EXERCISE 11.1 - Question No. 1

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

EXERCISE 11.1 - Question No. 2

Find the direction cosines of a line which makes equal angles with the coordinate axes.

EXERCISE 11.1 - Question No. 3

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

EXERCISE 11.1 - Question No. 4

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

EXERCISE 11.1 - Question No. 5

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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EXERCISE 11.2 - Question No. 1

Show that the three lines with direction cosines $\frac{12}{13}, \frac{-3}{13}, \frac{-4}{13}, \frac{4}{13}, \frac{12}{13}, \frac{3}{13}; \frac{3}{13}, \frac{-4}{13}, \frac{12}{13}$ are mutually perpendicular.

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EXERCISE 11.2 - Question No. 2

Show that the line through the points $(1, 1, 2), (3, 4, 2)$ is perpendicular to the line through the points $(0, 3, 2)$ and $(3, 5, 6)$.

EXERCISE 11.2 - Question No. 3

Show that the line through the points $(4, 7, 8), (2, 3, 4)$ is parallel to the line through the points $(1, 2, 1)$,$(1, 2, 5)$.

EXERCISE 11.2 - Question No. 4

Find the equation of the line which passes through the point (1, 2, 3) and is parallel to the vector $3\hat{i} + 2\hat{j} - 2\hat{k}$.

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EXERCISE 11.2 - Question No. 5

Find the equation of the line in vector and in cartesian form that passes through the point with position vector $2\hat{i} - \hat{j} + 4\hat{k}$ and is in the direction $\hat{i} + 2\hat{j} - \hat{k}$.

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EXERCISE 11.2 - Question No. 6

Find the cartesian equation of the line which passes through the point $(2, 4, 5)$ and parallel to the line given by

$$\frac{x+3}{3} = \frac{y-4}{5} = \frac{z+8}{6}.$$

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EXERCISE 11.2 - Question No. 7

The cartesian equation of a line is $\frac{x-5}{3} = \frac{y+4}{7} = \frac{z-6}{2}$.

Write its vector form.

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EXERCISE 11.2 - Question No. 8

Find the vector and the cartesian equations of the lines that passes through the origin and $(5, 2, 3)$.

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EXERCISE 11.2 - Question No. 9

Find the vector and the cartesian equations of the line that passes through the points$(3, 2, 5), (3, 2, 6)$.

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EXERCISE 11.2 - Question No. 10

Find the angle between the following pairs of lines: (i)

$\rightarrow r = 2\hat{i} - 5\hat{j} + \hat{k} + \lambda\left(3\hat{i} + 2\hat{j} + 6\hat{k}\right)$ and

$\rightarrow r = 7\hat{i} - 6\hat{k} + \mu\left(\hat{i} + 2\hat{j} + 2\hat{k}\right)$ (ii)

$\rightarrow r = 3\hat{i} + \hat{j} - 2\hat{k} + \lambda\left(\hat{i} - \hat{j} - 2\hat{k}\right)$ and ` -

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EXERCISE 11.2 - Question No. 11

Find the angle between the following pair of lines: (i)

$\frac{x-2}{2} = \frac{y-1}{5} = \frac{z+3}{-3}$ and $\frac{x+2}{-1} = \frac{y-4}{8} = \frac{z-5}{4}$ (ii)

$\frac{x}{2} = \frac{y}{2} = \frac{z}{1}$ and $\frac{x-5}{4} = \frac{y-2}{1} = \frac{z-3}{8}$

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EXERCISE 11.2 - Question No. 12

Find the values of p so that the lines $\frac{1-x}{3}=\frac{7y-14}{2p}=\frac{z-3}{2}$ and $\frac{7-7x}{3p}=\frac{y-5}{1}=\frac{6-z}{5}$ are at right angles.

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EXERCISE 11.2 - Question No. 13

Show that the lines $\frac{x-5}{7}=\frac{y+2}{-5}=\frac{z}{1}$ and $\frac{x}{1}=\frac{y}{2}=\frac{z}{3}$ are perpendicular to each other.

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EXERCISE 11.2 - Question No. 14

Find the shortest distance between the lines

$$\rightarrow r = \left(\hat{i} + 2\hat{j} + \hat{k}\right) + \lambda\left(\hat{i} - \hat{j} + \hat{k}\right) \text{ and}$$

$$\rightarrow r = 2\hat{i} - \hat{j} - \hat{k} + \mu\left(2\hat{i} + \hat{j} + 2\hat{k}\right)$$

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EXERCISE 11.2 - Question No. 15

Find the shortest distance between the lines

$$\frac{x+1}{7} = \frac{y+1}{-6} = \frac{z+1}{1} \text{ and } \frac{x-3}{1} = \frac{y-5}{-2} = \frac{z-7}{1}$$

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EXERCISE 11.2 - Question No. 16

Find the shortest distance between the lines whose vector equations

are $\rightarrow r = \left(\hat{i} + 2\hat{j} + 3\hat{k}\right) + \lambda\left(\hat{i} - 3\hat{j} + 2\hat{k}\right)$ and

$\rightarrow r = 4\hat{i} + 5\hat{j} + 6\hat{k} + \mu\left(2\hat{i} + 3\hat{j} + \hat{k}\right)$.

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EXERCISE 11.2 - Question No. 17

Find the shortest distance between the lines whose vector equations

are $\rightarrow r = (1 - t)\hat{i} + (t - 2)\hat{j} + (3 - 2t)\hat{k}$ and

$\rightarrow r = (s + 1)\hat{i} + (2s - 1)\hat{j} - (2s + 1)\hat{k}$

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EXERCISE 11.3 - Question No. 1

In each of the following cases, determine the direction cosines of the normal to the plane and the distance from the origin. (a) $z = 2$ (b) $x + y + z = 1$ (c) $2x + 3yz = 5$ (d) $5y + 8 = 0$

EXERCISE 11.3 - Question No. 2

Find the vector equation of a plane which is at a distance of 7 units from the origin and normal to the vector $3\hat{i} + 5\hat{j} - 6\hat{k}$.

EXERCISE 11.3 - Question No. 3

Find the Cartesian equation of the following planes: (a)

$\rightarrow r\hat{i} + \hat{j} - \hat{k} = 2$ (b) $\rightarrow r2\hat{i} + 3\hat{j} - 4\hat{k} = 1$ (c)

$\rightarrow r(s - 2t)\hat{i} + (3 - t)\hat{j} + (2s + t)\hat{k} = 15$

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EXERCISE 11.3 - Question No. 4

In the following cases, find the coordinates of the foot of the perpendicular drawn from the origin. (a) $2x + 3y + 4z12 = 0$ (b) $3y + 4z6 = 0$ (c) $x + y + z = 1$ (d) $5y + 8 = 0$

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EXERCISE 11.3 - Question No. 5

Find the vector and cartesian equations of the planes (a) that passes through the point $(1, 0, 2)$ and the normal to the plane is $\hat{i} + \hat{j} - \hat{k}$ (b) that passes through the point (1,4, 6) and the normal vector to the plane is

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EXERCISE 11.3 - Question No. 6

Find the equations of the planes that passes through three points.

(a)(1,1,-1),(6,4,-5),(-4,-2,3)

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EXERCISE 11.3 - Question No. 7

Find the intercepts cut off by the plane $2x + yz = 5$.

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EXERCISE 11.3 - Question No. 8

Find the equation of the plane with intercept 3 on the y-axis and parallel to ZOX plane.

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EXERCISE 11.3 - Question No. 9

Find the equation of the plane through the intersection of the planes $3x - y + 2z - 4 = 0$ and $x + y + z - 2 = 0$ and the point (2, 2,

1).

EXERCISE 11.3 - Question No. 10

Find the vector equation of the plane passing through the

intersection of the planes

$\rightarrow r2\hat{i} + 2\hat{j} - 3\hat{k} = 7, \rightarrow r2\hat{i} + 5\hat{j} + 3\hat{k} = 9$ and through the

point (2, 1, 3).

EXERCISE 11.3 - Question No. 11

Find the equation of the plane through the line of intersection of the planes $x + y + z = 1$ and $2x + 3y + 4z = 5$ which is perpendicular to the plane$xy + z = 0$.

EXERCISE 11.3 - Question No. 12

Find the angle between the planes whose vector equations are $\vec{r} . \left(2\hat{i} + 2\hat{j} - 3\hat{k}\right) = 5$ and $\vec{r} . \left(3\hat{i} - 3\hat{j} + 5\hat{k}\right) = 3$.

EXERCISE 11.3 - Question No. 13

In the following cases, determine whether the given planes are parallel or perpendicular, and in case they are neither, find the angles between them. (a)

$7x + 5y + 6z + 30 = 0$ and $3x - y - 10z + 4 = 0$ (b)

$2x + y + 3z - 2 = 0$ and $x - 2y + 5z = 0$ (c)

$2x - 2y + 4z + 5 = 0$ and $3x - 3y + 6z - 1 = 0$ (d)

$2x - y + 3z - 1 = 0$ and $2x - y + 3z + 3 = 0$ (e)

$4x + 8y + z - 3 = 0$ and $y + z - 4 = 0$

EXERCISE 11.3 - Question No. 14

In the following cases, find the distance of each of the given points from the corresponding given plane. Point Plane (a) $(0, 0, 0)$ $3x4y + 12z = 3$ (b) $(3, 2, 1)$ $2xy + 2z + 3 = 0$ (c) `(2,

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MISCELLANEOUS EXERCISE - Question No. 1

Show that the line joining the origin to the point $(2, 1, 1)$ is perpendicular to the line determined by the points$(3, 5, 1)$,$(4, 3, 1)$.

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MISCELLANEOUS EXERCISE - Question No. 2

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

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

MISCELLANEOUS EXERCISE - Question No. 3

Find the angle between the lines whose direction ratios are a, b, c and bc, ca, ab .

MISCELLANEOUS EXERCISE - Question No. 4

Find the equation of a line parallel to x-axis and passing through the origin.

MISCELLANEOUS EXERCISE - Question No. 5

If the coordinates of the points A, B, C, D be $(1, 2, 3)$, $(4, 5, 7)$, $(4, 3, 6)$ and $(2, 9, 2)$ respectively, then find the angle between the lines AB and CD.

MISCELLANEOUS EXERCISE - Question No. 6

If the lines $\frac{x-1}{-3}=\frac{y-2}{2k}=\frac{z-3}{2}$ and $\frac{x-1}{3k}=\frac{y-1}{1}=\frac{z-6}{-5}$ are perpendicular, find the value of k.

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MISCELLANEOUS EXERCISE - Question No. 7

Find the vector equation of the line passing through (1, 2, 3) and perpendicular to the plane $\vec{r}.\left(\hat{i}+2\hat{j}-5\hat{k}\right)+9=0$.

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MISCELLANEOUS EXERCISE - Question No. 8

Find the equation of the plane passing through (a, b, c) and parallel to the plane $\rightarrow r\hat{i} + \dot{\hat{j}} + \hat{k} = 2$.

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MISCELLANEOUS EXERCISE - Question No. 9

Find the shortest distance between lines

$\rightarrow r = 6\hat{i} + 2\hat{j} + \hat{k} + \lambda\left(\hat{i} - 2\hat{j} + 2\hat{k}\right)$ and

$\rightarrow r = -4\hat{i} - \hat{k} + \mu\left(3\hat{i} - 2\hat{j} - 2\hat{k}\right)$.

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MISCELLANEOUS EXERCISE - Question No. 10

Find the coordinates of the point where the line through (5, 1, 6) and (3, 4,1) crosses the YZ-plane.

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MISCELLANEOUS EXERCISE - Question No. 11

Find the coordinates of the point where the line through (5, 1, 6) and (3, 4, 1) crosses the ZX-plane.

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MISCELLANEOUS EXERCISE - Question No. 12

Find the coordinates of the point where the line through $(3, 4, 5)$ and $(2, 3, 1)$ crosses the plane$2x + y + z = 7$.

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MISCELLANEOUS EXERCISE - Question No. 13

Find the equation of the plane passing through the point $(1, 3, 2)$ and perpendicular to each of the planes $x + 2y + 3z = 5$ and $3x + 3y + z = 0$.

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MISCELLANEOUS EXERCISE - Question No. 14

If the points $(1, 1, p) and (3, 0, 1)$ be equidistant from the plane

$\vec{r} \cdot \left(3\hat{i} + 4\hat{j} - 12\hat{k}\right) + 13 = 0$, then find the value of p.

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MISCELLANEOUS EXERCISE - Question No. 15

Find the equation of the plane passing through the line of

intersection of the planes $\rightarrow r\hat{i} + \dot{\hat{j}} + \hat{k} = 1$ and

$\rightarrow r2\hat{i} + \dot{3}\hat{j} - \hat{k} + 4 = 0$ and parallel to x-axis.

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MISCELLANEOUS EXERCISE - Question No. 16

If O be the origin and the coordinates of P be$(1, 2, -3)$, then find the equation of the plane passing through P and perpendicular to OP.

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MISCELLANEOUS EXERCISE - Question No. 17

Find the equation of the plane which contains the line of intersection of the planes

$\rightarrow r\hat{i} + 2\hat{j} + 3\hat{k} - 4 = 0, \rightarrow r2\hat{i} + \hat{j} - \hat{k} + 5 = 0$ and which is perpendicular to the plane

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MISCELLANEOUS EXERCISE - Question No. 18

Find the distance of the point $(1, 5, 10)$ from the point of intersection of the line $\rightarrow r = 2\hat{i} - \hat{j} + 2\hat{k} + \lambda\left(3\hat{i} + 4\hat{j} + 2\hat{k}\right)$ and the plane $\rightarrow r = \left(\hat{i} - \hat{j} + \hat{k}\right) = 5$.

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MISCELLANEOUS EXERCISE - Question No. 19

Find the vector equation of the line passing through $(1, 2, 3)$ and parallel to the planes $\rightarrow r\hat{i} - \hat{j} + 2\hat{k} = 5$ and $\rightarrow r3\hat{i} + \hat{j} + \hat{k} = 6$.

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MISCELLANEOUS EXERCISE - Question No. 20

Find the vector equation of the line passing through the point

$(1, 2, -4)$ and perpendicular to the two lines:

$$\frac{x-8}{3} = \frac{y+19}{-16} = \frac{z-10}{7} \text{ and } \frac{x-15}{3} = \frac{y-29}{8} = \frac{z-5}{-5}$$

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MISCELLANEOUS EXERCISE - Question No. 21

Prove that if a plane has the intercepts a, b, c and is at a distance of p units from the origin, then $\frac{1}{a^2} + \frac{1}{b^2} + \frac{1}{c^2} = \frac{1}{p^2}$.

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MISCELLANEOUS EXERCISE - Question No. 22

Distance between the two planes: $2x + 3y + 4z = 4$ and

$4x + 6y + 8z = 12$ is (A) 2 units (B) 4 units (C) 8 units (D) $\frac{2}{\sqrt{29}}$

units

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MISCELLANEOUS EXERCISE - Question No. 23

The planes: $2xy + 4z = 5and5x2.\ 5y + 10z = 6$ are (A)

Perpendicular (B) Parallel (C) intersect y-axis (D) passes through

$\left(0, 0, \frac{5}{4}\right)$

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SOLVED EXAMPLES - Question No. 1

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

SOLVED EXAMPLES - Question No. 2

If a line has direction ratios 2, 1, 2.determine its direction cosines.

SOLVED EXAMPLES - Question No. 3

Find the direction cosines of the line passing through the two points $(2, 4, 5)$ and $(1, 2, 3)$.

SOLVED EXAMPLES - Question No. 4

Find the direction cosines of x, y and z-axis.

SOLVED EXAMPLES - Question No. 5

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

SOLVED EXAMPLES - Question No. 6

Find the vector and the Cartesian equations of the line through the point $(5, 2, 4)$ and which is parallel to the vector $3\hat{i} + 2\hat{j} - 8\hat{k}$.

SOLVED EXAMPLES - Question No. 7

Find the vector equation for the line passing through the points $(1, 0, 2)$ and $(3, 4, 6)$.

SOLVED EXAMPLES - Question No. 8

The Cartesian equation of a line is $\frac{x+3}{2} = \frac{y-5}{4} = \frac{z+6}{2}$.

Find the vector equation for the line.

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SOLVED EXAMPLES - Question No. 9

Find the angle between the pair of lines given by

$\vec{r} = 3\hat{i} + 2\hat{j} - 4\hat{k} + \lambda\left(\hat{i} + 2\hat{j} + 2\hat{k}\right)$ and

$\vec{r} = 5\hat{i} - 2\hat{j} + \mu\left(3\hat{i} + 2\hat{j} + 6\hat{k}\right)$.

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SOLVED EXAMPLES - Question No. 10

Find the angle between the pair of lines

$$\frac{x+3}{3}=\frac{y-1}{5}=\frac{z+3}{4} \text{ and } \frac{x+1}{1}=\frac{y-4}{1}=\frac{z-5}{2}.$$

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SOLVED EXAMPLES - Question No. 11

Find the shortest distance between the lines l1 and l2 whose vector equations are $\rightarrow r=\hat{i}+\hat{j}+\lambda\left(2\hat{i}-\hat{j}+\hat{k}\right)$ (1) and

$\rightarrow r=2\hat{i}+\hat{j}-k+\mu\left(3\hat{i}-5\hat{j}+2\hat{k}\right)$ (2)

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SOLVED EXAMPLES - Question No. 12

Find the distance between the lines l_1 and l_2 given by

$\rightarrow r = \hat{i} + 2\hat{j} - 4k + \lambda\left(2\hat{i} + 3\hat{j} + 6\hat{k}\right)$ and

$\rightarrow r = 3\hat{i} + 3\hat{j} - 5k + \mu\left(2\hat{i} + 3\hat{j} + 6\hat{k}\right)$.

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SOLVED EXAMPLES - Question No. 13

Find the vector equation of the plane which is at a distance of $\frac{6}{\sqrt{29}}$

from the origin and its normal vector from the origin is

$2\hat{i} - 3\hat{j} + 4\hat{k}$. Also find its cartesian form.

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SOLVED EXAMPLES - Question No. 14

Find the direction cosines of the unit vector perpendicular to the

plane $\rightarrow r6\hat{i} - 3\hat{j} - 2\hat{k} + 1 = 0$ passing through the origin.

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SOLVED EXAMPLES - Question No. 15

Find the distance of the plane $2x3y + 4z6 = 0$ from the origin.

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SOLVED EXAMPLES - Question No. 16

Find the coordinates of the foot of the perpendicular drawn from the origin to the plane $2x - 3y + 4z - 6 = 0$.

SOLVED EXAMPLES - Question No. 17

Find the vector and cartesian equations of the plane which passes through the point $(5, 2, 4)$ and perpendicular to the line with direction ratios $(2, 3, 1)$.

SOLVED EXAMPLES - Question No. 18

Find the vector equations of the plane passing through the points $R(2, 5, 3)$, $S(2, 3, 5)$ and $T(5, 3, 3)$.

SOLVED EXAMPLES - Question No. 19

Find the equation of the plane with intercepts 2, 3 and 4 on the x, y and z-axis respectively.

SOLVED EXAMPLES - Question No. 20

Find the vector equation of the plane passing through the intersection of the planes $\rightarrow r\hat{i} + \dot{\hat{j}} + \hat{k} = 6$ and $\rightarrow r2\hat{i} + 3\dot{\hat{j}} + 4\hat{k} = -5$ and the point (1, 1, 1).

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SOLVED EXAMPLES - Question No. 21

Show that the lines $\frac{x+3}{-3} = \frac{y-1}{1} = \frac{z-5}{5}$ and $\frac{x+1}{-1} = \frac{y-2}{2} = \frac{z-5}{5}$ are coplanar.

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SOLVED EXAMPLES - Question No. 22

Find the angle between the two planes $2x + y2z = 5$ and

$3x6y2z = 7$ using vector method.

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SOLVED EXAMPLES - Question No. 23

Find the angle between the two planes $3x6y + 2z = 7$ and

$2x + 2y2z = 5$.

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SOLVED EXAMPLES - Question No. 24

Find the distance of a point $(2, 5, 3)$ from the plane

$\rightarrow r6\hat{i} - 3\hat{j} + 2\hat{k} = 4$.

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SOLVED EXAMPLES - Question No. 25

Find the angle between the line $\frac{x+1}{2} = \frac{y}{3} = \frac{z-3}{6}$ and the plane $10x + 2y11z = 3$.

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SOLVED EXAMPLES - Question No. 26

A line makes angles α, β, γ and δ with the diagonals of a cube,

prove that $\cos^2\alpha + \cos^2\beta + \cos^2\gamma + \cos^2\delta = \frac{4}{3}$

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SOLVED EXAMPLES - Question No. 27

Find the equation of the plane that contains the point $(1, 1, 2)$ and

is perpendicular to each of the planes $2x + 3y2z = 5$ and

$x + 2y3z = 8$.

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SOLVED EXAMPLES - Question No. 28

Find the distance between the point $P(6, 5, 9)$ and the plane determined by the points $A(3, 1, 2)$, $B(5, 2, 4)$ and $C(1, 1, 6)$.

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SOLVED EXAMPLES - Question No. 29

Show that the lines $\frac{x-a+d}{\alpha-\delta}=\frac{y-a}{\alpha}=\frac{z-a-d}{\alpha+\delta}$ and $\frac{x-b+c}{\beta-\gamma}=\frac{y-b}{\beta}=\frac{z-b-c}{\beta+\gamma}$ are coplanar.

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SOLVED EXAMPLES - Question No. 30

Find the coordinates of the point where the line through the points

A (3, 4, 1) and B(5, 1, 6) crosses the XY-plane.