1. Write the $4 \times 4$ transformation matrix for the translation where $\Delta x = 5, \Delta y = 8,$ and $\Delta z = -3$.

2. Multiply the following two translation matrices and verify that the resulting matrix represents the composition of the translations.

$$A = \begin{pmatrix}
1 & 0 & 0 & 2 \\
0 & 1 & 0 & 4 \\
0 & 0 & 1 & 6 \\
0 & 0 & 0 & 1 \\
\end{pmatrix} \quad \text{and} \quad B = \begin{pmatrix}
1 & 0 & 0 & 1 \\
0 & 1 & 0 & 3 \\
0 & 0 & 1 & 5 \\
0 & 0 & 0 & 1 \\
\end{pmatrix}.$$ 

3. Write the $4 \times 4$ transformation matrix for the scaling where $s_x = 2, s_y = 4, \text{ and } s_z = \frac{1}{2}$.

4. Multiply the following two scaling matrices and verify that the resulting matrix represents the composition of the scalings.

$$A = \begin{pmatrix}
3 & 0 & 0 & 0 \\
0 & 2 & 0 & 0 \\
0 & 0 & 5 & 0 \\
0 & 0 & 0 & 1 \\
\end{pmatrix} \quad \text{and} \quad B = \begin{pmatrix}
5 & 0 & 0 & 0 \\
0 & 4 & 0 & 0 \\
0 & 0 & 2 & 0 \\
0 & 0 & 0 & 1 \\
\end{pmatrix}.$$ 

5. Write the $4 \times 4$ transformation matrix for the rotation about the $x$-axis through an angle $\theta = 45^\circ$.

6. The following matrices represent rotations about the $z$-axis of $45^\circ$ and $90^\circ$, respectively. Multiply them together and verify that the resulting matrix represents a rotation of $135^\circ$ about the $z$-axis.

$$A = \begin{pmatrix}
\frac{1}{\sqrt{2}} & -\frac{1}{\sqrt{2}} & 0 & 0 \\
\frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} & 0 & 0 \\
0 & 0 & 1 & 0 \\
0 & 0 & 0 & 1 \\
\end{pmatrix} \quad \text{and} \quad B = \begin{pmatrix}
0 & -1 & 0 & 0 \\
1 & 0 & 0 & 0 \\
0 & 0 & 1 & 0 \\
0 & 0 & 0 & 1 \\
\end{pmatrix}.$$ 

7. Use matrices to verify that the composition of the two scalings $(s_x = -1, s_y = 1, s_z = 1)$ and $(s_x = 1, s_y = -1, s_z = 1)$ is the same as a rotation of $180^\circ$ about the $z$-axis. [The first scaling represents a reflection in the $x$-axis and the second scaling represents a reflection in the $y$-axis. In general, the composition of two reflections is a rotation!]