

1. Find the equation of the plane through the point $P = (1, 2, 3)$ with normal vector $\vec{N} = \langle 1, -2, 4 \rangle$.

Solution. Let $P' = \langle x, y, z \rangle$ be a point on the plane. Then $\overrightarrow{PP'} = \langle x - 1, y - 2, z - 3 \rangle$ is a vector in the plane, so it is orthogonal to \vec{N} , the normal vector. That is, $\vec{N} \cdot \overrightarrow{PP'} = 0$, and expanding, we get

$$\begin{aligned} 0 &= \vec{N} \cdot \overrightarrow{PP'} \\ &= \langle 1, -2, 4 \rangle \cdot \langle x - 1, y - 2, z - 3 \rangle \\ &= x - 2y + 4z - 9. \end{aligned}$$

So the desired equation of the plane is $x - 2y + 4z = 9$. □