I. List in the proper order the matrices which, when multiplied together, will “halve” the size of the “stickman” and rotate him $30^\circ$ about the point $P = (5, 3)$. Do **not** multiply the matrices together. (20 points)

![Figure 1: Original Stickman Position](image)

![Figure 2: Rotated/Scaled Stickman Position](image)
II. For each of the following polygons, show the result of performing *polygon clipping* to the given clip rectangle. The first polygon has already been properly “clipped” as an example. (20 points)
Figure 3: Polygon Clipping Problems
III. In class we have discussed the use of matrices for transforming (scaling, translating, and rotating about the origin) 2D homogeneous coordinates. For each of the lines below, give the 3x3 matrix, $A$, for reflecting 2D homogeneous coordinates about that line. The first matrix has already been calculated as an example. (20 points)

1. The $x$-axis

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

Reflection about $x$-axis matrix, $A$:

![Figure 4: Reflection about $x$-axis Example](image)

2. The line, $x + y = 0$

3. The line, $3x - 2y = 0$
IV. Complete steps 3 – 6 of the scan-line seed-fill algorithm for the region defined below. Steps 1 – 2 have been given. (20 points)
Figure 5: Progress of the Scan-line Seed-fill Algorithm
V. Answer any **one** of the following questions: (20 points)

1. Show by multiplying the appropriate matrices together (homogeneous 2D coordinates) that a translation by \((dx, dy)\) followed by a rotation by \(\theta\) is **not** the same as rotating first and then translating (unless \(dx = dy = 0\) or \(\theta = 2k\pi\)).

2. Do as in problem III, but for the line, \(3x - 2y = 12\).

3. In the \(X-Y\) coordinate system, point \(A\) has coordinates \((5, 2)\). What coordinates does it have in the \(X'-Y'\) coordinate system?

![Change of Coordinate System Problem](image)

**Figure 6: Change of Coordinate System Problem**

7
Extra space for answers, if needed. Please identify which problem you are answering.