

Geometry – Multiple Transformations

The following worksheet is for you to discover how to do MULTIPLE TRANSFORMATIONS!

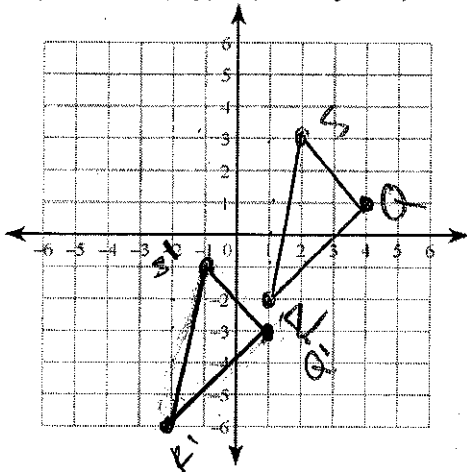
Work with your group– but make sure you are **WORKING THE WHOLE PERIOD!!!**

You should already know how to do the following:

- Translations (slides)
- Reflections (flips, like with a mirror)
- Rotations (spins or turns)

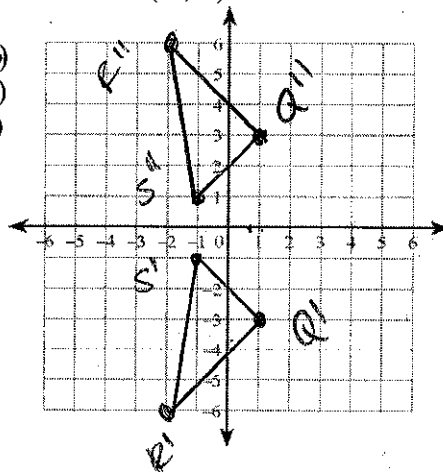
Let's start out with some easier single-transformations to get "warmed-up".

1) Translate  $\triangle QRS$  if  $Q(4,1)$ ,  $R(1,-2)$ ,  $S(2,3)$  by the rule  $(x,y) \rightarrow (x-3, y-4)$



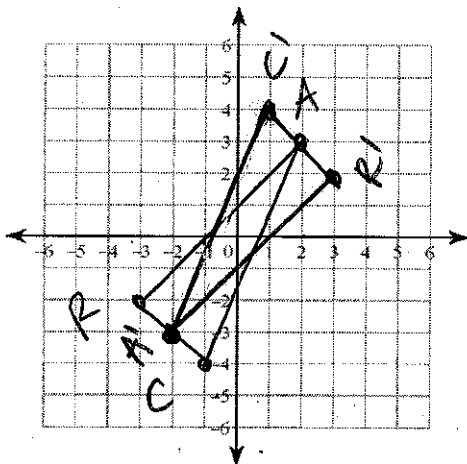
$Q'(-1, -3)$   
 $R'(-2, -6)$   
 $S'(-1, -1)$

2) Reflect  $\triangle Q'R'S'$  if  $Q'(1,-3)$ ,  $R'(-2,-6)$ , and  $S'(-1,-1)$  over the x-axis.



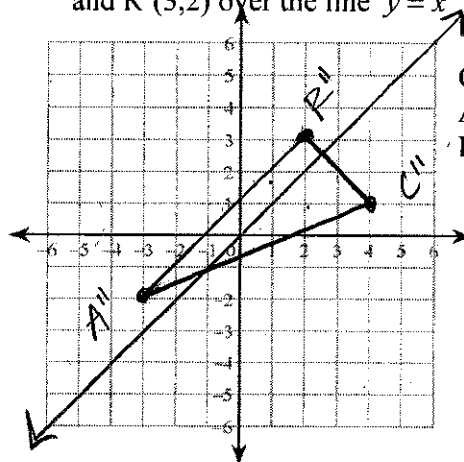
$Q''(1, 3)$   
 $R''(-2, 6)$   
 $S''(-1, 1)$

3) Rotate  $\triangle CAR$  if  $C(-1,-4)$ ,  $A(2,3)$ ,  $R(-3,-2)$   $180^\circ$  about the origin.



$C'(1, 4)$   
 $A'(-2, -3)$   
 $R'(3, 2)$

4) Reflect  $\triangle C'A'R'$  if  $C'(1,4)$ ,  $A'(-2,-3)$ , and  $R'(3,2)$  over the line  $y=x$



$C''(4, 1)$   
 $A''(-3, 2)$   
 $R''(2, 3)$

5) What did you notice in problems 1&2 and problems 3&4. How were the shapes related? Explain how you could translate  $\triangle QRS$  by the rule  $(x,y) \rightarrow (x-3, y-4)$  and then reflect the image of the x-axis. Where does the final image end up?

shapes maintained same properties. Every x and y moves 3 units left, 4 units down and then is flipped across the x-axis.

How would you rotate  $\triangle CAR$   $180^\circ$  about the origin and then reflect it over the line  $y=x$ ?

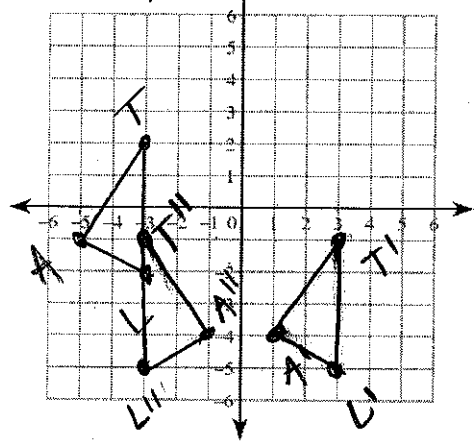
When rotating, every point becomes opposite of what it started as and then each point  $(x,y)$  becomes  $(y,x)$  for the reflection.

6) Also notice that on the previous page, when we did two transformations, the first image had one prime notation (one '), and the second image (after the second transformation) has two prime notations (''). This is the notation we are going to use. How many transformations would have been applied to a figure if it had four prime notations? (''''?)

4 Transformations

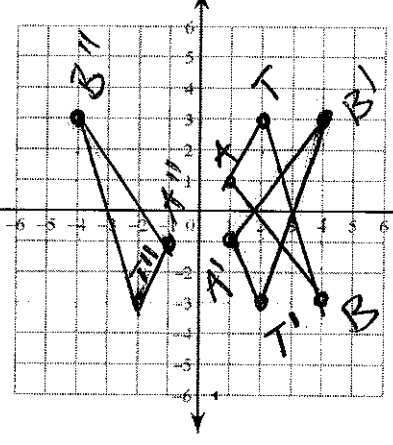
7) Now you are going to try some multiple transformations:

a) Translate  $\triangle ALT$  if  $A(-5,-1)$ ,  $L(-3,-2)$ ,  $T(-3,2)$  by the rule  $(x,y) \rightarrow (x+6, y-3)$ , then reflect the image over the y-axis



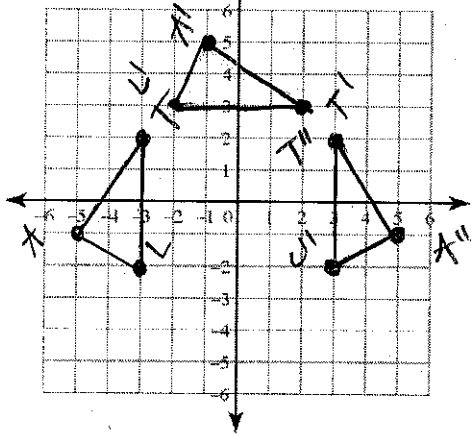
- $A' (1, -4)$
- $L' (3, -5)$
- $T' (3, -1)$
- $A'' (-1, -4)$
- $L'' (-3, -5)$
- $T'' (-3, -1)$

b) Reflect  $\triangle TAB$  if  $T(2,3)$ ,  $A(1,1)$ , and  $B(4,-3)$  over the x-axis, then reflect the image over the y-axis



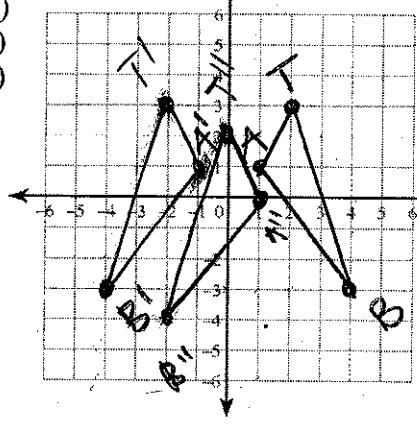
- $T' (2, -3)$
- $A' (1, -1)$
- $B' (4, 3)$
- $T'' (-2, -3)$
- $A'' (-1, -1)$
- $B'' (-4, 3)$

c) Rotate  $\triangle ALT$  if  $A(-5,-1)$ ,  $L(-3,-2)$ ,  $T(-3,2)$   $90^\circ$  clockwise about the origin, then reflect the image over the line  $y=x$



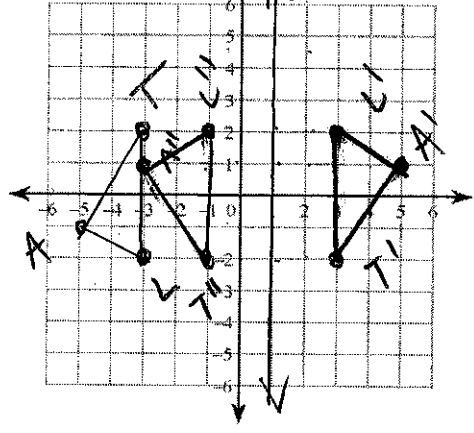
- $A' (-1, 5)$
- $L' (-2, 3)$
- $T' (2, 3)$
- $A'' (5, -1)$
- $L'' (3, -2)$
- $T'' (3, 2)$

d) Reflect  $\triangle TAB$  if  $T(2,3)$ ,  $A(1,1)$ , and  $B(4,-3)$  over the y-axis, then translate the image by the rule  $(x,y) \rightarrow (x+2, y-1)$



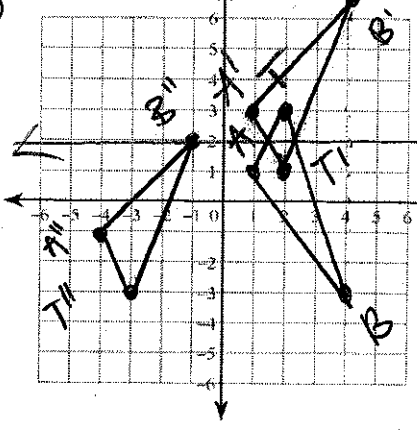
- $T' (-2, 3)$
- $A' (-1, 1)$
- $B' (-4, -3)$
- $T'' (0, 2)$
- $A'' (1, 0)$
- $B'' (-2, -4)$

e) Rotate  $\triangle ALT$  if  $A(-5,-1)$ ,  $L(-3,-2)$ ,  $T(-3,2)$   $180^\circ$  clockwise about the point  $(-1,-1)$ , then reflect the image over the line  $x=1$



- $A' (5, 1)$
- $L' (3, 2)$
- $T' (3, -2)$
- $A'' (-3, 1)$
- $L'' (-1, 2)$
- $T'' (-1, -2)$

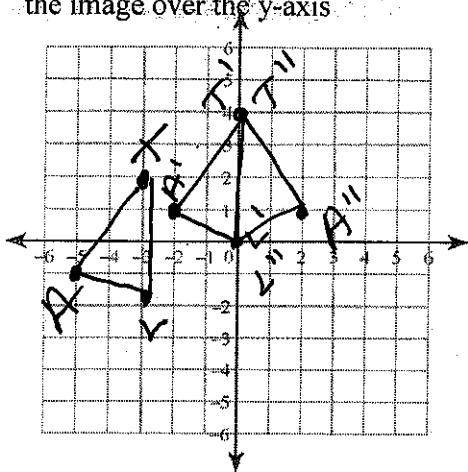
f) Reflect  $\triangle TAB$  if  $T(2,3)$ ,  $A(1,1)$ , and  $B(4,-3)$  over the line  $y=2$ , then translate the image by the rule  $(x,y) \rightarrow (x-5, y-4)$



- $T' (2, 1)$
- $A' (1, 3)$
- $B' (4, 6)$
- $T'' (-3, -3)$
- $A'' (-4, 1)$
- $B'' (-1, 2)$

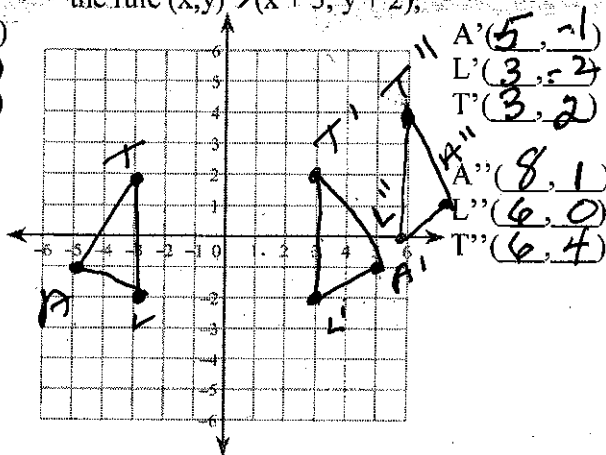
8) Now we are going to explore if the order in which you do multiple transformations matters.

a) Translate  $\triangle ALT$  if  $A(-5,-1)$ ,  $L(-3,-2)$ ,  $T(-3,2)$  by the rule  $(x,y) \rightarrow (x+3, y+2)$ , then reflect the image over the  $y$ -axis.



$$\begin{aligned} A' & (-2, 1) \\ L' & (0, 0) \\ T' & (0, 4) \\ A'' & (2, 1) \\ L'' & (0, 0) \\ T'' & (0, 4) \end{aligned}$$

b) Reflect  $\triangle ALT$  if  $A(-5,-1)$ ,  $L(-3,-2)$ ,  $T(-3,2)$  over the  $y$ -axis, then translate the image by the rule  $(x,y) \rightarrow (x+3, y+2)$ .



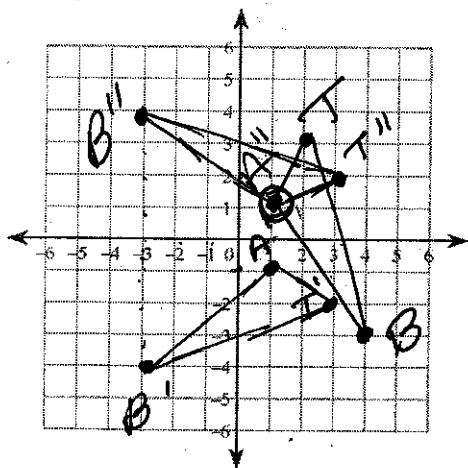
$$\begin{aligned} A' & (5, -1) \\ L' & (3, -2) \\ T' & (3, 2) \\ A'' & (8, 1) \\ L'' & (6, 0) \\ T'' & (6, 4) \end{aligned}$$

Did the order you did the transformations change the final image?

So, does order matter?

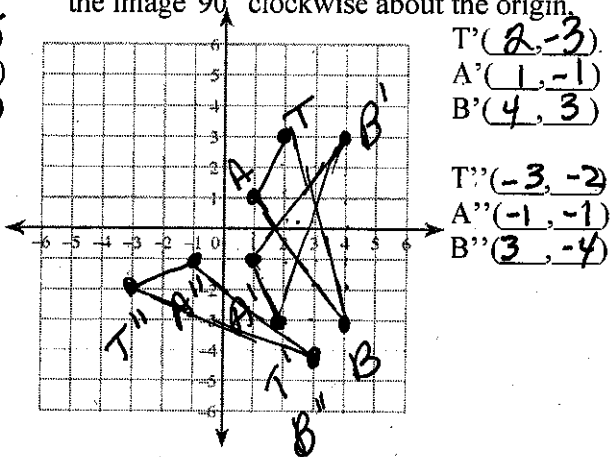
What about with rotations and reflections?

c) Rotate  $\triangle TAB$  if  $T(2,3)$ ,  $A(1,1)$ ,  $B(4,-3)$   $90^\circ$  clockwise about the origin, then reflect the image over the line  $x$ -axis.



$$\begin{aligned} T' & (3, -2) \\ A' & (1, -1) \\ B' & (-3, -4) \\ T'' & (3, 2) \\ A'' & (1, 1) \\ B'' & (-3, 4) \end{aligned}$$

d) Reflect  $\triangle TAB$  if  $T(2,3)$ ,  $A(1,1)$ , and  $B(4,-3)$  over the  $x$ -axis, then rotate the image  $90^\circ$  clockwise about the origin.



$$\begin{aligned} T' & (2, -3) \\ A' & (1, -1) \\ B' & (4, 3) \\ T'' & (-3, -2) \\ A'' & (-1, -1) \\ B'' & (3, -4) \end{aligned}$$

Did the order you did the transformations change the final image?

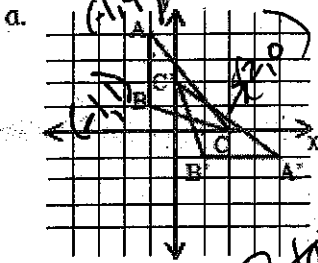
So, does order matter?

So, if you want to get the correct answer, should you do the transformations in the order given?

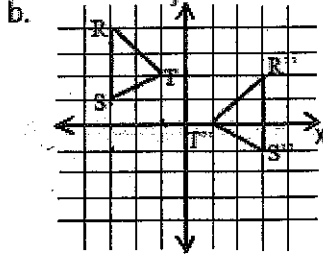
For this page you are going to try to discover what transformation(s) have taken place.

9.

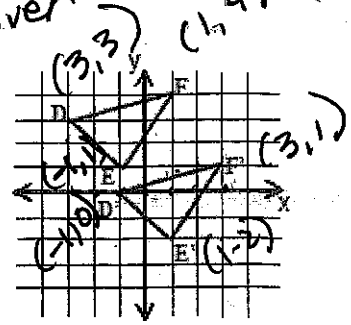
Identify the transformation(s) that has taken place.



Rotate 180°

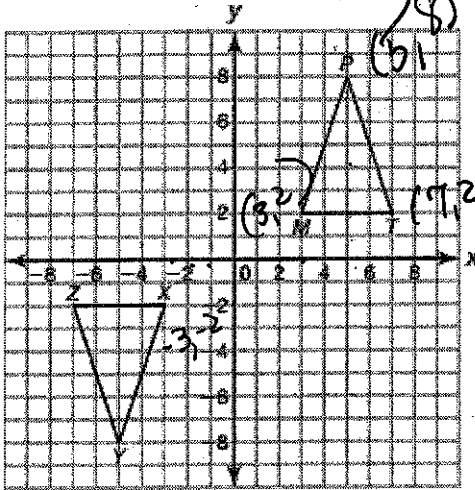


$(x, y) \rightarrow (x, y-2)$   
Reflected over y-axis



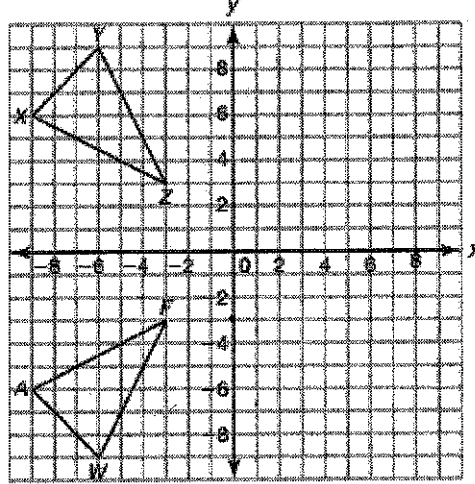
$(x, y) \rightarrow (x+2, y)$

d.



Rotate 180°

e.



Reflect over x-axis