Write legibly and show all work. No partial credit can be given for an unjustified, incorrect answer. Put your name in the top right corner.

1. (2, 1), (0, 7), and (6, 2) are three vertices of a parallelogram in \( \mathbb{R}^2 \).

   (a) (Two points) What is the fourth vertex of this parallelogram?

   **Solution.** There are actually three answers to this question.\(^1\) The most obvious one is to say that the vector representing the displacement from (2, 1) to (0, 7) is
   \[
   \begin{bmatrix}
   -2 \\
   6
   \end{bmatrix}
   \]
   and the vector representing the displacement from (2, 1) to (6, 2) is
   \[
   \begin{bmatrix}
   4 \\
   1
   \end{bmatrix}
   .
   \]
   Therefore the fourth vertex comes from adding either
   \[
   \begin{bmatrix}
   -2 \\
   6
   \end{bmatrix}
   \]
   to (6, 2) or adding
   \[
   \begin{bmatrix}
   4 \\
   1
   \end{bmatrix}
   \]
   to (0, 7). This gives you (4, 8). (The other solutions come from subtracting said vectors instead of adding them.)

   (b) (Four points) Find the area of the parallelogram.

   **Solution.** The three different answers to the previous question all give you the same answer here. We take the vectors representing the sides of the parallelogram, load them into a matrix, and then take the determinant:
   \[
   \text{area} = \det \begin{bmatrix}
   4 & -2 \\
   1 & 6
   \end{bmatrix} = 26.
   \]
   It turned out with this configuration that we didn’t need the absolute value, as the determinant is already positive.

2. (Four points) Use Cramer’s rule to solve the matrix equation
   \[
   \begin{bmatrix}
   3 & 4 \\
   2 & -3
   \end{bmatrix}
   \vec{x} = \begin{bmatrix}
   1 \\
   4
   \end{bmatrix}.
   \]

   **Solution.** We have
   \[
   \begin{align*}
   &\det \begin{bmatrix}
   3 & 4 \\
   2 & -3
   \end{bmatrix} = -17 \\
   &\det \begin{bmatrix}
   1 & 4 \\
   4 & -3
   \end{bmatrix} = -19 \\
   &\det \begin{bmatrix}
   3 & 1 \\
   2 & 4
   \end{bmatrix} = 10,
   \end{align*}
   \]
   so the solution is \( x_1 = \frac{19}{17}, x_2 = -\frac{10}{17} \).

\(^1\)Still wiping the egg off my face from not seeing that ahead of time.