ and $\vec{b}(x) = (\cos 2x)\hat{i} + (\sin 2x)\hat{j}$ be two variable vectors ($x \in R$). Then $\vec{a}(x)$ and $\vec{b}(x)$ 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 $\vec{a} = 2\hat{i} + \hat{j} + \hat{k}, \vec{b} = \hat{i} + 2\hat{j} + 2\hat{k}, \vec{c} = \hat{i} + \hat{j} + 2\hat{k}$ and $(1 + \alpha)\hat{i} + \beta(1 + \alpha)\hat{j} + \gamma(1 + \alpha)\hat{k} = \vec{a} + \vec{b} + \vec{c}$

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

$$|\vec{a} - \vec{b}|^2 + |\vec{b} - \vec{c}|^2 + |\vec{c} - \vec{a}|^2 = 9, \text{ then } |2\vec{a} + 5\vec{b} + 5\vec{c}| \text{ is.}$$



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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

$$\left| (\vec{d} \cdot \vec{c})(\vec{a} \times \vec{b}) + (\vec{d} \cdot \vec{a})(\vec{b} \times \vec{c}) + (\vec{d} \cdot \vec{b})(\vec{c} \times \vec{a}) \right| = 0, \text{ then}$$

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



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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. $-\hat{i} + \hat{j}$ 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 $\vec{r} \cdot \vec{a} = 0$, then find the value of $\vec{r} \cdot \vec{b}$.

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333. Let \vec{a}, \vec{b} , and \vec{c} be vectors forming right-hand triad. Let

$$\vec{p} = \frac{\vec{b} \times \vec{c}}{[\vec{a}\vec{b}\vec{c}]}, \vec{q} = \frac{\vec{c} \times \vec{a}}{[\vec{a}\vec{b}\vec{c}]}, \text{ and } \vec{r} = \frac{\vec{a} \times \vec{b}}{[\vec{a}\vec{b}\vec{c}]}.$$

If $x \in \mathbb{R}^+$, 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. $[\vec{p}\vec{q}\vec{r}] > 0$ d. none of these



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334. From a point O inside a triangle ABC , perpendiculars OD , OE and OF are drawn to the sides BC , CA and AB , respectively. Prove that the perpendiculars from A , B , and C to the sides EF , FD and DE 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 $F = 3\hat{i} - \hat{j} - 2\hat{k}$ acting 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. $OABC$ is regular tetrahedron in which D is the circumcentre of OAB and E is the midpoint of edge AC . Prove that DE is equal to half the edge of tetrahedron.

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339. In the quadrilateral $ABCD$, the diagonals AC and BD are equal and perpendicular to each other. What type of a quadrilateral is $ABCD$?

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340. If $\vec{e}_1, \vec{e}_2, \vec{e}_3$ and $\vec{E}_1, \vec{E}_2, \vec{E}_3$ are two sets of vectors such that $\vec{e}_i \cdot \vec{E}_j = 1$, if $i = j$ and $\vec{e}_i \cdot \vec{E}_j = 0$ and if $i \neq j$, then prove that $[\vec{e}_1 \vec{e}_2 \vec{e}_3][\vec{E}_1 \vec{E}_2 \vec{E}_3] = 1$.

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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 , and d 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 $\vec{a} + \vec{b} + \vec{c}$ 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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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 $|3\vec{a} - 2\vec{b} + 4\vec{c}|$

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346. Let $\vec{OA} = \vec{a}$, $\vec{OB} = 10\vec{a} + 2\vec{b}$ and $\vec{OC} = \vec{b}$, where O, A and C are non-collinear points. Let p denotes the area of quadrilateral $OACB$, and let q denote the area of parallelogram with OA and OC as adjacent sides. If $p = kq$, then find k

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347. If $\vec{a}, \vec{b}, \vec{c}$ are unit vectors such that $\vec{a} \cdot \vec{b} = 0 = \vec{a} \cdot \vec{c}$ 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 $[(a-2)\alpha^2 + (b-3)\alpha + c]\vec{x} + [(a-2)\beta^2 + (b-3)\beta + c]\vec{y} + [(a-2)\gamma^2 + (b-3)\gamma + c]\vec{z}$ are three distinct real numbers, then find the value of $(a^2 + b^2 + c^2 - 4)$.



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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 the value of 6α , 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, 5 and 3, respectively, such that the angle between \vec{a} and \vec{b} is θ and $\vec{a} \times (\vec{a} \times \vec{b}) = \vec{c}$.

Then $\tan\theta$ is equal to a. 0 b. $\frac{2}{3}$ c. $\frac{3}{5}$ d. $\frac{3}{4}$

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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

$\vec{a} \cdot \vec{d} = 0 = [\vec{b} \vec{c} \vec{d}]$, 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.

$\pm \hat{k}$

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353. If vectors \vec{a} and \vec{b} are two adjacent sides of a parallelogram, then the vector representing 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.

(a) $(\vec{a} \cdot \vec{c})|\vec{b}|^2 = (\vec{a} \cdot \vec{b})(\vec{b} \cdot \vec{c})(\vec{c} \cdot \vec{a})$ b. $\vec{a} \vec{b} = 0$ c. $\vec{a} \vec{c} = 0$ 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) $[\vec{a} \vec{b} \vec{e}][\vec{f} \vec{c} \vec{d}] - [\vec{a} \vec{b} \vec{f}][\vec{e} \vec{c} \vec{d}]$

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

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

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356. \vec{b} and \vec{c} are non-collinear if

$$\vec{a} \times (\vec{b} \times \vec{c}) + \left(\vec{a} \vec{b} \right) \vec{b} = (4 - 2x - \sin y) \vec{b} + (x^2 - 1) \vec{c} \text{ and } \left(\vec{c} \vec{c} \right) \vec{a} = \vec{c}$$

a. $x = 1$ b. $x = -1$ c. $y = (4n + 1)\pi/2, n \in I$ d. $y = (2n + 1)\pi/2, n \in I$

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357. If \vec{a} and \vec{b} are unit vectors, then angle between \vec{a} and \vec{b} for

$\sqrt{3} \vec{a} - \vec{b}$ to be unit vector is

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358. If $\vec{a} \perp \vec{b}$, then vector \vec{v} in terms of \vec{a} and \vec{b} satisfying the equation $\vec{v} \cdot \vec{a} = 0$ and $\vec{v} \cdot \vec{b} = 1$ and $[\vec{v} \vec{a} \vec{b}] = 1$ is

a. $\frac{\vec{b}}{|\vec{b}|^2} + \frac{\vec{a} \times \vec{b}}{|\vec{a} \times \vec{b}|^2}$ b. $\frac{\vec{b}}{|\vec{b}|^2} + \frac{\vec{a} \times \vec{b}}{|\vec{a} \times \vec{b}|^2}$ c.

d. none of these



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359. If $\vec{a}' = \hat{i} + \hat{j}$, $\vec{b}' = \hat{i} - \hat{j} + 2\hat{k}$ and $\vec{c}' = 2\hat{i} + \hat{j} - \hat{k}$, 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}' 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. $\frac{\hat{i} + \hat{j} - \hat{k}}{2}$



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361. If unit vectors \vec{a} and \vec{b} are inclined at angle 2θ such that $|\vec{a} - \vec{b}| < 1$ and $0 \leq \theta \leq \pi$, then θ 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} and \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 $(\vec{a} + \vec{b}) \cdot \vec{p} + (\vec{b} + \vec{c}) \cdot \vec{q} + (\vec{c} + \vec{a}) \cdot \vec{r}$ is a. 0 b. 1 c. 2 d. 3



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363. Let $\vec{a} = a_1\hat{i} + a_2\hat{j} + a_3\hat{k}$, $\vec{b} = b_1\hat{i} + b_2\hat{j} + b_3\hat{k}$, 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 vectors \vec{a} and \vec{b} . If the angle between a and b is $\pi/6$, then

$$\begin{vmatrix} a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \\ c_1 & c_2 & c_3 \end{vmatrix}^2 \text{ is equal to}$$

A. (a) 0

B. (b) 1

C. (c) $\frac{1}{4}(a_1^2 + a_2^2 + a_3^2)(b_1^2 + b_2^2 + b_3^2)$

D. (d) $\frac{3}{4}(a_1^2 + a_2^2 + a_3^2)(b_1^2 + b_2^2 + b_3^2)(c_1^2 + c_2^2 + c_3^2)$

Answer: null



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364. A, B, C and D are four points such that

$$\vec{AB} = m(2\hat{i} - 6\hat{j} + 2\hat{k}), \vec{BC} = (\hat{i} - 2\hat{j}) \text{ and } \vec{CD} = n(-6\hat{i} + 15\hat{j} - 3\hat{k}) \text{ If } CD$$

intersects AB 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} and \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. $-3\hat{i} - 3\hat{j} + 3\hat{k}$ c. $3\hat{i} - \hat{j} + 3\hat{k}$ 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. $\vec{u} \cdot (\vec{v} \times \vec{w})$ b. $\vec{u} \cdot \vec{v} \cdot \vec{w}$ c. $(\vec{u} \cdot \vec{v}) \cdot \vec{w}$ d. $\vec{u} \times (\vec{v} \cdot \vec{w})$



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368. Find the value of λ if the volume of a tetrahedron whose vertices are with position vectors $\hat{i} - 6\hat{j} + 10\hat{k}$, $-\hat{i} - 3\hat{j} + 3\hat{k}$, $5\hat{i} - \hat{j} + \lambda\hat{k}$ and $7\hat{i} - 4\hat{j} + 7\hat{k}$ is 11 cubic unit.



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369. Let $\vec{a} = 2\hat{i} - \hat{j} + \hat{k}$, $\vec{b} = \hat{i} + 2\hat{j} + \hat{k}$ and $\vec{c} = \hat{i} + \hat{j} - 2\hat{k}$ 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 $(\vec{a} \times \vec{b}) \times (\vec{c} \times \vec{d}) \cdot \vec{a} \times \vec{d} = 0$, 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} d. \vec{c} lies in the plane of \vec{a} and \vec{d}



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371. Vector $\frac{1}{3}(2\hat{i} - 2\hat{j} + \hat{k})$ 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 $(-\hat{i} + \hat{j} - \frac{1}{2}\hat{k})$ (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 scalars l and m 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 $OABC$ is a tetrahedron where O is the origin and $A, B,$ 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

given by position vector
$$\frac{a^2(\vec{b} \times \vec{c}) + b^2(\vec{c} \times \vec{a}) + c^2(\vec{a} \times \vec{b})}{2[\vec{a}\vec{b}\vec{c}]}.$$

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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 $\triangle ABC$, a point P is taken on AB such that $AP/BP = 1/3$ and point Q is taken on BC such that $CQ/BQ = 3/1$. If R is the point of intersection of the lines AQ and CP , using vector method, find the area of ABC if the area of BRC is 1 unit

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377. Let $ABCD$ be a parallelogram whose diagonals intersect at P and let O be the origin. Then prove that $\vec{OA} + \vec{OB} + \vec{OC} + \vec{OD} = 4\vec{OP}$

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378. Find $\vec{a} \cdot \vec{b}$ 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 $\vec{a} \times \vec{b}$ is

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380. If $\vec{a} = x\hat{i} + y\hat{j} + z\hat{k}$, $\vec{b} = y\hat{i} + z\hat{j} + x\hat{k}$ and $\vec{c} = z\hat{i} + x\hat{j} + y\hat{k}$, 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 $|\vec{a} \times \vec{b}|$, if $\vec{a} = 2\hat{i} + \hat{j} + 3\hat{k}$ and $\vec{b} = 3\hat{i} + 5\hat{j} - 2\hat{k}$.

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382. find the value of x, y and z so that the 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 distance between these edges is d , and the angle between them is θ . Prove using vectors that the volume of the tetrahedron is $\frac{abdsin\theta}{6}$.

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

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385. If vectors $\vec{A} = 2\hat{i} + 3\hat{j} + 4\hat{k}, \vec{B} = \hat{i} + \hat{j} + 5\hat{k}$ and \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 $\vec{a}=2\vec{i}-\vec{j}+\vec{k}, \vec{b}=\vec{i}+2\vec{j}-\vec{k}$ and $\vec{c}=\vec{i}+\vec{j}-2\vec{k}$ be three vectors. A vector in the plane of \vec{b} and \vec{c} whose projection on \vec{a} is of magnitude $\left(\frac{\sqrt{3}}{2}\right)$ is

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387. Vectors \vec{A} and \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. $\vec{B} = \frac{(\vec{b} \times \vec{a}) + \vec{a}(a^2 - 1)}{a^2}$ c. $\vec{A} = \frac{(\vec{a} \times \vec{b}) + \vec{a}}{a^2}$ d.

$\vec{B} = \frac{(\vec{b} \times \vec{a}) - \vec{a}(a^2 - 1)}{a^2}$

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388. if $\vec{\alpha} \perp (\vec{\beta} \times \vec{\gamma})$, then $(\vec{\alpha} \times \vec{\beta}) \cdot (\vec{\alpha} \times \vec{\gamma})$ equals to a. $|\vec{\alpha}|^2(\vec{\beta} \cdot \vec{\gamma})$ b. $|\vec{\beta}|^2(\vec{\gamma} \cdot \vec{\alpha})$ c. $|\vec{\gamma}|^2(\vec{\alpha} \cdot \vec{\beta})$ d. $|\vec{\alpha}||\vec{\beta}||\vec{\gamma}|$

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389. Let $\vec{\alpha} = a\hat{i} + b\hat{j} + c\hat{k}$, $\vec{\beta} = b\hat{i} + c\hat{j} + a\hat{k}$ and $\vec{\gamma} = c\hat{i} + a\hat{j} + b\hat{k}$ are three coplanar vectors with $a \neq b$, and $\vec{v} = \hat{i} + \hat{j} + \hat{k}$. Then \vec{v} is perpendicular to $\vec{\alpha}$ b. $\vec{\beta}$ c. $\vec{\gamma}$ d. none of these

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390. $a_1, a_2, a_3 \in \mathbb{R} - \{0\}$ and $a_1 + a_2 \cos 2x + a_3 \sin^2 x = 0$ for all $x \in \mathbb{R}$, 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 $(a_1, a_2, a_3) = (1, -1, -2)$

D. (d) If $2a_1 + 3a_2 + 6a_3 = 26$, then $|a_1\hat{i} + a_2\hat{j} + a_3\hat{k}|$ is $2\sqrt{6}$

Answer: null



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



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392. Let \vec{a} and \vec{b} be two non-zero perpendicular vectors. A vector \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 β can be



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393. If \vec{a} and \vec{b} are two vectors and angle between them is θ , then

$$|\vec{a} \times \vec{b}|^2 + (\vec{a} \cdot \vec{b})^2 = |\vec{a}|^2 |\vec{b}|^2 \qquad |\vec{a} \times \vec{b}| = (\vec{a} \cdot \vec{b}), \text{ if } \theta = \pi/4$$

$$\vec{a} \times \vec{b} = (\vec{a} \cdot \vec{b}) \hat{n}, \text{ (where } \hat{n} \text{ is unit vector,)} \text{ if } \theta = \pi/4 \quad (\vec{a} \times \vec{b}) \cdot \vec{a} + \vec{b} = 0$$

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394. Let \vec{r} be a unit vector satisfying

$$\vec{r} \times \vec{a} = \vec{b}, \text{ where } |\vec{a}| = \sqrt{3} \text{ and } |\vec{b}| = \sqrt{2}. \text{ Then}$$

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395. If vector $\vec{b} = (\tan\alpha, -1, 2\sqrt{\sin\alpha/2})$ and $\vec{c} = (\tan\alpha, \tan\alpha, -\frac{3}{\sqrt{\sin\alpha/2}})$

are orthogonal and vector $\vec{a} = (1, 3, \sin 2\alpha)$ makes an obtuse angle with the z-axis, then the value of α is

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396. Let \vec{a} , \vec{b} , and \vec{c} be non-zero vectors and

$\vec{V}_1 = \vec{a} \times (\vec{b} \times \vec{c})$ and $\vec{V}_2 = (\vec{a} \times \vec{b}) \times \vec{c}$. Vectors \vec{V}_1 and \vec{V}_2 are equal. Then

(a). \vec{a} and \vec{b} are orthogonal (b). \vec{a} and \vec{c} are collinear (c). \vec{b} and \vec{c} are orthogonal

(d). $\vec{b} = \lambda(\vec{a} \times \vec{c})$ when λ is a scalar



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397. $\vec{a} = 2\hat{i} - \hat{j} + \hat{k}$, $\vec{b} = \hat{i} + 2\hat{j} - \hat{k}$, $\vec{c} = \hat{i} + \hat{j} - 2\hat{k}$ A vector coplanar with

\vec{b} and \vec{c} whose projection 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 $\vec{PR} = 3\hat{i} + \hat{j} - 2\hat{k}$ and $\vec{SQ} = \hat{i} - 3\hat{j} - 4\hat{k}$ determine diagonals of a

parallelogram $PQRS$, and $\vec{PT} = \hat{i} + 2\hat{j} + 3\hat{k}$ be another vector. Then the

volume of the parallelepiped determine by the vectors \vec{PT} , \vec{PQ} and \vec{PS} is 5

b. 20 c. 10 d. 30

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399. If in a right-angled triangle ABC , the hypotenuse $AB = p$, then

$\vec{AB} \cdot \vec{AC} + \vec{BC} \cdot \vec{BA} + \vec{CA} \cdot \vec{CB}$ is equal to $2p^2$ b. $\frac{p^2}{2}$ c. p^2 d. none of these

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

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

$\lambda\hat{i} + (2\lambda + 1)\hat{j} + \lambda\hat{k}, \lambda \in \mathbb{R}$ d. $\lambda\hat{i} - (1 + 2\lambda)\hat{j} + \lambda\hat{k}, \lambda \in \mathbb{R}$



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

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



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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.

$\pm \frac{1}{3}(2\hat{i} - 2\hat{j} - \hat{k})$ 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. $\frac{19}{6\sqrt{43}}$

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405. If vectors \vec{a} and \vec{b} are two adjacent sides of a parallelogram, then the vector representing 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 $\vec{a} = 2x^2\hat{i} + 4x\hat{j} + \hat{k}$ and $\vec{b} = 7\hat{i} - 2\hat{j} + \hat{k}$ is obtuse and the angle between \vec{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} and \vec{b} are unit vectors and the unit vector \vec{c} is inclined at an angle θ to both \vec{a} and \vec{b} . If

$$\vec{c} = m\vec{a} + n\vec{b} + p(\vec{a} \times \vec{b}), (m, n, p \in R), \text{ then a. } \frac{\pi}{4} \leq \theta \leq \frac{\pi}{4} \text{ b. } \frac{\pi}{4} \leq \theta \leq \frac{3\pi}{4}$$

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} and \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 P and Q 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 P and Q . Then λ 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 angle between a and c is $\cos^{-1}(1/4)$ and $a \times b = 2a \times c$ then, $b - 2c = \lambda a$. The value of λ 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 $|(\vec{d} \cdot \vec{c})(\vec{a} \times \vec{b}) + (\vec{d} \cdot \vec{a})(\vec{b} \times \vec{c}) + (\vec{d} \cdot \vec{b})(\vec{c} \times \vec{a})| = 0$, then a. $|\vec{a}| = |\vec{b}| = |\vec{c}|$ b. $|\vec{a}| + |\vec{b}| + |\vec{c}| = |\vec{d}|$ 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 a. $\frac{\vec{d} \cdot \vec{a} + \vec{c}}{[\vec{a}\vec{b}\vec{c}]} = 2$ b.

$$\frac{\vec{d}\vec{a} + \vec{c}}{[\vec{a}\vec{b}\vec{c}]} = -2 \text{ c. minimum value of } x^2 + y^2 \text{ is } \pi^2/4 \text{ d. minimum value of } x^2 + y^2 \text{ is } 5\pi^2/4$$

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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. $\vec{0}$

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414. If \vec{a} and \vec{b} are two non-collinear unit vector, and $|\vec{a} + \vec{b}| = 3$ then $(2\vec{a} - 5\vec{b}) \cdot (3\vec{a} + \vec{b}) =$

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415. The angles of triangle, two of whose sides are represented by vectors

$$\sqrt{3}(\vec{a} \times \vec{b}) \text{ and } \vec{b} - \left(\hat{a} \vec{b} \right) \hat{a}, \text{ where } \vec{b} \text{ is a non zero vector and } \hat{a} \text{ is unit vector}$$

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 them. 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° , 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 $-\hat{i} + \hat{j} + \hat{k}$ are $\hat{i} + \hat{k}$ b. $2\hat{i} + \hat{j} + \hat{k}$ c. $3\hat{i} + 2\hat{j} + \hat{k}$ d. $-4\hat{i} - 2\hat{j} - 2\hat{k}$

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418. If side \vec{AB} of an equilateral triangle ABC lying in the x - y plane is $3\hat{i}$, then side \vec{CB} can be a. $-\frac{3}{2}(\hat{i} - \sqrt{3}\hat{j})$ 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 $\vec{a} \cdot \vec{c} = \frac{1}{2}$ 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 vectors \hat{a} and \hat{b} form an acute angle. A point P moves so that at any time t , the position vector OP (where O is the origin) is given by $\hat{a}\cos t + \hat{b}\sin t$. When P is farthest from origin O , let M be the length of OP and \hat{u} be the unit vector along OP . Then (a)

$$\hat{u} = \frac{\hat{a} + \hat{b}}{|\hat{a} + \hat{b}|} \text{ and } M = \left(1 + \hat{a} \cdot \hat{b}\right)^{1/2} \quad \text{(b)} \quad \hat{u} = \frac{\hat{a} - \hat{b}}{|\hat{a} - \hat{b}|} \text{ and } M = \left(1 + \hat{a} \cdot \hat{b}\right)^{1/2} \quad \text{(c)}$$

$$\hat{u} = \frac{\hat{a} + \hat{b}}{|\hat{a} + \hat{b}|} \text{ and } M = \left(1 + 2\hat{a} \cdot \hat{b}\right)^{1/2} \quad \text{(d)} \quad \hat{u} = \frac{\hat{a} - \hat{b}}{|\hat{a} - \hat{b}|} \text{ and } M = \left(1 + 2\hat{a} \cdot \hat{b}\right)^{1/2}$$

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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 \vec{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 $\vec{b}_1 = \vec{b} - \frac{\vec{b} \cdot \vec{a}}{|\vec{a}|^2} \vec{a}$,

$$\vec{c}_1 = \vec{c} - \frac{\vec{c} \cdot \vec{a}}{|\vec{a}|^2} \vec{a} + \frac{\vec{b} \cdot \vec{c}}{|\vec{c}|^2} \vec{b}_1, \quad \vec{c}_2 = \vec{c} - \frac{\vec{c} \cdot \vec{a}}{|\vec{a}|^2} \vec{a} - \frac{\vec{b} \cdot \vec{c}}{|\vec{b}_1|^2} \vec{b}_1,$$

$$b_1, \vec{c}_3 = \vec{c} - \frac{\vec{c} \cdot \vec{a}}{|\vec{c}|^2} \vec{a} + \frac{\vec{b} \cdot \vec{c}}{|\vec{c}|^2} \vec{b}_1, \vec{c}_4 = \vec{c} - \frac{\vec{c} \cdot \vec{a}}{|\vec{c}|^2} \vec{a} = \frac{\vec{b} \cdot \vec{c}}{|\vec{b}|^2} \vec{b}_1$$

orthogonal vectors is $(\vec{a}, \vec{b}_1, \vec{c}_3)$ b. $(\vec{a}, \vec{b}_1, \vec{c}_2)$ c. $(\vec{a}, \vec{b}_1, \vec{c}_1)$ d. $(\vec{a}, \vec{b}_2, \vec{c}_2)$

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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 θ between \vec{a} and \vec{b} is 0 b. $\pi/2$ c. $\pi/4$ d. π

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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 ABC , $\vec{AB} = \frac{\vec{u}}{|\vec{u}|} - \frac{\vec{v}}{|\vec{v}|}$ and $\vec{AC} = \frac{2\vec{u}}{|\vec{u}|}$, where $|\vec{u}| \neq |\vec{v}|$, then

a. $1 + \cos 2A + \cos 2B + \cos 2C = 0$

b. $\sin A = \cos C$

c. projection of AC on BC is equal to BC

d. projection of AB on BC is equal to AB



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427. A vector \vec{d} is equally inclined to three vectors

$$\vec{a} = \hat{i} + \hat{j} + \hat{k}, \vec{b} = 2\hat{i} + \hat{j} \text{ and } \vec{c} = 3\hat{j} - 2\hat{k}$$

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. $\vec{x} \cdot \vec{d} = -1$ b. $\vec{y} \cdot \vec{d} = 1$ c. $\vec{z} \cdot \vec{d} = 0$ d. $\vec{r} \cdot \vec{d} = 0$, 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 $(\vec{c} \times \vec{a}) \times \vec{b} = \vec{0}$ b. $\vec{c} \times (\vec{a} \times \vec{b}) = \vec{0}$ c.

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

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429. If \hat{a}, \hat{b} , and \hat{c} are three unit vectors inclined to each other at angle θ ,

then the maximum value of θ 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. $(\vec{a} \times \vec{c}) \times (\vec{b} \times \vec{d}) = \vec{0}$ b. $(\vec{a} \times \vec{c}) \cdot (\vec{b} \times \vec{d}) = 0$ c. $(\vec{a} \times \vec{b}) \times (\vec{c} \times \vec{d}) = \vec{0}$ d. $(\vec{a} \times \vec{b}) \cdot (\vec{c} \times \vec{d}) = 0$

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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 vector variable 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 $ABCD$ are $2\hat{i} + 4\hat{j} - 5\hat{k}$ and $\hat{i} + 2\hat{j} + 3\hat{k}$. Then the value of $|AC \times BD|$ 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 θ 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 b. 1 c. 2 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. π b. $7\pi/4$ c. $\pi/4$ d. $3\pi/4$



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437. \vec{a} , \vec{b} , and \vec{c} are three vectors of equal magnitude. The angle 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. $\sqrt{3}$ 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.

c. $\frac{\vec{a}}{|\vec{a}|} + \frac{\vec{b}}{|\vec{b}|} + \frac{\vec{c}}{|\vec{c}|}$ d. $\frac{\vec{a}}{|\vec{a}|^2} + \frac{\vec{b}}{|\vec{b}|^2} + \frac{\vec{c}}{|\vec{c}|^2}$ 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

$$\vec{u} = \vec{a} - \left(\vec{a} \cdot \vec{b} \right) \vec{b} \text{ and } \vec{v} = \vec{a} \times \vec{b}, \text{ then } |\vec{v}| \text{ is } |\vec{u}| \text{ b. } |\vec{u}| + \left| \vec{u} \cdot \vec{a} \right| \text{ c. } |\vec{u}| + \left| \vec{u} \cdot \vec{b} \right| \text{ d.}$$

$$|\vec{u}| + \hat{u} |\vec{a} + \vec{b}|$$

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440. The vertex A triangle ABC is on the line $\vec{r} = \hat{i} + \hat{j} + \lambda \hat{k}$ and the vertices B and C have respective position vectors \hat{i} and \hat{j} . Let Δ be the area of the triangle and $\Delta \in \left[\frac{3}{2}, \frac{\sqrt{33}}{2} \right]$. Then the range of values of λ 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 $\sqrt{a^2 - 4} \tan A + a \tan B + \sqrt{a^2 + 4} \tan C = 6a$, 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, B and C 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 ABC 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 μ is a scalar. Then

$\left| \left(\vec{a}\vec{q} \right) \vec{p} - \left(\vec{p}\vec{q} \right) \vec{a} \right|$ is equal to (a) $2|\vec{p} \cdot \vec{q}|$ (b) $(1/2)|\vec{p} \cdot \vec{q}|$ (c) $|\vec{p} \times \vec{q}|$ (d) $|\vec{p} \cdot \vec{q}|$



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444. In $\triangle ABC$, DE and GF are parallel to each other and AD , BG and EF are parallel to each other. If $CD:CE = CG:CB = 2:1$ then the value of area ($\triangle AEG$): area($\triangle ABD$) is equal to (a) $7/2$ (b) 3 (c) 4 (d) $9/2$



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445. In a quadrilateral $ABCD$, \vec{AC} is the bisector of \vec{AB} and \vec{AD} , angle between \vec{AB} and \vec{AD} is $2\pi/3$, $15|\vec{AC}| = 3|\vec{AB}| = 5|\vec{AD}|$. Then the angle between \vec{BA} and \vec{CD} 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. $\frac{\cos^{-1}(2\sqrt{7})}{14}$



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446. Position vector \hat{k} is rotated about the origin by angle 135° 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 $\vec{a} = 2i + j - 2k$ and $\vec{b} = i + j$. If \vec{c} is a vector such that $\vec{a} \cdot \vec{c} = |\vec{c}|$, $|\vec{c} - \vec{a}| = 2\sqrt{2}$ between $\vec{a} \times \vec{b}$ and \vec{c} is 30° , then $|(\vec{a} \times \vec{b}) \times \vec{c}|$ is equal to a. $2/3$ b. $3/2$ c. 2 d. 3

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450. Let $ABCD$ be a tetrahedron such that the edges AB , AC and AD are mutually perpendicular. Let the area of triangles ABC , ACD and ADB be 3 , 4 and 5 sq. units, respectively. Then the area of triangle BCD is

a. $5\sqrt{2}$
 b. 5

$$\frac{\sqrt{5}}{2}$$

$$\frac{5}{2}$$



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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 is 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.

$$\frac{\hat{i} - \hat{j} + \hat{k}}{\sqrt{3}} \quad \text{c. } \frac{2\hat{i} + \hat{j}}{\sqrt{5}} \quad \text{d. } \frac{2\hat{i} + \hat{j}}{\sqrt{5}}$$



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452. If \vec{a} , \vec{b} and \vec{c} are non-coplanar unit vectors such that

$$\vec{a} \times (\vec{b} \times \vec{c}) = \frac{\vec{b} + \vec{c}}{\sqrt{2}}, \text{ then the angle between } \vec{a} \text{ and } \vec{b} \text{ is a. } 3\pi/4 \text{ b. } \pi/4 \text{ c.}$$

$$\pi/2 \text{ d. } \pi$$



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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

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

from the origin.

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456. Let \vec{a} , \vec{b} and \vec{c} be three non-coplanar vectors 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
 $\vec{a} \times \vec{b} = ((\hat{i} \times \vec{a}) \cdot \vec{b})\hat{i} + ((\hat{j} \times \vec{a}) \cdot \vec{b})\hat{j} + ((\hat{k} \times \vec{a}) \cdot \vec{b})\hat{k}$ Statement 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 λ and μ are scalars, is, p. -4 The angle between vectors $\vec{a} = \lambda\hat{i} - 3\hat{j} - \hat{k}$ and $\vec{b} = 2\lambda\hat{i} + \lambda\hat{j} - \hat{k}$ is acute, whereas vector \vec{b} makes an obtuse angle with the axes of coordinates. Then λ may be, q. -2 The possible value of a such that $2\hat{i} - \hat{j} + \hat{k}$, $\hat{i} + 2\hat{j} + (1+a)\hat{k}$ and $3\hat{i} + a\hat{j} + 5\hat{k}$ are coplanar is, r. 2 If $\vec{A} = 2\hat{i} + \lambda\hat{j} + 3\hat{k}$, $\vec{B} = 2\hat{i} + \lambda\hat{j} + \hat{k}$, $\vec{C} = 3\hat{i} + \hat{j}$ and $\vec{A} + \lambda\vec{B}$ 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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461. 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} and \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 angle between $\vec{a} = \hat{i} + 2\hat{j} + 2\hat{k}$ and $\vec{b} = 8\hat{i} + \hat{j} - 4\hat{k}$. Statement 2: \vec{c} is equally inclined to \vec{a} and \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 $\vec{a} = \hat{i} + \hat{j} + \hat{k}$ is $-\hat{j}$. Statement 2: A component of vector in the direction of $\vec{a} = \hat{i} + \hat{j} + \hat{k}$ is $2\hat{i} + 2\hat{j} + 2\hat{k}$.

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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 , and D form an isosceles trapezium or

AB and CD meet at E Then $EAEB = ECED$

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465. Let \vec{r} be a non-zero vector satisfying $\vec{r} \cdot \vec{a} = \vec{r} \cdot \vec{b} = \vec{r} \cdot \vec{c} = 0$ for given

non-zero vectors \vec{a}, \vec{b} and \vec{c} Statement 1: $[\vec{a} - \vec{b} \quad \vec{b} - \vec{c} \quad \vec{c} - \vec{a}] = 0$

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 $\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix} = 2$



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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 $|A \times (A \times (A \times B)) \cdot C| = |A|^2 2|[ABC]|$



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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 and 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 and P_2 is a. 0 b. $\pi/4$ c. $\pi/3$ d. $\pi/2$



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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 vectors \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. $\vec{a} \cdot \vec{b}$ b. $2\vec{a} \cdot \vec{b}$ c. zero d. none of these



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472. Let $\vec{f}(t) = [t]\hat{i} + (t - [t])\hat{j} + [t + 1]\hat{k}$, where $[.]$ denotes the greatest integer function. Then the vectors $\vec{f}\left(\frac{5}{4}\right)$ and $\vec{f}(t)$, $0 < t < 1$ are (a) parallel to

each other (b) perpendicular (c) inclined at $\cos^{-1} 2\left(\sqrt{7(1-t^2)}\right)$ (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.

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

$$\left| (\vec{d} \cdot \vec{c})(\vec{a} \times \vec{b}) + (\vec{d} \cdot \vec{a})(\vec{b} \times \vec{c}) + (\vec{d} \cdot \vec{b})(\vec{c} \times \vec{a}) \right| = 0, \quad \text{then a.}$$

$|\vec{a}| = |\vec{b}| = |\vec{c}|$ b. $|\vec{a}| + |\vec{b}| + |\vec{c}| = |\vec{d}|$ c. $\vec{a}, \vec{b},$ and \vec{c} are coplanar d. none of

these

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476. If $|a| = 2$ and $|b| = 3$ and $a \cdot b = 0$, then $(a \times (a \times (a \times (a \times b))))$ is equal to

$48\hat{b}$ b. $-48\hat{b}$ c. $48\hat{a}$ d. $-48\hat{a}$

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477. If the two diagonals of one of its faces are $6\hat{i} + 6\hat{k}$ and $4\hat{j} + 2\hat{k}$ 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 $[\vec{a} + \vec{b} + \vec{c}, \vec{a} + \vec{b}, \vec{c}]$ 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 $\vec{c} \cdot (\hat{i} + 2\hat{j} - 7\hat{k}) = 10$. 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 $\vec{a} = x\hat{i} + y\hat{j} + 2\hat{k}$, $\vec{b} = \hat{i} - \hat{j} + \hat{k}$, $\vec{c} = \hat{i} + 2\hat{j}$; $\vec{a} \perp \vec{b}$, $\vec{a} \cdot \vec{c} = 4$. Then

$$[\vec{a}\vec{b}\vec{c}]^2 = |\vec{a}| \text{ b. } [\vec{a}\vec{b}\vec{c}] = |\vec{a}| \text{ c. } [\vec{a}\vec{b}\vec{c}] = 0 \text{ d. } [\vec{a}\vec{b}\vec{c}] = |\vec{a}|^2$$

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482. \vec{a} and \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.

$$\frac{1}{2}(\vec{a} \times \vec{b} + \vec{a} + \vec{b}) \text{ c. } \frac{1}{\sqrt{3}}(\vec{a} + \vec{b} + \vec{a} \times \vec{b}) \text{ d. } \frac{1}{3}(\vec{a} + \vec{b} + \vec{a} \times \vec{b})$$

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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. $|\vec{r}|^2$

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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 the parallelepiped whose sides are given by $\vec{OA} = 2i - 2j$, $\vec{OB} = i + j - k$ and $\vec{OC} = 3i - k$ 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} , $\left| (\vec{a} \times \vec{b}) \cdot \vec{c} \right| = |\vec{a}| |\vec{b}| |\vec{c}|$ holds if and only if a. $\vec{a} \cdot \vec{b} = 0$, $\vec{b} \cdot \vec{c} = 0$ b. $\vec{b} \cdot \vec{c} = 0$, $\vec{c} \cdot \vec{a} = 0$ c. $\vec{c} \cdot \vec{a} = 0$, $\vec{a} \cdot \vec{b} = 0$ 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} and \vec{w} which of the following expressions is not equal to any of the remaining three ? a. $\vec{u} \cdot \vec{v} \times \vec{w}$ b. $(\vec{v} \times \vec{w}) \cdot \vec{u}$ c. $\vec{v} \cdot \vec{u} \times \vec{w}$ d.

$$(\vec{u} \times \vec{v}) \cdot \vec{w}$$

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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 $4\hat{j} - 3\hat{k}$ and P_2 is parallel to $\hat{j} - \hat{k}$ and $3\hat{i} + \hat{j}$. Then the angle between vector \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 $\vec{a} \cdot \vec{b} = \beta$ and $\vec{a} \times \vec{b} = \vec{c}$, then \vec{b} is

a. $\frac{(\beta \vec{a} - \vec{a} \times \vec{c})}{|\vec{a}|^2}$ b. $\frac{(\beta \vec{a} + \vec{a} \times \vec{c})}{|\vec{a}|^2}$ c.

d. $\frac{(\beta \vec{c} - \vec{a} \times \vec{c})}{|\vec{a}|^2}$ d. $\frac{(\beta \vec{a} + \vec{a} \times \vec{c})}{|\vec{a}|^2}$

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490. Let \vec{a} , \vec{b} and \vec{c} be three non-coplanar vectors 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} and \vec{b} be mutually perpendicular unit vectors. Then for any

arbitrary \vec{r} , a. $\vec{r} = \left(\vec{r}\hat{a}\right)\hat{a} + \left(\vec{r}\hat{b}\right)\hat{b} + \left(\vec{r}\hat{a} \times \hat{b}\right)(\hat{a} \times \hat{b})$ b.

$\vec{r} = \left(\vec{r}\hat{a}\right) - \left(\vec{r}\hat{b}\right)\hat{b} - \left(\vec{r}\hat{a} \times \hat{b}\right)(\hat{a} \times \hat{b})$ c.

$\vec{r} = \left(\vec{r}\hat{a}\right)\hat{a} - \left(\vec{r}\hat{b}\right)\hat{b} + \left(\vec{r}\hat{a} \times \hat{b}\right)(\hat{a} \times \hat{b})$ 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.

$(\vec{a} \vec{c})[\vec{a} \vec{b} \vec{d}]$ c. $(\vec{a} \vec{b})[\vec{a} \vec{b} \vec{d}]$ d. none of these

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493. Let \vec{a} and \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 $[abc]$ is equal to $|a||b||c|$

b. $-|a||b||c|$ c. 0 d. none of these

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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} and \vec{b} . If the angle between \vec{a} and \vec{b} is $\pi/6$, then the value of $|a_1b_1c_1 + a_2b_2c_2 + a_3b_3c_3|^2$ is
- a. 0 b. 1 c. $\frac{1}{4}(a_1^2 + a_2^2 + a_3^2)(b_1^2 + b_2^2 + b_3^2)$
 d. $\frac{3}{4}(a_1^2 + a_2^2 + a_3^2)(b_1^2 + b_2^2 + b_3^2)$

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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. a vector perpendicular to the plane of a, b, c b. a scalar quantity c. $\vec{0}$ 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} and \vec{b} is $\frac{2\pi}{3}$, $|\vec{a}| = \sqrt{2}$, $|\vec{b}| = \sqrt{3}$ and $|\vec{c}| = \frac{1}{\sqrt{3}}$, then the angle 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 vector $\vec{a} = \hat{i} + \hat{j} + 2\hat{k}$ and $\vec{b} = \hat{i} + 2\hat{j} + \hat{k}$, 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 ABC . If $PA + PB + PC$ is a null vector, then w.r.t. triangle ABC , point P is its a. centroid b. orthocentre c. incentre d. circumcentre

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500. G is the centroid of triangle ABC and A_1 and B_1 are the midpoints of sides AB and AC , respectively. If Δ_1 is the area of quadrilateral

GA_1AB_1 and Δ is the area of triangle ABC , then Δ/Δ_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 $(\sin\alpha)\vec{a} + (2\sin2\beta)\vec{b} + (3\sin3\gamma)\vec{c} - \vec{d} = 0$. Then the least value of $\sin^2\alpha + \sin^22\beta + \sin^23\gamma$ is a. $\frac{1}{14}$ b. 14 c. 6 d. $1/\sqrt{6}$

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502. If \vec{a} and \vec{b} are any two vectors of magnitudes 1 and 2, respectively, and $\left(1 - 3\vec{a}\vec{b}\right)^2 + \left|2\vec{a} + \vec{b} + 3(\vec{a} \times \vec{b})\right|^2 = 47$, then the angle between \vec{a} and \vec{b} is $\pi/3$ b. $\pi - \cos^{-1}(1/4)$ 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 $\vec{a} \cdot \vec{b} = 1$, find the angle between \vec{a} and \vec{b} .

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505. If the vector product of a constant vector \vec{OA} with a variable vector \vec{OB} in a fixed plane OAB be a constant vector, then the locus of B is a. a straight line perpendicular to \vec{OA} b. a circle with centre O and radius equal to $|\vec{OA}|$ c. a straight line parallel to \vec{OA} d. none of these

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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} and \vec{w} are perpendicular to each other, then $|\vec{u} - \vec{v} + \vec{w}|$ equals 2 b. $\sqrt{7}$ c. $\sqrt{14}$ d.

14

A. 2

B. $\sqrt{7}$

C. $\sqrt{14}$

D. 14

Answer: 3



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507. If the two adjacent sides of two rectangles are represented by vectors $\vec{p} = 5\vec{a} - 3\vec{b}; \vec{q} = -\vec{a} - 2\vec{b}$ and $\vec{r} = -4\vec{a} - \vec{b}; \vec{s} = -\vec{a} + \vec{b}$, respectively, then the angle between the vector

$$\vec{x} = \frac{1}{3}(\vec{p} + \vec{r} + \vec{s}) \text{ and } \vec{y} = \frac{1}{5}(\vec{r} + \vec{s}) \quad \text{is} \quad \text{a. } \cos^{-1}\left(\frac{19}{5\sqrt{43}}\right) \quad \text{b.}$$

$$\cos^{-1}\left(\frac{19}{5\sqrt{43}}\right) \quad \text{c. } \pi - \cos^{-1}\left(\frac{19}{5\sqrt{43}}\right) \quad \text{d. cannot be evaluate}$$

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508. Let P, Q, R and S be the points on the plane with position vectors $-2i - j, 4i, 3i + 3j$ and $-3j + 2j$, respectively. The quadrilateral $PQRS$ 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 vectors and α, β and γ 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 α, β and γ , 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 $[3\vec{a} + \vec{b} \quad 3\vec{b} + \vec{c} \quad 3\vec{c} + \vec{a}] = \lambda[\vec{a}\vec{b}\vec{c}]$, 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 \vec{a} and \vec{b} are nonzero non-collinear vectors, then

$[\vec{a}\vec{b}\hat{i}] \hat{i} + [\vec{a}\vec{b}\hat{j}] \hat{j} + [\vec{a}\vec{b}\hat{k}] \hat{k}$ 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. $\neq 0$ 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 $3x^2 + 8xy + 2y^2 - 3 = 0$ 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, b and c 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

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

which of the following is not correct? a. $\vec{x} = \frac{\vec{b} \times \vec{c} + \vec{a} + \left(\vec{c} \vec{a} \right) \vec{c}}{1 + \vec{c} \vec{c}}$ b.

$$\vec{x} = \frac{\vec{c} \times \vec{b} + \vec{b} + \left(\vec{c} \vec{a} \right) \vec{c}}{1 + \vec{c} \vec{c}} \quad \text{c. } \vec{y} = \frac{\vec{a} \times \vec{c} + \vec{b} + \left(\vec{c} \vec{b} \right) \vec{c}}{1 + \vec{c} \vec{c}} \quad \text{d. none of these}$$

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520. If \vec{a} and \vec{b} are two unit vectors incline at angle $\pi/3$, then

$$\left\{ \vec{a} \times \left(\vec{b} + \vec{a} \times \vec{b} \right) \right\} \vec{b} \text{ is equal to } \frac{-3}{4} \quad \text{b. } \frac{1}{4} \quad \text{c. } \frac{3}{4} \quad \text{d. } \frac{1}{2}$$

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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

$$\vec{a} = a_1 \hat{i} + a_2 \hat{j} + a_3 \hat{k} \quad \text{and} \quad \vec{b} = b_1 \hat{i} + b_2 \hat{j} + b_3 \hat{k} \quad \text{and} \quad \vec{c} = c_1 \hat{i} + c_2 \hat{j} + c_3 \hat{k} .$$

If a_r, b_r and c_r , where $r = 1, 2, 3$, are non-negative real numbers and

$$\sum_{r=1}^3 (a_r + b_r + c_r) = 3L \quad \text{show that} \quad V \leq L^3$$



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523. Find 3-dimensional vectors $\vec{v}_1, \vec{v}_2, \vec{v}_3$ satisfying

$$\vec{v}_1 \cdot \vec{v}_1 = 4, \vec{v}_1 \cdot \vec{v}_2 = -2, \vec{v}_1 \cdot \vec{v}_3 = 6,$$

$$\vec{v}_2 \cdot \vec{v}_2 = 2, \vec{v}_2 \cdot \vec{v}_3 = -5, \vec{v}_3 \cdot \vec{v}_3 = 29$$



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524. 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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525. For any two vectors \vec{u} and \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 and 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 and C , whose permutation A', B' and C' , respectively, can be chosen such that A is on L_1 , B on P_1 but not on L_1 and C not on P_1 ; A' is on L_2 , B' on P_2 but not on L_2 and C' 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 $(\vec{a} - \vec{d}) \cdot (\vec{b} - \vec{c}) \neq 0$,

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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} and \vec{b} , p. $-3\hat{i} + 3\hat{j} + 4\hat{k}$ A vector which is perpendicular to both \vec{a} and \vec{b} , q. $2\hat{i} - 2\hat{j} + 3\hat{k}$ A vector which is equally

inclined to \vec{a} and \vec{b} , r. $\hat{i} + \hat{j}$ A vector which forms a triangle with \vec{a} and \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 l, 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) $lm+mn+nl = 0$ (B) $l+m+n = 0$ (C) $l^2 + m^2 + n^2 = 0$

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532. If \vec{a} , \vec{b} and \vec{c} are unit coplanar vectors, then the scalar triple product

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



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