INDIAN SCHOOL AL WADI AL KABIR
Dept. of Mathematics 2024 – 2025
Class XII – Mathematics
Work Sheet – Vector Algebra

1	If a unit vector $\vec{a}$ makes angles $\frac{\pi}{3}$ with $\hat{\imath}$, $\frac{\pi}{4}$ with $\hat{\jmath}$ and an angle θ with $\hat{k}$, then find the value of θ
2	Find the direction cosines of the vector joining the points $A\ (1,2,-3)$ and $B(-1,-2,\ 1)$ directed from B to A.
3	Find the magnitude of each of the two vectors $\vec{a}$ and $\vec{b}$, having the same magnitude such that the angle between them is 60^0 and their scalar product is $\frac{9}{2}$.
4	Find the projection of $\vec{a} = 2\hat{\imath} - \hat{\jmath} + \hat{k}$ on $\vec{b} = \hat{\imath} - 2\hat{\jmath} + \hat{k}$
5	Find $\lvert\vec{x}\rvert$, if for a unit vector $\vec{a}$, $(\vec{x} - \vec{a}).(\vec{x} + \vec{a}) = 15$
6	Find a unit vector in the direction of $\vec{a} + \vec{b}$ where $\vec{a} = -\hat{\imath} + \hat{\jmath} + \hat{k}$ and $\vec{b} = 2\hat{\imath} + \hat{\jmath} - 3\hat{k}$
7	If $\lvert\vec{a}\rvert = 13, \lvert\vec{b}\rvert = 5$ and $\vec{a}.\vec{b} = 60$, then find $\lvert\vec{a} \times \vec{b}\rvert$
8	For what values of μ, the vectors $\vec{a} = 2\,\hat{\imath} + \mu\hat{\jmath} + \hat{k}$ and $\vec{b} = \hat{\imath} - 2\,\hat{\jmath} + 3\,\hat{k}$ are perpendicular to each other?
9	Find the area of the parallelogram, whose diagonals are $\vec{d}1 = 5\hat{\imath}$ and $\vec{d}_2 = 2\hat{\jmath}$.
10	Find the value of 'p' for which vectors $3\hat{\imath} + 2\hat{\jmath} + 9\hat{k}$ and $\hat{\imath} - 2p\hat{\jmath} + 3\hat{k}$ are parallel.
11	Find the position vector of the point which divides the join of the points with position vectors $\vec{a} + 3\vec{b}$ and $\vec{a} - \vec{b}$ internally in the ratio $1:3$.
12	Find the vector in the direction of the vector $\hat{\imath} - 2\hat{\jmath} + 2\hat{k}$ that has magnitude 9.
13	Find the direction cosines of the vector $\hat{\imath} + 2\hat{\jmath} + 3\hat{k}$.
14	Find the value of $a + b$, if the point $(2,\ a,\ 3)$, $(3,-5,\ b)$ and $(-1,\ 11,\ 9)$ are collinear.
15	Find a unit vector perpendicular to the plane of the triangle ABC, where the coordinates of its vertices are A $(3,-1,2)$, B $(1,-1,-3)$ and C $(4,-3,1)$.

16	The scalar product of the vector $\vec{a} = \hat{\imath} + \hat{\jmath} + k$ with a unit vector along the sum of the vectors $\vec{b} = 2\hat{\imath} + 4\hat{\jmath} - 5\hat{k}$ and $\vec{c} = \lambda\,\hat{\imath} + 2\hat{\jmath} + 3\hat{k}$ is equal to one. Find the value of λ.
17	Show that the direction cosines of avector equally inclined to the axes OX, OY and OZ are $\frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}}$.
18	If $\vec{a} + \vec{b} + \vec{c} = 0$ and $\lvert\vec{a}\rvert = 3$, $\lvert\vec{b}\rvert = 5$ and $\lvert\vec{c}\rvert = 7$, show that the angle between $\vec{a}$ and $\vec{b}$ is $\frac{\pi}{3}$.
19	Find a unit vector perpendicular to each of the vectors $(\vec{a} + \vec{b})$ and $(\vec{a} - \vec{b})$, where $\vec{a} = \hat{\imath} + \hat{\jmath} + \hat{k}$ and $\vec{b} = \hat{\imath} + 2\hat{\jmath} + 3\hat{k}$.
20	If $\lvert\vec{a} \times \vec{b}\rvert^2 + \lvert\vec{a} \cdot \vec{b}\rvert^2 = 400$ and $\lvert\vec{a}\rvert = 5$, then write the value of $\lvert\vec{b}\rvert$
21	The two adjacent sides of a parallelogram are $2\hat{\imath} - 4\hat{\jmath} + 5\hat{k}$ and $\hat{\imath} - 2\hat{\jmath} - 3\hat{k}$. Find the unit vector parallel to one of its diagonals. Also, find its area.
22	If $\vec{a}$ and $\vec{b}$ are two unit vectors inclined to x- axis at angles 45^0 and 135^0 respectively, then find the value of $\lvert\vec{a} + \vec{b}\rvert$.
23	If $\vec{a} = \hat{\imath} + \hat{\jmath} + \hat{k}$ and $\vec{b} = \hat{\jmath} - \hat{k}$, find a vector $\vec{c}$ such that $\vec{a} \times \vec{c} = \vec{b}$ and $\vec{a} \cdot \vec{c} = 3$.
24	Show that the four points A, B, C and D with position vectors $4\hat{\imath} + 5\hat{\jmath} + \hat{k}$, $-\hat{\jmath} - \hat{k}$, $3\hat{\imath} + 9\hat{\jmath} + 4\hat{k}$ and $4(-\hat{\imath} + \hat{\jmath} + \hat{k})$ respectively are coplanar.
25	Find the value of λ if the points A$(-1, 4, -3)$, B$(3, \lambda, -5)$, C$(-3, 8, -5)$ and D$(-3, 2, 1)$ are coplanar.
26	If $\vec{a}, \vec{b}$ and $\vec{c}$ are three vectors such that $\lvert\vec{a}\rvert = 1$, $\lvert\vec{b}\rvert = 4$, $\lvert\vec{c}\rvert = 2$ and $\vec{a} + \vec{b} + \vec{c} = 0$, then find the value of μ, if $\mu = \vec{a} \cdot \vec{b} + \vec{b} \cdot \vec{c} + \vec{c} \cdot \vec{a}$
27	Let If $\vec{a}, \vec{b}$ and $\vec{c}$ are three vectors such that $\lvert\vec{a}\rvert = 3$, $\lvert\vec{b}\rvert = 4$ and $\lvert\vec{c}\rvert = 5$ and each one of them is perpendicular to the sum of other two, find $\lvert\vec{a} + \vec{b} + \vec{c}\rvert$
28	Show that the points A, B, C with position vectors $2\hat{\imath} - \hat{\jmath} + \hat{k}$, $\hat{\imath} - 3\hat{\jmath} - 5\hat{k}$ and $3\hat{\imath} - 4\hat{\jmath} - 4\hat{k}$ respectively, are the vertices of a right- angled triangle. Hence find the area of the triangle.
29	The magnitude of the vector product of the vector $\hat{\imath} + \hat{\jmath} + k$ with a unit vector along the sum of the vectors $2\hat{\imath} + 4\hat{\jmath} - 5\hat{k}$ and $\vec{c} = \lambda\,\hat{\imath} + 2\hat{\jmath} + 3\hat{k}$ is equal to $\sqrt{2}$. Find the value of λ.
30	Let $\vec{a} = \hat{\imath} + 4\hat{\jmath} + 2\hat{k}$, $\vec{b} = 3\hat{\imath} - 2\hat{\jmath} + 7\hat{k}$ and $\vec{c} = 2\hat{\imath} - \hat{\jmath} + 4\hat{k}$. Find a vector $\vec{d}$ which is perpendicular to both $\vec{a}$ and $\vec{b}$, and $\vec{c} \cdot \vec{d} = 15$.

Answers

1	$\frac{\pi}{3}$	2	$\frac{1}{3},\frac{2}{3},\frac{-2}{3}$	3	$\|\vec{a}\| = \|\vec{b}\| = 3$
4	$\frac{5}{6}\sqrt{6}$	5	4	6	$\frac{1}{3}(\hat{\imath} + 2\hat{\jmath} - 2\hat{k})$
7	25	8	$\frac{5}{2}$	9	5 sq.units
10	$-\frac{1}{3}$	11	$\vec{a} + 2\vec{b}$	12	$3(\hat{\imath} - 2\hat{\jmath} + 2\hat{k})$
13	$\frac{1}{\sqrt{14}},\frac{2}{\sqrt{14}},\frac{3}{\sqrt{14}}$	14	$a = -1, b = 1, a + b = 0$	15	$\frac{1}{\sqrt{165}}(10\hat{\imath} + 7\hat{\jmath} - 4\hat{k})$
16	$\lambda = 1$	19	$-\frac{1}{\sqrt{6}}\hat{\imath} + \frac{1}{\sqrt{6}}\hat{\jmath} - \frac{1}{\sqrt{6}}\hat{k}$	20	4
21	$\frac{1}{7}(3\hat{\imath} - 6\hat{\jmath} + 2\hat{k})$ $11\sqrt{5}$ sq. unit	22	$\sqrt{2}$	23	$\vec{c} = \left(\frac{5}{3}\hat{\imath} + \frac{2}{3}\hat{\jmath} + \frac{2}{3}\hat{k}\right)$
25	$\lambda = 2$	26	$-\frac{21}{2}$	27	$5\sqrt{2}$
28	$\frac{1}{2}\sqrt{210}$	29	$\lambda = 1$	30	$\frac{1}{3}(160\,\hat{\imath} - 5\hat{\jmath} + 70\,\hat{k})$