Matrices in Geometry - 4.7.35

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Problem Statement

If the line drawn from the point $(-2, -1, -3)$ meets a plane at right angle at the point $(1, -3, 3)$, find the equation of the plane.

Solution

We have two points $\mathbf{A} = \begin{pmatrix} -2 \\ -1 \\ -3 \end{pmatrix}$ and $\mathbf{B} = \begin{pmatrix} 1 \\ -3 \\ 3 \end{pmatrix}$

We have to find the equation for the plane that passes through **B** and is perpendicular to the line that joins **A** and **B**.

For that we first need the normal vector **n** to this plane, which will be:

$$\mathbf{n} = \mathbf{Q} - \mathbf{P} \implies \mathbf{n} = \begin{pmatrix} 3 \\ -2 \\ 6 \end{pmatrix} \tag{1}$$

Solution

Therefore, the equation of this plane is given by

$$\mathbf{n}^\top \mathbf{x} = d \tag{2}$$

Since the point **B** lies on this plane, it should satisfy this equation.

$$\mathbf{n}^\top \mathbf{B} = d \implies \begin{pmatrix} 3 & -2 & 6 \end{pmatrix} \begin{pmatrix} 1 \\ -3 \\ 3 \end{pmatrix} = d \implies d = 27 \tag{3}$$

Therefore, the equation of this plane is

$$\mathbf{n}^\top \mathbf{x} = 27 \implies \begin{pmatrix} 3 & -2 & 6 \end{pmatrix} \begin{pmatrix} x \\ y \\ z \end{pmatrix} = 27 \implies 3x - 2y + 6z = 27 \tag{4}$$

Solution

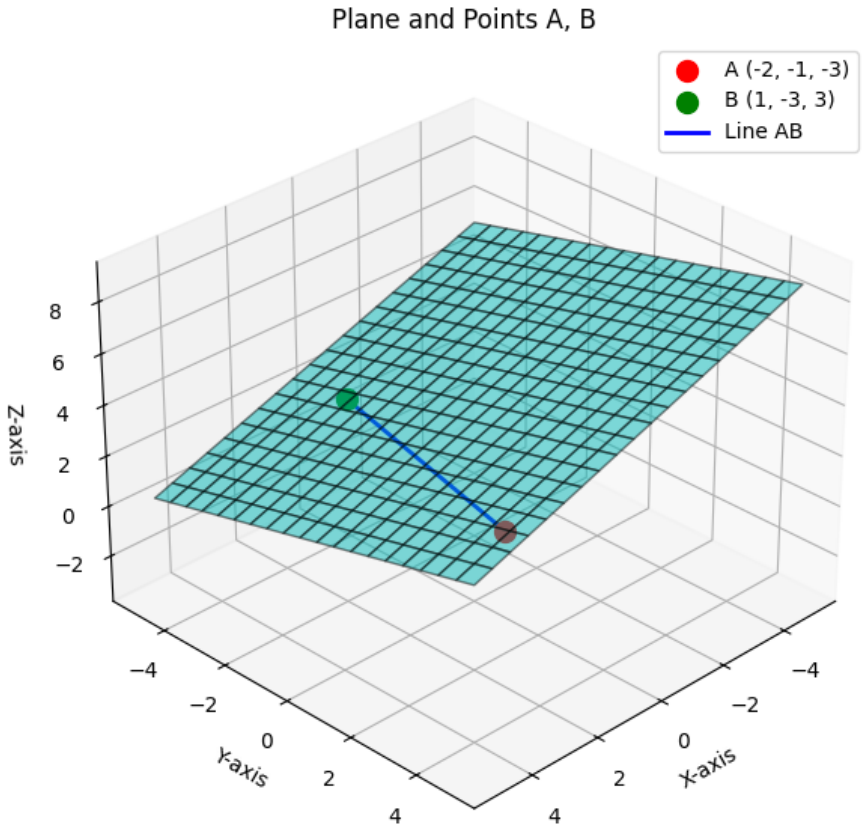

Figure: Figure for 4.7.35