1. **Reading Assignment:** Read and practice the algorithm for finding the inverse of a matrix, found at the end of section 2.2 of the textbook.

2. For each of the following transformations, find a matrix corresponding to the transformation.

   (a) $\mathcal{A}$: Rotate 90° counterclockwise around the origin (in $\mathbb{R}^2$).
   (b) $\mathcal{B}$: Send every vector in $\mathbb{R}^2$ to the zero vector.
   (c) $\mathcal{C}$: Project (in $\mathbb{R}^3$) onto the yz-plane.
   (d) $\mathcal{D}$: Project (in $\mathbb{R}^3$) onto the x-axis.
   (e) $\mathcal{E}$: Reflect (in $\mathbb{R}^3$) across the xy-plane.
   (f) $\mathcal{F}$: Stretch by a factor of 2 in the y-direction (in $\mathbb{R}^2$).
   (g) $\mathcal{G}$: Stretch by a factor of 2 in the y-direction (in $\mathbb{R}^3$).
   (h) $\mathcal{H}$: Rotate 90° counterclockwise (as viewed looking "down" from the positive y-axis towards the origin) around the y-axis (in $\mathbb{R}^3$).

3. (a) For each transformation in problem 2, explain geometrically whether or not the transformation is invertible.
   (b) Which of the matrices you generated in problem 2 are invertible? (You may wish to use the algorithm you read about.)
   (c) Suppose f is a transformation that is represented by the matrix M. Is it possible for f to be invertible and M not invertible? Is it possible for M to be invertible and f not be invertible? Explain your reasoning.

4. Each of the following matrices gives a transformation of $\mathbb{R}^2$ or $\mathbb{R}^3$. Describe the effect of that transformation in terms of the transformations from problem 2. (Hint: you may need to combine two, three, or more transformations from problem 2 for some examples.)

$$X = \begin{bmatrix} 0 & -1 \\ 2 & 0 \end{bmatrix} \qquad Y = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & -1 \end{bmatrix}$$

$$Z = \begin{bmatrix} 0 & 0 & 1 \\ 0 & 2 & 0 \\ -1 & 0 & 0 \end{bmatrix} \qquad W = \begin{bmatrix} 0 & 0 & 1 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

5. Use the definition of a linear transformation to show that if T is a linear transformation, then $T(\vec{0}) = \vec{0}$. Do not appeal to the matrix representation of T.

6. Consider the matrices $A = \begin{bmatrix} 1 & 0 \\ k & 1 \end{bmatrix}$, and $B = \begin{bmatrix} 2 & 0 \\ 0 & 1 \end{bmatrix}$.

   (a) Describe the geometric effect of A. Feel free to use the language of the in-class worksheets.
   (b) Compute the product BA.
   (c) Find a matrix C such that $AC = BA$.
   (d) Describe geometrically why $C \neq B$.

7. Suppose A is an unknown matrix, but $A^{-1} = \begin{bmatrix} 3 & 2 & -1 \\ -2 & 0 & 1 \\ 2 & 1 & 1 \end{bmatrix}$

   (a) Find a solution to the matrix equation $A\vec{x} = \begin{bmatrix} 2 \\ 1 \\ 6 \end{bmatrix}$.
   (b) Are there other solutions besides the one you found in (a)? Explain how you know.