*Matrix* Transformations
Lab Activity

Name_____

In the movie, *Matrix Revolutions*, our hero Neo and the others try to save Zion, the last real-world city and the center of the human resistance. Neo's nemesis, Agent Smith, has learned how to replicate by taking over other organisms and is determined to defeat our hero. Numerous altercations occur.

**1.** Using your graphing calculator, represent Agent Smith as a rectangle with starting coordinates (2,2), (3,2), (3,5) and (2,5). Replicate Agent Smith using the translations $T_{-2,3}$ and $T_{-6,-1}$ applied to the original Agent Smith. Your screen should resemble the display at the right.
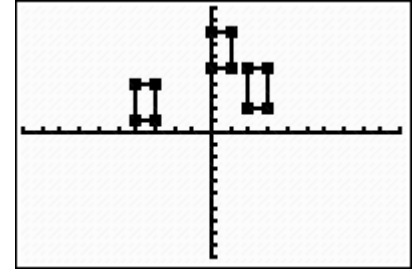
Show your LIST values. Show formulas used to create L3-L6.

| L1 | L2 | L3 | L4 | L5 | L6 |
|----|----|----|----|----|----|
|    |    |    |    |    |    |
|    |    | L3= | L4= | L5= | L6= |

**2.** During a fight scene, Agent Smith hurls himself through the air toward Neo. The path of his flight follows the composition $T_{-5,-3} \circ r_{y-axis} \circ T_{-1,4}$. Agent Smith is represented by a rectangle with starting location coordinates of (2,2), (3,2), (3,5) and (2,5). Neo's stationary location is represented by a triangle with coordinates (-4,0), (-2,0) and (-3,2). Using graph paper, determine if Agent Smith "hits" Neo. Show all of Agent Smith's locations as he hurls through the combination and show Neo's location.

**3.** Neo anticipates Agent Smith's maneuver described in question 2 before it occurs. From his position, state one transformation that would allow him to make contact with Agent Smith at Smith's starting position.

**4.** Agent Smith's rectangle is standing at coordinates (8,2), (9,2), (9,5) and (8,5). Anticipating another confrontation with Neo, Smith replicates according to the transformations listed below. All transformations are applied to Smith's original standing location.

a. translations: $T_{-a,-2}$ where $a \in \{1,2,3,4,5\}$

b. rotation (with respect to origin): $R_{90°}$

c. reflection: $r_{x-axis}$

Using graph paper, show the locations of the original Agent Smith and all of his replicas.

**5.** Anticipating yet another attack by Smith, Neo changes his triangle's starting position of (2,1), (5,5) and (1,3) through the composition $T_{-5,0} \circ r_{x-axis}$.   On your graphing calculator, display Neo's path through this composition.   Show your LIST values.  Show formulas used to create L3-L5.

| L1 | L2 | L3 | L4 | L5 | L6 |
|----|----|----|----|----|----|
|    |    |    |    |    |    |
|    |    | L3= | L4= | L5= | L6= |

Display Neo's triangle locations below.
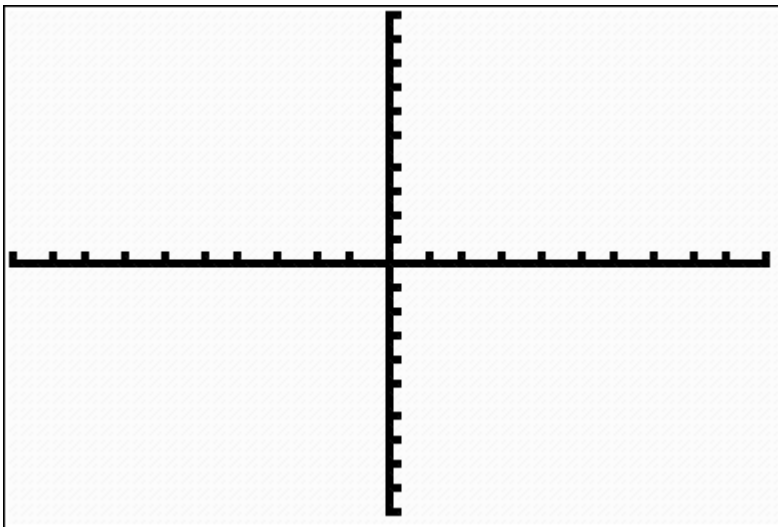


What are the coordinates of Neo's new position after the composition?

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Could this composition of Neo's position be called a *glide reflection*?  Explain.

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_____
_____
_____

**6.** Our hero, Neo, is often larger than life.  Neo's triangle is located at (2,3), (2,-1) and (-1,-1).  Using your graphing calculator, graph Neo and graph Neo's dilation $D_3$.  Show your LIST values.  Show formulas used to create L3-L4.   Display Neo and his enlargement below.

| L1 | L2 | L3 | L4 |
|----|----|----|----|
|    |    |    |    |
|    |    | L3= | L4= |