

2.4.43

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Question

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.

Equation

For the two lines to be perpendicular, the inner product or dot product of their direction vectors must be zero.

$$\mathbf{d}_1^\top \cdot \mathbf{d}_2 = 0 \quad (1)$$

From the equations of the lines L_1 and L_2 ,

$$\mathbf{d}_1 = \begin{pmatrix} 7 \\ -5 \\ 1 \end{pmatrix}, \mathbf{d}_2 = \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix} \quad (2)$$

Theoretical Solution

From 1,

$$\mathbf{d}_1^\top \cdot \mathbf{d}_2 = \begin{pmatrix} 7 & -5 & 1 \end{pmatrix} \cdot \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix} \quad (3)$$

$$= (7)(1) + (-5)(2) + (1)(3) \quad (4)$$

$$= 7 - 10 + 3 \quad (5)$$

$$= 0 \quad (6)$$

\therefore The dot product of the direction vectors of the two lines is 0

\implies The lines are **perpendicular** to each other.

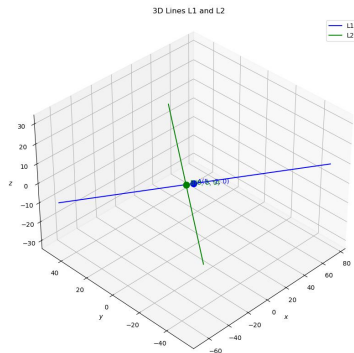


Figure: Lines L_1 and L_2