RD Sharma Solutions Class 12 Maths Chapter 28 Ex 28.4

Let foot of the perpendicular drawn from the point $P(1,0,0)$ to the line $\frac{x-1}{2}=\frac{y+1}{-3}=\frac{z+10}{8}$ is Q. We have to find length of PQ.

Q is a general point on the line,

$$\frac{x-1}{2}=\frac{y+1}{-3}=\frac{z+10}{8}=\lambda \text{ (say)}$$

Coordinate of $Q = (2\lambda+1, -3\lambda-1, 8\lambda-10)$

Direction ratios line PQ are

$$= (2\lambda+1-1), (-3\lambda-1-0), (8\lambda-10-0)$$

$$\Rightarrow \quad = (2\lambda), (-3\lambda-1), (8\lambda-10)$$

Since, line PQ is perpendicular to the given line, so

$$a_1a_2+b_1b_2+c_1c_2=0$$
$$(2)(2\lambda)+(-3)(-3\lambda-1)+8(8\lambda-10)=0$$
$$4\lambda+9\lambda+3+64\lambda-80=0$$
$$77\lambda-77=0$$
$$\lambda=1$$

Therefore, coordinate of Q is $(2\lambda+1, -3\lambda-1, 8\lambda-10)$

$$= (2(1)+1, -3(1)-1, 8(1)-10)$$
$$= (3,-4,-2)$$

Therefore, coordinate of Q is $(2\lambda+1, -3\lambda-1, 8\lambda-10)$

$$= (2(1)+1, -3(1)-1, 8(1)-10)$$
$$= (3,-4,-2)$$

$$PQ = \sqrt{(x_1-x_2)^2+(y_1-y_2)^2+(z_1-z_2)^2}$$
$$= \sqrt{(1-3)^2+(0+4)^2+(0+2)^2}$$
$$= \sqrt{4+16+4}$$
$$= \sqrt{24}$$
$$= 2\sqrt{6}$$

So, foot of perpendicular $= (3,-4,-2)$

length of perpendicular $= 2\sqrt{6}$ units

Straight Line in Space Ex 28.4 Q3

Let the foot of the perpendicular drawn from $A(1,0,3)$ to the line joining the points $B(4,7,1)$

And $C(3,5,3)$ be D

Equation of line passing through $B(4,7,1)$ and $C(3,5,3)$ is

$$\frac{x-x1}{x2-x1}=\frac{y-y1}{y2-y1}=\frac{z-z1}{z2-z1}$$
$$\Rightarrow \frac{x-4}{3-4}=\frac{y-7}{5-7}=\frac{z-1}{3-1}$$
$$\Rightarrow \frac{x-4}{-1}=\frac{y-7}{-2}=\frac{z-1}{2}=\lambda \text{ (say)}$$

Direction ratio of AD are

$$(-\lambda+4-1),(-2\lambda+7-0),(2\lambda+1-3)$$
$$=(-\lambda+3),(-2\lambda+7),(2\lambda-2)$$

Line AD is perpendicular to BC so

$$a1a2+b1b2+c1c2=0$$
$$\Rightarrow(-1)(-\lambda+3)+(-2)(-2\lambda+7)+2(2\lambda-2)=0$$
$$\Rightarrow \lambda-3+4\lambda-14+4\lambda-4=0$$
$$\Rightarrow 9\lambda-21=0$$
$$\Rightarrow \lambda=\frac{21}{9}$$

Co-ordinates of D are

$$=\left(-\frac{21}{9}+4,(-2)\left(\frac{21}{9}+7\right),2\left(\frac{21}{9}+1\right)\right)$$
$$=\left(\frac{15}{9},\frac{21}{9},\frac{51}{9}\right)$$
$$=\left(\frac{5}{3},\frac{7}{3},\frac{17}{3}\right)$$

Straight Line in Space Ex 28.4 Q4

Given that D is the foot of perpendicular from $A(1,0,4)$ on BC, so

Equation of line passing through B, C is

$$\frac{x-x_1}{x_2-x_1}=\frac{y-y_1}{y_2-y_1}=\frac{z-z_1}{z_2-z_1}$$

$$\Rightarrow \quad \frac{x-0}{2-0}=\frac{y+11}{-3+11}=\frac{z-3}{1-3}$$
$$\Rightarrow \quad \frac{x}{2}=\frac{y+11}{8}=\frac{z-3}{-2}=\lambda \text{ (say)}$$

Coordinate of $D=(2\lambda,\ 8\lambda-11,\ -2\lambda+3)$

Direction ratios of $AD = 2\lambda-1,\ 8\lambda-11-0,\ -2\lambda+3-4$
$$=(2\lambda-1),(8\lambda-11),(-2\lambda-1)$$

Since, line AD is perpendicular on BC, so
$$a_1a_2+b_1b_2+c_1c_2=0$$

$\Rightarrow \quad (2)(2\lambda - 1) + (8)(8\lambda - 11) + (-2)(-2\lambda - 1) = 0$

$\Rightarrow \quad 4\lambda - 2 + 64\lambda - 88 + 4\lambda + 2 = 0$

$\Rightarrow \quad 72\lambda - 88 = 0$

$\Rightarrow \quad \lambda = \dfrac{88}{72}$

$\lambda = \dfrac{11}{9}$

Coordinate of $D = (2\lambda,\ 8\lambda - 11,\ -2\lambda + 3)$

$$= \left(2\left(\frac{11}{9}\right),\ 8\left(\frac{11}{9}\right) - 11,\ -2\left(\frac{11}{9}\right) + 3\right)$$

Coordinate of $D = \left(\dfrac{22}{9}, \dfrac{-11}{9}, \dfrac{5}{9}\right)$

Straight Line in Space Ex 28.4 Q5

Let foot of the perpendicular from $P(2,3,4)$ is θ on the line $\dfrac{4-x}{2} = \dfrac{y}{6} = \dfrac{1-z}{3}$, so

Equation of given line is,

$$\frac{4-x}{2} = \frac{y}{6} = \frac{1-z}{3}$$

$$\frac{x-4}{-2} = \frac{y}{6} = \frac{z-1}{-3} = \lambda \quad (\text{say})$$

Coordinate of $Q = (-2\lambda + 4,\ 6\lambda,\ -3\lambda + 1)$

Direction ratios of $PQ = (-2\lambda + 4 - 2), (6\lambda - 3), (-3\lambda + 1 - 4)$

$= (-2\lambda + 2), (6\lambda - 3), (-3\lambda - 3)$

Line PQ is perpendicular to given line, so

$a_1a_2 + b_1b_2 + c_1c_2 = 0$

$(-2)(-2\lambda + 2) + (6)(6\lambda - 3) + (-3)(-3\lambda - 3) = 0$

$4\lambda - 4 + 36\lambda - 18 + 9\lambda + 9 = 0$

$49\lambda - 13 = 0$

$\lambda = \dfrac{13}{49}$

Coordinate of $Q = (-2\lambda + 4,\ 6\lambda,\ -3\lambda + 1)$

$$= \left(-2\left(\frac{13}{49}\right) + 4,\ 6\left(\frac{13}{49}\right),\ -3\left(\frac{13}{49}\right) + 1\right)$$

$$= \left(\frac{-26 + 196}{49},\ \frac{78}{49},\ \frac{-39 + 49}{49}\right)$$

Coordinate of $Q = \left(\frac{170}{49}, \frac{78}{49}, \frac{10}{49}\right)$

$$PQ = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2 + (z_1 - z_2)^2}$$

$$= \sqrt{\left(\frac{170}{49} - 2\right)^2 + \left(\frac{78}{49} - 3\right)^2 + \left(\frac{10}{49} - 4\right)^2}$$

$$= \sqrt{\left(\frac{72}{49}\right)^2 + \left(\frac{69}{49}\right)^2 + \left(-\frac{168}{49}\right)^2}$$

$$= \sqrt{\frac{5184 + 4761 + 34596}{2401}}$$

$$= \sqrt{\frac{44541}{2401}}$$

$$= \sqrt{\frac{909}{49}}$$

$$= \frac{3\sqrt{101}}{49}$$

Perpendicular distance from $(2, 3, 4)$ to given line is $\frac{3\sqrt{101}}{49}$ units.

Straight Line in Space Ex 28.4 Q6

Let θ be the foot of the perpendicular drawn from $P(2, 4, -1)$ to the line

$$\frac{x+5}{1} = \frac{y+3}{4} = \frac{z-6}{-9}$$

Given line is $\frac{x+5}{1} = \frac{y+3}{4} = \frac{z-6}{-9} = \lambda$ (say)

Coordinate of Q (General point on the line)

$$= (\lambda - 5,\ 4\lambda - 3,\ -9\lambda + 6)$$

Direction ratios of PQ are

$$= (\lambda - 5 - 2),\ (4\lambda - 3 - 4),\ (-9\lambda + 6 + 1)$$

$$= \lambda - 7,\ 4\lambda - 7,\ -9\lambda + 7$$

Line PQ is perpendicular to the given line, so

$$a_1a_2 + b_1b_2 + c_1c_2 = 0$$

$$(1)(\lambda - 7) + (4)(4\lambda - 7) + (-9)(-9\lambda + 7) = 0$$

$$\lambda - 7 + 16\lambda - 28 + 81\lambda - 63 = 0$$

$$98\lambda - 98 = 0$$

$$\lambda = 1$$

$\therefore$ Coordinate of $Q = (\lambda - 5,\ 4\lambda - 3,\ -9\lambda + 6)$

$$= (1 - 5,\ 4(1) - 3,\ -9(1) + 6)$$

Coordinate of foot of perpendicular $= (-4, 1, -3)$

So, equation of the perpendicular PQ is

$$\frac{x - x_1}{x_2 - x_1} = \frac{y - y_1}{y_2 - y_1} = \frac{z - z_1}{z_2 - z_1}$$

$$\Rightarrow \quad \frac{x - 2}{-4 - 2} = \frac{y - 4}{1 - 4} = \frac{z + 1}{-3 + 1}$$

$$\Rightarrow \quad \frac{x - 2}{-6} = \frac{y - 4}{-3} = \frac{z + 1}{-2}$$

Straight Line in Space Ex 28.4 Q7

Let foot of the perpendicular drawn from $P(5, 4, -1)$ to the given line is Q, so

Given equation of line is,

$$\vec{r} = \hat{i} + \lambda\left(2\hat{i} + 9\hat{j} + 5\hat{k}\right)$$

$$\left(x\hat{i} + y\hat{j} + z\hat{k}\right) = (1 + 2\lambda)\hat{i} + (9\lambda)\hat{j} + (5\lambda)\hat{k}$$

Equation the coefficients of $\hat{i}, \hat{j}$ and $\hat{k}$

$$\Rightarrow \quad x = 1 + 2\lambda,\ y = 9\lambda,\ z = 5\lambda$$

$$\Rightarrow \quad \frac{x - 1}{2} = \lambda,\ \frac{y}{9} = \lambda,\ \frac{z}{5} = \lambda$$

$$\Rightarrow \quad \frac{x - 1}{2} = \frac{y}{9} = \frac{z}{5} = \lambda \ \text{(say)}$$

Coordinate of $Q = (2\lambda + 1,\ 9\lambda,\ 5\lambda)$

Direction ratios of line PQ are

$$(2\lambda + 1 - 5),\ 9\lambda - 4,\ 5\lambda + 1$$

$$\Rightarrow \quad 2\lambda - 4,\ 9\lambda - 4,\ 5\lambda + 1$$

Straight Line in Space Ex 28.4 Q8

Let position vector of foot of perpendicular drown from $P\left(\hat{i} + 6\hat{j} + 3\hat{k}\right)$ on

$\vec{r} = \left(\hat{j} + 2\hat{k}\right) + \lambda\left(\hat{i} + 2\hat{j} + 3\hat{k}\right)$ be $Q(\vec{q})$. So

Q is on the line $\vec{r} = \left(\hat{j} + 2\hat{k}\right) + \lambda\left(\hat{i} + 2\hat{j} + 3\hat{k}\right)$

So, Position vector of Q = $(\lambda)\hat{i} + (1 + 2\lambda)\hat{j} + (2 + 3\lambda)\hat{k}$

$\overrightarrow{PQ}$ = Position vector of Q – Position vector of P

$$= \left\{\lambda\hat{i} + (1 + 2\lambda)\hat{j} + (2 + 3\lambda)\hat{k}\right\} - \left(\hat{i} + 6\hat{j} + 3\hat{k}\right)$$

$$= (\lambda - 1)\hat{i} + (1 + 2\lambda - 6)\hat{j} + (2 + 3\lambda - 3)\hat{k}$$

$$\overrightarrow{PQ} = (\lambda - 1)\hat{i} + (2\lambda - 5)\hat{j} + (3\lambda - 1)\hat{k}$$

Here, $\overrightarrow{PQ}$ is perpendicular to given line

So,

$$\left\{(\lambda - 1)\hat{i} + (2\lambda - 5)\hat{j} + (3\lambda - 1)\hat{k}\right\}\left(\hat{i} + 2\hat{j} + 3\hat{k}\right) = 0$$

$\Rightarrow \quad (\lambda - 1)(1) + (2\lambda - 5)(2) + (3\lambda - 1)(3) = 0$

$\Rightarrow \quad \lambda - 1 + 4\lambda - 10 + 9\lambda - 3 = 0$

$\Rightarrow \quad 14\lambda - 14 = 0$

$\Rightarrow \quad \lambda = 1$

Position vector of Q = $\left(\hat{j} + 2\hat{k}\right) + \lambda\left(\hat{i} + 2\hat{j} + 3\hat{k}\right)$

$$= \left(\hat{j} + 2\hat{k}\right) + (1)\left(\hat{i} + 2\hat{j} + 3\hat{k}\right)$$

Foot of perpendicular $= \hat{i} + 3\hat{j} + 5\hat{k}$

$\overrightarrow{PQ}$ = Position vector of Q – Position vector of P

$$= \left(\hat{i} + 3\hat{j} + 5\hat{k}\right) - \left(\hat{i} + 6\hat{j} + 3\hat{k}\right)$$

$$= \hat{i} + 3\hat{j} + 5\hat{k} - \hat{i} - 6\hat{j} - 3\hat{k}$$

$$= -3\hat{i} + 2\hat{k}$$

$$\left|\overrightarrow{PQ}\right| = \sqrt{(-3)^2 + (2)^2}$$

$$= \sqrt{13} \text{ units}$$

Length of perpendicular $= \sqrt{13}$ units

Straight Line in Space Ex 28.4 Q9

Let Q be the perpendicular drawn from $P\left(-\hat{i}+3\hat{j}+2\hat{k}\right)$ on the line

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

Let the position vector of Q be

$$\left(2\hat{j}+3\hat{k}\right)+\lambda\left(2\hat{i}+\hat{j}+3\hat{k}\right)$$

$$(2\lambda)\hat{i}+(2+\lambda)\hat{j}+(3+3\lambda)\hat{k}$$

$$\overrightarrow{PQ}=\text{Position vector of }Q-\text{Position vector of }P$$

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

$$=(2\lambda+1)\hat{i}+(2\lambda-3)\hat{j}+(3+3\lambda-2)\hat{k}$$

$$\overrightarrow{PQ}=(2\lambda+1)\hat{i}+(\lambda-1)\hat{j}+(3\lambda+1)\hat{k}$$

Since, $\overrightarrow{PQ}$ is perpendicular to the given line, so

$$\left\{(2\lambda+1)\hat{i}+(\lambda-1)\hat{j}+(3\lambda+1)\hat{k}\right\}\left(2\hat{i}+\hat{j}+3\hat{k}\right)=0$$

$$(2\lambda+1)(2)+(\lambda-1)(1)+(3\lambda+1)3=0$$

$$4\lambda+2+\lambda-1+9\lambda+3=0$$

$$14\lambda+4=0$$

$$\lambda=-\frac{4}{14}$$

$$\lambda=-\frac{2}{7}$$

$$\text{Position vector of }Q=(2\lambda)\hat{i}+(2+\lambda)\hat{j}+(3+3\lambda)\hat{k}$$

$$=2\left(-\frac{2}{7}\right)\hat{i}+\left(2-\frac{2}{7}\right)\hat{j}+\left(3+3\left(-\frac{2}{7}\right)\right)\hat{k}$$

$$=-\frac{4}{7}\hat{i}+\frac{12}{7}\hat{j}+\frac{15}{7}\hat{k}$$

Coordinates of foot of the perpendicular $=\left(-\frac{4}{7},\frac{12}{7},\frac{15}{7}\right)$

Equation of PQ is

$$\vec{r}=\vec{a}+\lambda\left(\vec{b}-\vec{a}\right)$$

$$\Rightarrow\quad \vec{r}=\left(-\hat{i}+3\hat{j}+2\hat{k}\right)+\lambda\left(\left(-\frac{4}{7}\hat{i}+\frac{12}{7}\hat{j}+\frac{15}{7}\hat{k}\right)-\left(-\hat{i}+3\hat{j}+2\hat{k}\right)\right)$$

Straight Line in Space Ex 28.4 Q10

Let foot of the perpendicular drawn from $(0,2,7)$ to the line $\frac{x+2}{-1}=\frac{y-1}{3}=\frac{z-3}{-2}$ be Q.

Given equation of the line is

$$\frac{x+2}{-1}=\frac{y-1}{3}=\frac{z-3}{-2}=\lambda \ (\text{say})$$

Coordinate of Q is $(-\lambda-2,\ 3\lambda+1,\ -2\lambda+3)$

Direction ratios of PQ are $(-\lambda-2-0),\ (3\lambda+1-2),\ (-2\lambda+3-7)$

$$=(-\lambda-2),\ (3\lambda-1),\ (-2\lambda-4)$$

Since, PQ is perpendicular to given line, so

$$a_1a_2+b_1b_2+c_1c_2=0$$

$$(-1)(-\lambda-2)+(3)(3\lambda-1)+(-2)(-2\lambda-4)=0$$

$\Rightarrow$ $\lambda+2+9\lambda-3+4\lambda+8=0$

$\Rightarrow$ $14\lambda+7=0$

$$\lambda=-\frac{1}{2}$$

Foot of the perpendicular $=(-\lambda-2,\ 3\lambda+1,\ -2\lambda+3)$

$$=\left(-\left(-\frac{1}{2}\right)-2,\ 3\left(-\frac{1}{2}\right)+1,\ -2\left(-\frac{1}{2}\right)+3\right)$$

Foot of the perpendicular $=\left(-\frac{3}{2},-\frac{1}{2},4\right)$

Straight Line in Space Ex 28.4 Q11

Let foot of the perpendicular from $P(1, 2, -3)$ to the line $\frac{x+1}{2} = \frac{y-3}{-2} = \frac{z}{-1}$ be Q

Given equation of the line is

$$\frac{x+1}{2} = \frac{y-3}{-2} = \frac{z}{-1} = \lambda$$

$\Rightarrow \quad x = 2\lambda - 1,\ y = -2\lambda + 3,\ z = -\lambda$

Coordinate of Q $(2\lambda - 1,\ -2\lambda + 3,\ -\lambda)$

Direction ratios of PQ are

$$(2\lambda - 1 - 1),\ (-2\lambda + 3 - 2),\ (-\lambda + 3)$$

$\Rightarrow \quad (2\lambda - 2),\ (-2\lambda + 1),\ (-\lambda + 3)$

Let PQ is perpendicular to given line, so

$$a_1a_2 + b_1b_2 + c_1c_2 = 0$$

$\Rightarrow \quad (2)(2\lambda - 2) + (-2)(-2\lambda + 1) + (-1)(-\lambda + 3) = 0$

$\Rightarrow \quad 4\lambda - 4 + 4\lambda - 2 + \lambda - 3 = 0$

$\Rightarrow \quad 9\lambda - 9 = 0$

$\Rightarrow \quad \lambda = 1$

Coordinate of foot of perpendicular

$$= (2\lambda - 1,\ -2\lambda + 3,\ -\lambda)$$

$$= (2(1) - 1,\ -2(1) + 3,\ -1)$$

$$= (1, 1, -1)$$

Straight Line in Space Ex 28.4 Q12

Equation of line AB is

$$\frac{x - x_1}{x_2 - x_1} = \frac{y - y_1}{y_2 - y_1} = \frac{z - z_1}{z_2 - z_1}$$

$$\Rightarrow \quad \frac{x - 0}{-3 - 0} = \frac{y - 6}{-6 - 6} = \frac{z + 9}{3 + 9}$$

$$\Rightarrow \quad \frac{x}{-3} = \frac{y - 6}{-12} = \frac{z + 9}{12} = \lambda \text{ (say)}$$

Coordinate of point $D = (-3\lambda, -12\lambda + 6, 12\lambda - 9)$

Direction ratios of $CD = (-3\lambda - 7), (-12\lambda + 6 - 4), (12\lambda - 9 + 1)$

$$= (-3\lambda - 7), (-12\lambda + 2), (12\lambda - 8)$$

Line CD is perpendicular to line AB, so

$$a_1a_2 + b_1b_2 + c_1c_2 = 0$$

$$\Rightarrow \quad (-3)(-3\lambda - 7) + (-12)(-12\lambda + 2) + (12)(12\lambda - 8) = 0$$

$$\Rightarrow \quad 9\lambda + 21 + 144\lambda - 24 + 144\lambda - 96 = 0$$

$$\Rightarrow \quad 297\lambda - 99 = 0$$

$$\Rightarrow \quad \lambda = \frac{1}{3}$$

Coordinate of $D = (-3\lambda, -12\lambda + 6, 12\lambda - 9)$

$$= \left(-3\left(\frac{1}{3}\right), -12\left(\frac{1}{3}\right) + 6, 12\left(\frac{1}{3}\right) - 9\right)$$

Coordinate of $D = (-1, 2, -5)$

Equation of CD is,

$$\frac{x - x_1}{x_2 - x_1} = \frac{y - y_1}{y_2 - y_1} = \frac{z - z_1}{z_2 - z_1}$$

$$\Rightarrow \quad \frac{x - 7}{-1 - 7} = \frac{y - 4}{2 - 4} = \frac{z + 1}{-5 + 1}$$

$$\Rightarrow \quad \frac{x - 7}{-8} = \frac{y - 4}{-2} = \frac{z + 1}{-4}$$

or $$\frac{x - 7}{4} = \frac{y - 4}{1} = \frac{z + 1}{2}$$

Straight Line in Space Ex 28.4 Q13

Let P ≡ (2, 4, -1).

In order to find the distance we need to find a point Q on the line.

We see that line is passing through the point Q(-5, -3, 6).

So, let take this point as required point.

Also line is parallel to the vector $\vec{b} = \hat{i} + 4\hat{j} - 9\hat{k}$.

Now, $\overrightarrow{PQ} = \left(-5\hat{i} - 3\hat{j} + 6\hat{k}\right) - \left(2\hat{i} + 4\hat{j} - \hat{k}\right) = -7\hat{i} - 7\hat{j} + 7\hat{k}$

$$\vec{b} \times \overrightarrow{PQ} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & 4 & -9 \\ -7 & -7 & 7 \end{vmatrix} = -35\hat{i} + 56\hat{j} + 21\hat{k}$$

$$\left|\vec{b} \times \overrightarrow{PQ}\right| = \sqrt{1225+3136+441} = \sqrt{4802}$$

$$\left|\vec{b}\right| = \sqrt{1+16+81} = \sqrt{98}$$

$$d = \frac{\left|\vec{b} \times \overrightarrow{PQ}\right|}{\left|\vec{b}\right|} = \frac{\sqrt{4802}}{\sqrt{98}} = 7$$

Straight Line in Space Ex 28.4 Q14

Let L be the foot of the perpendicular drawn from A(1, 8, 4) on the line joining the points B (0, -1, 3) and C (2, -3, -1).

Equation of the line passing through the points B (0, -1, 3) and C (2, -3, -1) is given by,

$\vec{r} = \vec{b} + \lambda(\vec{c} - \vec{b})$

$\vec{r} = (0 + 2\lambda)\hat{i} + (-1 - 2\lambda)\hat{j} + (3 - 4\lambda)\hat{k}$

Let positon vector of L be,

$\vec{r} = (2\lambda)\hat{i} + (-1 - 2\lambda)\hat{j} + (3 - 4\lambda)\hat{k}$ ....(i)

Then, $\overrightarrow{AL}$ = Position vector of L - position vector of A

$\Rightarrow \overrightarrow{AL} = (2\lambda)\hat{i} + (-1 - 2\lambda)\hat{j} + (3 - 4\lambda)\hat{k} - (1\hat{i} + 8\hat{j} + 4\hat{k})$

$\Rightarrow \overrightarrow{AL} = (-1 + 2\lambda)\hat{i} + (-9 - 2\lambda)\hat{j} + (-1 - 4\lambda)\hat{k}$

Since $\overrightarrow{AL}$ is perpendicular to the given line which is parallel to $\vec{b} = 2\hat{i} - 2\hat{j} - 4\hat{k}$

$\therefore \overrightarrow{AL} \cdot \vec{b} = 0$

$\Rightarrow 2(-1 + 2\lambda) - 2(-9 - 2\lambda) - 4(-1 - 4\lambda) = 0$

$\Rightarrow -2 + 4\lambda + 18 + 4\lambda + 4 + 16\lambda = 0$

$\Rightarrow 24\lambda = -20$

$\Rightarrow \lambda = \frac{-5}{6}$

Putting value of $\lambda = \frac{-5}{6}$ in (i) we get

$\vec{r} = -\frac{5}{3}\hat{i} + \frac{2}{3}\hat{j} + \frac{19}{3}\hat{k}$

Coordinates of the foot of the perpendicular are $\left(-\frac{5}{3}, \frac{2}{3}, \frac{19}{3}\right)$.