3 (a)

eye = [0, 1, 0] lookat = [0, 0, 0]

$\vec{up} = [1, 1, 0]$

$\vec{v} = (lookat - eye)/\|lookat - eye\| = [0, -1, 0]$

$\vec{r} = \vec{v} \times \vec{up}/\|\vec{v} \times \vec{up}\| = [0, 0, 1]$

$\vec{u} = \vec{r} \times \vec{v} = [1, 0, 0]$

$$TM = \begin{bmatrix} 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & -1 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & -1 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

3. (b)

$$XRotate\left(\frac{\pi}{2}\right) = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} = A$$

$$translate(1,0,0) = \begin{bmatrix} 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} = B$$

$$scale(2) = \begin{bmatrix} 2 & 0 & 0 & 0 \\ 0 & 2 & 0 & 0 \\ 0 & 0 & 2 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} = C$$

$$T = C \cdot B \cdot A = \begin{bmatrix} 2 & 0 & 0 & 2 \\ 0 & 0 & -2 & 0 \\ 0 & 0 & 0 & 2 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$T \cdot \begin{bmatrix} 0.5 \\ 2.0 \\ 3.0 \\ 1 \end{bmatrix} = \begin{bmatrix} 3 \\ -6 \\ 2 \\ 1 \end{bmatrix}$$

Hence $(0.5, 2, 3) \Rightarrow (3, -6, 2)$

$$T \cdot \begin{bmatrix} 1 \\ 3.5 \\ 7 \\ 1 \end{bmatrix} = \begin{bmatrix} 4 \\ -14 \\ 2 \\ 1 \end{bmatrix}$$

Hence $(1, 3.5, 7) \Rightarrow (4, -14, 2)$

$$T \cdot \begin{bmatrix} 2.0 \\ 0 \\ 1 \\ 1 \end{bmatrix} = \begin{bmatrix} 6 \\ -2 \\ 2 \\ 1 \end{bmatrix}$$

Hence $(2, 0, 1) \Rightarrow (6, -2, 2)$