1. (10 points) Consider two parallel planes:

\[ \Pi_1 : ax + by + cz + d_1 = 0, \]
\[ \Pi_2 : ax + by + cz + d_2 = 0. \]

(a) (4 points) What is the affine transformation from \(R^3\) to \(R^1\) that sends \(\Pi_1\) to \(d_1\) and \(\Pi_2\) to \(d_2\)?

(b) (2 points) What is the 1D translation that sends \(d_1\) to 0?

(c) (2 points) What is the 1D uniform scaling by a factor \(\frac{1}{d_2 - d_1}\)?

(d) (2 points) What is the composite affine transformation of the above three?

\[
\begin{align*}
\text{(a)} & \quad \begin{bmatrix}
-a & -b & -c & 0 \\
0 & 0 & 0 & 1
\end{bmatrix} \\
\text{(b)} & \quad \begin{bmatrix}
1 & -d_1 \\
0 & 1
\end{bmatrix} \\
\text{(c)} & \quad \begin{bmatrix}
1 & 0 \\
0 & d_2 - d_1
\end{bmatrix} \\
\text{(d)} & \quad \begin{bmatrix}
1 & 0 \\
0 & d_2 - d_1
\end{bmatrix} \begin{bmatrix}
1 & -d_1 \\
0 & 1
\end{bmatrix} \begin{bmatrix}
a & b & c & 0 \\
0 & 0 & 0 & -1
\end{bmatrix} = \begin{bmatrix}
a & b & c & d_1 \\
0 & 0 & 0 & d_1 - d_2
\end{bmatrix}
\end{align*}
\]