MATHS

BOOKS - KC SINHA ENGLISH

SCALAR PRODUCT OF TWO VECTORS

Solved Examples

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

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

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3. Find the scalar product of vectors $\vec{a} = 2\hat{i} - \hat{j} + 2\hat{k}$ and $\vec{b} = \hat{i} - 3\hat{j} - 5\hat{k}$

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4. Show that the vectors $2\hat{i} - \hat{j} + \hat{k}$ and $\hat{i} - 3\hat{j} - 5\hat{k}$ are at righat angles.

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5. Find the angle between the vectors $4\hat{i} - 2\hat{j} + 4\hat{k}$ and $3\hat{i} - 6\hat{j} - 2\hat{k}$.

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6. If $\vec{a} = \hat{i} + 2\hat{j} - 3\hat{k}$ and $\vec{b} = 3\hat{i} + \hat{j} + 2\hat{k}$ show that the vectors $\vec{a} + \vec{b}$ and $\vec{a} - \vec{b}$ are perpendicular to other.

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7. Find the angle between the vectors $\vec{a} + \vec{b}$ and $\vec{a} - \vec{b}$ if $\vec{a} = 2\hat{i} - \hat{j} + 3\hat{k}$ and $\vec{b} = 3\hat{i} + \hat{j} - 2\hat{k}$.

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8. If $a = 5\hat{i} - \hat{j} + 7\hat{k}$ and $b = \hat{i} - \hat{j} + \lambda\hat{k}$, then find λ such that a+b and a-b are orthogonal.

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9. Find the value of λ so that the two vectors $2\hat{i} + 3\hat{j} - \hat{k}$ and $-4\hat{i} - 6\hat{j} + \lambda\hat{k}$ are parallel

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10. Find the value of λso that the two vectors $2\hat{i}+3\hat{j}-\hat{k}$ and $-4\hat{i}-6\hat{j}+\lambda\hat{k}$ are Perpendicular to each other

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11. If $\vec{a}$ makes equal angles with the coordinate axes and has magnitude 3,find the angle between $\vec{a}$ and each of the three coordinate axes.

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12. The vectors $\vec{a}=3\hat{i}+x\hat{j}-\hat{k}$ and $\vec{b}=2\hat{i}+\hat{j}+y\hat{k}$ are mutually perpedicular. Given that $\left|\vec{a}\right|=\left|\vec{b}\right|$, find the value of x and y.

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13. Using dot product of vectors 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 a righat angled triangle

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14. Prove that points $(2, -1, 1), (1, -3, -5)$ and $(3, -4, -4)$ are the vertices of a righat angled triangle.

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15. Find a vector whose magnitude is 3 units and which is perpendicular to the vectors $\vec{a}$ and $\vec{b}$ where $\vec{a}=3\hat{i}+\hat{j}-4\hat{k}$ and $\vec{b}=6\hat{i}+\hat{j}-2\hat{k}$

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16. Let $\vec{a} = \hat{i} - \hat{j}$, $\vec{b} = \hat{i} - \hat{k}$ and $\vec{c} = 7\hat{i} - \hat{k}$. Find a vector $\hat{d}$ which is perpendicular to vectors $\vec{a}$ and $\vec{b}$ and satisfies the condition $\vec{c} . \vec{d}$ =1.

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17. The scalar product of the vector $\hat{i} + \hat{j} + \hat{k}$ with a unit vector along the sum of the 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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18. A unit vector $\vec{a}$ makes angles $\frac{\pi}{4}$ and $\frac{\pi}{3}$ with $\hat{i}$ and $\hat{j}$ respectively and an acute angle θ with $\hat{k}$. Find the angle θ and components of $\vec{a}$.

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19. Find the projection of $A = 2\hat{i} - \hat{j} + \hat{k}$ on $B = \hat{i} - 2\hat{j} + \hat{k}$.

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20. Find the projection of the vector $2\hat{i} - 3\hat{j} - 6\hat{k}$ on the line joining the points (5,6,-3) and (3,4,-2).

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21. Find the vector component of a vector $2\hat{i} + 3\hat{j} + 6har(k)$ along and perpendicular to the non-zero vecotr $2\hat{i} + \hat{j} + 2\hat{k}$.

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22. Find λ if the scalar 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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23. Find the perpendicular distance of the point A(1,0,1) to the line through the points B(2,3,4) and C(-1,1,-2)

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24. A line l is passing through the point $\vec{b}$ and is parallel to vector $\vec{c}$. Determine the distance of point A($\vec{a}$) from the line l in from $\left|\vec{b}-\vec{a}+\frac{\left(\vec{a}-\vec{b}\right)\vec{c}}{\left|\vec{c}\right|^2}\vec{c}\right|$ or $\frac{\left|\left(\vec{b}-\vec{a}\right)\times\vec{c}\right|}{\left|\vec{c}\right|}$

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25. Express the vector $\vec{a}=\left(5\hat{i}-2\hat{j}+5\hat{k}\right)$ as sum of two vectors such that one is paralle to the vector $\vec{b}=\left(3\hat{i}+\hat{k}\right)$ and the other is perpendicular to $\vec{b}$.

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26. Let $\vec{b} = 4\hat{i} + 3\hat{j}$ and $\vec{c}$ be two vectors perpendicular to each other in the xy- plane. All vectors in the sme plane having projections 1 and 2 along $\vec{b}$ and $\vec{c}$., respectively, are given by _____

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

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28. If $\vec{a}, \vec{b}, \vec{c}$ are non coplanar non zero vectors and $\vec{n}.\vec{a} = \vec{n}.\vec{b} = \vec{n}.\vec{c} = 0$, Show that $\vec{n}$ is a zero vector

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29. Find the angle between any two diagonals of a cube.

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30. A line makes angles $\angle, \beta, \gamma$ and δ with the diagonals of a cube. Show that $\cos^2\alpha + \cos^2\beta + \cos^2\gamma + \cos^2\delta = 4/3.$

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31. (Cauchy-Schawarz inequality) For any two vectors $\vec{a}$ *and* $\vec{b}$ prove that $\left(\vec{a}\,\dot{\vec{b}}\right)^2 \leq \left|\vec{a}\right|^2\left|\vec{b}\right|^2$ and hence show that $(a_1b_2 + a_2b_2 + a_3b_3)^2 \leq (a12 + a22 + a32)(b12 + b22 + b32)\cdot$

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32. A vector whose modulus is $\sqrt{51}$ and makes the same angle with $a = \dfrac{\hat{i} - 2\hat{j} + 2\hat{k}}{3}, b = \dfrac{-4\hat{i} - 3\hat{k}}{5}$ and $c = \hat{j}$, will be

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33. If $\left|\vec{a}+\vec{b}\right|=\left|\vec{a}-\vec{b}\right|,\left(\vec{a},\vec{b}\neq\vec{0}\right)$ show that the vectors $\vec{a}$ and $\vec{b}$ are perpendicular to each other.

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

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35. If $\hat{a}and\hat{b}$ are unit vectors inclined at an angle θ, then prove that $\frac{\sin\theta}{2}=\frac{1}{2}\left|\hat{a}+\hat{b}\right|.$

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

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37. For any two vectors $\vec{a}$ and $\vec{b}$, we always have $\left|\vec{a}+\vec{b}\right| \leq \left|\vec{a}\right| + \left|\vec{b}\right|$ [Triangle inequality].

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38. Given $\vec{a}$ is perpendicular to $\vec{b}+\vec{c}$, $\vec{b}$ is perpendicular to $\vec{c}+\vec{a}$ and $\vec{c}$ is perpendicular to $\vec{a}+\vec{b}$. If $\left|\vec{a}\right| = 1, \left|\vec{b}\right| = 2, \left|\vec{c}\right| = 3$, find $\left|\vec{a}+\vec{b}+\vec{c}\right|$

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39. If $\vec{a}$, $\vec{b}$ and $\vec{c}$ are unit vectors such that $\vec{a}+\vec{b}+\vec{c} = \vec{0}$ then the value of $\vec{a}.\vec{b}+\vec{b}.\vec{c}+\vec{c}.\vec{a}$ is a) 1 b) 0 c) 3 d) $-\frac{3}{2}$

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

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41. (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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42. Prove that the mid-point of the hypotenuse of a right triangle is equidistant from its vertices.

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43. Using distance formula, prove the apollonius' theorem that is in $\Delta ABC, AB^2 + AC^2 = 2\left(AD^2 + BD^{20}\right)$, where D is the middle point

of BC.

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44. Show that the diagonals of a rhombus bisect each other at right angles.

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

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

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47. Prove using vectors: If two medians of a triangle are equal, then it is isosceles.

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48. Prove that an angle inscribed in a semi-circle is a right angle using vector method.

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49. Using vector method, prove that the altitudes of a triangle are concurrent.

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50. Show that the perpendicular bisectors of the sides of a triangle are concurrent.

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51. In any ΔABC, prove that

$ac\cos B - bc\cos A = a^2 - b^2$

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52. $2(bosA + ca\cos B + ab\cos C) = a^2 + b^2 + c^2$

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53. Prove by vector metod the following formula of plane trigonometry

$\cos(\alpha - \beta) = \cos\alpha\cos\beta + \sin\alpha\sin\beta$

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54. In any ΔABC, prove that $\cos C = \frac{a^2 + b^2 - c^2}{2ab}$ with the help of vectors

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55. Constant forces $P_1 = \hat{i} - \hat{j} + \hat{k}, P_2 = -\hat{i} + 2\hat{j} - \hat{i}k$ and $P_3 = \hat{j} - \hat{k}$ act on a particle at a point A . Determine the work done when particle is displaced from position $A\left(4\hat{i} - 3\hat{j} - 2\hat{k}\right)$ $\text{to}B\left(6\hat{i} + \hat{j} - 3\hat{k}\right)$

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56. A paticle acted on by constant forces $4\hat{i} + \hat{j} - 3\hat{k}$ and $3\hat{i} + \hat{j} - \hat{k}$ is displaced from the point $\hat{i} + 2\hat{j} + 3\hat{k} \to 5\hat{i} + 4\hat{j} + \hat{k}$. Find the work done

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Exercise

1. Find the scalar product of vectors $\vec{a}$ and $\vec{b}$, where : $\vec{a} = 2\hat{i} + 4\hat{k}, \vec{b} = 3\hat{j} - 2\hat{k}$

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

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3. If $\vec{a} = \hat{i} + \hat{j} + \hat{k}, \vec{b} = 2\hat{i} - \hat{j}$ and $\vec{c} = 3\hat{j} + \hat{k}$ then verify the following: $\vec{a} . \left(\vec{b} + \vec{c}\right) = \vec{a} . \vec{b} + \vec{a} . \vec{c}$.

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4. If $\vec{a} = \hat{i} + \hat{j} + \hat{k}$, $\vec{b} = 2\hat{i} - \hat{j}$ and $\vec{c} = 3\hat{j} + \hat{k}$ then verify the following: $\left(\vec{a} + \vec{b}\right).\left(\vec{a} - \vec{b}\right) = a^2 - b^2$.

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

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6. IF $\left|\vec{a}\right| = \sqrt{3}, \left|\vec{b}\right| = 2$ and $\left|\vec{a} - \vec{b}\right| = 3$ find the angle between $\vec{a}$ and $\vec{b}$.

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7. Find the angle between the following pairs of vectors $3\hat{i} + 2\hat{j} - 6\hat{k}, 4\hat{i} - 3\hat{j} + \hat{k}, \hat{i} - 2\hat{j} + 3\hat{k}, 3\hat{i} - 2\hat{j} + \hat{k}$

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8. Find the angel between the following pairs of vectors $2\hat{i}-3\hat{j}+\hat{k}, 3\hat{i}-\hat{j}-2\hat{k}$

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9. Find the angel between the following pairs of vectors $\hat{i}+\hat{j}-\hat{k}, \hat{i}-\hat{j}+\hat{k}$

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10. Find the angle between the following pairs of vectors $3\hat{i}+2\hat{j}-6\hat{k}, 4\hat{i}-3\hat{j}+\hat{k}, \hat{i}-2\hat{j}+3\hat{k}, 3\hat{i}-2\hat{j}+\hat{k}$

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11. Prove that the following vectors are at righat angle: $2\hat{i} - \hat{j} + \hat{k}, \hat{i} - 3\hat{j} + 5\hat{k}$

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12. Prove that the following vectors are at righat angle: $2\hat{i} + 5\hat{j} + \hat{k}, 3\hat{i} - 2\hat{j} + 4\hat{k}$

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13. Find the angle between the vectors $3\hat{i} + 4\hat{j}$ and $2\hat{j} - 5\hat{k}$.

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14. Find the angle betwene the vecrtors $3\hat{i} + 4\hat{j} + 5\hat{k}$ and $\hat{i} + \hat{j} + \hat{k}$. Also find the sine of the angle between them.

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15. Show that the following vectors are perpendicular to each other:

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

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16. Show that the following vectors are perpendicular to each other:

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

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17. Show that the following vectors are perpendicular to each other:

$3\hat{i}+\hat{j}+2\hat{k}, \hat{i}-\hat{j}-5\hat{j}-4\hat{k}$

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18. If $\vec{a} = 3\hat{i} + 2\hat{j} + 9\hat{k}$ and $\vec{b} = \hat{i} + \lambda\hat{j} + 3\hat{k}$, find the value λ so that $\vec{a} + \vec{b}$ is perpendicular to $\vec{a} - \vec{b}$

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19. If $a = 4\hat{i} + 2\hat{j} - \hat{k}$ and $\vec{b} = 5\hat{i} + 2\hat{j} - 3\hat{k}$ find the angle between the vectors $\vec{a} + \vec{b}$ and $\vec{a} - \vec{b}$

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20. 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 perpendicular.

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21. Find the value of λ such that the vectors $\vec{a} = 2\hat{i} + \lambda\hat{j} + \hat{k}$ and $\vec{b} = \hat{i} + 2\hat{j} + 3\hat{k}$ are orthogonal.

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22. If $\overrightarrow{OA} = 2\hat{i} - \hat{j} + \hat{k}, \overrightarrow{OB} = \hat{i} - 3\hat{j} - 5\hat{k}$ and $\overrightarrow{OC} = 3\hat{i} - 3\hat{j} - 3\hat{k}$ then show that CB is perpendicular to AC.

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

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24. 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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25. Show that the thre angles of the triangle with vertices (1,-1,1), (2,3,-1) and $(3, 0, 2) are, respectively, \cos^{-1}\left(\frac{2}{\sqrt{114}}\right), \cos^{-1}\left(\frac{4}{\sqrt{126}}\right)$ and $\cos$

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26. Find the scalar components of a unit vector which is perpendicular to each of the vectors $\hat{i} + 2\hat{j} - \hat{k}$ and $3\hat{i} - \hat{j} + 2\hat{k}$.

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27. If $\vec{a} = 2\hat{i} - \hat{j} + \hat{k}$, $\vec{b} = \hat{i} - 3\hat{j} - 5\hat{k}$. Find a vector $\vec{c}$ such that $\vec{a}$, $\vec{b}$, $\vec{c}$ from the sides of a righat angled tringle taken in order.

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28. Find the vector magnitude $\sqrt{2}$ which lies in zx-plane and is at righat angles to the vector $2\hat{i} + \hat{j} + 2\hat{k}$

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29. Find the values of x for which the angle between the vectors $\vec{a} = -3\hat{i} + x\hat{j} + \hat{k}$ and $\vec{b} = x\hat{i} + 2x\hat{j} + \hat{k}$ is acute nd the angle between $\vec{b}$ and x-axis lies between $\frac{\pi}{2}$ and π.

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30. The diagonals of as parallelogram are given by $\vec{a} = 3\hat{i} - 4\hat{j} - \hat{k}$ and $\vec{b} = 2\hat{i} + 3\hat{j} - 6\hat{k}$ Show that the parallelogram is as rhombus and determine the length of its sides.

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

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32. Find the projection of $\vec{b} + \vec{c}$ on $\vec{a}$ where $\vec{a} = \hat{i} + 2\hat{j} + \hat{k}$, $\vec{b} = \hat{i} + 3\hat{j} + \hat{k}$ and $\vec{c} = \hat{i} + \hat{k}$.

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33. Find the projection of the vector $\hat{i} - 2\hat{j} + \hat{k}$ on the vector $4\hat{i} - 4\hat{j} + 7\hat{k}$.

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34. If $\overrightarrow{OA} = 2\hat{i} + 3\hat{j} - 4\hat{k}$ and $\overrightarrow{OB} = \hat{j} + \hat{k}$ are two vectors through the origin O, find the projection of $\overrightarrow{OA}$ and $\overrightarrow{OB}$

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35. If $\overrightarrow{OA} = 2\hat{i} + 3\hat{j} - 4\hat{k}$ and $\overrightarrow{OB} = \hat{j} + \hat{k}$ are two vectors through the origin O, find the projection of $\overrightarrow{OB} on \overrightarrow{OA}$.

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36. Let $\vec{a} = \hat{i} + 3\hat{j} + 7\hat{k}$ and $\vec{b} = 7\hat{i} - \hat{j} + 8\hat{k}$ find the projection of $\vec{a}$ on $\vec{b}$

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37. Let $\vec{a} = \hat{i} + 3\hat{j} + 7\hat{k}$ and $\vec{b} = 7\hat{i} - \hat{j} + 8\hat{k}$ find the projection of $\vec{b}$ on $\vec{a}$

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38. Find the projection oif $\vec{a} = 2\hat{i} + 3\hat{j} + 2\hat{k}$ on the vector $\vec{b} = \hat{i} + 2\hat{j} + \hat{k}$.

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

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40. Find the vector component of $\overrightarrow{F} = \hat{i} + 2\hat{j} + 2\hat{k}$ along the direction of $\overrightarrow{p} = -3\hat{i} - 4\hat{j} + 12\hat{k}$ in the plane of $\overrightarrow{F}$ and $\overrightarrow{P}$,

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41. P,Q,R,S are points $\hat{i} - \hat{j} - \hat{k}$, $-\hat{i} + \hat{j}, 2\hat{i} - 3\hat{k}$ and $3\hat{i} - 2\hat{j} - \hat{k}$ respectivley. Show that the projectionof PQ on RS is equal to that of RS on PQ each being $-\frac{4}{3}$. Also find the cosine of their inclination.

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42. If $\vec{a} = 4\hat{i} + 6\hat{j}$ and $\vec{b} = 3\hat{i} + 4\hat{k}$ find the vector component of $\vec{a}$ alond $\vec{b}$.

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

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44. Prove that: $\left(\frac{\vec{a}}{a^2} - \frac{\vec{b}}{b^2}\right)^2 = \left(\frac{\vec{a} - \vec{b}}{ab}\right)^2$

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45. Given that $\vec{p} = \vec{a} + \vec{b}$ and $\vec{q} = \vec{a} - \vec{b}$ and $\left|\vec{a}\right| = \left|\vec{b}\right|$, show that $\vec{p}.\vec{q} = 0$

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46. 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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47. If $\vec{a}$ is unit vector and $\left(\vec{x}-a\right).\left(\vec{x}+a\right)=12$ then find $|x|$.

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48. Find $\left|\vec{a}\right|$ and $\left|\vec{b}\right|$ 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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49. show that $\left|\vec{a}\right|\vec{b}+\left|\vec{b}\right|\vec{a}$ is a perpendicular to $\left|\vec{a}\right|\vec{b}-\left|\vec{b}\right|\vec{a}$ .for any two non-zero vectors $\vec{a}$ and $\vec{b}$

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50. The angle between $\vec{a}$ and $\vec{b}$,is 30^0 and the angle between $\vec{b}$ and $\vec{c}$ $is, 60^0$ the angle being measured in each case from the first vectro to the second vector nd in counter clockwise dirction. Compute $\left|\vec{a}+2\vec{b}-3\vec{c}\right|$, given that $\vec{a}$, $\vec{b}$, $\vec{c}$ are three coplanar unit vectors.

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51. If $\left|\vec{a}\right|=1, \left|\vec{b}\right|=2, \left|\vec{c}\right|=3$ and $\vec{a}+\vec{b}+\vec{c}=0$ the show that $\vec{a}.\vec{b}+\vec{b}.\vec{c}+\vec{c}.\vec{a}=-7$

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52. prove by vector method that the sum of the squares of the diagonals of a parallelogram is equal to the sum of the squares of its sides.

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53. Using vector method, prove that in a triangle, $a^2 = b^2 + c^2 - 2bc \quad \cos A$ (cosine law).

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

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

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56. Find the equation of the plane passing through the point $\hat{i} - \hat{j} + \hat{k}$ and perpendicular to the vectro $3\hat{i} - \hat{j} - 2\hat{k}$ and show that

the point $2\hat{i}+4\hat{j}$ lies on the plane.

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57. If $\vec{\alpha}$ is a constant vectro and $\vec{\gamma}$ is the position vector of a variable point (x,y,z), show that $\left(\vec{\gamma}-\vec{\alpha}\right)\vec{\alpha}$=0 is the equation of a plane through fixed point $\vec{\alpha}$

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58. A paticle acted on by constant forces $4\hat{i}+\hat{j}-3\hat{k}$ and $3\hat{i}+\hat{j}-\hat{k}$ is displaced from the point $\hat{i}+2\hat{j}+3\hat{k}\rightarrow 5\hat{i}+4\hat{j}+\hat{k}$. Find the work done

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59. Froces acting on a particle have magnitude 5,3,1 and act in the direction of the vectors (6,2,3),(3,-2,6),(2,-3,-6) respectively. These remain

constant while the particle is displaced form the point $A(4, -2, -6) \to B(7, -2, -2)$. Find the work done by the forces.

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60. A force $\vec{F} = 2\hat{i} + \hat{j} - \hat{k}$ acts at a point A whose position vectro is $2\hat{i} - \hat{j}$. If the point aplication of $\vec{F}$ moves from point A to point B, with position vector $2\hat{i} + \hat{j}$, find the workdown by $\vec{F}$

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61. Two forces $-\hat{i} + 2\hat{j} - \hat{k}$ and $2\hat{i} - 5\hat{j} + 6\hat{k}$ act on a particfle whose position vector is $4\hat{i} - 3\hat{j} + 2\hat{k}$ and displace it to another point whose positon vector is $6\hat{i} + \hat{j} - 3\hat{k}$. Find the total work done by the force.

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62. Two forces whose magnitudes are 2N and 3N act on a particle in the direction of the vectros $2\hat{i}+4\hat{j}+4\hat{k}$ and $4\hat{i}-4\hat{j}+2\hat{k}$ respectively. If the particle is displaced from the origin O to the point (1,2,2). Find the work done.

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