



MATHS

BOOKS - KC SINHA MATHS (HINGLISH)

3D - ANGLE BETWEEN TWO LINES

Solved Examples

1. Find the direction cosines of the vector

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



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2. Find the angle at which the vector $\hat{i} - \hat{j} + \hat{k}$ is inclined to each of the coordinate axes.



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3. Show by using direction ratios, that the points

$(2, -4, 5)$, $(1, -1, 3)$ and $(5, -13, 11)$

are collinear



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4. Find the values of a for which points $(8, -7, a)$, $(5, 2, 4)$ and $(6, -1, 2)$ are collinear.



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5. If Q be the foot of perpendicular from $P(2, 4, 3)$ on the line joining the points $A(1, 2, 4)$ and $B(3, 4, 5)$, then co-ordinate of Q is given by



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6. Find the direction cosines of the lines, connected by the relations: $l + m + n = 0$ and $2lm + 2ln - mn = 0$.



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7. can $-\frac{1}{2\sqrt{2}}, -\frac{1}{\sqrt{2}}, -\frac{1}{\sqrt{3}}$ be the direction cosines of any directed line? Justify your answer.

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8. If a line makes angles α, β, γ with the coordinate axes, prove that

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

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9. A line OP through origin O is inclined at 60° and 45° to OX and OY respectively, where O is the origin. Find the angle at which it is inclined to OZ.



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10. What are the direction cosines of a line which is equally inclined to the axes?



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11. What are the direction cosines of a line whose direction ratios are 3,4,12?



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12. Find the angles at which a line with direction ratios $2, -1, 2$ is inclined to each of the coordinate axes.



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13. A line passes through the points $(6, -7, -1)$ and $(2, -3, 1)$. Find the direction cosines of the line if the line makes an acute angle with the positive direction of the x-axis.



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14. Show that the three lines drawn from the origin with direction cosines proportional to $1, -1, 2, -3, 0$ and $1, 0, 3$ are coplanar



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15. If l_1, m_1, n_1 and l_2, m_2, n_2 are the direction cosines of two mutually perpendicular lines, show that the direction cosines of the line

perpendicular to both of these are

$$m_1n_2 - m_2n_1, n_1l_2 - n_2l_1, l_1m_2 - l_2m_1.$$



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16. Prove that the lines whose direction cosines are given by the equations

$$l + m + n = 0 \text{ and } 3lm - 5mn + 2nl = 0$$

are mutually perpendicular.



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17. The direction cosines of two lines are given by the equations

$$3m + n + 5l = 0, 6nl - 2lm + 5mn = 0.$$

find the angle between them



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18. Find the angel between any two diagonals of a cube.



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19. Find the projection of the line joining $(1,2,3)$ and $(-1,4,2)$ on the line having direction ratios $2,3,-6$.



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20. If P, Q, R, S are $(3,6,4), (2,5,2), (6,4,4), (0,2,1)$ respectively find the projection of PQ on RS .



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21. The projection of a vector on the coordinate axes are 6, -3 , 2. Find its length and direction cosines.



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Exercise

1. If a line makes angle 90° , 60° and 30° with the positive direction of x, y and z-axis respectively, find its direction cosines.



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2. If a line makes angles 90° , 135° , 45° with the x, y and z-axes respectively, find its direction cosines.



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3. If $\vec{r} = 2\hat{i} - 3\hat{j} + 2\hat{k}$ find the direction cosines of \vec{r} .



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4. Find the direction COSINES of the joining the points $P(4, 3, -5)$ and $Q(-2, 1, -8)$



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5. If a line has direction ratios $-18, -12, -4$ then what are its direction cosines?



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6. Show that the joint of the points $(1,2,3)$, $(4,5,7)$ is parallel to the join of the points $(-4,3,-6)$, $(2,9,2)$.



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7. Show that the line joining the points $(1,2,3)$, $(-1,-2,-3)$ is perpendicular to the line joining $(-2,1,5)$, $(3,3,2)$.



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8. Show that the points $(2, 3, 4)$, $(-1, -2, 1)$, $(5, 8, 7)$ are collinear.



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9. Show that the points $A(2, 3, 4)$, $B(1, 2, 3)$ and $C(3, 8, 11)$ are collinear.



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10. Find the direction cosines of the sides of the triangle whose vertices are $(3, 5, 4)$, $(1, 1, 2)$ and $(5, 5, 2)$.



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11. Determine the value of k so that the line joining points $A(k, 1, -1)$ and $B(2, 0, 2k)$ is perpendicular to the line joining the points $C(4, 2k, 1)$ and $D(2, 3, 2)$.



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12. Determine the values of x and y so that the line joining the points $A(x, 3, 11)$, $B(1, 1, -2)$ is parallel to the line joining the points $C(2, 5, 3)$, $D(-4, y, -6)$.



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13. Find the direction cosines of the lines, connected by the relations: $l + m + n = 0$ and $2lm + 2ln - mn = 0$.



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14. Find the coordinates of the foot of the perpendicular from $P(2, 1, 3)$ on the lines joining the points $A(1, 2, 4)$ and $B(3, 4, 5)$.



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15. If O be the origin and OP makes an angle of 45° and 60° with the positive direction of x

and y axes respectively and $OP=12$ units, find the coordinates of P.



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16. Find the angles of $\triangle ABC$ whose vertices are

$A((-1, 3, 2))$, $B(2, 3, 5)$ and $C(3, 5, -2)$.



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17. Find the angle between the lines whose direction-cosines are give $l + 2m + 3n = 0$ and $3/m - 4/n + mn = 0$



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18. Find the acute angle between the two straight lines whose direction cosines are given by $l + m + n = 0$ and $l^2 + m^2 - n^2 = 0$



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19. Find the projection of the line segment joining $(2, -1, 3)$ and $(4, 2, 5)$ on a line which makes equal acute angles with co-ordinate axes.



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20. The length of the line segment whose projection on the coordinate axes are of magnitudes 12, 4, 3 is (1) 13 (2) 17 (3) 19 (4) 21



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21. The direction cosines of x-axis are (A) 0,0,1
(B) 1,0,0 (C) 0,1,0 (D) 0,1,1



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22. The direction cosines of any normal to the xy-plane are (A) 1,0,0 (B) 0,1,0 (C) 1,1,0 (D) 0,0,1



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23. How many lines through the origin make equal angles with the coordinate axes? (A) 1
(B) 4 (C) 8 (D) 2



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24. The number 3,4,5 can be (A) direction cosines of a line in space (B) direction numbers of a line in space (C) coordinates of a point on the line $y = 4z = 0$ (D) coordinates of a point in the plane $x + y - z = 0$



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25. If the direction cosines of a straight line are k, k, k the (A) $k > 0$ (B) $0 < k < 1$ (C) $k = 1$
(D) $k = \frac{1}{\sqrt{3}}$ or $-\frac{1}{\sqrt{3}}$

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26. The direction cosines of line joining $(1, -1, 1)$ and $(-1, 1, 1)$ are (A) $2, -2, 0$
(B) $1, -1, 0$ (C) $\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}, 0$ (D) none of these



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27. If $\alpha + \beta + \gamma$ are the angle which a half ray makes with the positive direction of the axes then $\sin^2 \alpha + \sin^2 \beta + \sin^2 \gamma =$ (A) 1 (B) 2 (C) 0 (D) -1



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28. The direction cosines of the ray from $(0, 0, 0) \rightarrow (2, -3, 6)$ are (A) $-\frac{2}{7}, \frac{3}{7}, -\frac{6}{7}$

(B) $\frac{2}{7}, 37, \frac{6}{7}$ (C) $-\frac{2}{7}, -\frac{3}{7}, \frac{6}{7}$ (D)

$\frac{2}{7}, -\frac{3}{7}, -\frac{6}{7}$



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29. Two lines with direction cosines

l_1, m_1, n_1 and l_2, m_2, n_2 are at right angles

iff (A) $l_1 l_2 + m_1 m_2 + n_1 n_2 = 0$ (B)

$l_1 = l_2, m_1 = m_2, n_1 = n_2$ (C)

$\frac{l_1}{l_2} = \frac{m_1}{m_2} = \frac{n_1}{n_2}$ (D) $l_1 l_2 = m_1 m_2 = n_1 n_2$



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30. The projections of the segment PQ on the coordinate axes are -9,12,-8 respectively. The direction cosines of the line PQ are (A)

$$-\frac{9}{\sqrt{17}}, \frac{12}{\sqrt{17}}, -\frac{8}{\sqrt{17}} \quad (\text{B})$$

$$-\frac{9}{288}, \frac{12}{289}, -\frac{8}{289} \quad (\text{C}) \quad -\frac{9}{17}, \frac{12}{17}, -\frac{8}{17}$$

(D) none of these



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31. If the direction cosines of a line are $\frac{1}{c}, \frac{1}{c}, \frac{1}{c}$ then (A) $c=0$ (B) $0 < c < 1$ (C) $c = \pm \sqrt{3}$ (D) $c > 2$



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32. A line making angles 45° and 60° with the positive directions of the x and y axes respectively, makes with the positive direction of z -axis an angle of (A) 60° (B) 120° (C) 60° or 120° (D) none of these



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33. Find the angle between the following pair of lines: A line with direction ratios 2,2,1 A line joining (3,1,4) to (7,2,12)



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34. 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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35. If a line makes angles α, β, γ with the axes then

$$\cos 2\alpha + \cos 2\eta + \cos 2\gamma =$$

$$(A) - 2(B) - 1(C)1(D)2$$



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