Exercise 28g

Question 1.

Find the angle between the line $\vec{r} = \left(\hat{i} + 2\hat{j} - \hat{k}\right) + \lambda\left(\hat{i} - \hat{j} + \hat{k}\right)$ and the plane $\vec{r} \cdot \left(2\hat{i} - \hat{j} + \hat{k}\right) = 4.$

Answer:

Given - $\vec{r} = (\hat{\imath} + 2\hat{\jmath} - \hat{k}) + \lambda(\hat{\imath} - \hat{\jmath} + \hat{k})$ and $\vec{r}.(2\hat{\imath} - \hat{\jmath} + \hat{k}) = 4$

To find – The angle between the line and the plane

Direction ratios of the line = (1, - 1, 1)

Direction ratios of the normal of the plane = (2, - 1, 1)

Formula to be used – If (a, b, c) be the direction ratios of a line and (a′, b′, c′) be the direction ratios of the normal to the plane, then, the angle between the two is given by

$$\sin^{-1}\left(\frac{a \times a' + b \times b' + c \times c'}{\sqrt{a^2 + b^2 + c^2}\sqrt{a'^2 + b'^2 + c'^2}}\right)$$

The angle between the line and the plane

$$= \sin^{-1}\left(\frac{1 \times 2 + (-1) \times (-1) + 1 \times 1}{\sqrt{1^2 + 1^2 + 1^2}\sqrt{2^2 + 1^2 + 1^2}}\right)$$

$$= \sin^{-1}\left(\frac{2 + 1 + 1}{\sqrt{3}\sqrt{6}}\right)$$

$$= \sin^{-1}\left(\frac{4}{3\sqrt{2}}\right)$$

$$= \sin^{-1}\left(\frac{2\sqrt{2}}{3}\right)$$

Question 2.

Find the angle between the line $\vec{r}=\left(2\hat{i}-\hat{j}+3\hat{k}\right)+\lambda\left(3\hat{i}-\hat{j}+2\hat{k}\right)$ and the plane $\vec{r}\cdot\left(\hat{i}+\hat{j}+\hat{k}\right)=3.$

Answer:
Given - $\vec{r} = (2\hat{\imath}-\hat{\jmath} + 3\hat{k}) + \lambda(3\hat{\imath}-\hat{\jmath} + 2\hat{k})$ and $\vec{r}.(\hat{\imath} + \hat{\jmath} + \hat{k}) = 3$

To find – The angle between the line and the plane

Direction ratios of the line = (3, - 1, 2)

Direction ratios of the normal of the plane = (1, 1, 1)

Formula to be used – If (a, b, c) be the direction ratios of a line and (a′, b′, c′) be the direction ratios of the normal to the plane, then, the angle between the two is given by

$$\sin^{-1}\left(\frac{a\times a' + b\times b' + c\times c'}{\sqrt{a^2+b^2+c^2}\sqrt{a'^2+b'^2+c'^2}}\right)$$

The angle between the line and the plane

$$= \sin^{-1}\left(\frac{3\times 1 + (-1)\times 1 + 2\times 1}{\sqrt{3^2 + 1^2 + 2^2}\sqrt{1^2 + 1^2 + 1^2}}\right)$$

$$= \sin^{-1}\left(\frac{3-1+2}{\sqrt{14}\sqrt{3}}\right)$$

$$= \sin^{-1}\left(\frac{4}{\sqrt{42}}\right)$$

Question 3.

Find the angle between the line $\vec{r}=\left(3\hat{i}+\hat{k}\right)+\lambda\left(\hat{j}+\hat{k}\right)$ and the plane $\vec{r}\cdot\left(2\hat{i}-\hat{j}+2\hat{k}\right)=1.$

Answer:
Given - $\vec{r} = (3\hat{\imath} + \hat{k}) + \lambda(\hat{\jmath} + \hat{k})$ and $\vec{r}.(2\hat{\imath}-\hat{\jmath} + 2\hat{k}) = 1$

To find – The angle between the line and the plane

Direction ratios of the line = (0, 1, 1)

Direction ratios of the normal of the plane = (2, - 1, 2)

Formula to be used – If (a, b, c) be the direction ratios of a line and (a′, b′, c′) be the direction ratios of the normal to the plane, then, the angle between the two is given by

$$\sin^{-1}\left(\frac{a\times a' + b\times b' + c\times c'}{\sqrt{a^2+b^2+c^2}\sqrt{a'^2+b'^2+c'^2}}\right)$$

The angle between the line and the plane

$$= \sin^{-1}\left(\frac{0\times 2 + 1\times(-1) + 1\times 2}{\sqrt{0^2 + 1^2 + 1^2}\sqrt{2^2 + 1^2 + 2^2}}\right)$$

$$= \sin^{-1}\left(\frac{-1 + 2}{3\sqrt{2}}\right)$$

$$= \boldsymbol{\sin^{-1}\left(\frac{1}{3\sqrt{2}}\right)}$$

Question 4.

Find the angle between the line $\frac{x-2}{3} = \frac{y+1}{-1} = \frac{z-3}{2}$ and the plane 3x + 4y + z + 5 = 0.

Answer:

Given - $\frac{x-2}{3} = \frac{y+1}{-1} = \frac{z-3}{2}$ and $3x + 4y + z + 5 = 0$

To find – The angle between the line and the plane

Direction ratios of the line = (3, - 1, 2)

Direction ratios of the normal of the plane = (3, 4, 1)

Formula to be used – If (a, b, c) be the direction ratios of a line and (a′, b′, c′) be the direction ratios of the normal to the plane, then, the angle between the two is given by

$$\sin^{-1}\left(\frac{a\times a' + b\times b' + c\times c'}{\sqrt{a^2+b^2+c^2}\sqrt{a'^2+b'^2+c'^2}}\right)$$

The angle between the line and the plane

$$= \sin^{-1}\left(\frac{3 \times 3 + (-1) \times 4 + 2 \times 1}{\sqrt{3^2 + 1^2 + 2^2}\sqrt{3^2 + 4^2 + 1^2}}\right)$$

$$= \sin^{-1}\left(\frac{9 - 4 + 2}{\sqrt{14}\sqrt{26}}\right)$$

$$= \sin^{-1}\left(\frac{7}{\sqrt{2}\sqrt{7} \times \sqrt{2} \times \sqrt{13}}\right)$$

$$= \mathbf{\sin^{-1}\left(\frac{7}{2\sqrt{91}}\right)}$$

Question 5.

Find the angle between the line $\frac{x+1}{2} = \frac{y}{3} = \frac{z-3}{6}$ and the plane 10x + 2y – 11z = 3.

Answer:

Given - $\frac{x+1}{2} = \frac{y}{3} = \frac{z-3}{6}$ and $10x + 2y - 11z = 3$

To find – The angle between the line and the plane

Direction ratios of the line = (2, 3, 6)

Direction ratios of the normal of the plane = (10, 2, - 11)

Formula to be used – If (a, b, c) be the direction ratios of a line and (a′, b′, c′) be the direction ratios of the normal to the plane, then, the angle between the two is given by

$$\sin^{-1}\left(\frac{a \times a' + b \times b' + c \times c'}{\sqrt{a^2 + b^2 + c^2}\sqrt{a'^2 + b'^2 + c'^2}}\right)$$

The angle between the line and the plane

$$= \sin^{-1}\left(\frac{2 \times 10 + 3 \times 2 + 6 \times (-11)}{\sqrt{2^2 + 3^2 + 6^2}\sqrt{10^2 + 2^2 + 11^2}}\right)$$

$$= \sin^{-1}\left(\frac{20 + 6 - 66}{7 \times 15}\right)$$

$$= \sin^{-1}\left(\frac{-40}{7 \times 15}\right)$$

$$= \sin^{-1}\left(-\frac{8}{21}\right)$$

Question 6.
Find the angle between the line joining the points A(3, - 4, - 2) and B(12, 2, 0) and the plane 3x – y + z = 1.

Answer:
Given - A = (3, - 4, - 2) , B = (12, 2, 0) and 3x - y + z = 1

To find – The angle between the line joining the points A and B and the plane

Tip – If P = (a, b, c) and Q = (a′, b′, c′), then the direction ratios of the line PQ is given by ((a′ - a), (b′ - b), (c′ - c))

The direction ratios of the line AB can be given by

((12 - 3), (2 + 4), (0 + 2))

= (9, 6, 2)

Direction ratios of the normal of the plane = (3, - 1, 1)

Formula to be used – If (a, b, c) be the direction ratios of a line and (a′, b′, c′) be the direction ratios of the normal to the plane, then, the angle between the two is given by

$$\sin^{-1}\left(\frac{a \times a' + b \times b' + c \times c'}{\sqrt{a^2 + b^2 + c^2}\sqrt{a'^2 + b'^2 + c'^2}}\right)$$

The angle between the line and the plane

$$= \sin^{-1}\left(\frac{9 \times 3 + 6 \times (-1) + 2 \times 1}{\sqrt{9^2 + 6^2 + 2^2}\sqrt{3^2 + 1^2 + 1^2}}\right)$$

$$= \sin^{-1}\left(\frac{27 - 6 + 2}{11 \times \sqrt{11}}\right)$$

$$= \sin^{-1}\left(\frac{23}{11\sqrt{11}}\right)$$

Question 7.
If the plane 2x – 3y – 6z = 13 makes an angle sin $^{-1}$ (λ) with the x - axis, then find the value of λ.

Answer:
Given - $y = z = 0$ and $2x - 3y - 6z = 13$

To find – The angle between the line and the plane

Direction ratios of the line = (1, 0, 0)

Direction ratios of the normal of the plane = (2, - 3, - 6)

Formula to be used – If (a, b, c) be the direction ratios of a line and (a′, b′, c′) be the direction ratios of the normal to the plane, then, the angle between the two is given by

$$\sin^{-1}\left(\frac{a\times a' + b\times b' + c\times c'}{\sqrt{a^2+b^2+c^2}\sqrt{a'^2+b'^2+c'^2}}\right)$$

The angle between the line and the plane

$$= \sin^{-1}\left(\frac{1\times 2 + 0\times(-3) + 0\times(-6)}{\sqrt{1^2+0^2+0^2}\sqrt{2^2+3^2+9^2}}\right)$$

$$= \sin^{-1}\left(\frac{2}{7}\right)$$

Question 8.
Show that the line $\vec{r} = \left(2\hat{i}+5\hat{j}+7\hat{k}\right)+\lambda\left(\hat{i}+3\hat{j}+4\hat{k}\right)$ is parallel to the plane $\vec{r}\cdot\left(\hat{i}+\hat{j}-\hat{k}\right)=7$. Also, find the distance between them.

Answer:
Given - $\vec{r} = \left(2\hat{i} + 5\hat{j} + 7\hat{k}\right) + \lambda\left(\hat{i} + 3\hat{j} + 4\hat{k}\right)$ and $\vec{r}.\left(\hat{i} + \hat{j} - \hat{k}\right) = 7$

To prove – The line and the plane are parallel &

To find – The distance between them

Direction ratios of the line = (1, 3, 4)

Direction ratios of the normal of the plane = (1, 1, - 1)

Formula to be used – If (a, b, c) be the direction ratios of a line and (a′, b′, c′) be the direction ratios of the normal to the plane, then, the angle between the two is given by

$$\sin^{-1}\left(\frac{a\times a' + b\times b' + c\times c'}{\sqrt{a^2+b^2+c^2}\sqrt{a'^2+b'^2+c'^2}}\right)$$

The angle between the line and the plane

$$= \sin^{-1}\left(\frac{1\times 1 + 3\times 1 + 4\times(-1)}{\sqrt{1^2+3^2+4^2}\sqrt{1^2+1^2+1^2}}\right)$$

$$= \sin^{-1}\left(\frac{1+3-4}{\sqrt{26}\sqrt{3}}\right)$$

$$= \sin^{-1}(0)$$

$$= 0$$

Hence, **the line and the plane are parallel.**

Now, the equation of the plane may be written as x + y - z = 7.

Tip – If ax + by + c + d = 0 be a plane and $\vec{r} = (a'\hat{\imath} + b'\hat{\jmath} + c'\hat{k}) + \lambda(a''\hat{\imath} + b''\hat{\jmath} + c''\hat{k})$ be a line vector, then the distance between them is given by $\left|\frac{a\times a' + b\times b' + c\times c' + d}{\sqrt{a^2+b^2+c^2}}\right|$

The distance between the plane and the line

$$= \left|\frac{1\times 2 + 1\times 5 - 1\times 7 - 7}{\sqrt{1^2+1^2+1^2}}\right|$$

$$= \left|\frac{2+5-7-7}{\sqrt{3}}\right|$$

$= \frac{7}{\sqrt{3}}$**units**

Question 9.

Find the value of m for which the line $\vec{r} = \left(\hat{i} + 2\hat{k}\right) + \lambda\left(2\hat{i} - m\hat{j} - 3\hat{k}\right)$ is parallel to the plane $\vec{r} \cdot \left(m\hat{i} + 3\hat{j} + \hat{k}\right) = 4.$

Answer:

Given - $\vec{r} = (\hat{i} + 2\hat{k}) + \lambda(2\hat{i} - m\hat{j} - 3\hat{k})$ and $\vec{r}.(m\hat{i} + 3\hat{j} + \hat{k}) = 4$ and they are parallel

To find – The value of m

Direction ratios of the line = (2, - m, - 3)

Direction ratios of the normal of the plane = (m, 3, 1)

Formula to be used – If (a, b, c) be the direction ratios of a line and (a′, b′, c′) be the direction ratios of the normal to the plane, then, the angle between the two is given by

$$\sin^{-1}\left(\frac{a\times a' + b\times b' + c\times c'}{\sqrt{a^2 + b^2 + c^2}\sqrt{a'^2 + b'^2 + c'^2}}\right)$$

$$\therefore \sin^{-1}\left(\frac{2\times m + (-m)\times 3 + (-3)\times 1}{\sqrt{2^2 + m^2 + 3^2}\sqrt{m^2 + 3^2 + 1^2}}\right) = 0$$

$$\Rightarrow \sin^{-1}\left(\frac{2m - 3m - 3}{\sqrt{13 + m^2}\sqrt{10 + m^2}}\right) = 0$$

$$\Rightarrow \frac{-m - 3}{\sqrt{13 + m^2}\sqrt{10 + m^2}} = 0$$

$$\Rightarrow \mathbf{m = -3}$$

Question 10.

Find the vector equation of a line passing through the origin and perpendicular to the plane $\vec{r} \cdot \left(\hat{i} + 2\hat{j} + 3\hat{k}\right) = 3.$

Answer:

Given - $\vec{r}.\left(\hat{\imath} + 2\hat{\jmath} + 3\hat{k}\right) = 3$

To find – The vector equation of the line passing through the origin and perpendicular to the given plane

Tip – The equation of a plane can be given by $\vec{r}.\hat{n} = d$ where $\hat{n}$ is the normal of the plane

A line parallel to the given plane will be in the direction of the normal and will have the direction ratios same as that of the normal.

Formula to be used – If a line passes through the point (a, b, c) and has the direction ratios as (a′, b′, c′), then its vector equation is given by $\vec{r} = \left(a\hat{\imath} + b\hat{\jmath} + c\hat{k}\right) + \lambda\left(a'\hat{\imath} + b'\hat{\jmath} + c'\hat{k}\right)$ where λ is any scalar constant

The required equation will be $\vec{r} = \left(0.\hat{\imath} + 0.\hat{\jmath} + 0.\hat{k}\right) + \lambda\left(\hat{\imath} + 2\hat{\jmath} + 3\hat{k}\right)$

$= \boldsymbol{\lambda}\left(\hat{\boldsymbol{\imath}} + \mathbf{2}\hat{\boldsymbol{\jmath}} + \mathbf{3}\hat{\mathbf{k}}\right)$**for some scalar λ**

Question 11.
Find the vector equation of the line passing through the point with position vector $\left(\hat{i}-2\hat{j}+5\hat{k}\right)$ and perpendicular to the plane $\vec{r}\cdot\left(2\hat{i}-3\hat{j}-\hat{k}\right)=0.$

Answer:
Given - $\vec{r}.\left(2\hat{\imath} - 3\hat{\jmath} - \hat{k}\right) = 0$ and the vector has position vector $\left(\hat{\imath} - 2\hat{\jmath} + 5\hat{k}\right)$

To find – The vector equation of the line passing through (1, - 2, 5) and perpendicular to the given plane

Tip – The equation of a plane can be given by $\vec{r}.\hat{n} = d$ where $\hat{n}$ is the normal of the plane

A line parallel to the given plane will be in the direction of the normal and will have the direction ratios same as that of the normal.

Formula to be used – If a line passes through the point (a, b, c) and has the direction ratios as (a′, b′, c′), then its vector equation is given by $\vec{r} = \left(a\hat{\imath} + b\hat{\jmath} + c\hat{k}\right) + \lambda\left(a'\hat{\imath} + b'\hat{\jmath} + c'\hat{k}\right)$ where λ is any scalar constant

The required equation will be $\vec{\mathbf{r}} = \left(\hat{\boldsymbol{\imath}} - \mathbf{2}\hat{\boldsymbol{\jmath}} + \mathbf{5}\hat{\mathbf{k}}\right) + \boldsymbol{\lambda}\left(\mathbf{2}\hat{\boldsymbol{\imath}} - \mathbf{3}\hat{\boldsymbol{\jmath}} - \hat{\mathbf{k}}\right)$**for some scalar λ**

Question 12.
Show that the equation ax + by + d = 0 represents a plane parallel to the z - axis. Hence, find the equation of a plane which is parallel to the z - axis and passes through the points A(2, - 3, 1) and B(- 4, 7, 6).

Answer:
Given – The equation of the plane is given by ax + by + d = 0

To prove – The plane is parallel to z - axis

Tip – If ax + by + cz + d is the equation of the plane then its angle with the z - axis will be given by $\sin^{-1}\left(\frac{c}{\sqrt{a^2 + b^2 + c^2}}\right)$

Considering the equation, the direction ratios of its normal is given by (a, b, 0)

The angle the plane makes with the z - axis = $\sin^{-1}[0/\sqrt{(a^2 + b^2)}] = 0$

Hence, **the plane is parallel to the z - axis**

To find – Equation of the plane parallel to z - axis and passing through points A = (2, - 3, 1) and B = (- 4, 7, 6)

The given equation ax + by + d = 0 passes through (2, - 3, 1) & (- 4, 7, 6)

$\therefore 2a - 3b + d = 0$.........(i)

$\therefore -4a + 7b + d = 0$......(ii)

Solving (i) and (ii),

$\therefore \frac{a}{\begin{vmatrix} -3 & 1 \\ 7 & 1 \end{vmatrix}} = \frac{b}{\begin{vmatrix} 1 & 2 \\ 1 & -4 \end{vmatrix}} = \alpha$ [α → arbitrary constant]

$\therefore a = -10\alpha$

$\therefore b = -6\alpha$

Substituting the values of a and b in eqn (i), we get,

- 2X10α + 3X6α + d = 0 i.e. d = - 2α

Putting the value of a, b and d in the equation ax + by + d = 0,

$(-10\alpha)x + (-6\alpha)y + (-2\alpha) = 0$

i.e. **5x + 3y + 1 = 0**

Question 13.
Find the equation of the plane passing through the points (1, 2, 3) and (0, - 1, 0) and parallel to the line $\frac{x-1}{2} = \frac{y+2}{3} = \frac{z}{-3}$.

Answer:
Given – A plane passes through points (1, 2, 3) and (0, - 1, 0) and is parallel to the line $\frac{x-1}{2} = \frac{y+2}{3} = \frac{z}{-3}$

To find – Equation of the plane

Tip – If a plane passes through points (a′, b′, c′), then its equation may be given as a(x - a′) + b(y - b′) + c(z - c′) = 0

Taking points (1, 2, 3):

a(x - 1) + b(y - 2) + c(z - 3) = 0...........(i)

The plane passes through (0, - 1, 0):

a(0 - 1) + b(- 1 - 2) + c(0 - 3) = 0

i.e. a + 3b + 3c = 0.................(ii)

The plane is parallel to the line $\frac{x-1}{2} = \frac{y+2}{3} = \frac{z}{-3}$

Tip – The normal of the plane will be normal to the given line since both the line and plane are parallel.

Direction ratios of the line is (2, 3, - 3)

Direction ratios of the normal of the plane is (a, b, c)

So, 2a + 3b - 3c = 0.........................(iii)

Solving equations (ii) and (iii),

$\therefore \frac{a}{\begin{vmatrix} 3 & 3 \\ 3 & -3 \end{vmatrix}} = -\frac{b}{\begin{vmatrix} 1 & 3 \\ 2 & -3 \end{vmatrix}} = \frac{c}{\begin{vmatrix} 1 & 3 \\ 2 & 3 \end{vmatrix}} = \alpha$ [α → arbitrary constant]

$\therefore a = -18\alpha$

$\therefore b = 9\alpha$

$\therefore c = -3\alpha$

Putting these values in equation (i) we get,

$-18\alpha(x-1) + 9\alpha(y-2) - 3\alpha(z-3) = 0$

$\Rightarrow 18(x-1) - 9(y-2) + 3(z-3) = 0$

$\Rightarrow 6(x-1) - 3(y-2) + (z-3) = 0$

$\Rightarrow 6x - 3y + z - 3 = 0$

$\Rightarrow \mathbf{6x - 3y + z = 3}$

Question 14.
Find the equation of a plane passing through the point (2, - 1, 5), perpendicular to the plane x + 2y - 3z = 7 and parallel to the line $\frac{x+5}{3} = \frac{y+1}{-1} = \frac{z-2}{1}$.

Answer:
Given – A plane passes through (2, - 1, 5), perpendicular to the plane x + 2y - 3z = 7 and parallel to the line $\frac{x+5}{3} = \frac{y+1}{-1} = \frac{z-2}{1}$

To find – The equation of the plane

Let the equation of the required plane be ax + by + cz + d = 0……(a)

The plane passes through (2, - 1, 5)

So, 2a - b + 5c + d = 0…………………(i)

The direction ratios of the normal of the plane is given by (a, b, c)

Now, this plane is perpendicular to the plane x + 2y - 3z = 7 having direction ratios (1, 2, - 3)

So, a + 2b - 3c = 0...............(ii)

This plane is also parallel to the line having direction ratios (3, - 1, 1)

So, the direction of the normal of the required plane is also at right angles to the given line.

So, 3a - b + c = 0..................(iii)

Solving equations (ii) and (iii),

$$\therefore \frac{a}{\begin{vmatrix} 2 & -3 \\ -1 & 1 \end{vmatrix}} = -\frac{b}{\begin{vmatrix} 1 & -3 \\ 3 & 1 \end{vmatrix}} = \frac{c}{\begin{vmatrix} 1 & 2 \\ 3 & -1 \end{vmatrix}} = \alpha$$ [α → arbitrary constant]

$\therefore a = -\alpha$

$\therefore b = -10\alpha$

$\therefore c = -7\alpha$

Putting these values in equation (i) we get,

2X(- α) - (- 10α) + 5(- 7α) + d = 0 i.e. d = 27α

Substituting all the values of a, b, c and d in equation (a) we get,

$$-\alpha x - 10\alpha y - 7\alpha z + 27\alpha = 0$$

$$\Rightarrow \mathbf{x + 10y + 7z + 27 = 0}$$

Question 15.
Find the equation of the plane passing through the intersection of the planes 5x - y + z = 10 and x + y - z = 4 and parallel to the line with direction ratios 2, 1, 1. Find also the perpendicular distance of (1, 1, 1) from this plane.

Answer:

Given – A plane passes through the intersection of $5x - y + z = 10$ and $x + y - z = 4$ and parallel to the line with direction ratios (2, 1, 1)

To find – Equation of the plane

Tip – If $ax + by + cz + d = 0$ and $a'x + b'y + c'z + d' = 0$ be two planes, then the equation of the plane passing through their intersection will be given by

$(ax + by + cz + d) + \lambda(a'x + b'y + c'z + d') = 0$, where λ is any scalar constant

So, the equation of the plane maybe written as

$(5x - y + z - 10) + \lambda(x + y - z - 4) = 0$

$\Rightarrow (5 + \lambda)x + (-1 + \lambda)y + (1 - \lambda)z + (-10 - 4\lambda) = 0$

This is plane parallel to a line with direction ratios (2, 1, 1)

So, the normal of this line with direction ratios $((5 + \lambda), (-1 + \lambda), (1 - \lambda))$ will be perpendicular to the given line.

Hence,

$2(5 + \lambda) + (-1 + \lambda) + (1 - \lambda) = 0$

$\Rightarrow \lambda = -5$

The equation of the plane will be

$(5 + (-5))x + (-1 + (-5))y + (1 - X(-5))z + (-10 - 4X(-5)) = 0$

$\Rightarrow -6y + 6z + 10 = 0$

$\Rightarrow$ **$3y - 3z = 5$**

To find – Perpendicular distance of point (1, 1, 1) from the plane

Formula to be used - If $ax + by + c + d = 0$ be a plane and (a', b', c') be the point, then the distance between them is given by $\left|\frac{a \times a' + b \times b' + c \times c' + d}{\sqrt{a^2 + b^2 + c^2}}\right|$

The distance between the plane and the line

$$= \left|\frac{0 \times 2 + 3 \times 1 - 3 \times 1 - 5}{\sqrt{0^2 + 3^2 + 3^2}}\right|$$

$$= \left|\frac{3 - 3 - 5}{2\sqrt{3}}\right|$$

$= \frac{\mathbf{5}}{\mathbf{2\sqrt{3}}}$**units**