MATHS

BOOKS - ARIHANT MATHS (HINGLISH)

VECTOR ALGEBRA

Illustrative Examples

1. Classify the following measures as scalar and vector quantities :

(i) 40°

(ii) 50 watt

(iii) $10gm/cm^3$

(iv) 20 m/sec towards north

(v) 5 seconds.

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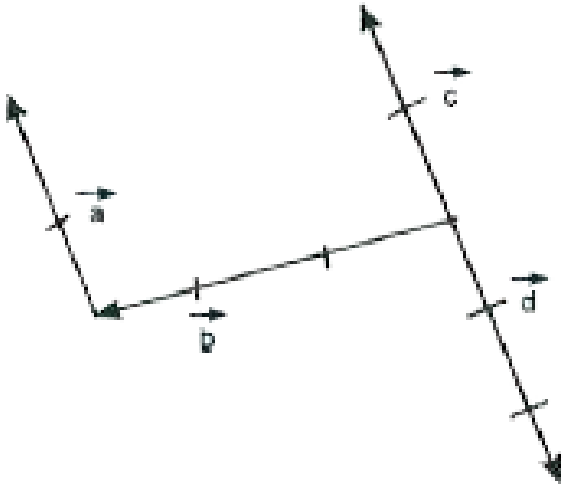
2. In the figure, which of the vectors are :

(i) Collinear

(ii) Equal

(iii) Co - initial.



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3. Prove that the resultant of the vectors represented by the sides $\overrightarrow{AB}$ and $\overrightarrow{AC}$ of a triangle ABC is $2\overrightarrow{AD}$, where D is the mid - point of [BC].

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

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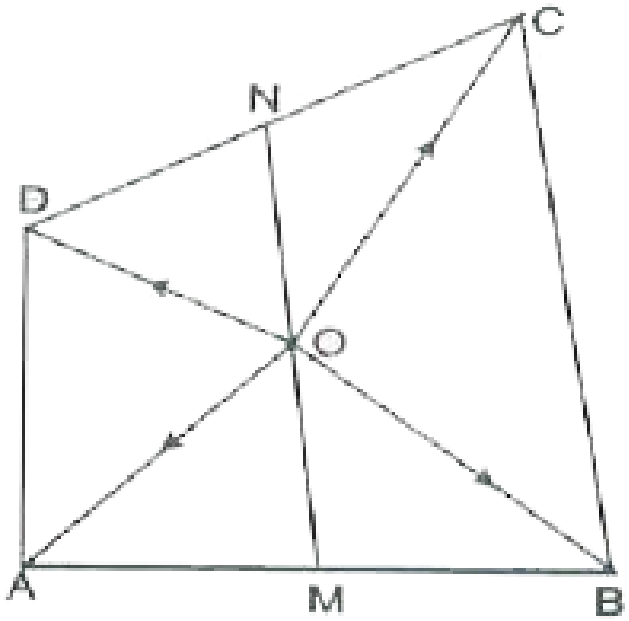
5. In the figure, M is the mid - point of [AB] and N is the mid - point of [CD] and O is the mid - point of [MN]. Prove that :

(i) $\overrightarrow{OA} + \overrightarrow{OB} + \overrightarrow{OC} + \overrightarrow{OD} = \vec{0}$

(ii) $\overrightarrow{BC} + \overrightarrow{AD} = 2\overrightarrow{MN}$.



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6. $ABCD$ is parallelogram and P is the point of intersection of its diagonals. If O is the origin of reference, show that $\vec{OA} + \vec{OB} + \vec{OC} + \vec{OD} = 4\vec{OP}$.

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7. (a) What is the geometric significance of the relation $\left|\vec{a} + \vec{b}\right| = \left|\vec{a} - \vec{b}\right|$?

(b) Prove geometrically that $\left|\vec{a} + \vec{b}\right| \leq \left|\vec{a}\right| + \left|\vec{b}\right|$.

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8. If the sum of two unit vectors is a unit vector, prove that the magnitude of their difference is $\sqrt{3.}$

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9. If D, E, F are the mid points of the side BC, CA and AB respectively of a triangle ABC, write the value of $\overrightarrow{A}D + \overrightarrow{B}E + \overrightarrow{C}F$.

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

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11. Prove, by vector method, that the diagonals of a parallelogram bisect each other , conversely, if the diagonals of a quadrilateral bisect each other, it is a parallelogram.

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12. Prove using vectors: The diagonals of a quadrilateral bisect each other iff it is a parallelogram.

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13. Prove that the segment joining the middle points of two non-parallel sides of a trapezium is parallel to the parallel sides and half of their sum.

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14. (Pythagorass Theorem) Prove by vector method that in a right angled triangle, the square of the hypotenuse is equal to the sum of the squares of the other two sides.

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15. Prove using vectors: The median to the base of an isosceles triangle is perpendicular to the base.

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16. Prove that the perpendicular let fall from the vertices of a triangle to the opposite sides are concurrent.

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17. Prove that in any triangle ABC(i) $c^2 = a^2 + b^2 - 2ab\cos C$ (ii) $c = b\cos A + a\cos B$

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18. Show that the diagonals of a rhombus are perpendicular to each other

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19. In a tetrahedraon, if two pairs of opposite edges are perpendicular to each other, prove that the third pair is also perpendicular and that the sum of the squares on the two opposite edges is same for each pair.

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20. For any A, B in R, prove that $\cos(A-B) = \cos A \cos B + \sin A \sin B$

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21. Find the moment (torque) about the point $\hat{i} + 2\hat{j} + 3\hat{k}$ of a force represented by $\hat{i} + \hat{j} + \hat{k}$ acting through the point $-2\hat{i} + 3\hat{j} + \hat{k}$.

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22. Two unlike forces of equal magnitudes $3\hat{i} + \hat{k}$ and $-3\hat{i} - \hat{k}$ acting at the points $\hat{i} + 2\hat{j} - \hat{k}$ and $2\hat{i} - \hat{j} + 3\hat{k}$ respectively. Find the moment of the coupie formed by the forces.

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23. What is the magnitude of the moment of the couple consisting of the force $\vec{F} = 3\hat{i} + 2\hat{j} - \hat{k}$ acting through the point $\hat{i} - \hat{j} + \hat{k}$ and $-\vec{F}$ acting through the point $2\hat{i} - 3\hat{j} - \hat{k}$?

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24. Find the moment about a line through (0, 0, 0) having the direction $2\hat{i} - 2\hat{j} + \hat{k}$ due to a 20 kg force acting at $(-4, 2, 5)$ in the direction of $12\hat{i} - 4\hat{j} - 3\hat{k}$.

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Frequently Asked Questions Example

1. Find the position vector of a point which divides the join of points with position vectors $\vec{a} - 2\vec{b}$ and $2\vec{a} + \vec{b}$ externally in the ration 2:1.

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2. The two vectors $\hat{j} + \hat{k}$ and $3\hat{i} - \hat{j} + 4\hat{k}$ represent the two sides AB and AC, respectively of a ABC. Find the length of the median through A.

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3. If $\vec{a} = 4\hat{i} - \hat{j} + \hat{k}$ and $\vec{b} = 2\hat{i} - 2\hat{j} + \hat{k}$, then find a unit vector parallel to the vector $\vec{a} + \vec{b}$.

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4. Find the vector joining the points P(2, 3, 0) and $Q(-1, -2, -4)$ directed from P to Q.

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5. Write the direction ratios of the vector $\rightarrow a = \hat{i} + \hat{j} - 2\hat{k}$ and hence calculate its direction cosines.

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6. Find the unit vector in the direction of the sum of the vectors :

$\overrightarrow{a} = 2\hat{i} - \hat{j} + 2\hat{k}$ and $\overrightarrow{b} = -\hat{i} + \hat{j} + 3\hat{k}$.

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

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8. Prove that if $\vec{u} = u_1\hat{1}\hat{i} + u_2\hat{j}$ and $\vec{v} = v_1\hat{i} + v_2\hat{j}$ are non - zero vectors, then they are parallel if and only if $u_1v_2 - u_2v_1 = 0$.

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9. Find the value of $'p'$ for which the vectors $3\hat{i} + 2\hat{j} + 9\hat{k}$ *and* $\hat{i} - 2p\hat{j} + 3\hat{j} + 3\hat{k}$ are parallel.

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10. Show that the points, A, B and C having position vectors $\left(2\hat{i} - \hat{j} + \hat{k}\right)$, $\left(\hat{i} - 3\hat{j} - 5\hat{k}\right)$ and $\left(3\hat{i} - 4\hat{j} - 4\hat{k}\right)$ respectively are the vertices of a rightangled triangle. Also, find the remaining angles of the triangle.

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11. The position vectors of A, B, C are $2\hat{i}+\hat{j}-\hat{k}, 3\hat{i}-2\hat{j}+\hat{k}$ and $\hat{i}+4\hat{j}-3\hat{k}$ respectively. Show that A, B and C are collinear.

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12. Prove that the four points having position vectors are coplanar: $2\hat{i}-\hat{j}+\hat{k},\ \hat{i}-3\hat{j}-5\hat{k}\ and\ 3\hat{i}-4\hat{j}-4\hat{k}$

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13. Show that the found points A, B, C, D with position vectors $\vec{a}, \vec{b}, \vec{c}, \vec{d}$ respectively such that $3\vec{a}-2\vec{b}+5\vec{c}-6\vec{d}=\vec{0}$, are coplanar. Also, find the position vector of the point of intersection of the line segments AC and BD.

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14. Find the magnitude of each of the two vectors $\vec{a}$ and $\vec{b}$ having the same magnitude such that the angle between them is 60° and their scalar product is 9/2.

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15. If $\vec{a}$ and $\vec{b}$ are perpendicular vectors such that $\left|\vec{a}+\vec{b}\right|=13$ and $\left|\vec{a}\right|=5$, find the value of $\left|\vec{b}\right|$.

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16. Find the projection of the vector $\hat{i}+3\hat{j}+7\hat{k}$ on the vector $2\hat{i}-3\hat{j}+6\hat{k}$.

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17. Find λ, when the projection of $\vec{a} = \lambda\hat{i} + \hat{j} + 4\hat{k}$ on $\vec{b} = 2\hat{i} + 6\hat{j} + 3\hat{k}$ is 4 units.

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18. If $\vec{a}$ and $\vec{b}$ are two unit vectors such that $\vec{a} + \vec{b}$ is also a unit vector, then find the angle between $\vec{a}$ and $\vec{b}$.

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19. Find $\left|\vec{x}\right|$, if for a unit vector $\vec{a}$, $\left(\vec{x} - \vec{a}\right)\vec{x} + \vec{a} = 15$

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20. If ā,b,c are three vectors such that $\left|\vec{a}\right| = 5, \left|\vec{b}\right| = 12$ and $\left|\vec{c}\right| = 13$ and $\vec{a} + \vec{b} + \vec{c} = 0$ then $\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a}$

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21. If $\vec{a}, \vec{b}$ and $\vec{c}$ be three vectors such that $\vec{a}+\vec{b}+\vec{c}=0$ and $\left|\vec{a}\right|=3, \left|\vec{b}\right|=5, \left|\vec{C}\right|=7$, find the angle between $\vec{a}$ and $\vec{b}$.

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22. Three vectors $\vec{A}=2\hat{i}-\hat{j}+\hat{k}, \vec{B}=\hat{i}-3\hat{j}-5\hat{k}$, and $\vec{C}=3\hat{i}-4\hat{j}-4\hat{k}$ are sides of an :

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23. If $\vec{a}, \vec{b}, \vec{c}$ are three mutually perpendicular vectors of equal magniltgude, prove that $\vec{a}+\vec{b}+\vec{c}$ is equally inclined with vectors $\vec{a}, \vec{b}, and \vec{\cdot}$ also find the angle.

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24. Find a vector $\vec{a}$ of magnitude $5\sqrt{2}$ making an angle $\frac{\pi}{4}$ with x-axis , $\frac{\pi}{2}$ with y-axis and an acute angle θ with z-axis

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25. Let $\vec{A} = 4\hat{i} + 5\hat{j} - \hat{k}$, $\vec{b} = \hat{i} - 4\hat{j} + 5\hat{k}$ and $\vec{c} = 3\hat{i} + \hat{j} - \hat{k}$. Find a vector $\vec{d}$ which is perpendicular to both $\vec{a}$ and $\vec{b}$, and is such that $\vec{d} \cdot Vec(c) = 21$.

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26. If with reference to a right handed system of mutually perpendicular unit vectors $\hat{i}$, $\hat{j}$, $\hat{k}$ we have $\vec{\alpha} = 3\hat{i} - \hat{j}$, and $\vec{\beta} = 2\hat{i} + \hat{j} - 3\hat{k}$. Express $\vec{\beta}$ in the form $\vec{\beta} = \vec{\beta}_1 + \vec{\beta}_2$, $where$ $\vec{\beta}_1$ is parallel to $\vec{\alpha}$ and $\vec{\beta}_2$ is perpendicular to $\vec{\alpha}$.

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27. If vectors $\vec{a}$ and $\vec{b}$ are such that $\left|\vec{a}\right| = 3$, $\left|\vec{b}\right| = \frac{2}{3}$ and $\vec{a} \times \vec{b}$ is a unit vector, then write the angle between $\vec{a}$ and $\vec{b}$.

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28. If $'\theta'$ is the angle between the vectors : $\vec{a} = \hat{i} + 2\hat{j} + 3\hat{k}$ and $\vec{b} = 3\hat{i} - 2\hat{j} + \hat{k}$, find sin θ.

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29. Find $'\lambda'$ and $'\mu'$ if :

$$\left(\hat{i} + 3\hat{j} + 9\hat{k}\right) \times \left(3\hat{i} - \lambda\hat{j} + \mu\hat{k}\right) = \hat{0}.$$

A. $\lambda = -9$ and $\mu = 27$

B. $\lambda = 9$ and $\mu = 27$

C. $\lambda = -3$ and $\mu = 27$

D. $\lambda = -9$ and $\mu = -27$

Answer: A

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30. If $\vec{a} = \hat{i} + \hat{j} + \hat{k}$ and $\vec{b} = \hat{j} - \hat{k}$, find a vector $\vec{c}$ such that $\vec{a} \times \vec{c} = \vec{b}$ and $\vec{a} \cdot \vec{c} = 3$

A. $5\hat{i} + 2\hat{j} + 2\hat{k}$

B. $\frac{1}{3}\left(5\hat{i} + 2\hat{j} + 2\hat{k}\right)$

C. $\frac{1}{5}\left(5\hat{i} + 2\hat{j} + 2\hat{k}\right)$

D. $\frac{1}{3}\left(4\hat{i} + 2\hat{j} + 2\hat{k}\right)$

Answer: B

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31. If $\vec{r} = x\hat{i} + y\hat{j} + x\hat{k}$, find : $\left(\vec{r} \times \hat{i}\right).\left(\vec{r} \times \hat{j}\right) + xy.$

A. 0

B. 1

C. 2

D. 3

Answer: A

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32. If $\vec{a} \times \vec{b} = \vec{c} \times \vec{d}$ and $\vec{a} \times \vec{c} = \vec{b} \times \vec{d}$, show that $\left(\vec{a} - \vec{d}\right)$ is p

, it being given that$a \neq d$ and $b \neq c$.

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33. Find a vector of magnitude 7 units, which is perpendicular to two vectors :

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

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

A. $15\sqrt{5}$ sq. units

B. $2\sqrt{2}$ sq. units

C. $12\sqrt{2}$ sq. units

D. $15\sqrt{2}$ sq. units

Answer: D

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35. Find the area of a parallelogram whose adjacent sides are given by the vectors $\vec{a} = 3\hat{i} + \hat{j} + 4\hat{k}$ and $\vec{b} = \hat{i} - \hat{j} + \hat{k}$.

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36. Find the area of a triangle having the points $A(1, 1, 1)$, $B(1, 2, 3)$ and $C(2, 3, 1)$ as its vertices.

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37. If $\vec{a} = 2\hat{i} - 3\hat{j} + 4\hat{k}$ and $\vec{b} = 5\hat{i} + \hat{j} - \hat{k}$ represent sides of parallelogram, then find both diagonals and a unit vector perpendicular to both diagonals of parallelogram.

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38. If $\vec{a}$, $\vec{b}$, $\vec{c}$ are the position vectors of the vecrtices A, B, C of a ΔABC respectively, find an expression for the area of ΔABC and hence deduce the condition for the points A, B, C to be collinear.

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39. Largange's Identify. Prove that $\left(\vec{a} \times \vec{b}\right)^2 = \left|\vec{a}\right|^2 \left|\vec{b}\right|^2 - \left(\vec{a} . \vec{b}\right)^2$.

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40. Show that $\vec{a} \times \vec{b} = \vec{a} \times \vec{c}$ does not imply $\vec{b} = \vec{c}$. Illustrate geometrically.

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Questions From Ncert Exemplar Example

1. Find a vector of magnitude 11 in the direction opposite to that of $\overrightarrow{PQ}$, where P and Q are the points (1, 3, 2) and $(-1, 0, 8)$ respectively.

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2. Find a vector $\vec{r}$ of magnitude $3\sqrt{2}$ units which makes an angle of $\frac{\pi}{4}$ and $\frac{\pi}{2}$ with y and z-axis respectively.

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3. Find all vectors of magnitude $10\sqrt{3}$ that are perpendicular to the plane of $\hat{i}+2\hat{j}+\hat{k}$ and $-\hat{i}+\hat{j}+4\hat{k}$.

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Exercise 10 A Short Answer Type Questions

1. Represent the following graphically a displacement of :

(i) 40 km, 30° west of south

(ii) 40 km, 30° east of south

(iii) 40 km, 30° west of north.

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2. Classify the following measures as scalars and vectors. (i) 10 kg (ii) 2 meters north-west (iii) $40o$ (iv) 40 watt (v) 1019 coulomb (vi) m / s^2

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3. Classify the following as scalars and vector: 40^0

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4. Classify the following measures as scalars and vectors

(i) 20 m north-west

(ii) 10 newton

(iii) 30 km/h

(iv) 50m/s towards north

(v) 10^{-19} coloumb

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5. Classify the following measures as scalars and vectors. (i) 10 kg (ii) 2 meters north-west (iii) $40o$ (iv) 40 watt (v) 1019 coulomb (vi) m / s^2

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6. Classify the following as scalars and vector: 10^{-19} Coulomb`

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7. Classify the following measures as scalars and vectors :

$20m / s^2$

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8. Classify the following measures as scalars and vector: $1000cm^3$

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9. Classify the following measures as scalars and vector: 10 Newton

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10. Classify the following measures as scalars and vectors :

30 km/h.

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11. Classify the following as scalar and vector quantities. (i) time period (ii) distance (iii) force (iv) velocity (v) work done

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12. Classify the following as scalar and vector quantity: distance

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13. Classify the following as scalar and vector quantity: force

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14. Classify the following as scalar and vector quantities :

velocity

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15. Classify the following as scalar and vector quantity: work

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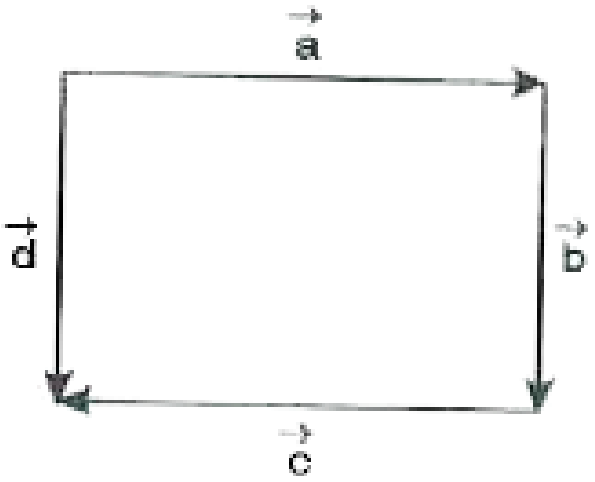
16. In the figure, identify the following vectors :

(i) Co - initial

(ii) Equal

(iii) Collinear but not equal.



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17. A girl walks 4 km towards west, then she walks 3 km in a direction 30^o east of north and stops. Determine the girls displacement from her initial point of departure.

A. $\sqrt{23}$

B. $\sqrt{3}$

C. $\sqrt{13}$

D. $\sqrt{15}$

Answer: C

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18. Answer the following as true or false.(i) $\rightarrow a$and $-\rightarrow a$are collinear. (ii) Two collinear vectors are always equal in magnitude.(iii) Two vectors having same magnitude are collinear.(iv) Two collinear vectors having the same magni

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19. Answer the following as true or false: Two colliner vectors are always equal in magnitude.

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20. Answer the following as true or false: Two vectors having same magnitude are collinear

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21. Answer the following as true or false: Two collinear vectors having the same magnitude are equal

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Exercise 10 B Short Answer Type Questions

1. Give a condition that three vectors $\vec{a}$, $\vec{b}$ and $\vec{c}$ from the three sides of a triangle. What are the other possibilities?

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2. If D E and F be the mid ponts of the sides BC, CA and AB respectively of the $\triangle ABC$ and O be any point, then prove that $\overrightarrow{OA} + \overrightarrow{OB} + \overrightarrow{OC} = \overrightarrow{OD} + \overrightarrow{OE} + \overrightarrow{OF}$

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3. ABCDE is a pentagon prove that vec(AB+ (vec(BC)+vec(CD)+vec(DE)+vec(EA)=vec0`

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4. ABCD is a parallelogram and AC, BD are its diagonals. Show that :

$\overrightarrow{AC} + \overrightarrow{BD} = 2\overrightarrow{BC}, \overrightarrow{AC} - \overrightarrow{BD} = 2\overrightarrow{AB}.$

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5. ABCDEF is a regular hexagon. Show that :

$\overrightarrow{OA} + \overrightarrow{OB} + \overrightarrow{OC} + \overrightarrow{OD} + \overrightarrow{OE} + \overrightarrow{OF} = \overrightarrow{0}$

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6. In a regular hexagon ABCDEF, prove that $\overrightarrow{AB} + \overrightarrow{AC} + \overrightarrow{AD} + ec(AE) + \overrightarrow{AF} = 3\overrightarrow{AD}$

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7. In Fig. ABCDEF is a regular hexagon. Prove that $\overrightarrow{AB} + \overrightarrow{AC} + \overrightarrow{AD} + \overrightarrow{AE} + \overrightarrow{AF} = 6\overrightarrow{AO}.$

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8. Prove that $\left|\overrightarrow{a}\right| - \left|\overrightarrow{b}\right| \leq \left|\overrightarrow{a} - \overrightarrow{b}\right|.$

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9. If $\overrightarrow{a} + 5\overrightarrow{b} = \overrightarrow{c}$ and $\overrightarrow{a} - 7\overrightarrow{b} = 2\overrightarrow{c}$, then show that $\overrightarrow{a}$ has the same direction as that of $\overrightarrow{c}$ and opposite direction to that of $\overrightarrow{b}$.

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Exercise 10 C Short Answer Type Questions

1. Find the magnitude of the vector :

$$\frac{1}{\sqrt{3}}\hat{i}+\frac{1}{\sqrt{3}}\hat{j}-\frac{1}{\sqrt{3}}\hat{k}$$

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2. Find the magnitude of the vector :

$\hat{i}-3\hat{j}+4\hat{k}.$

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3. Find the values of 'x' for which $x\left(\hat{i}+\hat{j}+\hat{k}\right)$ is a unit vector.

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4. Find the unit vector in the direction of the vector $\vec{a} = \hat{i}9 + \hat{j} + 2\hat{k}$.

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5. Find the unit vector in the direction of the vector :

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

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6. Find the unit vector in the direction of the vector :

$\vec{a} = 3\hat{i} + 2\hat{j} + 6\hat{k}$

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7. Find the unit vector in the direction of the vector :

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

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8. Find the unit vector in the direction of the vector :

$\vec{a} = 2\hat{i} - 3\hat{j} + 6\hat{k}$

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9. Find the unit vector in the direction of the vector :

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

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

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11. Find x and y for which the vectors $2\hat{i} + 3\hat{j}$ and $x\hat{i} + y\hat{j}$ are equal

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12. Find the values of x, y and z so that the vectors $\rightarrow a = x\hat{i} + 2\hat{j} + z\hat{k}$ and $\rightarrow b = 2\hat{i} + y\hat{j} + \hat{k}$ are equal.

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13. Show that the direction cosines of a vector equally inclined to the axes $OX,\ OY\ and\ OZ$ are $\frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}}$.

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14. Show that the vector $\hat{i} + \hat{j} + \hat{k}$ is equally inclined with the coordinate axes.

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

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16. A and B are two points with position vectors $2\vec{a} - 3\vec{b}$ and $6\vec{b} - \vec{a}$ respectively. Write the position vector of a point, which divides the line segment AB internally in the ratio 1 : 2.

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17. P and Q are two points with position vectors $3\vec{a} - 2\vec{b}$ and $\vec{a} + \vec{b}$ respectively. Write the position vector of a point R which divides the line segment PQ in the ratio 2:1 externally.

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18. X and Y are two points with position vectors $3\vec{a} + \vec{b}$ and $\vec{a} - 3\vec{b}$ respectively. Write the position vector of a point Z, which divides the line segment XY in the ratio 2 : 1 externally.

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19. Find the position vector of the mid-point of the vector joining point $P(2, 3, 4)$ and $Q(4, 1, -2)$

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20. Find the position vector of the mid point of the ne segment AB, where A is the point (3, 4, -2) and B is the point (1, ,2 4).

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21. 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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22. Find a vector in the direction of $\vec{a} = 2\hat{i} - \hat{j} + 2\hat{k}$, which has magnitude of 6 units.

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23. Find a vector in the direction of :

$\vec{a} = \hat{i} - 2\hat{j} + 2\hat{k}$, which has magnitude 15 units

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24. Find a vector in the direction of :

$\vec{a} = -2\hat{i} + \hat{j} + 2\hat{k}$, which has magnitude 9 units.

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25. Find the scalar components and magnitude of the vector joining the points $P(x_1, y_1, z_1)$and $Q(x_2, y_2, z_2)$

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26. If $\left|\overrightarrow{a}\right| = 3$, what is :

$\left|5\overrightarrow{a}\right|$

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27. If $\left|\overrightarrow{a}\right| = 3$, what is :

$\left|-2\overrightarrow{a}\right|$

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28. If $\left|\overrightarrow{a}\right| = 3$, what is :

$\left|0\overrightarrow{a}\right|$?

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29. If $\overrightarrow{a} = 3\hat{i} - 2\hat{j} + \hat{k}$, $\overrightarrow{b} = 2\hat{i} - 4\hat{j} - 3\hat{k}$, find $\left|\overrightarrow{a} - 2\overrightarrow{b}\right|$.

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30. Let $\overrightarrow{a}$ be a given vector whose initial point is $P(x_1, y_1)$ and terminal point is $Q(x_2, y_2)$. Find the magnitude and components of the vector along x and y directions : $P(2, 3), Q(4, 6)$.

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31. In the following, find the components of the vector $\overrightarrow{PQ}$ along x and y directions whose magnitude is M, and makes an angle θ with the x - axis :

$M = 15, \theta = 30^\circ$.

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32. If the position vectors of the points A and B are : $7\hat{i} + 3\hat{j} - \hat{k}$ and $2\hat{i} - 5\hat{j} + 4\hat{k}$ respectively, find the magnitude and direction - cosines of the vector $\overrightarrow{AB}$.

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33. Find the position vector of the centroid of the ΔABC when the position vectors of its vertices are $A(1, 3, 0)$, $B(2, 1, 1)$ and $C(0, -1, 0)$.

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34. Show that the vectors $\vec{a} = 2\hat{i} + 3\hat{j}$ and $\vec{b} = 4\hat{i} + 6\hat{j}$ are parallel.

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35. Find a unit vector in the direction of $\left(\vec{a}+\vec{b}\right)$, where : $\vec{a}=2\hat{i}+2\hat{j}-5\hat{k}$ and $\vec{b}=2\hat{i}+\hat{j}+3\hat{k}$.

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36. If $\vec{a}=2\hat{i}-\hat{j}+2\hat{k}$ and $\vec{b}=6\hat{i}+2\hat{j}+3\hat{k}$, find a unit vector parallel to $\vec{a}+\vec{b}$.

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37. Find the unit vector in the direction of $\vec{a}-\vec{b}$, where : $\vec{a}=\hat{i}+3\hat{j}-\hat{k}$, $\vec{b}=3\hat{i}+2\hat{j}+\hat{k}$.

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38. If $\rightarrow a = \hat{i} + \hat{j} + \hat{k}$, $\rightarrow b = 2\hat{i} - \hat{j} + 3\hat{k}$ and $\rightarrow c = \hat{i} - 2\hat{j} + \hat{k}$ find a unit vector parallel to the vector $2 \rightarrow a - \rightarrow b + 3 \rightarrow c$.

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39. (a) Find the condition that the vectors $\vec{a} = k\hat{i} + l\hat{j}$ and $\vec{b} = l\hat{i} + k\hat{j}(k, l \neq 0)$ are parallel.

(b) Show that the vectors $2\hat{i} - 3\hat{j} + 4\hat{k}$ and $-4\hat{i} + 6\hat{j} - 8\hat{k}$ are collinear.

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Exercise 10 C Long Answer Type Questions I

1. Find the position of R, which divides the line joining $P\left(3\vec{a} - 2\vec{b}\right)$ and $Q\left(\vec{a} + \vec{b}\right)$ in the ratio 2 : 1

internally and

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2. Find the position of R, which divides the line joining $P\left(3\vec{a}-2\vec{b}\right)$ and $Q\left(\vec{a}+\vec{b}\right)$ in the ratio 2 : 1

externally.

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3. Find the position vector of R, which divides the line joining two points $P\left(2\vec{a}+\vec{b}\right)$ and $Q\left(\vec{a}-3\vec{b}\right)$ externally in the ratio 1 : 2. Also show that P is the middle point of the segment RQ.

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4. Show that the following points are collinear :

$A(-2,1), B(-5,-1), C(1,3)$

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5. Show that the following points are collinear :

$A(1, 2, 7), B(2, 6, 3), C(3, 10, -1)$

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6. Prove that the points $A(2, 0, -3), B(1, -2, -5)$ and $C(3, 2, -1)$ are collinear.

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7. If $\vec{a} = -2\hat{i} + 3\hat{j} + 5\hat{k}$, $\vec{b} = \hat{i} + 2\hat{j} + 3\hat{k}$ and $\vec{c} = 7\hat{i} - \hat{k}$ are position vectors of three points A, B, C respectively, prove that A, B, C are collinear.

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8. Show that the following vectors are coplanar :

$\hat{i} - \hat{j} + \hat{k}, 6\hat{i} - \hat{k}$ and $4\hat{i} + 2\hat{j} - 3\hat{k}$

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9. Show that the following vectors are coplanar :

$3\hat{i} - 2\hat{j} + 4\hat{k}, 6\hat{i} + 3\hat{j} + 2\hat{k}, 5\hat{i} + 7\hat{j} + 3\hat{k}$ and $2\hat{i} + 2\hat{j} + 5\hat{k}$.

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10. Show that the points $A(3, -2, 1), B(1, -3, 5), C(2, 1, -4)$ do not form a right - angled triangle.

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11. The three vector $\vec{A} = 3\hat{i} - 2\hat{j} + \hat{k}, \vec{B} = \hat{i} - 3\hat{j} + 5\hat{k}$ and $\vec{C} = 2\hat{i} + \hat{j} - 4\hat{k}$ form

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12. If $\vec{a} = \hat{i} + \hat{j} + \hat{k}$, $\vec{b} = 4\hat{i} - 2\hat{j} + 3\hat{k}$ and $\vec{c} = \hat{i} - 2\hat{j} + \hat{k}$, find a vector of magnitude 6 units which is parallel to the vector $2\vec{a} - \vec{b} + 3\vec{\cdot}$

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Exercise 10 C Long Answer Type Questions Ii

1. Show that the four points $A, B, CandD$ with position vectors $\vec{a}, \vec{b}, \vec{c}$ and $\vec{d}$ respectively are coplanar if and only if $3\vec{a} - 2\vec{b} + \vec{c} - 2\vec{d} = 0.$

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2. Show that the four points P, Q, R, S with position vectors $\vec{p}$, $\vec{q}$, $\vec{r}$, $\vec{s}$ respectively such that $5\vec{p} - 2\vec{q} + 6\vec{r} - 9\vec{s} = \vec{0}$, are

coplanar. Also find the position vector of the point of intersection of the line segments PR and QS.

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3. 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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Exercise 10 D Long Answer Type Questions I

1. If $\vec{a}$, $\vec{b}$, $\vec{c}$, $\vec{d}$ respectively, are position vectors representing the vertices A, B, C, D of a parallelogram, then write $\vec{d}$ in terms of $\vec{a}$, $\vec{b}$ and $\vec{c}$.

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2. If G is the centroid of a triangle ABC, prove that $\overrightarrow{GA} + \overrightarrow{GB} + \overrightarrow{GC} = \overrightarrow{0}$.

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3. If G is the centroid of a triangle ABC, prove that $\overrightarrow{GA} + \overrightarrow{GB} + \overrightarrow{GC} = \overrightarrow{0}$.

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4. $\overrightarrow{a}, \overrightarrow{b}, \overrightarrow{c}, \overrightarrow{d}$ are the position vectors of the four distinct points A, B, C, D respectively. If $\overrightarrow{b} - \overrightarrow{a} = \overrightarrow{c} - \overrightarrow{d}$, then show that ABCD is a parallelogram.

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5. Show that the line joining any vertex of a parallelogram to the mid - point of an opposite side divides the opposite diagonal in the ratio 2 : 1.

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6. Prove that the quadrilateral formed by joining the mid-points of the pairs of consecutive sides of a quadrilateral is a parallelogram.

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Exercise 10 D Long Answer Type Questions Ii

1. Show that if P, A, B are any three points, then $\lambda\overrightarrow{PA} + \mu\overrightarrow{PB} = (\lambda + \mu)\overrightarrow{PC}$, where C divides [AB] in the ratio $\mu : \lambda$.

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Exercise 10 E Short Answer Type Questions

1. 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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2. Find the angle between the vectors :

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

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3. Find the angle between the vectors :

$\vec{a} = 2\hat{i} - \hat{j} + 2\hat{k}$ and $\vec{b} = 6\hat{i} + 2\hat{j} + 3\hat{k}.$

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4. What is the cosine of the angle which the vector $\sqrt{2}\hat{i} + \hat{j} + \hat{k}$ makes with $y - a\xi s$?

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5. Find the angle between two vectors $\vec{a}$ and $\vec{b}$ such that : $\left|\vec{a}\right| = \sqrt{3}, \left|\vec{b}\right| = 2$ and $\vec{a} . \vec{b} = \sqrt{6}.$

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6. Find the angle between two vectors $\vec{a}$ and $\vec{b}$ with magnitudes 1 and 2 respectively and when $\vec{a} . \vec{b} = 1$.

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7. Find the magnitude of two vectors $\rightarrow a$and $\rightarrow b$having the same magnitude and such that the angle between them is $60o$and their scalar product is $\frac{1}{2}$.

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8. If $\vec{a}\dot{\vec{a}} = 0$ and $\vec{a}\dot{\vec{b}} = 0$, what can you conclude about the vector $\vec{b}$?

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9. If either vector $\rightarrow a = \rightarrow 0$ or $\rightarrow b = \rightarrow 0$, then $\rightarrow a \dot{\longrightarrow} b = 0$

But the converse need not be true. Justify your answer with an example.

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10. Find the scalar projection of :

$\vec{a} = 7\hat{i} + \hat{j} - 4\hat{k}$ on $\vec{b} = 2\hat{i} + 6\hat{j} + 3\hat{k}$

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11. Find the scalar projection of :

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

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12. Find the scalar projection of :

$\vec{a} = 2\hat{i} + 3\hat{j} + 2\hat{k}$ on $\vec{b} = \hat{i} + 2\hat{j} + \hat{k}$

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13. Find the scalar projection of :

$\vec{a} = \hat{i} - \hat{j}$ on $\vec{b} = \hat{i} + \hat{j}$

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14. Find the scalar projection of :

$\vec{a} = \hat{i} + 3\hat{j} + 7\hat{k}$ on $\vec{b} = 7\hat{i} - \hat{j} + 8\hat{k}.$

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15. Find the scalar projection of $\vec{b}$ on $\vec{a}$, when :

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

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16. Find the scalar projection of $\vec{b}$ on $\vec{a}$, when :

$\vec{a} = 2\hat{i} + \hat{j} + 2\hat{k}$ and $\vec{b} = \hat{i} + 2\hat{j} + \hat{k}$.

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17. Find the vector projection of the vector :

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

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18. Find the vector projection of the vector :

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

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19. Find λ, when the projection of $\vec{a} = \lambda\hat{i} + \hat{j} + 4\hat{k}$ on $\vec{b} = 2\hat{i} + 6\hat{j} + 3\hat{k}$ is 4 units.

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20. Show that the vector $\vec{a} = \frac{1}{7}\left(2\hat{i} + 3\hat{j} + 6\hat{k}\right)$, $\vec{b} = \frac{1}{7}\left(3\hat{i} - 6\hat{j} + 2\hat{k}\right)$, $\vec{c} = \frac{1}{7}\left(6\hat{i} + 2\hat{j} - 3\hat{k}\right)$ are mutually perpendicular unit vectors.

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21. If $\vec{a} = 5\hat{i} - \hat{j} - 3\hat{k}$ and $\vec{b} = \hat{i} + 3\hat{j} - 5\hat{k}$, then show that the vectors $\left(\vec{a} + \vec{b}\right)$ and $\left(\vec{a} - \vec{b}\right)$ are perpendicular.

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22. If $\vec{a} = \hat{i} + 2\hat{j} - 3\hat{k}$ and $\vec{b} = 3\hat{i} - \hat{j} + 2\hat{k}$, then show that $\left(\vec{a} + \vec{b}\right)$ is perpendicular to $\left(\vec{a} - \vec{b}\right)$.

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23. Write the value of 'p' for which : $\vec{a} = 3\hat{i} + 2\hat{j} + 9\hat{k}$ and $\vec{b} = \hat{i} + p\hat{j} + 3\hat{k}$ are parallel.

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24. Find the value of $'\lambda'$ such that the vectors $\vec{a}$ and $\vec{b}$ are perpendicular (orthogonal), where :

$\vec{a} = 7\hat{i} - \lambda\hat{j} - 7\hat{k}$, $\vec{b} = 4\hat{i} + 5\hat{j} - \hat{k}$

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25. Find the value of $'\lambda'$ such that the vectors $\vec{a}$ and $\vec{b}$ are perpendicular (orthogonal), where :

$\vec{a} = 2\hat{i} + \lambda\hat{j} + \hat{k}, \vec{b} = \hat{i} - 2\hat{j} + 3\hat{k}.$

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26. If $2\hat{i} + \hat{j} - 3\hat{k}$ and $m\hat{i} + 3\hat{j} - \hat{k}$ are perpendicular to each other, then find 'm'. Also find the area of the rectangle having these two vectors as sides.

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27. Show that the projection of $\vec{b}$ on $\vec{a} \neq \vec{0}$ is :

$$\left(\frac{\vec{a} \cdot \vec{b}}{|\vec{a}|^2}\right)\vec{a}.$$

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28. Show that $|\vec{a}|\vec{b} - |\vec{b}|\vec{a}$, for any two non - zero vectors $\vec{a}$ and $\vec{b}$.

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Exercise 10 E Long Answer Type Questions I

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

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2. If vectors $\vec{a}=2\hat{i}+2\hat{j}+3\hat{k}$, $\vec{b}=-\hat{i}+2\hat{j}+\hat{k}$ and $\vec{c}=3\hat{i}+\hat{j}$ are such that $\vec{a}+\lambda\vec{b}$ is perpendicular to $\vec{c}$, then find the value of λ

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3. If $\vec{a}=\hat{a}=\hat{i}-\hat{j}+7\hat{k}$ and $\vec{b}=5\hat{j}-\hat{j}+\lambda\hat{k}$, then find the value of λ, so that $\vec{a}+\vec{b}$ and $\vec{a}-\vec{b}$ are perpendicular vectors.

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4. If $\vec{p} = 5\hat{i} + \lambda\hat{j} - 3\hat{k}$ *and* $\vec{q} = \hat{i} + 3\hat{j} - 5\hat{k}$, then find the value of λ such that $\vec{p} + \vec{q}$ and $\vec{p} - \vec{q}$ are perpendicular vectors.

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5. If $\vec{a} = 5\hat{i} - \hat{j} + 7\hat{k}$ and $\vec{b} = \hat{i} - \hat{j} - \lambda\hat{k}$, find the value of λ for which $\left(\vec{a} + \vec{b}\right)$ and $\left(\vec{a} - \vec{b}\right)$ are orthogonal.

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6. If $\vec{a} = 3\hat{i} + \hat{j} + 9\hat{k}$ and $\vec{b} = \hat{i} + \lambda\hat{j} + 3\hat{k}$, then find the value of $'\lambda'$ for which the vectors $\left(\vec{a} + \vec{b}\right)$ and $\left(\vec{a} - \vec{b}\right)$ are perpendicular to each other.

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7. Find the scalar product of the following pairs of vectors and the angle between them :

$2\hat{i} - 3\hat{j} + 6\hat{k} \quad \text{and} \quad 2\hat{i} - 3\hat{j} - 5\hat{k}$

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8. Find the scalar product of the following pairs of vectors and the angle between them :

$\hat{i} + 3\hat{j} - 8\hat{k} \quad \text{and} \quad -3\hat{i} - 5\hat{j} + 4\hat{k}.$

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9. Show that the vectors $2\hat{i} - \hat{j} + \hat{k}, \hat{i} - 3\hat{j} - 5\hat{k}$ and $3\hat{i} - 4\hat{j} - 4\hat{k}$ form the vertices of a right angled triangle.

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10. The position vectors of the vertices of ΔABC are : $3\hat{i} - 4\hat{j} - 4\hat{k}, 2\hat{i} - \hat{j} + \hat{k}$ and $\hat{i} - 3\hat{j} - 5\hat{k}$ respectively.

(a) Find $\overrightarrow{AB}, \overrightarrow{BC}$ and $\overrightarrow{CA}$

(b) Prove that ΔABC is a right - angles triangle.

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11. If $\left|\vec{a} + \vec{b}\right| = \left|\vec{a} - \vec{b}\right|$, prove that $\vec{a}$ and $\vec{b}$ are perpendicular.

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12. If $\vec{a}$ and $\vec{b}$ are perpendicular vectors, show that : $\left(\vec{a} + \vec{b}\right)^2 = \left(\vec{a} - \vec{b}\right)^2$.

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13. Prove that $(\rightarrow a + \rightarrow b) \rightarrow a \dot{+} \rightarrow c| \rightarrow a|^2 + | \rightarrow b|^2$, if and only if $\rightarrow a$, $\rightarrow b$ are perpendicular, given $\rightarrow a \neq \rightarrow 0$, $\rightarrow b \neq \rightarrow 0$

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14. 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 $\vec{a}\dot{\vec{b}} + \vec{b}\dot{\vec{c}} + \dot{\rightarrow}\vec{a}$.

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15. Three vectors $\vec{a}, \vec{b}$ and $\vec{c}$ satisfy the condition $\vec{a} + \vec{b} + \vec{c} = \vec{0}$ .Evaluate the quantity $\mu = \vec{a} . \vec{b} + \vec{b} . \vec{c} + \vec{c} . \vec{a}$,if $\left|\vec{a}\right| = 1, \left|\vec{b}\right| = 4$ and $\left|\vec{c}\right| = 2$

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16. If the vectors $\vec{a}, \vec{b}$ and $\vec{c}$ satisfy the condition $\vec{a}+\vec{b}+\vec{c}=\vec{0}$ and $\left|\vec{a}\right|=3, \left|\vec{b}\right|=4$ and $\left|\vec{c}\right|=5$, then show that $\vec{a}.\vec{b}+\vec{b}.\vec{c}+\vec{c}.\vec{a}=-25.$

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17. The scalar product of the vector $\vec{a}=\hat{i}+\hat{j}+\hat{k}$ with a unit vector along the sum of the vectors $\vec{b}=2\hat{i}+4\hat{j}-5\hat{k}$ and $\vec{c}=\lambda\hat{i}+2\hat{j}+3\hat{k}$ is equal to 1. Find the value of λ and hence find the unit vector along $\vec{b}+\vec{.}$

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18. Let $\rightarrow a, \rightarrow b$ and $\rightarrow c$ be three vectors such that $|\rightarrow a|=3, |\rightarrow b|=4, |\rightarrow c|=5$ and each one of them being perpendicular to the sum of the other two, find $|\rightarrow a+\rightarrow b+\rightarrow c|$.

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19. If $|a| = a$ and $\left|\vec{b}\right| = b$, prove that $\left(\frac{\vec{a}}{\vec{a}^2} - \frac{\vec{b}}{b^2}\right)^2 = \left(\frac{\vec{a} - \vec{b}}{ab}\right)^2$.

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20. If $\vec{a} = 3\hat{i} + \hat{j} - 4\hat{k}$, $\vec{b} = 6\hat{i} + 5\hat{j} - 2\hat{k}$ and $\left|\vec{c}\right| = 3$, find the vector $\vec{c}$, which is perpendicular to both $\vec{a}$ and $\vec{b}$.

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21. Let $\rightarrow a = \hat{i} + 4\hat{j} + 2\hat{k}$, $\rightarrow b = 3\hat{i} - 2\hat{j} + 7\hat{k}$ and $\rightarrow c = 2\hat{i} - \hat{j} + 4\hat{k}$. Find a vector $\rightarrow d$ which is perpendicular to both $\rightarrow a$ and $\rightarrow b$ and $\rightarrow c$. $\rightarrow d =$ 15.

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22. Let $\vec{a} = \hat{i} + 4\hat{j} + 2\hat{k}$, $\vec{b} = 3\hat{i} - 2\hat{j} + 7\hat{k}$ and $\vec{c} = 2\hat{i} - \hat{j} + 4\hat{k}$. Find a vector $\vec{d}$ which is perpendicular to both $\vec{a}$ and $\vec{b}$ and $\vec{c}$. $\vec{d}$ =18.

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23. 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 $\vec{c} \cdot \vec{d}$ =18.

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24. Vectors $\vec{a} = \hat{i} + \hat{j} + \hat{k}$, $\vec{b} = \hat{j} + 3\hat{k}$ and $\vec{c} = \hat{i} - 2\hat{j} + \hat{k}$ are given. Find vector $\vec{d}$ if $\vec{d}$ is perpendicular to $\vec{c}$ and $\vec{d} \cdot \vec{a} = 6, \vec{d} \cdot \vec{b} = 11$.

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25. Let $\vec{a} = \hat{i} - \hat{j}$, $\vec{b} = 3\hat{j} - \hat{k}$ and $\vec{c} = 7\hat{i} - \hat{k}$. Find a vector $\vec{d}$ which is perpendicular to both $\vec{a}$ and $\vec{b}$, and $\vec{c} \cdot \vec{d} = 1$.

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Exercise 10 E Long Answer Type Questions Ii

1. Consider $A(2, 3, 4)$, $B(4, 3, 2)$ and $C(5, 2, -1)$ be any three points.

(a) Find the projection of $\overrightarrow{BC}$ on $\overrightarrow{AB}$.

(b) Find the area of triangle ABC.

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2. Dot products of a vector with vectors $3\hat{i} - 5\hat{k}, 2\hat{i} + 7\hat{j} and \overrightarrow{a} = \hat{i} + \hat{j} + \hat{k}$ are respectively -1, 6 and 5. Find the vector.

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3. If $\hat{i} + \hat{j} + \hat{k}, 2\hat{i} + 5\hat{j}, 3\hat{i} + 2\hat{j} - 3\hat{k}$ and $\hat{i} - 6\hat{j} - \hat{k}$ are the position vectors of points A, B, C and D respectively, then find the angle between $\rightarrow AB$ and $\rightarrow CD$. Deduce that $\rightarrow AB$ and $\rightarrow CD$

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4. If $\vec{a} = 2\hat{i} - \hat{j} - 2\hat{k}$ and $\vec{b} = 7\hat{i} + 2\hat{j} - 3\hat{k}$, then express $\vec{b}$ in the form $\vec{b} = \vec{b}_1 + \vec{b}_2$, where $\vec{b}_1$ is parallel to $\vec{a}$ and $\vec{b}_2$ is perpendicular to $\vec{a}$.

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Exercise 10 F Short Answer Type Questions

1. What is the area of the triangle OAB where O is the origin, $\overrightarrow{OA} = 3\hat{i} - \hat{j} + \hat{k}$ and $\overrightarrow{OB} = 2\hat{i} - \hat{j} + 3\hat{k}$?

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2. Prove that

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

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3. If $\vec{a}, \vec{b}, \vec{c}$ are three vectors such that $\vec{a} \times \vec{b} = \vec{c}, \vec{b} \times \vec{c} = \vec{a}$, prove that $\vec{a}, \vec{b}, \vec{c}$ are mutually at right angles and $\left|\vec{b}\right| = 1, \left|\vec{c}\right| = \left|\vec{a}\right|$.

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4. If $\vec{a}, \vec{b}$ and $\vec{c}$ are mutually perpendicular unit vectors and $\vec{a} \times \vec{b} = \vec{c}$, show that $\vec{b} = \vec{c} \times \vec{a}$ and $\vec{a} = \vec{b} \times \vec{c}$.

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5. If $\vec{a} = \hat{i} + \hat{j} + \hat{k}$ *and* $\vec{b} = \hat{j} - \hat{k}$, find a vector $\vec{c}$ such that $\vec{a} \times \vec{c} = \vec{b}$ and $\vec{a} \cdot \vec{c} = 3$

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6. If $\vec{a} \times \vec{b} = \vec{b} \times \vec{c} \neq \vec{0}$, show that $\vec{a} + \vec{c} = m\vec{b}$, m being a scalar.

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7. Prove that $\left|\vec{a} \times \vec{b}\right|^2 = \left|\vec{a}\right|^2 \left|\vec{b}\right|^2 - \left(\vec{a} . \vec{b}\right)^2$

$= \begin{vmatrix} \vec{a} . \vec{a} & \vec{a} . \vec{b} \\ \vec{a} . \vec{b} & \vec{b} . \vec{b} \end{vmatrix}$.

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8. Adjacent sides of a parallelogram are given by vectors $2\hat{i} + \hat{j} + \hat{k}$ and $\hat{i} + 5\hat{j} + \hat{k}$. Find a unit vector in the direction of its diagonal. Also, find the area of parallelogram.

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9. If $\vec{a}$, $\vec{b}$, $\vec{c}$ are position vectors of non - collinear points A, B and C respectively, show that : $\vec{a} \times \vec{b} + \vec{b} \times \vec{c} + \vec{c} \times \vec{a}$ is perpendicular to the plane ABC.

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10. (a) Prove that the normal to the plane containing three points whose position vectors are $\vec{a}, \vec{b}, \vec{c}$ lie in the direction of $\vec{b} \times \vec{c} + \vec{c} \times \vec{a} + \vec{a} \times \vec{b}$.

(b) Find the unit vector perpendicular to the plane ABC, where the position vectors of A, B and C are : $2\hat{i} - \hat{j} + \hat{k}$, $\hat{i} + \hat{j} + 2\hat{k}$ and $2\hat{i} + \hat{k}$ respectively.

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11. Using the formula of $\sin(A - B) = \sin A \cos B - \cos A \sin B$ find the value of $\sin 15^\circ$

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Exercise 10 I Short Answer Type Questions

1. Find the moment about $(1, -1, -1)$ of the force $3\hat{i} + 4\hat{j} - 5\hat{k}$ acting at $(1, 0, -2)$.

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2. The force respresented by $3\hat{i} + 2\hat{k}$ is acting through the point $5\hat{i} + 4\hat{j} - 3\hat{k}$. Find the moment about the point $\hat{i} + 3\hat{j} + \hat{k}$.

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3. Find the moment about the point $\hat{i} + 2\hat{j} - \hat{k}$ of a force represented by $\hat{i} + 2\hat{j} + \hat{k}$ acting through the point $2\hat{i} + 3\hat{j} + \hat{k}$.

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Exercise 10 I Long Answer Type Questions I

1. A force $\vec{F} = 4\hat{i} + \hat{k}$ acts through point A (0, 2, 0). Find the moment $\vec{m}$ of $\vec{F}$ about the point B (4, 0, 4).

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2. Let $\vec{F} = 2\hat{i} + 4\hat{j} + 3\hat{k}$ at the point P with position vector $\hat{i} - \hat{j} + 3\hat{k}$. Find the moment of $\vec{F}$ about the line through the origin O in the direction of the vector $\vec{a} = \hat{i} + 2\hat{j} + 2\hat{k}$.

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3. A force $\vec{F} = 3\hat{i} + 2\hat{j} - 4\hat{k}$ is applied at the point $(1, -1, 2)$. Find the moment of $\vec{F}$ about the point $(2, -1, 3)$.

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4. Two unlike force of equal magnitudes $\hat{j}+2\hat{k}$ and $-\hat{j}-2\hat{k}$ are acting at the points whose position vectors are given by $\hat{i}+\hat{j}+\hat{k}$ and $\hat{i}+2\hat{j}+3\hat{k}$ respectively. Find the moment of the couple formed by these forces.

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5. A force of 3 units acts through the point $(4, -1, 7)$ in the direction of the vector $9\hat{i}+6\hat{j}-2\hat{k}$. Find the moment of the force about the point $(1, -3, 2)$ and the moment about the axes, parallel to the co - ordinate axes, which pass through $(1, -3, 2)$.

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6. Find the moment about the point (3, 4, 5) of the force through the point $(1, 2, -3)$ having components equal to $-2, 3, -4$. What is the moment of the same force about the line through the origin having direction - ratios $<4, -2, 5>$?

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7. Find the moment of the couple formed by the forces $5\hat{i} + \hat{k}$ and $-5\hat{i} - \hat{k}$ acting at the points $(9, -1, 2)$ and $(3, -2, 1)$ respectively.

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8. Find the vector moment of the forces :

$\hat{i} + 2\hat{j} - 3\hat{k}$, $2\hat{i} + 3\hat{j} + 4\hat{k}$ and $-\hat{i} - \hat{j} + \hat{k}$

acting on a particle at a point P (0, 1, 2) about the point $A(1, -2, 0)$.

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Exercise 10 J Short Answer Type Questions

1. Find $\vec{a} . \left(\vec{b} \times \vec{c}\right)$ if :

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

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2. Show that if $\vec{a}+\vec{b}, \vec{b}+\vec{c}, \vec{c}+\vec{a}$ are coplanar, then $\vec{a}, \vec{b}, \vec{c}$ are also coplanar.

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3. If $\vec{a}=7\hat{i}-2\hat{j}+3\hat{k}, \vec{b}=\hat{i}-\hat{j}+2\hat{k}, \vec{c}=2\hat{i}+8\hat{j}$, then find $\vec{a}.\left(\vec{b}\times\vec{c}\right)$ and $\left(\vec{b}\times\vec{c}\right).\vec{a}$.

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4. Show that the vectors $\vec{a}, \vec{b}, \vec{c}$ are coplanar, when

(i) $\vec{a}=\hat{i}-2\hat{j}+3\hat{k}, \vec{b}=-2\hat{i}+3\hat{j}-4\hat{k}$ and $\vec{c}=\hat{i}-3\hat{j}+5\hat{k}$

(ii) $\vec{a}=\hat{i}+3\hat{j}+\hat{k}, \vec{b}=2\hat{i}-\hat{j}-\hat{k}$ and $\vec{c}=7\hat{j}+3\hat{k}$

(iii) $\vec{a}=2\hat{i}-\hat{j}+2\hat{k}, \vec{b}=\hat{i}+2\hat{j}-3\hat{k}$ and $\vec{c}=3\hat{i}-4\hat{j}+7\hat{k}$

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5. Show that the following vectors are coplanar :

$-2\hat{i}-2\hat{j}+4\hat{k},\ -2\hat{i}+4\hat{j}-2\hat{k}, 4\hat{i}-2\hat{k}$ and $\hat{i}-\hat{j}+\hat{k}.$

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6. For what value of $'\lambda'$ are the following vectors coplanar ?

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

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7. For what value of $'\lambda'$ are the following vectors coplanar ?

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

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8. For what value of $'\lambda'$ are the following vectors coplanar ?

$\vec{a}=2\hat{i}-4\hat{j}+5\hat{k},\ \vec{b}=\hat{i}-\lambda\hat{j}+\hat{k}$ and $\vec{c}=3\hat{i}+2\hat{j}-5\hat{k}.$

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9. For what value of $'\lambda'$ are the following vectors coplanar ?

$\vec{a} = \hat{i} + 3\hat{j} + \hat{k}$, $\vec{b} = 2\hat{i} - \hat{j} - \hat{k}$ and $\vec{c} = \lambda\hat{i} + 7\hat{j} + 3\hat{k}$.

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10. Show that the four points A, B, C and D with position vectors $4\hat{i} + 5\hat{j} + \hat{k}$, $-\left(\hat{j} + \hat{k}\right)$, $3\hat{i} + 9\hat{j} + 4\hat{k}$ and $4\left(-\hat{i} + \hat{j} + \hat{k}\right)$ respectively are coplanar.

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11. Show that the four points with position vectors $4\hat{i} + 8\hat{j} + 12\hat{k}$, $2\hat{i} + 4\hat{j} + 6\hat{k}$, $3\hat{i} + 5\hat{j} + 4\hat{k}$ and $5\hat{i} + 8\hat{j} + 5\hat{k}$ are coplanar.

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12. Find λ for which the points $A(3,\ 2,\ 1),\ B(4,\ \lambda,\ 5),\ C(4,\ 2,\ -2)\ and\ D(6,\ 5,\ -1)$ are coplanar.

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13. Find the value of 'x' for which the four points : $A(x,\ -1,\ -1), B(4, 5, 1), C(3, 9, 4)$ and $D(-4, 4, 4)$ are coplanar.

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14. Find the value of 'x' such that four points with position vectors : $A\left(3\hat{i}-2\hat{j}+\hat{k}\right), B\left(4\hat{i}+x\hat{j}+5\hat{k}\right), C\left(4\hat{i}+2\hat{j}-2\hat{k}\right)$ and $D\left(6\hat{i}+5\hat{j}-\hat{k}\right)$ are coplanar.

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15. Show that the four points having position vectors $6\hat{i}-7\hat{j}, 16\hat{i}-19\hat{j}-4\hat{k}, 3\hat{j}-6\hat{k}, 2\hat{i}+5\hat{j}+10\hat{k}$ are not coplanar.

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16. Find the volume of the parallelopiped whose sides are given by the vectors :

(i) $11\hat{i}, 2\hat{j}, 13\hat{k}$

(ii) $3\hat{i}+4\hat{j}, 2\hat{i}+3\hat{j}+4\hat{k}, 5\hat{k}.$

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17. Find the volume of the parallelopiped with coteminous edges AB, AC and AD, where $A \equiv (3, 2, 1), B \equiv (4, 2, 1), C \equiv (0, 1, 4)$ and $D \equiv (0, 0, 7).$

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Exercise 10 J Long Answer Type Questions I

1. Prove that for any two vectors $\vec{a}$ and $\vec{b}$, $\vec{a}.\left(\vec{a}\times\vec{b}\right)=0$. Is $\vec{b}.\left(\vec{a}\times\vec{b}\right)=0$?

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2. If $\vec{a}$, $\vec{b}$ and $\vec{c}$ are mutually perpendicular, show that $\left[\vec{a}.\left(\vec{b}\times\vec{c}\right)\right]^2=a^2b^2c^2$

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3. What can you conclude about four non - zero vectors $\vec{a}$, $\vec{b}$, $\vec{c}$ and $\vec{d}$, given that : $\left[\left(\vec{a}\times\vec{b}\right).\vec{c}\right]+\left[\left(\vec{b}\times\vec{c}\right).\vec{d}\right]=0$?

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

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5. Prove that :

$$\left(\vec{b}+\vec{c}\right).\left\{\left(\vec{c}+\vec{a}\right)\times\left(\vec{a}+\vec{b}\right)\right\}=2\left[\vec{a}\,\vec{b}\,\vec{c}\right].$$

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6. Prove that :

$$\left\{\left(\vec{b}+\vec{c}\right)\times\left(\vec{c}+\vec{a}\right)\right\}.\left(\vec{a}+\vec{b}\right)=2\left[\vec{a}\,\vec{b}\,\vec{c}\right]$$

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7. Prove that :

$$\left\{\left(\vec{b}-\vec{c}\right)\times\left(\vec{c}-\vec{a}\right)\right\}.\left(\vec{a}-\vec{b}\right)=0.$$

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8. For three non-zero vectors $\vec{a}, \vec{b}$ and $\vec{c}$, prove that $\left[\vec{a} - \vec{b}\,\vec{b} - \vec{c}\,\vec{c} - \vec{a}\right] = 0$

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9. For any three coplanar vectors $\vec{a}, \vec{b}, \vec{c}$, show that $\vec{a} - \vec{b}, \vec{b} - \vec{c}, \vec{c} - \vec{a}$ are coplanar.

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10. If $\vec{a} . \vec{b} \times \vec{c} \neq 0$ and $\vec{a'} = \frac{\vec{b} \times \vec{c}}{\vec{a} . \vec{b} \times \vec{c}}, \vec{b'} = \frac{\vec{c} \times \vec{a}}{\vec{a} . \vec{b} \times \vec{c}}, \vec{c'} = \frac{\vec{a} \times \vec{b}}{\vec{a} . \vec{b} \times \vec{c}}$, show that : $\vec{a} . \vec{a'} + \vec{b} . \vec{b'} + \vec{c} . \vec{c'} = 3$

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11. If $\vec{a} . \vec{b} \times \vec{c} \neq 0$ and $\vec{a'} = \frac{\vec{b} \times \vec{c}}{\vec{a} . \vec{b} \times \vec{c}}, \vec{b'} = \frac{\vec{c} \times \vec{a}}{\vec{a} . \vec{b} \times \vec{c}}, \vec{c'} = \frac{\vec{a} \times \vec{b}}{\vec{a} . \vec{b} \times \vec{c}}$, show that : $\vec{a'} . \left(\vec{b'} \times \vec{c'}\right) = \frac{1}{\vec{a} . \left(\vec{b} \times \vec{c}\right)}$

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12. If $\vec{a} . \vec{b} \times \vec{c} \neq 0$ and $\vec{a'} = \frac{\vec{b} \times \vec{c}}{\vec{a} . \vec{b} \times \vec{c}}, \vec{b'} = \frac{\vec{c} \times \vec{a}}{\vec{a} . \vec{b} \times \vec{c}}, \vec{c'} = \frac{\vec{a} \times \vec{b}}{\vec{a} . \vec{b} \times \vec{c}}$, show that : $\vec{a} . \vec{a'} + \vec{b} . \vec{b'} + \vec{c} . \vec{c'} = 3.$

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Exercise 10 J Long Answer Type Questions Ii

1. If $\vec{a}, \vec{b}, \vec{c}$ are three vectors such that $\vec{a} + \vec{b} + \vec{c} = 0$, then prove that :

$\vec{a} \times \vec{b} = \vec{b} \times \vec{c} = \vec{c} \times \vec{a}$ and hence, show that $\left[\vec{a}\,\vec{b}\,\vec{c}\right] = 0.$

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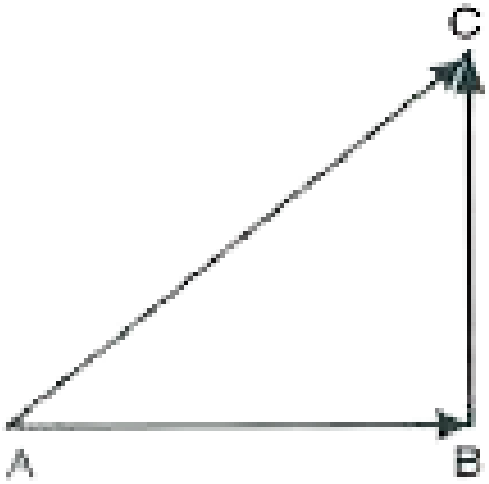
Objective Type Questions A Multiple Choice Questions

1. In ΔABC, which of the following is not true ?



A. $\overrightarrow{AB} + \overrightarrow{BC} + \overrightarrow{CA} = \overrightarrow{0}$

B. $\overrightarrow{AB} + \overrightarrow{BC} - \overrightarrow{AC} = \overrightarrow{0}$

C. $\overrightarrow{AB} + \overrightarrow{BC} - \overrightarrow{CA} = \overrightarrow{0}$

D. $\overrightarrow{AB} - \overrightarrow{CB} + \overrightarrow{CA} = \overrightarrow{0}$

Answer: C

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2. If $\vec{a}$ and $\vec{b}$ are two collinear vectors, then which of the following are incorrect :

A. $\vec{b} = \lambda \vec{a}$ for some scalar λ.

B. $\vec{a} = \pm \vec{b}$

C. the respective components of $\vec{a}$ and $\vec{b}$ are proportional

D. both the vectors $\vec{a}$ and $\vec{b}$ have the same direction, but different magnitude.

Answer: D

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3. If $\vec{a}$ is a non zero vector a magnitude $'a'$ and λ is a non a zero scalar, then λ $\vec{a}$ is a unit vector if

A. $\lambda = 1$

B. $\lambda = -1$

C. $a = |\lambda|$

D. $a = \frac{1}{|\lambda|}$

Answer: D

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4. Let λ be any non - zero scalar. Then for what possible values of x, y and z given below, the vectors $2\hat{i} - 3\hat{j} + 4\hat{k}$ and $x\hat{i} - y\hat{j} - z\hat{k}$ are perpendicular :

A. $x = 2\lambda, y = \lambda, z = \lambda$

B. $x = \lambda, y = 2\lambda, z = -\lambda$

C. $x = -\lambda, y = 2\lambda, z = \lambda$

D. $x = -\lambda, y = -2\lambda, z = \lambda$

Answer: C

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5. Let the vectors $\vec{a}$ and $\vec{b}$ be such that $\left|\vec{a}\right| = 3$ and $\left|\vec{b}\right| = \frac{\sqrt{2}}{3}$, then $\rightarrow a \times \rightarrow b$ is a unit vector, if the angle between $\vec{a}$ and $\vec{b}$

A. $\frac{\pi}{6}$

B. $\frac{\pi}{4}$

C. $\frac{\pi}{3}$

D. $\frac{\pi}{2}$

Answer: B

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6. Area of a rectangle having vertices :

$A\left(-\hat{i}+\frac{1}{2}\hat{j}+4\hat{k}\right)$, $B\left(\hat{i}+\frac{1}{2}\hat{j}+4\hat{k}\right)$,

$C\left(\hat{i}-\frac{1}{2}\hat{j}+4\hat{k}\right)$, $D\left(-\hat{i}-\frac{1}{2}\hat{j}+4\hat{k}\right)$ is :

A. $\frac{1}{2}$ square unit

B. 1 square unit

C. 2 square units

D. 4 square units

Answer: C

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7. If θ is the angle between two vectors $\vec{a}$ and $\vec{b}$, then $\vec{a}\cdot\vec{b} \geq 0$ only when

A. $0 < \theta < \frac{\pi}{2}$

B. $0 \leq \theta \leq \frac{\pi}{2}$

C. $0 < \theta < \pi$

D. $0 < \theta \leq \pi$

Answer: B

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

A. $\theta = \frac{\pi}{4}$

B. $\theta = \frac{\pi}{3}$

C. $\theta = \frac{\pi}{2}$

D. $\theta = \frac{2\pi}{3}$

Answer: D

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9. Write the value of $\hat{i}.\left(\hat{j}\times\hat{k}\right)+\hat{j}.\left(\hat{i}\times\hat{k}\right)+\hat{k}.\left(\hat{i}\times\hat{j}\right)$.

A. 0

B. -1

C. 1

D. 3

Answer: D

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10. If is the angle between any two vectors $\vec{a}$ and $\vec{b}$, then $\left|\vec{a}\,\vec{b}\right|=\left|\vec{a}\times\vec{b}\right|$ when θ is equal to

A. 0

B. $\frac{\pi}{4}$

C. $\frac{\pi}{2}$

D. π

Answer: B

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11. The area of the triangle whose adjacent sides are : $\vec{a} = 3\hat{i} + \hat{j} + 4\hat{k}$ and $\vec{b} = \hat{i} - \hat{j} + \hat{k}$ is :

A. $\frac{1}{2}\sqrt{42}$

B. 42

C. $\sqrt{42}$

D. $\sqrt{21}$

Answer: A

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12. The magnitude of the vector $6\hat{i} + 2\hat{j} + 3\hat{k}$ is :

A. 5

B. 7

C. 12

D. 1

Answer: B

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13. The vector with initial point $P(2, -3, 5)$ and terminal point $Q(3, -4, 7)$ is :

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

B. $5\hat{i} - 7\hat{j} + 12\hat{k}$

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

D. None of these

Answer: A

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14. The angle between the vectors $\hat{i} - \hat{j}$ and $\hat{j} - \hat{k}$ is

A. $\frac{\pi}{3}$

B. $\frac{2\pi}{3}$

C. $-\frac{\pi}{3}$

D. $\frac{5\pi}{6}$

Answer: B

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15. The value of $'\lambda'$ for which the two vectors : $2\hat{i} - \hat{j} + 2\hat{k}$ and $3\hat{i} + \lambda\hat{j} + \hat{k}$ are perpendicular is :

A. 2

B. 4

C. 6

D. 8

Answer: D

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16. If $\left(2\hat{i}+6\hat{j}+27\hat{k}\right)\times\left(\hat{i}+p\hat{j}+q\hat{k}\right)=\overrightarrow{0}$, then the values of p and q are ?

A. $p=6, q=27$

B. $p=3, q=\frac{27}{2}$

C. $p=6, q=\frac{27}{2}$

D. $p=3, q=27$

Answer: B

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17. If $\vec{a} = 2\hat{i} + 3\hat{j} - \hat{k}$, then $\left|\vec{a}\right|$ is :

A. $\sqrt{15}$

B. $\sqrt{14}$

C. 14

D. 15

Answer: B

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18. Write the value of $\hat{i}.\left(\hat{j} \times \hat{k}\right) + \hat{j}.\left(\hat{i} \times \hat{k}\right) + \hat{k}.\left(\hat{i} \times \hat{j}\right)$.

A. 0

B. -1

C. 1

D. 3

Answer: C

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19. For mutually perpendicular unit vectors $\hat{i}, \hat{j}, \hat{k}$, we have :

A. $\hat{i}.\hat{i} = \hat{j}.\hat{j} = \hat{k}.\hat{k} = 3$

B. $\hat{i}.\hat{i} = \hat{j}.\hat{j} = \hat{k}.\hat{k} = 1$

C. $\hat{i}.\hat{i} = \hat{j}.\hat{j} = \hat{k}.\hat{k} = -1$

D. $\hat{i}.\hat{i} = \hat{j}.\hat{j} = \hat{k}.\hat{k} = 0$

Answer: B

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20. Direction - ratios of vector $\overrightarrow{a} = \hat{i} + \hat{j} - 2\hat{k}$ are :

A. $< 1, 2, 2 >$

B. $< 1, 1, -2 >$

C. $< \frac{2}{\sqrt{16}}, \frac{1}{\sqrt{6}}, \frac{2}{\sqrt{6}} >$

D. $< \frac{1}{\sqrt{6}}, \frac{1}{\sqrt{6}}, \frac{-2}{\sqrt{6}} >$

Answer: B

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21. If $\vec{a} = \hat{i} + 2\hat{j}$, then $\left|\vec{a}\right|$ is :

A. 3

B. -1

C. 5

D. $\sqrt{5}$

Answer: D

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22. Direction - cosines of $\vec{a} = \hat{i} + \hat{j} - 2\hat{k}$ are :

A. $< \frac{1}{6}, \frac{1}{6}, \frac{-2}{6} >$

B. $< \frac{1}{\sqrt{6}}, \frac{1}{\sqrt{6}}, \frac{-2}{\sqrt{6}} >$

C. $< \sqrt{6}, \sqrt{6}, -\sqrt{6} >$

D. $< \sqrt{6}, \sqrt{6}, \frac{-\sqrt{6}}{2} >$

Answer: B

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23. If $p\hat{i} + 3\hat{j}$ is a vector of magnitude 5, then the value of p is :

A. 0

B. 1

C. ± 3

D. ± 4

Answer: D

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24. If is the angle between any two vectors $\vec{a}$ and $\vec{b}$, then $\left|\vec{a}\,\dot{\vec{b}}\right| = \left|\vec{a} \times \vec{b}\right|$ when θ is equal to

A. 0°

B. 45°

C. 30°

D. 60°

Answer: B

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25. The inequality $\left|\vec{a}.\ \vec{b}\right| \leq \left|\vec{a}\right|\left|\vec{b}\right|$ is called :

A. Cauchy - Schwartz

B. Triangle Inequality

C. Rolle's Theorem

D. Lagrange's Mean Value Theorem

Answer: A

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26. The vectors $\vec{a}$ and $\vec{b}$ are perpendicular if :

A. $\vec{a} . \vec{b} = 0$

B. $\vec{a} . \vec{b} \neq 0$

C. $\vec{a} \times \vec{b} = \vec{0}$

D. $\vec{a} \times \vec{b} \neq \vec{0}$

Answer: A

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27. Find the angle between two vectors $\vec{a}$ and $\vec{b}$ with magnitudes 1 and 2 respectively and when $\vec{a} . \vec{b} = 1$.

A. 3

B. $\frac{\pi}{2}$

C. $\frac{\pi}{3}$

D. $\frac{\pi}{4}$

Answer: C

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28. Find $\left|\vec{a} - \vec{b}\right|$, if $: \left|\vec{a}\right| = 2, \left|\vec{b}\right| = 3 \, and \, \vec{a}\,\dot{\vec{b}} = 4$

A. $\sqrt{3}$

B. $\sqrt{2}$

C. $\sqrt{5}$

D. $\sqrt{7}$

Answer: C

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29. The angle between the vectors :

$\vec{a} = \hat{i} + 2\hat{j} - 3\hat{k}$ and $3\hat{i} - \hat{j} + 2\hat{k}$ is :

A. $\cos^{-1}\left(\frac{5}{14}\right)$

B. $\cos^{-1}\left(\frac{9}{14}\right)$

C. $\cos^{-1}\left(-\frac{5}{14}\right)$

D. None of these

Answer: C

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30. The D.C.'s of the vector $\hat{i} + 2\hat{j} + 3\hat{k}$ are :

A. $\frac{1}{\sqrt{6}}, \frac{2}{\sqrt{6}}, \frac{3}{\sqrt{6}}$

B. $\frac{1}{\sqrt{14}}, \frac{2}{\sqrt{14}}, \frac{3}{\sqrt{14}}$

C. $1, 2, 3$

D. None of these

Answer: B

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31. If $\vec{a} = 2\hat{i} + 2\hat{j} + 3\hat{k}$, then its magnitude is :

A. 17

B. $\sqrt{17}$

C. 34

D. None of these

Answer: B

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32. If $\vec{a}$ and $\vec{b}$ are unlike vectors, then the angle between them is :

A. 0

B. $\frac{\pi}{2}$

C. $-\pi$

D. π

Answer: D

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33. The angle between the vectors $\hat{i} - \hat{j}$ and $\hat{j} + \hat{k}$ is :

A. $\frac{\pi}{6}$

B. $\frac{\pi}{4}$

C. $\frac{\pi}{3}$

D. $\frac{2\pi}{3}$

Answer: D

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34. If $\vec{a}.\ \vec{b} = \left|\vec{a} \times \vec{b}\right|$, then angle between vector $\vec{a}$ and vector $\vec{b}$ is :

A. $\frac{\pi}{2}$

B. $\frac{\pi}{6}$

C. $\frac{\pi}{4}$

D. $\frac{\pi}{3}$

Answer: D

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

A. $\frac{60}{\sqrt{114}}$

B. $\frac{60}{114}$

C. $\frac{66}{\sqrt{114}}$

D. None of the above

Answer: A

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36. If the angle between two vectors $\vec{a}$ and $\vec{b}$ is zero, then :

A. $\vec{a}.\vec{b}=\left|\vec{a}\right|\left|\vec{b}\right|$

B. $\vec{a}.\vec{b}=0$

C. $\left|\vec{a}\right|\left|\vec{b}\right|=1$

D. None of the above

Answer: A

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37. The projection of vector $\vec{a} = 2\hat{i} + 3\hat{j} + 2\hat{k}$ on $\vec{b} = \hat{i} + 2\hat{j} + \hat{k}$ is :

A. $\frac{\sqrt{5}}{6}$

B. $\frac{2}{3}\sqrt{6}$

C. $\frac{\sqrt{3}}{2}$

D. $\frac{5}{3}\sqrt{6}$

Answer: D

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38. If the vectors $5\hat{i} + 2\hat{j} - \hat{k}$ and $\lambda\hat{i} - \hat{j} + 5\hat{k}$ are orthogonal vectors, then the value of λ is :

A. $\frac{3}{5}$

B. $\frac{5}{7}$

C. $\frac{7}{5}$

D. $\frac{2}{5}$

Answer: C

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39. Let the vectors $\vec{a}$ and $\vec{b}$ be such that $\left|\vec{a}\right| = 3$ and $\left|\vec{b}\right| = \frac{\sqrt{2}}{3}$, then $\vec{a} \times \vec{b}$ is a unit vector, if the angle between $\vec{a}$ and $\vec{b}$

A. $\frac{\pi}{6}$

B. $\frac{\pi}{4}$

C. $\frac{\pi}{3}$

D. $\frac{\pi}{2}$

Answer: B

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40. Which of the following is true ?

A. $\hat{i}.\hat{j} = \hat{j}.\hat{k} = \hat{k}.\hat{i} = 0$

B. $\hat{i}.\hat{i} = \hat{j}.\hat{j} = \hat{k}.\hat{k} = 0$

C. $\hat{i}^2 + \hat{j}^2 + \hat{k}^2 = 0$

D. None of these

Answer: A

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Objective Type Questions B Fill In The Blanks

1. The magnitude of projection of $\left(2\hat{i} - \hat{j} + \hat{k}\right)$ $\text{on}\left(\hat{i} - 2\hat{j} + 2\hat{k}\right)$ is

_____

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2. Vector of magnitude 5 units and in the direction opposite to $2\hat{i} + 3\hat{j} - 6\hat{k}$ is _____.

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3. Find the sum of vectors $\vec{a} = \hat{i} - 2\hat{j} + \hat{k}, \vec{b} = -2\hat{i} + 4\hat{j} + 5\hat{k}$ and $\vec{c} = \hat{i} - 6\hat{j} - 7\hat{k}$.

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4. The value of 'a' when the vectors :

$2\hat{i} - 3\hat{j} + 4\hat{k}$ and $a\hat{i} + b\hat{j} - 8\hat{k}$ are collinear is _____.

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5. If $\vec{a} = 2\hat{i} + \hat{j} - 2\hat{k}$, then $\left|\vec{a}\right| =$ _____.

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6. The direction - ratios of the vector $\vec{a} = 6\hat{i} - 3\hat{j} + 2\hat{k}$ are _____.

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

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8. If $\vec{a}$ is a unit vector and $\left(\vec{x} - \vec{a}\right).\left(\vec{x} + \vec{a}\right) = 8$, then find $\left|\vec{x}\right|$

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9. If $\vec{p}$ is a unit vector and $\left(\vec{x} - \vec{p}\right).\left(\vec{x} + \vec{p}\right) = 80$, then $\left|\vec{x}\right| =$ _____.

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10. Angle between $\hat{i} - \hat{j}$ and $\hat{j} - \hat{k}$ is _____.

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11. Find the value of :

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

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

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12. $\left(\hat{k} \times \hat{j}\right).\ \hat{i} + \hat{j}.\ \hat{k} =$ .....

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13. $\left(\hat{k} \times \hat{i}\right).\ \hat{j} + \hat{i}.\ \hat{k}$ .....

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14. Find λ if $\left(2\hat{i}+6\hat{j}+14\hat{k}\right)x\left(\hat{i}-\lambda\hat{j}+7\hat{k}\right)=\vec{0}$

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15. The magnitude of $\vec{a}\times\vec{b}$ if $\vec{a}=2\hat{i}+\hat{k}$ and $\vec{b}=\hat{i}+\hat{j}+\hat{k}$ is _____.

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16. If any two of three vectors $\vec{a}$, $\vec{b}$, $\vec{c}$ are parallel, then $\left[\vec{a}\,\vec{b}\,\vec{c}\right]=$ _____.

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17. The value of $'\lambda'$ such that the vectors :

$3\hat{i}+\lambda\hat{j}+5\hat{k}$, $\hat{i}+2\hat{j}-3\hat{k}$ and $2\hat{i}-\hat{j}+\hat{k}$ are coplanar is _____.

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Objective Type Questions C True False Questions

1. If $\vec{a} = -\vec{b}$, then $|\vec{a}| = |\vec{b}|$.

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2. If $|\vec{a}| = |\vec{b}|$, then $\vec{a} = \vec{b}$.

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3. Show that If $\vec{a} = x\hat{i} + 2\hat{j} - z\hat{k}$ and $\vec{b} = 3\hat{i} - y\hat{j} + \hat{k}$ are two equal vectors, then $x + y + z = 0$.

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4. Let $\vec{a} = \hat{i} + 2\hat{j}$ and $\vec{b} = 2\hat{i} + \hat{j}$.

(i) Then, $\left|\vec{a}\right| = \left|\vec{b}\right|$

(ii) Then vectors $\vec{a}$ and $\vec{b}$ are equal.

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5. If $\vec{a} = \vec{b} + \vec{c}$, then $\left|\vec{a}\right| = \left|\vec{b} + \vec{c}\right|$.

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6. Two vectors $\vec{a}$ and $\vec{b}$ are perpendicular to each other if $\vec{a} . \vec{b} = 0$.

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7. The value of $\vec{a} \times \vec{b}$ if $\vec{a} = \hat{i} - 7\hat{j} + \hat{k}$ and $\vec{b} = 3\hat{i} - 2\hat{j} + 2\hat{k}$ is $19\hat{i} + 19\hat{k}$.

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8. If $\vec{a} = 2\hat{i} - 3\hat{j} - \hat{k}$ and $\vec{b} = \hat{i} + 4\hat{j} - 2\hat{k}$, then check whether $\vec{a} \times \vec{b} = \vec{b} \times \vec{a}$.

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9. $\left[\vec{a}\ \vec{b}\ \vec{c}\right] = \left[\vec{b}\ \vec{c}\ \vec{a}\right] = \left[\vec{c}\ \vec{a}\ \vec{b}\right]$.

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10. Prove that $\hat{i}.\left(\hat{j} \times \hat{k}\right) = 1$.

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Objective Type Questions D Very Short Answers Type Questions

1. Find the sum of the vectors : $\vec{a} = \hat{i} - 2\hat{j}$, $\vec{b} = -2\hat{i} - 3\hat{j}$ and $\vec{c} = 2\hat{i} + 3\hat{k}$.

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2. Write a unit vector in the direction of $\vec{a} = 3\hat{i} - 2\hat{j} + 6\hat{k}$.

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3. Write a unit vector in the direction of the sum of the vectors : $\vec{a} = 2\hat{i} + 2\hat{j} - 5\hat{k}$ and $\vec{b} = 2\hat{i} + \hat{j} + 3\hat{k}$.

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4. If vectors $\vec{a} = \hat{i} - 2\hat{j} + \hat{k}$, $\vec{b} = -2\hat{i} + 4\hat{j} + 5\hat{k}$ and $\vec{c} = \hat{i} - 6\hat{j} - 7\hat{k}$, then find the value of $\left|\vec{a} + \vec{b} + \vec{c}\right|$.

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5. If $\vec{a} = \hat{i} + 2\hat{j} - 3\hat{k}$ *and* $\vec{b} = 2\hat{i} + 4\hat{j} + 9\hat{k}$ find a unit vector parallel to $\vec{a} + \vec{b}$.

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6. For what value of 'a' the vectors :

$2\hat{i} - 3\hat{j} + 4\hat{k}$ and $a\hat{i} + 6\hat{j} - 8\hat{k}$ are collinear ?

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7. Write a unit vector in the direction of $\vec{PQ}$, *where* P *and* Q are the points (1, 3, 0) and (4, 5, 6) respectively.

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8. In a triangle OAC, if B is the mid point of side AC and $\vec{OA} = \vec{a}$, $\vec{OB} = \vec{b}$, then what is $\vec{OC}$?

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9. Find the position vector of the point, which divides the join of points with position vectors $3\vec{a} - 2\vec{b}$ and $2\vec{a} + 3\vec{b}$ in the ratio 2 : 1.

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10. If $\left|\vec{a}.\ \vec{b}\right| = \left|\vec{a} \times \vec{b}\right|$, find the angle between $\vec{a}$ and $\vec{b}$.

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11. Obtain the dot product of the vectors :

$\vec{a} = \hat{i} - \hat{j} + \hat{k}$ and $\vec{b} = \hat{i} - \hat{k}$.

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12. Write the magnitude of the vector $\vec{a}$ in terms of dot product.

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13. Let $\vec{a} = \left(2\hat{i} + 3\hat{j} + 2\hat{k}\right)$ and $\vec{b} = \left(\hat{i} + 2\hat{j} + \hat{k}\right)$.

Find the projection of (i) $\vec{a}$ on $\vec{b}$ and (ii) $\vec{b}$ on $\vec{a}$.

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14. Evaluate : $\left(3\vec{a} - 5\vec{b}\right).\left(2\vec{a} + 7\vec{b}\right)$.

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15. If $\vec{a}$ is a unit vector and $\left(\vec{x} - \vec{a}\right).\left(\vec{x} + \vec{a}\right) = 8$, then find $\left|\vec{x}\right|$

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16. Find the angle between $\hat{i}+\hat{j}+\hat{k}$ and $\hat{i}+\hat{j}-\hat{k}$.

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17. Find the angle between $\vec{a}$ and $\vec{b}$ such that : $\left|\vec{a}\right|=\sqrt{2}, \left|\vec{b}\right|=2$ and $\vec{a}.\vec{b}=\sqrt{6}$.

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18. The position vectors of three vectors A, B and C are given to be $\hat{i}+3\hat{j}+3\hat{k}, 4\hat{i}+4\hat{k}$ and $-2\hat{i}+4\hat{j}+2\hat{k}$ respectively. Find the angle between $\overrightarrow{AB}$ and $\overrightarrow{AC}$.

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19. Find $'\lambda'$ when the vectors : $\vec{a}=2\hat{i}+\lambda\hat{j}+\hat{k}$ and $\vec{b}=\hat{i}-2\hat{j}+3\hat{k}$ are perpendicular to each other.

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20. If $\vec{a}$ and $\vec{b}$ are perpendicular vectors, $\left|\vec{a}+\vec{b}\right|=3$ and $\left|\vec{a}\right|=5$, find the value of $\left|\vec{b}\right|$.

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21. Find the magnitude of each of the two vectors $\vec{a}$ and $\vec{b}$ having the same magnitude such that the angle between them is 60° and their scalar product is 9/2.

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22. Find λ if $\left(2\hat{i}+6\hat{j}+14\hat{k}\right)x\left(\hat{i}-\lambda\hat{j}+7\hat{k}\right)=\vec{0}$

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23. Find a vector of magnitude $\sqrt{171}$ which is perpendicular to both of the vectors $\vec{a} = \hat{i} + 2\hat{j} - 3\hat{k}$ *and* $\vec{b} = 3\hat{i} - \hat{j} + 2\hat{k}$.

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24. If $\vec{a} = 2\hat{i} + 3\hat{j} + \hat{k}$, $\vec{b} = \hat{i} - 2\hat{j} + \hat{k}$ and $\vec{c} = -3\hat{i} + \hat{j} + 2\hat{k}$, find $\left[\vec{a}\ \vec{b}\ \vec{c}\right]$.

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25. Find the value of $'\lambda'$ such that the vectors : $3\hat{i} + \lambda\hat{j} + 5\hat{k}$, $\hat{i} + 2\hat{j} - 3\hat{k}$ and $2\hat{i} - \hat{j} + \hat{k}$ are coplanar.

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Ncert File Question From Ncert Book Exercise 10 1

1. Respresent graphically a displacement of $40km$, 30° east of north.

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2. Classify the following measures as scalars and vectors. (i) 10 kg (ii) 2 meters north-west (iii) $40o$ (iv) 40 watt (v) 1019 coulomb (vi) m/s^2

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3. Classify the following as scalar and vector quantities. (i) time period (ii) distance (iii) force (iv) velocity (v) work done

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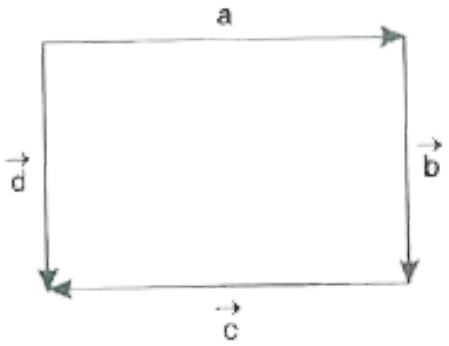
4. In the Fig., identify the following vectors :



(i) Coinitial

(ii) Equal

(iii) Collinear but not equal

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5. Answer the following as true or flase: $\vec{a}$ and $\vec{b}$ are collinear. Two collinear vectors are always equal in magnitude. Zero vector is unique. Two vectors having same magnitude are collinear. Two collinear vectors having the same magnitude are equal.

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Ncert File Question From Ncert Book Exercise 10 2

1. Compute the magnitude of the following vectors: $\rightarrow a = \hat{i} + \hat{j} + \hat{k}$; $\rightarrow b = 2\hat{i} - 7\hat{j} - 3\hat{k}$; $\rightarrow c = \frac{1}{\sqrt{3}}\hat{i} + \frac{1}{\sqrt{3}}\hat{j} - \frac{1}{\sqrt{3}}\hat{k}$

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2. Write two different vectors having same magnitude.

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3. Write two different vectors having same direction.

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4. Find the values of 'x' and 'y' so that vectors $2\hat{i}+3\hat{j}$ and $x\hat{i}+y\hat{j}$ are equal.

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5. Find the scalar and vector components of the vector with initial point $A(2,1)$ and terminal point $B(-5,7)$.

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6. Find the sum of the vectors

$\vec{a}=\hat{i}-2\hat{j}+\hat{k}$, $\vec{b}=-2\hat{i}+4\hat{j}+5\hat{k}$, and $\vec{c}=\hat{i}-6\hat{j}-7\hat{k}$.

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7. Find the unit vector in the direction of the vector $\vec{a}=\hat{i}9+\hat{j}+2\hat{k}$.

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

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

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10. Find a vector in the direction of vector $5\hat{i} - \hat{j} + 2\hat{k}$which has magnitude 8 units.

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11. Show that the vectors $2\hat{i} - 3\hat{j} + 4\hat{k}\ and\ -4\hat{i} + 6\hat{j} - 8\hat{k}$ are collinear.

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

Watch Video Solution

13. Find the direction cosines of the vector joining the points $A(1, 2, -3)$ and $B(-1, -2, 1)$ directed from A to B.

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14. Show that the vector $\hat{i} + \hat{j} + \hat{k}$is equally inclined to the axes OX, OY and OZ.

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15. Find the position vector of a point R which divides the line joining two points P and Q whose position vectors are $\hat{i} + 2\hat{j} - \hat{k}$and $-\hat{i} + \hat{j} + \hat{k}$

respectively, in the ratio 2 : 1(i) internally (ii) externally

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16. Find the position vector of the mid point of the vector joining the points $P(2, 3, 4) and\, Q(4, 1, -2)$.

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

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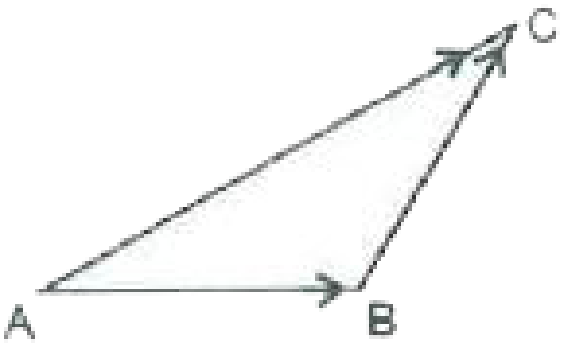
18. In triangle ABC, which of the following is not true :



A. $\overrightarrow{AB} + \overrightarrow{BC} + \overrightarrow{CA} = \overrightarrow{0}$

B. $\overrightarrow{AB} + \overrightarrow{BC} - \overrightarrow{AC} = \overrightarrow{0}$

C. $\overrightarrow{AB} + \overrightarrow{BC} - \overrightarrow{CA} = \overrightarrow{0}$

D. $\overrightarrow{AB} - \overrightarrow{CB} + \overrightarrow{CA} = \overrightarrow{0}$

Answer: C

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19. If $\vec{a}$ and $\vec{b}$ are two collinear vectors, then which of the following are incorrect :

A. $\vec{b} = \lambda \vec{a}$ for some scalar λ.

B. $\vec{a} = \pm \vec{b}$

C. the respective components of $\vec{a}$ and $\vec{b}$ are proportional

D. both the vectors $\vec{a}$ and $\vec{b}$ have the same direction, but different magnitude.

Answer: D

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Ncert File Question From Ncert Book Exercise 10 3

1. Find the angle between two vectors $\vec{a}$ and $\vec{b}$ with magnitudes $\sqrt{3}$ nd 2 respectively such that $\vec{a} . \vec{b} = \sqrt{6}$

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2. 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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3. Find the projection of the vector $\hat{i} - \hat{j}$ on the vector $\hat{i} + \hat{j}$

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

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5. Show that each of the given three vectors is a unit vector: $\frac{1}{7}\left(2\hat{i} + 3\hat{j} + 6\hat{k}\right), \frac{1}{7}\left(3\hat{i} - 6\hat{j} + 2\hat{k}\right), \frac{1}{7}\left(6\hat{i} + 2\hat{j} - 3\hat{k}\right)$ Also, show that they are mutually perpendicular to each other.

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6. find $\left|\vec{a}\right|, \left|\vec{b}\right|$ if $\left(\vec{a}+\vec{b}\right).\left(\vec{a}-\vec{b}\right)=8$ and $\left|\vec{a}\right|=8\left|\vec{b}\right|$

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7. Evaluate the product $\left(3\vec{a}-5\vec{b}\right).\left(2\vec{a}+7\vec{b}\right)$.

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8. Find the magnitude of two vectors $\vec{a}$ and $\vec{b}$ having the same magnitude and such that the angle between them is 60^0 and their scalar product is .

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9. Find $\left|\vec{x}\right|$, if for a unit vector $\vec{a}$, $\left(\vec{x}-\vec{a}\right).\left(\vec{x}+\vec{a}\right)=12$.

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10. If vectors $\vec{a} = 2\hat{i} + 2\hat{j} + 3\hat{k}$, $\vec{b} = -\hat{i} + 2\hat{j} + \hat{k}$ and $\vec{c} = 3\hat{i} + \hat{j}$ are such that $\vec{a} + \lambda\vec{b}$ is perpendicular to $\vec{c}$, then find the value of λ.

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11. Show that $|\vec{a}|\vec{b} + |\vec{b}|\vec{a}$ is perpendicular to $|\vec{a}|\vec{b} - |\vec{b}|\vec{a}$ for any two nonzero vectors $\vec{a}$ and $\vec{b}$

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12. If $\vec{a} \cdot \vec{a} = 0$ and $\vec{a} \cdot \vec{b} = 0$, then what can be concluded about the vector $\vec{b}$?

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

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14. If either $\vec{a}=\vec{0}$ or $\vec{b}=\vec{0}$ $then$ $\vec{a}\cdot\vec{b}=\vec{0}$ but, the converse need not be true. Justify your answer with an example.

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15. 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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16. Show that the points A(1, 2, 7), B(2, 6, 3) and $C(3, 10, 1)$are collinear.

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17. Show that the points, A, B and C having position vectors $\left(2\hat{i}-\hat{j}+\hat{k}\right), \left(\hat{i}-3\hat{j}-5\hat{k}\right)$ and $\left(3\hat{i}-4\hat{j}-4\hat{k}\right)$ respectively are the vertices of a rightangled triangle. Also, find the remaining angles of the triangle.

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18. If $\overrightarrow{a}$ is a non zero vector a magnitude $'a'$ and λ is a non a zero scalar, then $\lambda\overrightarrow{a}$ is a unit vector if $\lambda=1$ b. $\lambda=-1$ c. $a-|\lambda|$ d. $a=\frac{1}{|\lambda|}$

A. $\lambda=1$

B. $\lambda=-1$

C. $a=|\lambda|$

D. $a=1/|\lambda|$

Answer: D

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Ncert File Question From Ncert Book Exercise 10 4

1. Find $\left|\vec{a} \times \vec{b}\right|$, 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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2. Find a unit vector perpendicular to each of the vector $\vec{a} + \vec{b}$ and $\vec{a} - \vec{b}$, where $\vec{a} = 3\hat{i} + 2\hat{j} + 2\hat{k}$ and $\vec{b} = \hat{i} + 2\hat{j} - 2\hat{k}$

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3. If a unit vector $\vec{a}$ makes an angle $\frac{\pi}{3}$ with $\hat{i}$, $\frac{\pi}{4}$ with $\hat{j}$ and an acute angle θ with $\hat{k}$ then find θ and hence, the components of $\vec{a}$.

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4. Prove that $\left(\vec{a}-\vec{b}\right)\times\left(\vec{a}+\vec{b}\right)=2\left(\vec{a}\times\vec{b}\right)$

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5. Find λ and μ if $\left(2\hat{i}+6\hat{j}+27\hat{k}\right)\times\left(\hat{i}+\lambda\hat{j}+\mu\hat{k}\right)=\hat{0}$.

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6. Given that $\rightarrow a\cdot\rightarrow b=0$ and $\rightarrow a\times\rightarrow b=\rightarrow 0$. What can you conclude about the vectors $\rightarrow a$ and $\rightarrow b$.

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7. Let the vectors $\rightarrow a,\ \rightarrow b,\ \rightarrow c$ be given as $a_1\hat{i}+a_2\hat{j}+a_3\hat{k}, b_1\hat{i}+b_2\hat{j}+b_3\hat{k}, c_1\hat{i}+c_2\hat{j}+c_3\hat{k}$. Then show that $\rightarrow a\times(\rightarrow b+\rightarrow c)=\rightarrow a\times\rightarrow b+\rightarrow a\times\rightarrow c$

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8. If either $\rightarrow a = \rightarrow 0$ and $\rightarrow b = \rightarrow 0$ then $\rightarrow a \times \rightarrow b = \rightarrow 0$.

Is Is the converse true? Justify your answer with an example.

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

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11. Let the vectors $\vec{a}$ and $\vec{b}$ be such that $|\vec{a}| = 3|\vec{b}| = \frac{\sqrt{2}}{3}$, then $\vec{a} \times \vec{b}$ is a unit vector, if the angel between $\vec{a}$ and $\vec{b}$ is?

A. $\pi/6$

B. $\pi/4$

C. $\pi/3$

D. $\pi/2$

Answer: B

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12. What is the area of the rectangle having vertices A, B, C and D with positive vectors $-\hat{i} + \frac{1}{2}\hat{j} + 4\hat{k}, \hat{i} + \frac{1}{2}\hat{j} + 4\hat{k}, \hat{i} - \frac{1}{2}\hat{j} + 4\hat{k}$ and $-\hat{1} - \frac{1}{2}\hat{j} + 4\hat{k}$?

A. $\frac{1}{2}$

B. 1

C. 2

D. 4

Answer: C

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Ncert File Question From Ncert Book Exercise 10 5

1. Find $\left[\vec{a}\,\vec{b}\,\vec{c}\right]$ if $\vec{a} = \hat{i} - 2\hat{j} + 3\hat{k}$, $\vec{b} = 2\hat{i} - 3\hat{j} + \hat{k}$ and $\vec{c} = 3\hat{i} + \hat{j} - 2\hat{k}$.

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2. Show that the vectors :

$\vec{a} = \hat{i} - 2\hat{j} + 3\hat{k}$, $\vec{b} = -2\hat{i} + 3\hat{j} - 4\hat{k}$ and $\vec{c} = \hat{i} - 3\hat{j} + 5\hat{k}$ are coplanar.

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3. Find $'\lambda'$ if the vectors :

$\hat{i}-\hat{j}+\hat{k}, 3\hat{i}+\hat{j}+2\hat{k}$ and $\hat{i}+\lambda\hat{j}-3\hat{k}$ are coplanar.

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4. Let $\vec{a}=\hat{i}+\hat{j}+\hat{k}, \vec{b}=\hat{i}$ and $\hat{c}=c_1\hat{i}+c_2\hat{j}+c_3\hat{k}$. Then, If $c_1=1$ and $c_2=2,$ find c_3 which makes $\vec{a}, \vec{b}$ and $\vec{c}$ coplanar. If $c_2=-1$ and $c_3=1,$ show that no value of c_1 can make $\vec{a}, \vec{b}$ and $\vec{c}$ coplanar.

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5. Show that the four points with position vectors $4\hat{i}+8\hat{j}+12\hat{k}, 2\hat{i}+4\hat{j}+6\hat{k}, 3\hat{i}+5\hat{j}+4\hat{k}$ *and* $5\hat{i}+8\hat{j}+5\hat{k}$are coplanar.

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6. Find x such that the four points $A\ (3,\ 2,\ 1)$, $B(4, x,\ 5)$, $C\ (4,\ 2,\ 2)$ and $D\ (6,\ 5,\ 1)$are coplanar

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7. Show that the vectors $\vec{a}$, $\vec{b}$ and $\vec{c}$ are coplanar if $\vec{a} + \vec{b}$, $\vec{b} + \vec{c}$ and $\vec{c} + \vec{a}$ are coplanar.

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Miscellaneous Exercise On Chapter 10

1. Write down a unit vector in XY-plane, making an angle of 30 with the positive direction of x-axis.

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2. Find the scalar components and magnitude of the vector joining the points $P(x_1, y_1, z_1)$and $Q(x_2, y_2, z_2)$

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3. A girl walks 4 km towards west, then she walks 3 km in a direction $30o$ east of north and stops. Determine the girls displacement from her initial point of departure.

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

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

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

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7. If $\rightarrow a = \hat{i} + \hat{j} + \hat{k}$, $\rightarrow b = 2\hat{i} - \hat{j} + 3\hat{k}$ and $\rightarrow c = \hat{i} - 2\hat{j} + \hat{k}$ find a unit vector parallel to the vector $2 \rightarrow a - \rightarrow b + 3 \rightarrow c$.

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8. Show that the points $A(1, -2, -8), B(5, 0, -2)$ and $C(11, 3, 7)$ are collinear, and find the ratio in which B divides AC.

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9. Find the position vector of a point R which divides the line joining two points P and Q whose position vectors are $\left(2\vec{a}+\vec{b}\right)$ and $\left(\vec{a}-3\vec{b}\right)$ respectively, externally in the ratio 1:2.Also, show that P is the mid-point of the line segment RQ.

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10. The two adjacent sides of a parallelogram are $2\hat{i}-4\hat{j}+5\hat{k}$ and $\hat{i}-2\hat{j}-3\hat{k}$. Find the unit vector parallel to one of its diagonals. Also, find its area.

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11. Show that the direction cosines of a vector equally inclined to the axes OX, OY and OZ are $\frac{1}{\sqrt{3}},\frac{1}{\sqrt{3}},\frac{1}{\sqrt{3}}$.

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12. Let $\rightarrow a = \hat{i} + 4\hat{j} + 2\hat{k}, \rightarrow b = 3\hat{i} - 2\hat{j} + 7\hat{k}$ and $\rightarrow c = 2\hat{i} - \hat{j} + 4\hat{k}$. Find a vector $\rightarrow d$ which is perpendicular to both $\rightarrow a$ and $\rightarrow b$ and $\rightarrow c$. $\rightarrow d =$ 15.

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13. The scalar product of the vector $\hat{i} + \hat{j} + \hat{k}$with a unit vector along the sum of vector $2\hat{i} + 4\hat{j} - 5\hat{k}$and $\lambda\hat{i} + 2\hat{j} + 3\hat{k}$is equal to one. Find the value of λ.

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14. If $\vec{a}, \vec{b}, \vec{c}$ are mutually perpenedicular vectors of equal magnitudes, show that the vector $\vec{a} + \vec{b} + \vec{c}$ is equally inclined to $\vec{a}, \vec{b}, and \vec{\cdot}$

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15. Prove that $(\rightarrow a + \rightarrow b) \rightarrow a \dot{+} \rightarrow c| \rightarrow a|^2 + | \rightarrow b|^2$, if and only if $\rightarrow a$, $\rightarrow b$ are perpendicular, given $\rightarrow a \neq \rightarrow 0$, $\rightarrow b \neq \rightarrow 0$

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16. If θ is the angle between two vectors $\vec{a}$ and $\vec{b}$, then $\vec{a}\dot{\vec{b}} \geq 0$ only when `0

A. $0 < \theta < \frac{\pi}{2}$

B. $0 \leq \theta \leq \frac{\pi}{2}$

C. $0 < \theta < \pi$

D. $0 < \theta \leq \pi$

Answer: B

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17. If $\vec{a}$ *and* $\vec{b}$ be two unit vectors and θ is the angle between them. Then $\vec{a} + \vec{b}$ is an unit vector, if $\theta =$ $\frac{\pi}{2}$ b. $\frac{2\pi}{3}$ c. $\frac{\pi}{4}$ d. $\frac{\pi}{3}$

A. $\theta = \frac{\pi}{4}$

B. $\theta = \frac{\pi}{3}$

C. $\theta = \frac{\pi}{2}$

D. $\theta = \frac{2\pi}{3}$

Answer: D

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18. Write the value of $\hat{i}.\left(\hat{j} \times \hat{k}\right) + \hat{j}.\left(\hat{i} \times \hat{k}\right) + \hat{k}.\left(\hat{i} \times \hat{j}\right)$.

A. 0

B. -1

C. 1

D. 3

Answer: C

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19. If is the angle between any two vectors $\rightarrow a$ and $\rightarrow b$, then $\left| \rightarrow a \dot{\longrightarrow} b \right| = | \rightarrow a \times \rightarrow b|$ when θ is equal to (a) 0 (B) $\frac{\pi}{4}$ (C) $\frac{\pi}{2}$ (d) π

A. 0

B. $\frac{\pi}{4}$

C. $\frac{\pi}{2}$

D. π

Answer: B

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Exercise

1. Using vectors, find the value of k, such that the points (k,-10, 3), (1,-1, 3) and (3, 5, 3) are collinear.

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2. If A, B, C, D are the points with position vectors : $\hat{i}+\hat{j}-\hat{k}, 2\hat{i}-\hat{j}+3\hat{k}, 2\hat{i}-3\hat{k}, 3\hat{i}-2\hat{j}+\hat{k}$ respectively. Find the projection of $\overrightarrow{AB}$ along CD.

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3. Using vectors, prove that the parallelogram on the same base and between the same parallels are equal in area.

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Revision Exercise

1. Write all the unit vectors in $XY - plane$.

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2. Write down a unit vector in XY-plane, making an angle of 30 with the positive direction of x-axis.

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

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4. If $\rightarrow a = \hat{i} + \hat{j} + \hat{k}$, $\rightarrow b = 2\hat{i} - \hat{j} + 3\hat{k}$ and $\rightarrow c = \hat{i} - 2\hat{j} + \hat{k}$ find a unit vector parallel to the vector $2 \rightarrow a - \rightarrow b + 3 \rightarrow c$.

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5. If $\vec{a} = 2\hat{i} - \hat{j} + \hat{k}$, $\vec{b} = \hat{i} + 3\hat{j} - \hat{k}$, $\vec{c} = -2\hat{i} + \hat{j} - 3\hat{k}$ and $\vec{d} = 3\hat{i} + 2\hat{j} + 5\hat{k}$, find the scalars α, β and γ such that $\vec{d} = \alpha\vec{a} + \beta\vec{b} + \gamma\vec{c}$.

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6. 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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7. The two adjacent sides of a parallelogram are $2\hat{i} - 4\hat{j} + 5\hat{k}$ and $\hat{i} - 2\hat{j} - 3\hat{k}$. Find the unit vector parallel to one of its diagonals. Also, find its area.

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8. The scalar product of the vector $\hat{i}+\hat{j}+\hat{k}$with a unit vector along the sum of vector $2\hat{i}+4\hat{j}-5\hat{k}$and $\lambda\hat{i}+2\hat{j}+3\hat{k}$is equal to one. Find the value of λ.

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9. If $\vec{a}, \vec{b}, \vec{c}$ are mutually perpenedicular vectors of equal magnitudes, show that the vector $\vec{a}+\vec{b}+\vec{c}$ is equally inclined to $\vec{a}, \vec{b}, and \cdot\vec{}$

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10. If $\vec{a}, \vec{b}, \vec{c}$ are three non coplanar vectors such that $\vec{a}.\vec{a}=\vec{d}\,\vec{b}=\vec{d}.\vec{c}=0$, then show that $\vec{d}$ is the null vector.

A. $\vec{d}=\vec{1}.$

B. $\vec{d}=\vec{0}.$

C. $\vec{d}=\vec{2}.$

D. $\vec{d} = \vec{3}$.

Answer: B

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Competition File

1. The non-zero vectors are $\vec{a}, \vec{b}$ and $\vec{c}$ are related by $\vec{a} = 8\vec{b}$ and $\vec{c} = -7\vec{b}$. Then the angle between $\vec{a}$ and $\vec{c}$ is

A. π

B. 0

C. $\frac{\pi}{4}$

D. $\frac{\pi}{2}$

Answer: A

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2. If $\vec{u}, \vec{v}, \vec{w}$ are noncoplanar vectors and p, q are real numbers, then the equality $\left[3\vec{u}, p\vec{v}, p\vec{w}\right] - \left[p\vec{v}, \vec{w}, q\vec{u}\right] - \left[2\vec{w}, q\vec{v}, q\vec{u}\right] = 0$ holds for

A. exactly two values of (p, q)

B. more than two but not all values (p, q)

C. all values of (p, q)

D. exactly one value of (p, q)

Answer: D

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3. Let $\vec{a} = \hat{j} - \hat{k}$ and $\vec{c} = \hat{i} - \hat{j} - \hat{k}$. Then the vector b satisfying $\vec{a} x \vec{b} + \vec{c} = 0$ and $\vec{a} . \vec{b} = 3$, is

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

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

C. $\hat{i} - \hat{j} - 2\hat{k}$

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

Answer: A

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4. If the vectors $\overrightarrow{a} = \hat{i} - \hat{j} + 2\hat{k}$, $\overrightarrow{b} = 2\hat{i} + 4\hat{j} + \hat{k}$ and $\overrightarrow{c} = \lambda\hat{i} + \hat{j} + \mu\hat{k}$ are mutually orthogonal, then (λ, μ)

A. $(-3, 2)$

B. $(2, -3)$

C. $(-2, 3)$

D. $(3, -2)$

Answer: A

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5. The vectors $\vec{a}$ and $\vec{b}$ are not perpendicular and $\vec{c}$ and $\vec{d}$ are two vectors satisfying : $\vec{b}\vec{c}\,\vec{b}\vec{d} = \vec{a}\dot{\vec{d}} = 0$. Then the vector $\vec{d}$ is equal to :

A. $\vec{b} - \left(\frac{\vec{b}\,.\,\vec{c}}{\vec{a}\,.\,\vec{b}}\right)\vec{c}$

B. $\vec{c} + \left(\frac{\vec{a}\,.\,\vec{c}}{\vec{a}\,.\,\vec{b}}\right)\vec{b}$

C. $\vec{b} + \left(\frac{\vec{b}\,.\,\vec{c}}{\vec{a}\,.\,\vec{b}}\right)\vec{c}$

D. $\vec{c} - \left(\frac{\vec{a}\,.\,\vec{c}}{\vec{a}\,.\,\vec{b}}\right)\vec{b}$

Answer: D

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6. If the vectors $p\hat{i} + \hat{j} + \hat{k}$, $\hat{i} + q\hat{j} + \hat{k}$ and $\hat{i} + \hat{j} + r\hat{k}(p \neq q \neq r \neq 1)$ are coplanar, then the value of $pqr - (p + q + r)$ is :

A. 2

B. 0

C. -1

D. -2

Answer: D

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7. Let $\vec{a}, \vec{b}, \vec{c}$ be three non-zero vectors such that any two of them are non-collinear. If $\vec{a} + 2\vec{b}$ is collinear with $\vec{c}$ and $\vec{b} + 3\vec{c}$ is collinear with $\vec{a}$ then prove that $\vec{a} + 2\vec{b} + 6\vec{c} = \vec{0}$

A. $\vec{a}$

B. $\vec{b}$

C. $\vec{0}$

D. $\vec{a} + \vec{c}$

Answer: C

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8. Let $\vec{a}$ and $\vec{b}$ he two unit vectors. If the vectors : $\vec{c} = \vec{a} + 2\vec{b}$ and $\vec{d} = 5\vec{a} - 4\vec{b}$ are perpendicular to eqach other, then the angle between $\vec{a}$ and $\vec{b}$ is :

A. $\frac{\pi}{6}$

B. $\frac{\pi}{2}$

C. $\frac{\pi}{3}$

D. $\frac{\pi}{4}$

Answer: C

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9. If the vectors $\vec{A}B = 3\hat{i} + 4\hat{k}$ 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. $\sqrt{72}$

B. $\sqrt{33}$

C. $\sqrt{45}$

D. $\sqrt{18}$

Answer: B

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10. If $\left[\vec{a} \times \vec{b}\,\vec{b} \times \vec{c}\,\vec{c} \times \vec{a}\right] = \lambda\left[\vec{a}\,\vec{b}\,\vec{c}\right]^2$, then λ is equal to

A. 3

B. 0

C. 1

D. 2

Answer: C

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11. Let $\vec{a}$, $\vec{b}$ and $\vec{c}$ be three non-zero vectors such that no two of them are collinear and $\left(\vec{a} \times \vec{b}\right) \times \vec{c} = \frac{1}{3}\left|\vec{b}\right|\left|\vec{c}\right|\vec{a}$. If θ is the angle between vectors $\vec{b}$ and $\vec{c}$, then the value of $\sin\theta$ is:

A. $\frac{2\sqrt{2}}{3}$

B. $\frac{-\sqrt{2}}{3}$

C. $\frac{2}{3}$

D. $\frac{-2\sqrt{3}}{3}$

Answer: A

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12. Let $\vec{a}$, $\vec{b}$ and $\vec{c}$ be there unit vectors such that $\vec{a} \times \left(\vec{b} \times \vec{c}\right) = \frac{\sqrt{3}}{2}\left(\vec{b} + \vec{c}\right)$. If $\vec{b}$ is not parallel to $\vec{e}$, then the angle between $\vec{a}$ & $\vec{b}$ is:

A. $\frac{\pi}{2}$

B. $\frac{2\pi}{3}$

C. $\frac{5\pi}{6}$

D. $\frac{3\pi}{4}$

Answer: C

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13. Let $\vec{a} = 2\hat{i} + \hat{j} - 2\hat{k}$ and $\vec{b} = \hat{i} + \hat{j}$ Let $\vec{c}$ be a vector such that $\left|\vec{c} - \vec{a}\right| = 3$, $\left|\left(\vec{a} \, x \, \vec{b}\right) x \, \vec{c}\right| = 3$ and the angle between $\vec{c}$ and $\vec{a} \, x \, \vec{b}$ be 30^0. Then $\vec{a} \, . \, \vec{c}$ is equatl to :

A. 5

B. $-\frac{1}{8}$

C. $\frac{25}{8}$

D. 2

Answer: D

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14. Let $\vec{u}$ be a vector coplanar with the vectors $\vec{a} = 2\hat{i} + 3\hat{j} - \hat{k}$ and $\vec{b} = \hat{j} + \hat{k}$. If $\vec{u}$ is perpendicular to $\vec{a}$ and $\vec{u} . \vec{b} = 24$ then $\left|\vec{u}\right|^2$ is equal to

A. 336

B. 315

C. 256

D. 84

Answer: A

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15. The sum of the distinct real values of mu for which the vectors, $\mu\hat{i}+\hat{j}+\hat{k}, \hat{i}+\mu\hat{j}+\hat{k}, \hat{i}+\hat{j}+\mu\hat{k}$ are co-planar is :

A. 2

B. 1

C. -1

D. 0

Answer: C

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16. Let $\vec{\alpha}=3\hat{i}+\hat{j}, \vec{\beta}=2\hat{i}-\hat{j}+3\hat{k}$ and $\vec{\beta}=\vec{\beta}_1-\vec{\beta}_2$, such that $\vec{\beta}_1$ is parallel to $\vec{\alpha}$ and $\vec{\beta}_2$ is perpendicular to α. Find $\vec{\beta}_1\times\vec{\beta}_2$.

A. $\frac{1}{2}\left(\hat{i}-9\hat{j}+8\hat{k}\right)$

B. $\frac{1}{2}\left(\hat{i}-3\hat{j}+4\hat{k}\right)$

C. $\frac{1}{2}\left(-3\hat{i}+9\hat{j}+10\hat{k}\right)$

D. $\frac{3}{2}\left(3\hat{i}+9\hat{j}+10\hat{k}\right)$

Answer: C

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Chapter Test 10

1. What is the area of the rectangle having vertices A, B, C and D with positive vectors $-\hat{i}+\frac{1}{2}\hat{j}+4\hat{k}, \hat{i}+\frac{1}{2}\hat{j}+4\hat{k}, \hat{i}-\frac{1}{2}\hat{j}+4\hat{k}$ and $-\hat{1}-\frac{1}{2}\hat{j}+4\hat{k}$?

A. $\frac{1}{2}$ square unit

B. 1 square unit

C. 2 square units

D. 4 square units

Answer: C

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2. Write the value of $\hat{i}.\left(\hat{j}\times\hat{k}\right)+\hat{j}.\left(\hat{i}\times\hat{k}\right)+\hat{k}.\left(\hat{i}\times\hat{j}\right)$.

A. 0

B. -1

C. 1

D. 3

Answer: D

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3. Find the value of x for which $x\left(\hat{i}+\hat{j}+\hat{k}\right)$ is a unit vector.

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4. Find the angle between the vectors $\hat{i}-\hat{j}$ and $\hat{j}-\hat{k}$.

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5. Find $\left|\vec{a} \times \vec{b}\right|$, 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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6. Show that the vectors $2\hat{i} - 3\hat{j} + 4\hat{k}\ and\ -4\hat{i} + 6\hat{j} - 8\hat{k}$ are collinear.

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7. Show that the vectors $2\hat{i} - \hat{j} + \hat{k}$, $\hat{i} - 3\hat{j} - 5\hat{k}$and $3\hat{i} - 4\hat{j} - 4\hat{k}$form the vertices of a right angled triangle.

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8. If $|a| = a$ and $\left|\vec{b}\right| = b$, prove that $\left(\frac{\vec{a}}{\vec{a}^2} - \frac{\vec{b}}{b^2}\right)^2 = \left(\frac{\vec{a} - \vec{b}}{ab}\right)^2$.

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9. If $\vec{r} = x\hat{i} + y\hat{j} + x\hat{k}$, find : $\left(\vec{r} \times \hat{i}\right).\left(\vec{r} \times \hat{j}\right) + xy.$

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10. Find the value of $'\lambda'$ such that vectors : $3\hat{i} + \lambda\hat{j} + 5\hat{k}$, $\hat{i} + 2\hat{j} - 3\hat{k}$ and $2\hat{i} - \hat{j} + \hat{k}$ are coplanar.

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11. Let $\vec{a}$, $\vec{b}$, $\vec{c}$ be three vectors of magnitudes 3, 4 and 5 respectively. If each one is perpendicular to the sum of the other two vectors, prove that $\left|\vec{a} + \vec{b} + \vec{c}\right| = 5\sqrt{2}$.

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12. Prove by vector method that sin(A-B)=sinAcosB-cosAsinB and sin(A+B)=sinAcosB+cosAsinB

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