

# MATHS

# **BOOKS - KC SINHA ENGLISH**

# SCALAR PRODUCT OF TWO VECTORS

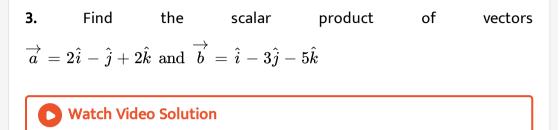
**Solved Examples** 

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

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2. Find the magnitude of two vectors  $\overrightarrow{a}$  and  $\overrightarrow{b}$  having the same magnitude and such that the angle between them is  $60^0$  and their scalar product is  $\frac{1}{2}$ .





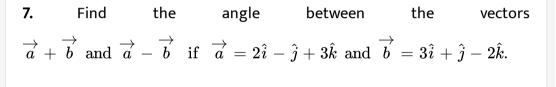
**4.** Show that the vectors  $2\hat{i} - \hat{j} + \hat{k}$  and  $\hat{i} - 3\hat{j} - 5\hat{k}$  are at righat angles.

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

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

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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  $\lambda$  such that a+b

and a-b are orthogonal.

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9. Find the value of  $\lambda$  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



10. Find the value of  $\lambda$ so 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  $\overrightarrow{a}$  makes equal angles with the coordinate axes and has magnitude 3,find the angle between  $\overrightarrow{a}$  and each of the three coordinate axes.

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

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

**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  $\overrightarrow{a}$  and  $\overrightarrow{b}$  where  $\overrightarrow{a} = 3\hat{i} + \hat{j} - 4\hat{k}$  and  $\overrightarrow{b} = 6\hat{i} + \hat{j} - 2\hat{k}$ 

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

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**18.** A unit vector  $\overrightarrow{a}$  makes angles  $\frac{\pi}{4}$  and  $\frac{\pi}{3}$  with  $\hat{i}$  and  $\hat{j}$  respectively and an acute angle  $\theta$  with  $\hat{k}$ . Find the angle  $\theta$  and components of  $\overrightarrow{a}$ .

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

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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 
$$\lambda$$
 if the scalar projection of  
 $\overrightarrow{a} = \lambda \hat{i} + \hat{j} + 4\hat{k}$  on  $\overrightarrow{b} = 2\hat{i} + 6\hat{j} + 3\hat{k}$  is 4 units.

**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)



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

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

**26.** Let  $\overrightarrow{b} = 4\hat{i} + 3\hat{j}$  and  $\overrightarrow{c}$  be two vectors perpendicular to each other in the xy- plane. All vectors in the sme plane having projections 1 and 2 along  $\overrightarrow{b}$  and  $\overrightarrow{c}$ , 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 
$$\overrightarrow{a}, \overrightarrow{b}, \overrightarrow{c}$$
 are non coplanar non zero vectors and  $\overrightarrow{n}, \overrightarrow{a} = \overrightarrow{n}, \overrightarrow{b} = \overrightarrow{n}, \overrightarrow{c} = 0$ , Show that  $\overrightarrow{n}$  is a zero vector

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



**30.** A line makes angles  $\angle, \beta, \gamma \text{ and } \delta$  with the diagonals of a cube. Show

that  $\cos^2lpha+\cos^2eta+\cos^2\gamma+\cos^2\delta=4/3.$ 



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

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

**33.** If 
$$\left| \overrightarrow{a} + \overrightarrow{b} \right| = \left| \overrightarrow{a} - \overrightarrow{b} \right|, \left( \overrightarrow{a}, \overrightarrow{b} \neq \overrightarrow{0} \right)$$
 show that the vectors

 $\overrightarrow{a}$  and  $\overrightarrow{b}$  are perpendicular to each other.

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

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

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

**37.** For any two vectors 
$$\overrightarrow{a}$$
 and  $\overrightarrow{b}$ , we always have  $\left|\overrightarrow{a} + \overrightarrow{b}\right| \leq \left|\overrightarrow{a}\right| + \left|\overrightarrow{b}\right|$  [Triangle inequality].  
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**38.** Given 
$$\overrightarrow{a}$$
 is perpendicular to  $\overrightarrow{b} + \overrightarrow{c}$ ,  $\overrightarrow{b}$  is perpendicular to  $\overrightarrow{c} + \overrightarrow{a}$   
and  $\overrightarrow{c}$  is perpendicular to  $\overrightarrow{a} + \overrightarrow{b}$ . If  $|\overrightarrow{a}| = 1$ ,  $|\overrightarrow{b}| = 2$ ,  $|\overrightarrow{c}| = 3$ , find  $|\overrightarrow{a} + \overrightarrow{b} + \overrightarrow{c}|$ 

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

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

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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.



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

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	-
<b>44.</b> Show that the diagonals of a rhombus bisect each other at righ	t

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.

**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.



**51.** In any  $\Delta ABC$ , 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

 $\cos(lpha-eta)=\coslpha\coseta+\sinlpha\sineta$ 

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

#### vectors

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#### Constant

forces

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

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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  $\hat{i} + 2\hat{j} + 3\hat{k} \rightarrow 5\hat{i} + 4\hat{j} + \hat{k}$ . Find the work done

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

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

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

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

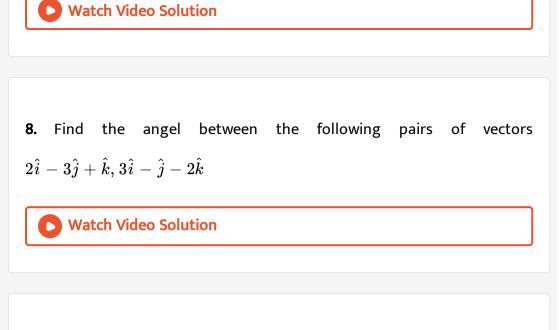
5. Find the angle between two vectors  $\overrightarrow{a}$  and  $\overrightarrow{b}$  with magnitudes 1 and 2 respectively and satisfying  $\overrightarrow{a}$ .  $\overrightarrow{b}$ . = 1

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

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



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

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  $2\hat{j} - 5\hat{k}$ .



14. Find the angle betwene the vectors  $3\hat{i} + 4\hat{j} + 5\hat{k}$  and  $\hat{i} + \hat{j} + \hat{k}$ . Also find the sine of the angle between them. 15. Show that the following vectors are perpendicular to each other:  $2\hat{j} + 3\hat{j} + 6\hat{k}, 3\hat{i} - 6\hat{j} + 2\hat{k}, 6\hat{i} + 2\hat{j} - 3\hat{k}$ 



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:

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

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

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

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

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**21.** Find the value of  $\lambda$  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.

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 
$$\overrightarrow{a} = 2\hat{i} + 2\hat{j} + 3\hat{k}$$
,  $\overrightarrow{b} = -\hat{i} + 2\hat{j} + k$  and  $\overrightarrow{c} = 3\hat{i} + \hat{j}$  such that  $\overrightarrow{a} + \lambda \overrightarrow{b} is$  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:  $\frac{1}{7} \left( 2\hat{i} + 3\hat{j} + 6\hat{k} \right), \frac{1}{7} \left( 3\hat{i} - 6\hat{j} + 2\hat{k} \right), \frac{1}{7} \left( 6\hat{i} + 2\hat{j} - 3\hat{k} \right) \text{Also}, \quad \text{show}$ 

that they are mutually perpendicular to each other.

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  $\cos^{-1}\left(\frac{4}{\sqrt{126}}\right)$ 

**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 
$$\overrightarrow{a} = 2\hat{i} - \hat{j} + \hat{k}$$
,  $\overrightarrow{b} = \hat{i} - 3\hat{j} - 5\hat{k}$ . Find a vector  $\overrightarrow{c}$  such that  $\overrightarrow{a}$ ,  $\overrightarrow{b}$ ,  $\overrightarrow{c}$  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  $2\hat{i} + \hat{j} + 2\hat{k}$ 

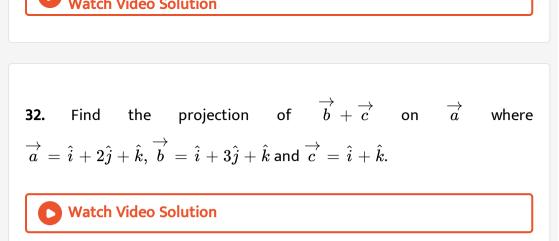
**29.** Find the values of x for which the angle between the vectors  $\vec{a} = -3\hat{i} + x\hat{j} + \hat{k}$  and  $\vec{b} = x\hat{i} + 2x\hat{j} + \hat{k}$  is acute nd the angle between  $\vec{b}$  and x-axis lies between  $\frac{\pi}{2}$  and  $\pi$ .

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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.

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



**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  $\overrightarrow{OB}$ 

**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  $\overrightarrow{OBonOA}$ .

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

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

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



**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 projection of PQ on RS is equal to that of RS on PQ each being  $-\frac{4}{3}$ . Also find the cosine of their inclination.

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

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

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

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

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

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

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**48.** Find 
$$\left|\overrightarrow{a}\right|$$
 and  $\left|\overrightarrow{b}\right|$  if  $\left(\overrightarrow{a} + \overrightarrow{b}\right)$ .  $\left(\overrightarrow{a} - \overrightarrow{b}\right) = 8$  and  $\left|\overrightarrow{a}\right| = 8\left|\overrightarrow{b}\right|$ .

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**49.** show that 
$$|\overrightarrow{a}|\overrightarrow{b} + |\overrightarrow{b}|\overrightarrow{a}|$$
 is a perpendicular to  $|\overrightarrow{a}|\overrightarrow{b} - |\overrightarrow{b}|\overrightarrow{a}|$  for any two non-zero vectors  $\overrightarrow{a}$  and  $\overrightarrow{b}$ 

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

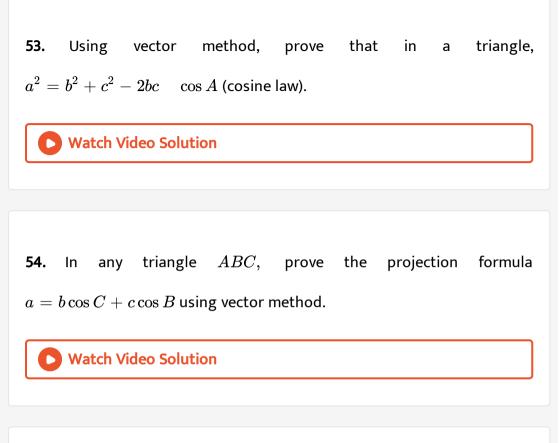
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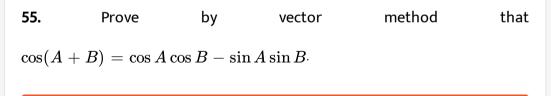
**51.** If 
$$\left|\overrightarrow{a}\right| = 1$$
,  $\left|\overrightarrow{b}\right| = 2$ ,  $\left|\overrightarrow{c}\right| = 3$  and  $\overrightarrow{a} + \overrightarrow{b} + \overrightarrow{c} = 0$  the show that  $\overrightarrow{a} \cdot \overrightarrow{b} + \overrightarrow{b} \cdot \overrightarrow{c}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

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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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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.



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

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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  $A(4,\ -2,\ -6) o B(7,\ -2,\ -2).$  Find the work done by the forces.

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

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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.

**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.