MATHS

BOOKS - NEW JYOTHI MATHS (TAMIL ENGLISH)

VECTOR ALGEBRA

Examples

1. Represent graphically a displacement of 40 km, 30° west of south.

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2. Classify the following measures as scalars and vectors.

(i) 5seconds (ii) $1000cm^3$ (iii) 10 Newton

(iv)$30\frac{km}{\text{hr}}$(v)$10g/cm^2$ (vi) 20 m/s towards North

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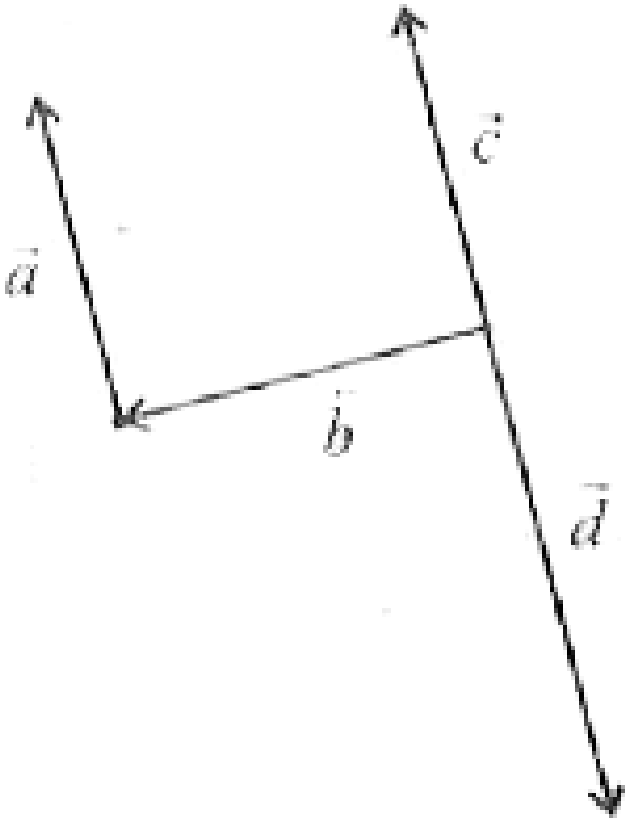
3. In the figure, which of the vectors are

(i) Collinear vectors

(ii) Equal vectors

(iii) Cointial vectors



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

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5. Let $\vec{a} = \hat{i} + 2\hat{j}$ and $\vec{b} = 2\hat{i} + \hat{j}$. Is $\left|\vec{a}\right| = \left|\vec{b}\right|$. Are the vectors $\vec{a}$ and $\vec{b}$ equal ?

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

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8. Find a vector in the direction of $\vec{a} = \hat{i} - 2\hat{j}$ that has a magnitude 7 units.

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9. Find a vector in the direction of $\vec{r} = 3\hat{i} - 4\hat{j}$ that has a magnitude 9.

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

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11. Find a unit vector in the direction of the sum of 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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12. Consider the vectors $\vec{a} = 2\hat{i} + 2\hat{j} - 5\hat{k}$ and $\vec{b} = -\hat{i} + 7\hat{k}$

(a).Find $\vec{a} + \vec{b}$.

(b) Find a unit vector in the direction of $\vec{a} + \vec{b}$.

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

$\vec{c} = 3\hat{i} + 5\hat{j} - 2\hat{k}$, $\vec{d} = -\hat{j} + \hat{k}$

(i) Find $\vec{b} - \vec{a}$.

(ii) Find the unit vector along $\vec{b} - \vec{a}$.

(iii) Prove that $\vec{b} - \vec{a}$ and $\vec{d} - \vec{c}$ are parallel vectors.

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

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16. For any three vectors $\vec{a}, \vec{b}, \vec{c}$ prove that $\left(\vec{a} + \vec{b}\right) + \vec{c} = \vec{a} + \left(\vec{b} + \vec{c}\right)$

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

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18. Let A(1, 2, 4) and B(2, -1, 3) be two points.

(i) Find $\overrightarrow{AB}$)

(ii) Find a unit vector along $\overrightarrow{AB}$

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19. Show the points A(3^i-2^j+^k) ,B(^i-3^j+5^k) and C(2^i+^j-4^k) are the vectors of a right angled triangle.

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20. 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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21. Show that the points with the position vectors $2\hat{i}+6\hat{j}+3\hat{k}$, $\hat{i}+2\hat{j}+7\hat{k}$ and $3\hat{i}+10\hat{j}-\hat{k}$ are collinear.

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22. 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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23. ABCD is a rectangle with A as the origin. $\overrightarrow{b}$ and $\overrightarrow{d}$ are the position vectors of B and D respectively.

(i) What is the position vector of C?

(ii) If P, Q, R and S are midpoints of sides of AB, BC, CD and DA respectively, find the position vector of P, Q, R,S,

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24. If $\vec{a}, \vec{b}, \vec{c}, \vec{d}$ respectively are the 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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25. Find the position vector of the centroid of a triangle when the position vectors of the vertices are given.

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26. Using vectors prove that the diagonals of a parallelogram bisect each other.

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27. Find the angle between the vectors

$\vec{a} = 3\hat{i} + 4\hat{j} + \hat{k}$

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

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

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29. Find the angle between the vecctors $\vec{a}$ and $\vec{b}$ with magnitudes 1 and 2 respectively and when $\vec{a} . \vec{b} = \sqrt{3}$

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30. If $\rightarrow a = 5\hat{i} - \hat{j} - 3\hat{k}$ and $\rightarrow b = \hat{i} + 3\hat{j} - 5\hat{k}$ then show that the vectors $\rightarrow a + \rightarrow b$ and $\rightarrow a - \rightarrow b$ are perpendicular.

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31. If $\vec{a} = 3\hat{i} - \hat{j} - 5\hat{k}, \vec{b} = \hat{i} - 5\hat{j} + 3\hat{k},$ show that $\vec{a} + \vec{b}$ and $\vec{a} - \vec{b}$ are perpendicular.

(b) Given the position vectors of three points $A\left(\hat{i}-\hat{j}+2\hat{k}\right)$ B$\left(4\hat{i}+5\hat{j}+8\hat{k}\right)$ C$\left(3\hat{i}+3\hat{j}+6\hat{k}\right)$

(i) Find $\overrightarrow{AB}$ and $\overrightarrow{AC}$

(ii) Prove that A, B, C are collinear points.

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32. 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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33. Show that the points $A\left(-2\hat{i}+3\hat{j}+5\hat{k}\right)$, B($\hat{i}+2\hat{j}+3\hat{k}$) and C($7\hat{i}-\hat{k}$) are collinear.

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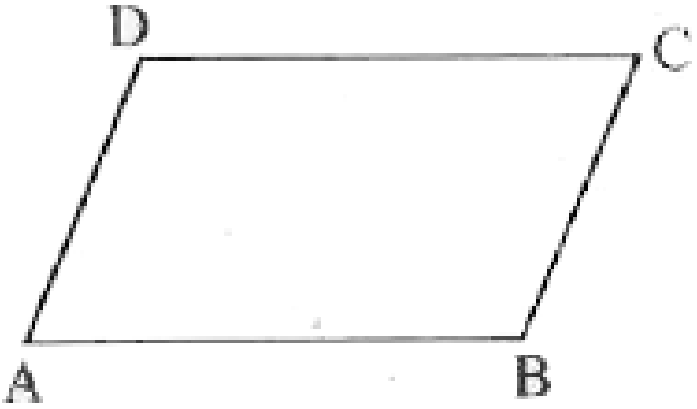
34. ABCD is a parallelogram with A as the origin. vec b and vec d` are the position vectors of B and D respectively.



a.What is the position vector of C?

(b) What is the angle between $\overrightarrow{AB}$ and $\overrightarrow{AD}$?

(c) Find $\overrightarrow{AC}$

(d) If $\left|\overrightarrow{AC}\right| = \left|\overrightarrow{BD}\right|$, show that ABCD is rectangle.

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35. (i) If $\vec{a}$, $\vec{b}$ and $\vec{a} + \vec{b}$ are unit vectors, then prove that the angle between $\vec{a}$ and $\vec{b}$ is $\frac{2\pi}{3}$

(ii) If $\left(2\hat{i} + \hat{j} - 3\hat{k}\right)$ and $\left(m\hat{i} + 3\hat{j} - \hat{k}\right)$ are perpendicular to each other , then find m.

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36. Find λ for which $\vec{a} = \lambda\hat{i} - \hat{j} + 5\hat{k}$ and $\vec{b} = 3\hat{i} + 4\hat{j} - \hat{k}$ are orthogonal.

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37. Let $\vec{a}, \vec{b}$ and $\vec{c}$ be the three vectors such that $\left|\vec{a}\right| = 3, \left|\vec{b}\right| = 4, \left|\vec{c}\right| = 5$, and each one of them being perpendicular to the sum of the other two . Find $\left|\vec{a} + \vec{b} + \vec{c}\right|$.

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

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39. Find $\left|\vec{a} - \vec{b}\right|$, if two vectors $\vec{a}$ and $\vec{b}$ are such that $\left|\vec{a}\right| = 2, \left|\vec{b}\right| = 3$ and $\vec{a} . \vec{b} = 4.$

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40. If $\vec{a}$ is any vector, show that $\vec{a} = \left(\vec{a} . \hat{i}\right)\hat{i} + \left(\vec{a} . \hat{j}\right)\hat{j} + \left(\vec{a} . \hat{k}\right)\hat{k}.$

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41. If θ is the angle between the unit vectors $\vec{a}$ and $\vec{b}$, then prove that $\frac{\sin(\theta)}{2} = \frac{1}{2}\left|\vec{a} - \vec{b}\right|$

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42. For any two vectors $\vec{a}$ and $\vec{b}$ show that $\left|\vec{a}.\vec{b}\right| \leq \left|\vec{a}\right|\left|\vec{b}\right|$.

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43. For any vectors $\vec{a}\,\vec{b}$, show that $\left|\vec{a}+\vec{b}\right| \leq \left|\vec{a}\right| + \left|\vec{b}\right|$

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44. If $\vec{\alpha} = 3\hat{i} - \hat{j}$ and $\vec{\beta} = 2\hat{i} + \hat{j} - 3\hat{k}$, then 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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45. Find the projection of the vector $\vec{\alpha} = 2\hat{i} + 3\hat{j} + 2\hat{k}$ on the vector $\vec{b} = \hat{i} + 2\hat{j} + \hat{k}$.

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46. Find the projection of $\hat{i} + \hat{j} + \hat{k}$ in the direction of $\hat{i} + \hat{j}$.

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47. Let $\vec{a} = \lambda\hat{i} + \hat{j} + 4\hat{k}$ and $\vec{b} = 2\hat{i} + 6\hat{j} + 3\hat{k}$. If the projection of $\vec{a}$ and $\vec{b}$ is 4 units, find λ.

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48. Find the projection vector of $\vec{b} = \hat{i} + 2\hat{j} + \hat{k}$ along the vector $\vec{a} = 2\hat{i} + \hat{j} + 2\hat{k}$.

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49. 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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50. If $\vec{a} = \hat{i} - \hat{j} + \hat{k}$, $\vec{b} = 2\hat{i} + \hat{j} + 3\hat{k}$, then

(i) Find $\vec{a} + \vec{b}$, $\vec{a} - \vec{b}$ and $\vec{a} . \vec{b}$.

(ii) Find $\left(\vec{a} + \vec{b}\right) \times \left(\vec{a} - \vec{b}\right)$.

(iii) Find a unit vector perpendicular to both $\vec{a} + \vec{b}$ and $\vec{a} - \vec{b}$.

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51. 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.

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

(ii) Prove that ΔABC is a right angled triangle.

(iii) Find the unit vector perpendicular to both $\overrightarrow{AB}$ and $\overrightarrow{BC}$.

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

(i) Find a unit vector perpendicular to both $\vec{a}$ and $\vec{b}$.

(ii) Find a vector of magnitude 9 which is perpendicular to both $\vec{a}$ and $\vec{b}$.

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53. The value of $\hat{i}\left(\hat{j}\times\hat{k}\right)+\hat{j}\left(\hat{i}\times\hat{k}\right)+\hat{k}\left(\hat{i}\times\hat{j}\right)$ is

A. 0

B. -1

C. 1

D. 3

Answer: (c)

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54. If θ 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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55. Given $\left|\vec{a}\right| = 10, \left|\vec{b}\right| = 2nd\vec{a}\dot{\vec{b}} = 12, f \in d\left|\vec{a} \times \vec{b}\right|\cdot$

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56. If $\left|\vec{a}\right| = 2, |b| = 5$ and $\left|\vec{a} x \vec{b}\right| = 8,$ find $\vec{a} \dot{\vec{b}}.$

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57. Prove that

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

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58. Prove that if the vectors $\vec{a}, \vec{b}, \vec{c}$ satisfy $\vec{a} + \vec{b} + \vec{c} = \vec{0}$, then $\vec{b} \times \vec{c} = \vec{c} \times \vec{a} = \vec{a} \times \vec{b}$

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59. For any two vectors $\vec{a}$ and $\vec{b}$, prove that $\left|\vec{a} \times \vec{b}\right|^2 = \left|\vec{a}\right|^2\left|\vec{b}\right|^2 - \left(\vec{a} . \vec{b}\right)^2 = \begin{bmatrix} \vec{a} . \vec{a} & \vec{a} . \vec{b} \\ \vec{a} . \vec{b} & \vec{b} . \vec{b} \end{bmatrix}$

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

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61. Consider the points A(1, 2, 3), B(4, 0, 4) and C(-2, 4, 2).

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

(b) Show that the points A, B, C are collinear.

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62. Consider the triangle ABC with vertices A(1, 1, 1) B(1, 2, 3) and C(2, 3, 1).

(a) Find $\overrightarrow{AB}$ and $\overrightarrow{AC}$

Find $\overrightarrow{AB} \times \overrightarrow{AC}$

(c) Hence find the area of the triangle ABC.

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63. Let A(2,3, 4) B(4, 3, 2), C(5, 2,-1) be three points

(i) Find AB and BC.

(ii) Find the area of ΔABC

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64. For any three vectors $\vec{a}, \vec{b}, \vec{c}$, show 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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65. Given A(1,1,1) , B(1, 2, 3) and C(2, 3, 1) are the vertices of ΔABC. Find the area of ΔABC.

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66. Consider the triangle ABC with vertices A(1,2,3) , B(-1, 0, 4) and C(0, 1, 2)

(a) Find $\overrightarrow{AB}$ and $\overrightarrow{AC}$

Find $\angle A$.

(c) Find the area of triangle ABC.

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

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68. Find the area of the parallelogram determined by the vectors $\overrightarrow{a} = \hat{i} + \hat{j} + 3\hat{k}$, $\overrightarrow{b} = 3\hat{i} - 4\hat{j} + 5\hat{k}$.

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69. Consider the vectors

$\vec{a} = \hat{i} - 7\hat{j} + 7\hat{k}, 3\hat{i} - 2\hat{j} + 2\hat{k}$

(a) Find $\vec{a} . \vec{b}$

(b) Find the angle between $\vec{a}$ and $\vec{b}$.

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70. The adjacent sides of a parallelogram are $\vec{a} = 3\hat{i} + \lambda\hat{j} + 4\hat{k}$ and $\vec{b} = \hat{i} - \lambda\hat{j} + \hat{k}$

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

(ii) If the area of the paralleogram is $\sqrt{42}$ square units, find the value of λ.

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71. Find the area of a parallelogram for which the vectors $2\hat{i}+\hat{j}$ and $3\hat{i}+\hat{j}+4\hat{k}$ are adjacent sides.

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72. 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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73. 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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74. 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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75. 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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76. Consider the vectors $\vec{a} = \hat{i} + 3\hat{j} + \hat{k}$, $\vec{b} = 2\hat{i} - \hat{j} - \hat{k}$ and $\vec{c} = \lambda\hat{i} + 7\hat{j} + 3\hat{k}$

(i) Find $\left[\vec{a}, \vec{b}, \vec{c}\right]$

(ii) Find the value of λ, if the vectors $\vec{a}$, $\vec{b}$ and $\vec{c}$ are coplanar.

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77. Find λ 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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78. Consider the 4 points A, B, C and D 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 $5\hat{i} + 8\hat{j} + + 5\hat{k}$.

(i) Find $\overrightarrow{AB}$, $\overrightarrow{AC}$, $\overrightarrow{AD}$

(ii) Show that the 4 points are coplanar.

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79. Consider the 4 points A(3, 2, 1) B(4, x, 5) C(4, 2, -2) and D(6, 5, -1)

(i) Find $\overrightarrow{AB}$, $\overrightarrow{AC}$ and $\overrightarrow{AD}$.

(ii) If the points A, B, C and D are coplanar, find the value of x.

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80. Let $\vec{a} = \hat{i} + \hat{j} + \hat{k}$, $\vec{b} = \hat{i}$ and $\vec{c} = c_1\hat{i} + c_2\hat{j} + c_3\hat{k}$. If $c_1 = 1$ and $c_2 = 2$, find c_3 which makes $\vec{a}$, $\vec{b}$ and $\vec{c}$ coplanar.

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81. Let $\vec{a} = \hat{i} + \hat{j} + \hat{k}$, $\vec{b} = \hat{i}$ and $\vec{c} = c_1\hat{i} + c_2\hat{j} + c_3\hat{k}$.

Then 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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82. (i)Show that $\left[\vec{a} + \vec{b}, \vec{b} + \vec{c}, \vec{c} + \vec{a}\right] = 2\left[\vec{a}\,\vec{b}\,\vec{c}\right]$.

(ii)If $\vec{a}$, $\vec{b}$, $\vec{c}$ are coplanar, prove that $\vec{a} + \vec{b}$, $\vec{b} + \vec{c}$, $\vec{c} + \vec{a}$ are also coplanar.

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

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84. Find the volume of a parallelopiped with coterminous edges represented by the vectors $3\hat{i}+4\hat{j}, 2\hat{i}+3\hat{j}+4\hat{k}$ and $5\hat{k}$.

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85. Prove that $\left[\vec{a}, \vec{b}, \vec{c}+\vec{d}\right] = \left[\vec{a}, \vec{b}, \vec{c}\right] + \left[\vec{a}, \vec{b}, \vec{d}\right]$.

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

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Solutions To Ncert Text Book Exercise 10 1

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

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2. Classify the following measures as scalars and vectors.

(i) 10 kg (ii) 2 metres north - west

(iii) 40° (iv) 40 watt

(v) 10^{-19} coulomb (vi) $\frac{20m}{s^2}$

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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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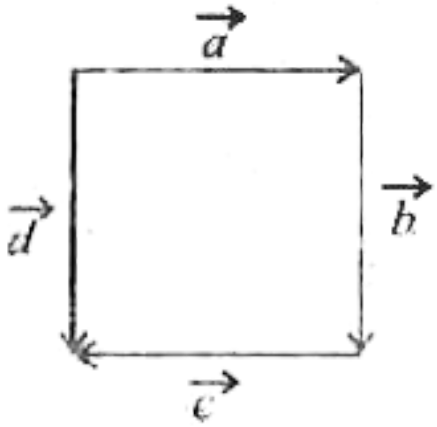
4. In the figure (a square), identify the following vectors.



(a) Cointial

(b) Equal

(c) Collinear but not equal

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Solutions To Ncert Text Book Exercise 10 1 Answer The Following As True Or False

1. (i) $\vec{a}$ and $-\vec{a}$ are collinear

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2. (ii) Two collinear vectors are always equal in magnitude.

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3. (iii) Two vectors having the same magnitude are collinear.

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4. (iv) Two collinear vectors having the same magnitude are equal.

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Solutions To Ncert Text Book Exercise 10 2

1. Compute the magnitude of the following vectors.

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

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2. Write two different vectors having the same magnitude.

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3. Write two different vectors having the same direction.

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4. Find the values of x and y so that the vectors $4\hat{i} + 5\hat{j}$ 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 (2, 1) and terminal point(-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 $\vec{a} = \hat{i} - \hat{j} + 2\hat{k}$.

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

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

the vector $\vec{a} + \vec{b}$.

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

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13. Find the direction cosines of the vector joining the points A(-1, 2, 3) and B(1, 4, 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 midpoint 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 vectors $\vec{a} = 3\hat{i} - 4\hat{j} - 4\hat{k}$, $\vec{b} = 2\hat{i} - \hat{j} + \hat{k}$ and $\vec{c} = \hat{i} - 3\hat{j} - 5\hat{k}$, respectively form the vertices of a right angled triangle.

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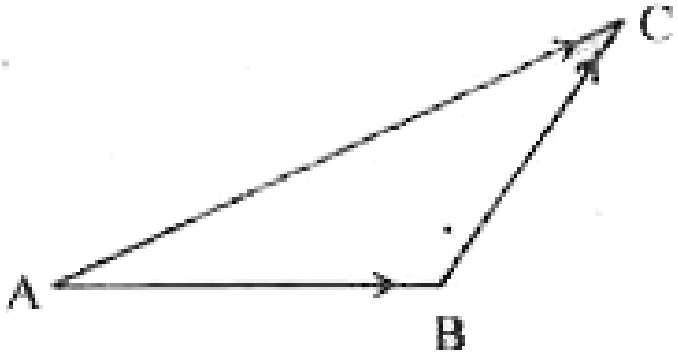
18. In triangle ABC, which of the following is not true?



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 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 magnitudes.

Answer: (d)

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Solutions To Ncert Text Book Exercise 10 3

1. Find the angle between two vectors $\vec{a}$ and $\vec{b}$ with magnitudes $\sqrt{3}$ and 2, respectivey having $\vec{a} . \vec{b} = \sqrt{6}$.

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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 they are mutually perpendicular to each other.

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6. Find $\left|\vec{a}\right|$ and $\left|\vec{b}\right|$, if $\left(\vec{a}+\vec{b}\right).\left(\vec{a}-\vec{b}\right)=7$ and $\left|\vec{a}\right|=7\left|\vec{b}\right|$

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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° and their scalar products is 1/2.

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

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12. If $\vec{a} . \vec{a} = 0$ and $\vec{a} . \vec{b} = 0$ the 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 $\vec{a} + \vec{b} + \vec{c} = 0$, find the value of $\vec{a} . \vec{b} + \vec{b} . \vec{c} + \vec{c} . \vec{a}$.

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14. If either vector $\vec{a} = \vec{0}$ or $\vec{b} = \vec{0}$, then $\vec{a} . \vec{b} = 0$.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 vectors $2\hat{i}-\hat{j}+\hat{k}$, $\hat{i}-3\hat{j}-5\hat{k}$ and $3\hat{i}-4\hat{j}-4\hat{k}$ from the vertices of a right angled triangle.

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

A. $\lambda = 1$

B. $\lambda = -1$

C. $a = |\lambda|$

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

Answer: (d)

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Solutions To Ncert Text 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 angles $\frac{\pi}{3}$ 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. Show 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 amd μ if $\left(2\hat{i}+6\hat{j}+27\hat{k}\right)\times\left(\hat{i}+\lambda j+\mu k\right)=\vec{0}$.

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6. Given that $\vec{a}.\vec{b}=0$ and $\vec{a}\times\vec{b}=\vec{0}$. What can you conclude about the vectors $\vec{a}$ and $\vec{b}$?

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

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8. If either $\vec{a} = \vec{0}$ or $\vec{a} \times \vec{b} = \vec{0}$ .Is the converse true? Justify your answer with an example.

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

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11. Let the vectors $\vec{a}$ and $\vec{b}$ be such that $\left|\vec{a}\right| = 3$ 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 $\vec{b}$ is

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

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

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

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

Answer: (b)

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12. Area of a rectangle having vertices A,B,C and D with positions 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 $-\hat{i}-\frac{1}{2}\hat{j}+4\hat{k}$, respectively is

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

B. 1

C. 2

D. 4

Answer: (c)

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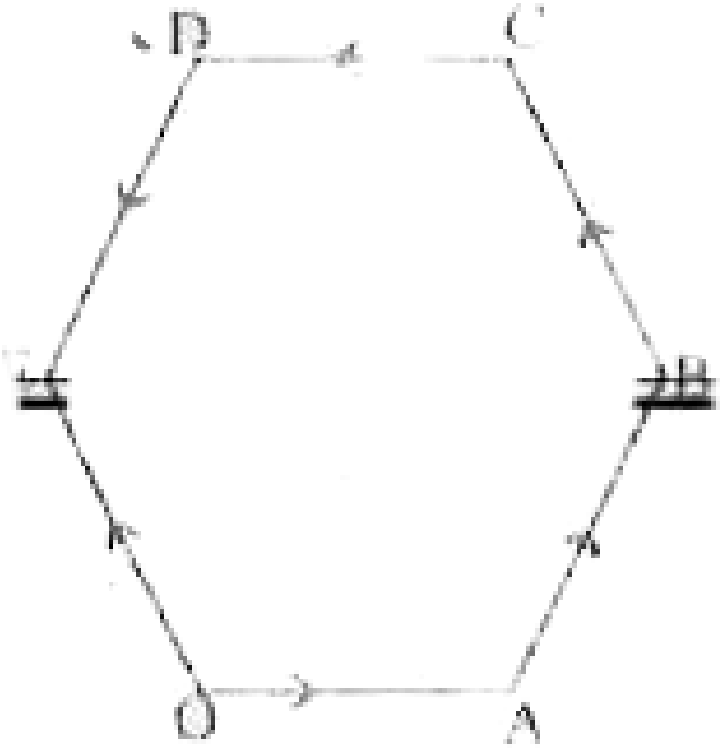
Additional Questions For Practice 10 1

1. In the figure which vectors are

(i) equal (ii) collinear (iii) coinitial



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2. Answer the following as true or false.

(i) A zero vector cannot be assigned a definite direction.

(ii) A zero vector may be regarded as having any direction.

(iii) Two vectors are equal if they have same magnitude and

direction regardless of the position of their initial points.

(iv) The length of a unit vector is 2.

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Additional Questions For Practice 10 2

1. Compute the magnitude of the following vectors and identify the unit vector.

$\vec{a} = 2\hat{i} - 3\hat{j} + 5\hat{k}$

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2. For what values of x, y and z the vectors $3\hat{i} - y\hat{j} + 8\hat{k}$ and $x\hat{i} + 7\hat{j} + z\hat{k}$ are equal?

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3. Find the scalar and vector components of the vectors $\vec{a} = 3\hat{i} - 2\hat{j} + 4\hat{k}$ and $\vec{b} = -2\hat{i} + \hat{j} - 3\hat{k}$.

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4. If $\vec{a} = \hat{i} - 2\hat{j} + \hat{k}$, $\vec{b} = -2\hat{i} + 4\hat{j} + 5\hat{k}$ and $\vec{c} = \hat{i} - 6\hat{j} - 7\hat{k}$, find (i) $\vec{a} - \vec{b} - \vec{c}$ (ii) $3\vec{a} + 5\vec{b} - 2\vec{c}$.

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

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6. Find the unit vector in the direction of vector $\overrightarrow{AB}$ where A and B are the points (6, 4,0) and (8, 0,4) respectively.

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7. Find the unit vector along $\vec{a} - \vec{b}$ where $\vec{a} = \hat{i} + 3\hat{j} - \hat{k}$ and $\vec{b} = 3\hat{i} + 2\hat{j} + \hat{k}$.

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8. Find a vector in the direction of the vector $5\hat{i} + \hat{j} - 2\hat{k}$ which has magnitude 6 units.

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9. Show that the points with position vectors $2\hat{i} + 6\hat{j} + 3\hat{k}$, $\hat{i} + 2\hat{j} + 7\hat{k}$ and $3\hat{i} + 10\hat{j} - \hat{k}$ are collinear.

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10. The direction angles of a vector with x-axis is $\frac{\pi}{4}$ with y - axis is $\frac{\pi}{3}$.Find the direction angle of the vector with z-axis.

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11. Show that $\frac{\pi}{4}, \frac{\pi}{6}$ and $\frac{2\pi}{3}$ cannot be the direction angles of any vector.

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12. Find the direction cosines of the vector joining the points (0, 5, 3) and (1, 7,2).

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13. Consider two points P and Q with position vectors $\overrightarrow{OP} = 3\vec{a} - 2\vec{b}$ and $\overrightarrow{OQ} = \vec{a} + \vec{b}$ .Find the position vector of a point R which divides the line joining P and Q in the ratio 2 : 1

(i) internally (ii) externally.

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Additional Questions For Practice 10 3

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

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2. Find the angle between the vectors $\vec{a}$ and $\vec{b}$ such that $\left|\vec{a}\right| = \left|\vec{b}\right| = \sqrt{2}$ and $\vec{a} . \vec{b} = 1$.

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

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4. Find λ if the vectors $5\hat{i} + 2\hat{j} - \hat{k}$ and $\lambda\hat{i} - \hat{j} + 5\hat{k}$ are orthogonal.

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5. 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 $\vec{a} + \vec{b}$ and $\vec{a} - \vec{b}$ are orthogonal

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

(i) Find $\vec{a} . \vec{b}$

(ii) Find the angle between $\vec{a}$ and $\vec{b}$.

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7. Prove that the vectors $3\hat{i} + \hat{j} + 3\hat{k}$ and $\hat{i} - \hat{k}$ are perpendicular.

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8. If A(0,1,1), B(3, 1,5) and C(0, 3, 3) are three points show that ΔABC is right angled at C.

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

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11. Find $\left|\vec{a}\right|$ and $\left|\vec{b}\right|$ if $\left(\vec{a}+\vec{b}\right).\left(\vec{a}-\vec{b}\right)=3$ and $2\left|\vec{b}\right|=\left|\vec{a}\right|$.

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12. Find $\left|\vec{a}-\vec{b}\right|$, if $\left|\vec{a}\right|=4$, $\vec{b}=12$ and $\vec{a}.\vec{b}=16$.

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13. Find the magnitude of two vectors $\vec{a}$ and $\vec{b}$ having the same magnitude such that the angle between them is 30° and their scalar product is $\sqrt{3}$.

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14. If θ is the angle between the unti vectors $\vec{a}$ and $\vec{b}$, then proves that $\cos\left(\frac{\theta}{2}\right)=\frac{1}{2}\left|\vec{a}+\vec{b}\right|$.

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15. If $\vec{a}$ and $\vec{b}$ are two non- zero vectors such that $\left|\vec{a}+\vec{b}\right|=\left|\vec{a}-\vec{b}\right|$, then show that $\vec{a}$ and $\vec{b}$ are perpendicular.

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16. If $\vec{a}$ and $\vec{b}$ are two vectors such that $\vec{a}+\vec{b}$ is perpendicular to $\vec{a}-\vec{b}$,then prove that $\left|\vec{a}\right|=\left|\vec{b}\right|$.

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17. If $\vec{a}$ and $\vec{b}$ are orthogonal vectors, prove that $\left(\vec{a}+\vec{b}\right)^2=\left(\vec{a}-\vec{b}\right)^2$.

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18. Consider the vectors $\vec{a}=\hat{i}+2\hat{j}-3\hat{k}$ and $\vec{b}=4\hat{i}-\hat{j}+2\hat{k}$.

(i) Find $\left|\vec{a}\right|$ and $\left|\vec{b}\right|$.

(ii) Find $\vec{a}.\vec{b}$

(iii) Find the projections of $\vec{a}$ on $\vec{b}$ and $\vec{b}$ on $\vec{a}$.

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19. If $\vec{a} + \vec{b} + \vec{c} = 0$ and $\left|\vec{a}\right| = 3, \left|\vec{b}\right| = 5, \left|\vec{c}\right| = 7,$ show that the angle between $\vec{a}$ and $\vec{b}$ is 60°

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20. (i) Write the scalar componets of $3\hat{i} - 2\hat{j} + 5\hat{k}$.

(ii) Find the angle between the vectors $\hat{i} + \hat{j}$ and $\hat{i} - \hat{j}$.

(iii) Find $\left|\vec{x}\right|$, if $\vec{a}$ is a unit and $\left(\vec{x} + \vec{a}\right).\left(\vec{x} - \vec{a}\right) = 0.$

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Additional Questions For Practice 10 4

1. Show that the points (1, 2, -1), (2, 5, 1) and (0, -1, -3) are collinear.

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

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

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4. Prove that the points A, B, and C with position vectors $\vec{a}$, $\vec{b}$ and $\vec{c}$ respectively are collinear if and only if $\left(\vec{b} \times \vec{c}\right) + \left(\vec{c} \times \vec{a}\right) + \left(\vec{a} \times \vec{b}\right) = \vec{0}$.

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

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

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

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Additional Questions For Practice 10 5

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

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

(i) find $\left[\vec{a}\ \vec{b}\ \vec{c}\right]$

(ii) find $\left[\vec{a} + \vec{b}\ \vec{b} + \vec{c}\ \vec{c} + \vec{a}\right]$.

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3. Find the volumes of the following parapllelopipeds whose three co - terminus edges are

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

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

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4. 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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5. 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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6. If $\hat{i},\hat{j}$ and $\hat{k}$ are three mutually perpendicular vectors prove that

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

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7. Show that the points A, B,C and D with positions 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

$-4\hat{i}+4\hat{j}+4\hat{k}$ respectively are coplanar.

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8. Find the value of λ if the points A(-1, 4, -3) B(3, λ, - 5), C (-3 ,8,-5) D(-3, 2, 1) are coplanar.

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

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10. If the vectors $\vec{A} = a\hat{i} + \hat{j} + \hat{k}, \vec{B} = \hat{i} + b\hat{j} + \hat{k}$ and $\vec{C} = \hat{i} + \hat{j} + c\hat{k}$ are coplanar, then $\frac{1}{1-a} + \frac{1}{1-b} + \frac{1}{1-c} = 1$ where $a, b, c \neq 1$.

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Solution To Exercise Miscellaneous Exercise

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 30° east of north and stops. Determine the girl's displacement from her initial point of departure.

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4. If $\vec{a} = \vec{b} + \vec{c}$, then is it true that $|\vec{a}| = |\vec{b}| + |\vec{c}|$? 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 $\vec{a}=2\hat{i}+3\hat{j}-\hat{k}$ and $\vec{b}=\hat{i}-2\hat{j}+\hat{k}$

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

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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 $\left(\vec{a}-3\vec{b}\right)$ externally in the ratio 1 :2. Also, show that P is the midpoint 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 its diagonal.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 $\vec{a} = \hat{i} + 4\hat{j} + 2\hat{k}$, $\vec{b} = 3\hat{i} - 2\hat{j} + 7\hat{k}$ 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 $\cdot \vec{d} = 15$.

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13. Thescalar product of the vector $\hat{i} + \hat{j} + \hat{k}$ with a unit vector along the sum of vectors $2\hat{i} + 4\hat{j} - 5\hat{k}$ 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 $\vec{a}, \vec{b}, and \cdot$

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15. Prove that $\left(\vec{a}+\vec{b}\right).\left(\vec{a}+\vec{b}\right)=\left|\vec{a}\right|^2+\left|\vec{b}\right|^2$, if and only if $\vec{a}$, $\vec{b}$ are perpendicualr, given $a \neq \vec{0}$, $b \neq \vec{0}$.

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

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

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

C. $0 < \theta < \pi$

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

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. N/A

D. N/A

Answer: N/A

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Unit Test

1. Consider the vector $\vec{a} = \hat{i} + \hat{j} - 2\hat{k}$

(i) Write the direction ratios of $\vec{a}$

(ii) Hence find the direction cosines of $\vec{a}$.

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2. Find the magnitude of the vectors $\vec{a}$ and $\vec{b}$ having same magnitude such that the angle between them is 30° and $\vec{a} . \vec{b} = 3$

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3. The vectors $\vec{a}$ and $\vec{b}$ are such that $|\vec{a}| = 2, |\vec{b}| = 3, \vec{a} . \vec{b} = 4$.Find $|\vec{a} - \vec{b}|$

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4. Find the area of the 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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5. Let $\vec{a} = 2\hat{i} - \hat{j} + \hat{k}$ and $\vec{b} = \hat{i} - 2\hat{j} + \hat{k}$,

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

(ii) Find theprojection vector of $\vec{a}$ on $\vec{b}$

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6. Find the value of p for the vectors $3\hat{i} + 2\hat{j} + 9\hat{k}$ and $\hat{i} + p\hat{j} + 3\hat{k}$ to be perpendicular

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

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Objective Type Questions

1. If a line lies in the octant OXYZ and it makes equal angles with the axes, then

A. $l = m = n = \frac{1}{\sqrt{3}}$

B. $l = m = n = \frac{\pm 1}{\sqrt{3}}$

C. $l = m = n = \frac{-1}{\sqrt{3}}$

D. $l = m = n = \frac{\pm 1}{\sqrt{2}}$

Answer: A

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2. If the vector $8\hat{i} + a\hat{j}$ of magnitude 10 is in the direction of the vector $4\hat{i} - 3\hat{j}$, then the value of a is equal to

A. 6

B. 3

C. -3

D. -6

Answer: D

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3. If $\frac{1}{2}, \frac{1}{3}, n$ are the direction cosines of a line , then the values of n is

A. $\frac{\sqrt{23}}{6}$

B. $\frac{23}{6}$

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

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

Answer: A

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

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5. If the projections of $\overrightarrow{PQ}$ on OX , OY OZ are respectively 12, 3 and 4 then the magnitude of $\vec{P}\,Q$ is

A. 169

B. 19

C. 13

D. 144

Answer: C

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6. The unit vector in the direction of the sum of vectors $\hat{i}+\hat{j}+\hat{k}$ and $2\hat{i}+3\hat{j}+4\hat{k}$ is

A. $\frac{1}{5\sqrt{2}}\left(3\hat{i}+4\hat{j}+5\hat{k}\right)$

B. $\frac{1}{5\sqrt{2}}\left(3\hat{i}-4\hat{j}-5\hat{k}\right)$

C. $\frac{1}{2\sqrt{2}}\left(4\hat{i}+3\hat{j}+5\hat{k}\right)$

D. $\frac{1}{3\sqrt{2}\left(-3\hat{k}+4\hat{i}+5\hat{j}\right)}$

Answer: A

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7. If the points A and B are (1, 2, -1) and (2, 1, -1) respectively then $\overrightarrow{AB}$ is

A. $\hat{i}+\hat{j}$

B. $\hat{i}-\hat{j}$

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

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

Answer: B

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8. If $\left|\overrightarrow{a}\right| = 4$ and $-3 \leq \lambda \leq 2$ then the range of $\left|\lambda\overrightarrow{a}\right|$

A. [0,8]

B. [-12, 8]

C. $[0, 12]$

D. $[8, 12]$

Answer: C

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9. If $\overrightarrow{a}$ and $\overrightarrow{b}$ are two unit vectors and θ is the angle between them, then $\left|\overrightarrow{a} - \overrightarrow{b}\right|$ is equal to _____

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10. If the vectors $3\hat{i} + \lambda\hat{j} + \hat{k}$ and $2\hat{i} - \hat{j} + 8\hat{k}$ are perpendicular, then λ is

A. -14

B. 7

C. 14

D. $\frac{1}{7}$

Answer: C

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11. Let $\vec{a}$ and $\vec{b}$ be two unit vectors such that angle between them is 60°.Then $\left|\vec{a} - \vec{b}\right|$ is equal to

A. $\sqrt{5}$

B. $\sqrt{3}$

C. 0

D. 1

Answer: D

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12. The two variable vectors $3x\hat{i} + y\hat{j} - 3\hat{k}$ and $x\hat{i} - 4y\hat{j} + 4\hat{k}$ are orthogonal to each other.Then the locus of (x, y) is

A. hyperbola

B. circle

C. straight line

D. ellipse

Answer: A

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13. Consider the vectors $\vec{a} = \hat{i} + 3\hat{j} + \hat{k}$ and $\vec{b} = 2\hat{i} - \hat{j} - \hat{k}$.

(i) Find $\vec{a} . \vec{b}$

(ii) Find the angle between $\vec{a}$ and $\vec{b}$.

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

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

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

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

Answer: A

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14. If $\left|\overrightarrow{a}\right| = 3, \left|\overrightarrow{b}\right| = 4$, then the value of λ for which $\overrightarrow{a} + \lambda\overrightarrow{b}$ is perpendicular to $\overrightarrow{a} = \lambda\overrightarrow{b}$ is

A. $\frac{9}{16}$

B. $\frac{3}{4}$

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

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

Answer: B

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15. If $\vec{a}$ and $\vec{b}$ are two non -zero vectors, then $\left(\vec{a}+\vec{b}\right).\left(\vec{a}-\vec{b}\right)$ is equal to

A. $\vec{a}+\vec{b}$

B. $\left(\vec{a}-\vec{b}\right)^2$

C. $\left(\vec{a}+\vec{b}\right)^2$

D. $\left(a^2-b^2\right)$

Answer: D

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16. $\vec{a} . \left(\vec{b} + \vec{c} \right)$ is equal to

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

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

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

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

Answer: A

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17. If $\vec{a} = \hat{i} + 2\hat{j} - 3\hat{k}$ and $\vec{b} = 3\hat{i} - \hat{j} + 2\hat{k}$, then $\vec{a} + \vec{b}$ and $\vec{a} - \vec{b}$ are

A. parallel vectors

B. perpendicular vectors

C. zero vectors

D. None of these

Answer: B

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18. If $\vec{a}$ and $\vec{b}$ are non - zero vectors and $\left|\vec{a}+\vec{b}\right|=\left|\vec{a}-\vec{b}\right|$, then the angle between $\vec{a}$ and $\vec{b}$ is

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

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

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

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

Answer: D

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19. The projection of the vector $\hat{i}+\hat{j}+\hat{k}$ along the vector $\hat{j}$ is

A. 1

B. 0

C. 2

D. -1

Answer: A

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20. A unit vector perpendicular to the vectors $\vec{a} = 2\hat{i} - 6\hat{j} - 3\hat{k}$ and $\vec{b} = 4\hat{i} + 3\hat{j} - \hat{k}$ is

A. $\frac{4\hat{i} + 3\hat{j} - \hat{k}}{\sqrt{26}}$

B. $\frac{2\hat{i} - 6\hat{j} - 3\hat{k}}{7}$

C. $\frac{3\hat{i} - 2\hat{j} + 6\hat{k}}{7}$

D. $\frac{2\hat{i} - 3\hat{j} - 6\hat{k}}{7}$

Answer: C

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21. The number of vectors of unit length perpendicular to the vectors $\vec{a} = 2\hat{i} + \hat{j} + 2\hat{k}$ and $\vec{b} = \hat{j} + \hat{k}$ is

A. one

B. two

C. three

D. infinite

Answer: B

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22. If $\vec{a}, \vec{b}, \vec{c}$ are any three mutually perpendicular vectors of equal magnitude a, then $\left|\vec{a} + \vec{b} + \vec{c}\right|$ is equal to

A. a

B. $\sqrt{2}a$

C. $\sqrt{3}a$

D. $2a$

Answer: C

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23. The volume (in cubic units) of the parallelopiped whose edges are represented by the vectors $\hat{i}+\hat{j}, \hat{j}+\hat{k}$ and $\hat{k}+\hat{i}$ is

A. 2

B. 0

C. $\sqrt{2}$

D. $2\sqrt{2}$

Answer: A

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24. The projection vector of $\vec{a}$ on $\vec{b}$ is

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

B. $\frac{a.\vec{b}}{\left|\vec{b}\right|}$

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

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

Answer: A

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25. If $\vec{a} \times \vec{b}$ and $\vec{a} \cdot \vec{b} = 0$ then

A. $\vec{a} \perp \vec{b}$

B. $\vec{a} \mid\mid \vec{b}$

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

D. $\vec{a} = \vec{0}$ or $\vec{b} = \vec{0}$

Answer: D

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26. If $\vec{a} = \hat{i} - \hat{j}$ and $\vec{b} = \hat{j} + \hat{k}$ then $\left|\vec{a} \times \vec{b}\right|^2 + \left|\vec{a} . \vec{b}\right|^2$ is equal to

A. $\sqrt{2}$

B. 2

C. $\sqrt{6}$

D. 4

Answer: D

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27. Let $\vec{a} = \hat{i} + \hat{j} + \hat{k}, \vec{b} = \hat{i} - \hat{j} + 2\hat{k}$ and $\vec{c} = x\hat{i} + (x-2)\hat{j} - \hat{k}$ .If the vector $\vec{c}$ lies in the plane of $\vec{a}$ and $\vec{b}$, thenx equals

A. 0

B. 1

C. -4

D. -2

Answer: D

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Continuous Evaluation

1. Complete the table

	$\vec{a}$	$\vec{b}$	$\vec{a}.\vec{b}$	$\vec{b}.\vec{a}$	$\vec{a}\times\vec{b}$	$\vec{b}\times\vec{a}$
i.	$\hat{i}+3\hat{j}+4\hat{k}$	$4\hat{j}+8\hat{k}$				
ii.	$\hat{i}+\hat{j}-6\hat{k}$	$2\hat{i}+\hat{j}+8\hat{k}$				
iii.	$2\hat{j}-6\hat{k}$	$\hat{i}-6\hat{j}+\hat{k}$				

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2. Draw vectors from the centre of a regular n sided polygon in a plane to its vertices. What happens to the sum of the vectors.

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