1. For each transformation $T : \mathbb{R}^2 \to \mathbb{R}^2$, find the corresponding matrix $A$.

   (a) $T$ rotates by $\frac{\pi}{3}$ counter-clockwise and then reflects over the line $y = x$

   (b) $T$ reflects over the line $y = x$ and then rotates by $\frac{\pi}{3}$ counter-clockwise

   (c) What is the image of $\mathbf{x} = \begin{bmatrix} 3 \\ 1 \end{bmatrix}$ under each transformation?

2. Let $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$, $B = \begin{bmatrix} 4 & 0 \\ 3 & 4 \end{bmatrix}$, and $C = \begin{bmatrix} 2 & -4 \\ 3 & -6 \end{bmatrix}$

   (a) Compute $AC$ and $BC$

   (b) What interesting property of matrix multiplication does this example demonstrate?