



# MATHS

## BOOKS - NAVBODH MATHS (HINGLISH)

### THREE DIMENSIONAL GEOMETRY

#### Solved Examples

1. A line lies in XZ-plane and makes an angle  $60^\circ$  with Z-axis, find its inclination with X-axis.



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2. Find the direction ratios of a vector perpendicular to the two lines whose direction ratios are  $-2, 1, -1$  and  $-3, -4, 1$ .



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3. If a line makes angles  $\alpha, \beta, \gamma$  with the coordinate axes, prove that  $\cos 2\alpha + \cos 2\beta + \cos 2\gamma + 1 = 0$ .



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4. The direction cosines of the line which bisects the angle between positive direction of Y and Z axis are



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5. Show that no line in space can make angles  $\frac{\pi}{6}$  and  $\frac{\pi}{4}$  with x -axis and y -axis.



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6. Find the measure of a acute angle between the line direction ratios are 5, 12, -13 and 3, -4, 5.



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7. A line makes angles of measures  $45^\circ$  and  $60^\circ$  with positive directions of Y-and Z-axes respectively. Find the d.c.s. of the line and also find the vector of magnitude 5 along the direction of line.



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8. Find the direction cosines of the line perpendicular to the lines whose direction ratios are  $-2, 1, -1$  and  $-3, -4, 1$ .



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9. IF the direction ratios of two vectors are connected by the relations  $p + q + r = 0$  and  $p^2 + q^2 - r^2 = 0$ . Find the angle between them.





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10. If the line  $\overrightarrow{OR}$  makes angles  $\theta_1, \theta_2, \theta_3$  with the planes  $XOY, YOZ, ZOX$  respectively, then  $\cos^2 \theta_1 + \cos^2 \theta_2 + \cos^2 \theta_3$  is equal to



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11. Show that the angle between two diagonals of a cube is  $\cos^{-1} \sqrt{\frac{1}{3}}$ .



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12. If a line drawn from the point  $A(1, 2, 1)$  is perpendicular to the line joining  $P(1, 4, 6)$  and  $Q(5, 4, 4)$ , then find the coordinates of the foot of the perpendicular.



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## Theory Question

1. If the direction cosines of a straight line are  $l, m$  and  $n$ , then prove that  $l^2 + m^2 + n^2 = 1$



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2. If  $\alpha, \beta, \gamma$  are direction angles of a line  $l$ , then prove that

$$\cos^2 \alpha + \cos^2 \beta + \cos^2 \gamma = 1.$$

Hence, deduce that

$$\sin^2 \alpha + \sin^2 \beta + \sin^2 \gamma = 2.$$



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## Example For Practice

1. A line makes angles of measures  $\frac{\pi}{6}$  and  $\frac{\pi}{3}$  with X-and Z-axes respectively. Find the angle made by the line with the Y-axis.



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2. Find the direction angles of the line with the X-axis which makes direction angles of  $135^\circ$  and  $45^\circ$  with Y-axis Z-axes respectively.



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3. Show that there is no line in space which makes angle of  $30^\circ$  with each of X-and Y-axes.



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4. A line passes through the point  $(3, 1, 2)$  and  $(5, -1, 1)$ , find the direction cosines of the line.



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5. Find the angles between the line whose direction ratios are  $4, -3, 5$  and  $3, 4, 5$ .



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6. If the direction ratios of two parallel lines are  $4, -3, -1$  and  $p + q, 1 + q, 2$ , then find the values of  $p$  and  $q$ .



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7. Direction ratios of two lines are  $3, -2, k$  and  $-2k, 4$ . Find  $k$ , if the lines are perpendicular to each other.



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8. If the angles between the vector  $\bar{a}$  and  $\bar{b}$  having direction ratios  $1, 2, 1$  and  $1, 3k, 1$  is  $\frac{\pi}{4}$ , find  $k$ .



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9. Find the vector of magnitude 9 which is equally inclined to the coordinates axes.



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10. Find  $\vec{r}$ , if direction ratios of vector  $\vec{r}$  are 2, -3, 6 and  $|\vec{r}| = 21$  and  $\vec{r}$  makes obtuse angle with the X-axis.



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**11.** Find the direction cosines of the line which is perpendicular to the lines with direction ratios 4, 1, 3 and 2, - 3, 1.



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**12.** Suppose  $A(2,3,7)$ ,  $B(-1,3,2)$  and  $C(p,s,r)$  are the vertices of  $\triangle ABC$ . If the median through A is equally inclined to the coordinate axes then the coordinate of the vertex C is



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**13.** The direction ratios of two lines satisfy the relation  $2a - b + 2c = 0$  and  $ab + bc + ca = 0$ . Show that the lines are perpendicular.



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**14.** If  $M$  is the foot of perpendicular drawn from  $A(4, 3, 2)$  on the lines joining the points  $B(2, 4, 1)$  and  $C(4, 5, 3)$ , Find the coordinates of  $M$ .



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## Multiple Choice Questions

1. If a line is inclined at  $60^\circ$  and  $30^\circ$  with the X-and Y-axes respectively, then the angle which makes with the Z-axes is

A. 0

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

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



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

**Answer:**



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2. If the points  $A(-1, 3, \lambda)$ ,  $B(-2, 0, 1)$  and  $C(-4, \mu, -3)$  are collinear, then the values of  $\lambda$  and  $\mu$  are

A. 3 and -6

B. -3 and 6

C.  $-3$  and  $-6$

D.  $3$  and  $6$

**Answer:**



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3. If a line makes angles  $90^\circ$ ,  $135^\circ$ ,  $45^\circ$  with the  $x$ ,  $y$  and  $z$ -axes respectively, find its direction cosines.

A.  $0, \frac{1}{\sqrt{2}}, -\frac{1}{\sqrt{2}}$

B.  $0, -\frac{1}{\sqrt{2}}, -\frac{1}{\sqrt{2}}$

C.  $0, \frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}$

D.  $0, -\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}$

**Answer:**



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**4.** Which of the following represents direction cosines of the line ?

A.  $0, \frac{1}{\sqrt{2}}, \frac{1}{2}$

B.  $0, -\frac{\sqrt{3}}{2}, \frac{1}{\sqrt{2}}$

C.  $0, \frac{\sqrt{3}}{2}, \frac{1}{2}$

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

**Answer:**



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5. Direction cosines of the line passing through the points

$A(-4, 2, 3)$  and  $B(1, 3, -2)$  are

A.  $\pm \frac{1}{\sqrt{51}}, \pm \frac{5}{\sqrt{51}}, \pm \frac{1}{\sqrt{51}}$

B.  $\pm \frac{5}{\sqrt{51}}, \pm \frac{1}{\sqrt{51}}, \pm \frac{-5}{\sqrt{51}}$

C.  $\pm 5, \pm 1, \pm 5$

D.  $\pm \sqrt{51}, \pm \sqrt{51}, \pm \sqrt{51}$ .

**Answer:**



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6. If a line makes angles  $\theta_1, \theta_2, \theta_3$  with the  
coordinate planes, then

$$\sin^2 \theta_1 + \sin^2 \theta_2 + \sin^2 \theta_3 = \dots\dots\dots$$

A. 1

B. 2

C.  $-1$

D.  $-2$

**Answer: 2**



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7. The two values of  $k$  for which the lines with direction ratios  $k, -6, -2$  and  $k - 1, k, 4$  are perpendicular to each other are

A. 8, - 1

B. 2, 3

C. 8, 1

D. - 8, - 1

**Answer:**



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8. The measure of acute angle between the lines whose direction ratios are 3, 2, 6 and -2, -1, 2` is

A.  $\cos^{-1}\left(\frac{1}{7}\right)$

B.  $\cos^{-1}\left(\frac{8}{15}\right)$

C.  $\cos^{-1}\left(\frac{1}{3}\right)$

D.  $\cos^{-1}\left(\frac{8}{21}\right)$

**Answer:**



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