

## Transformations: Rigid vs. Non-Rigid

### Geometry—Congruence

#### Experiment with Transformations in the Plane

G-CO.2 Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch).

G-CO.5 Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.

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“We formally introduce the concept of a transformation  $F$  of the plane as a rule that assigns to each point  $P$  of the plane a point  $F(P)$  of the plane. ... According to this definition, to each point, a transformation can only assign *one* unambiguous point; thus, by definition, it cannot happen that for a given transformation  $F$  and a given point  $P$ , the assigned point  $F(P)$  could be one of several possibilities.

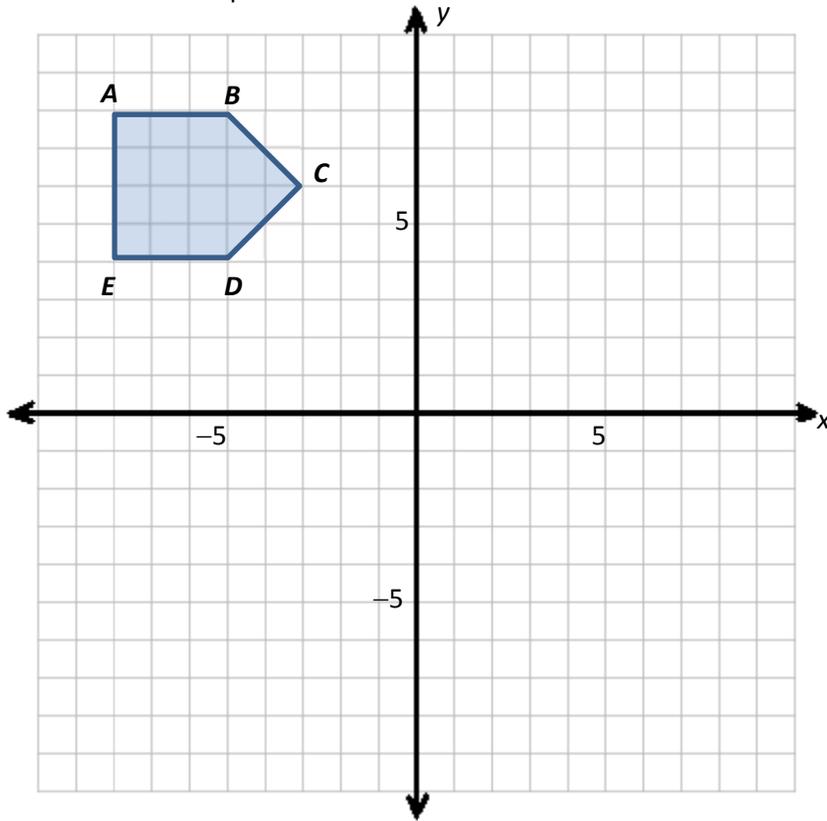
The point  $F(P)$  is called the image of  $P$  by  $F$ , and we could state that  $F$  maps  $P$  to  $F(P)$ .

If  $S$  is a geometric figure in the plane (i.e., a subset of the plane), then the collection of all the points  $F(Q)$  where  $Q$  is a point of  $S$  is called the image of  $S$  by  $F$ , which is usually denoted by  $F(S)$ . Likewise,  $F$  maps  $S$  to  $F(S)$ .”

A coordinate system is used *only* to give students opportunities to develop a familiarity with the concept of a transformation.

This activity is designed to give the students a better appreciation of the basic rigid motions and a sense for their distance- and angle-preserving properties.

**Directions.** Please perform all six transformations.



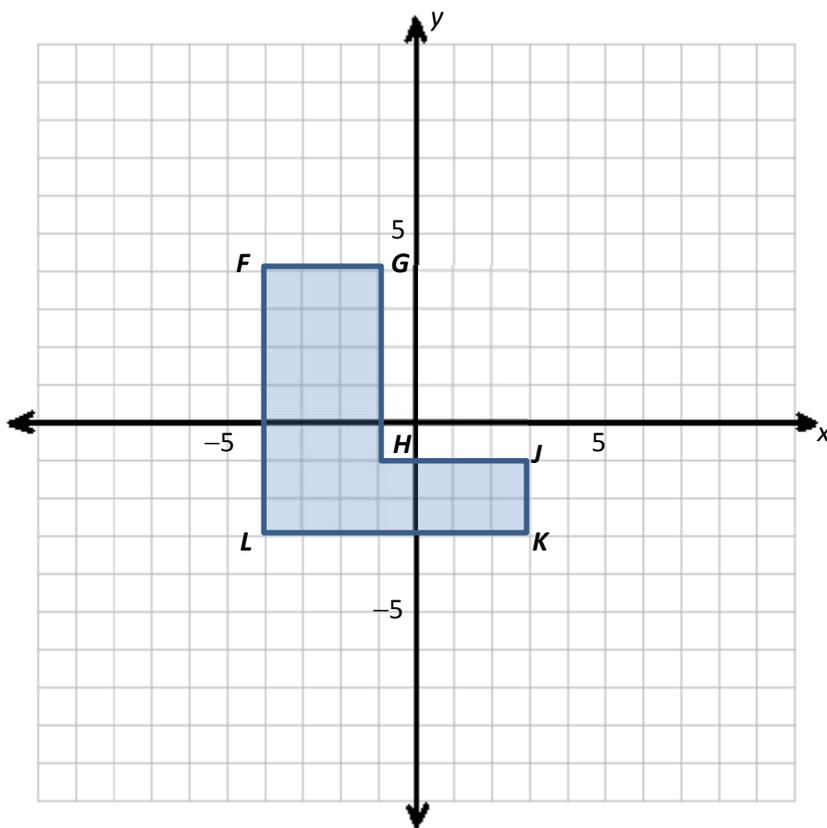
Transform the polygon using the rule

$$G(x, y) \rightarrow (x + 4, y - 7)$$

(i) Describe the type and direction of the transformation.

(ii) Use patty paper to trace the pre-image and make statements that compare it to the image relative to

- The geometric figure,
- Side lengths, and
- Interior angle measures.



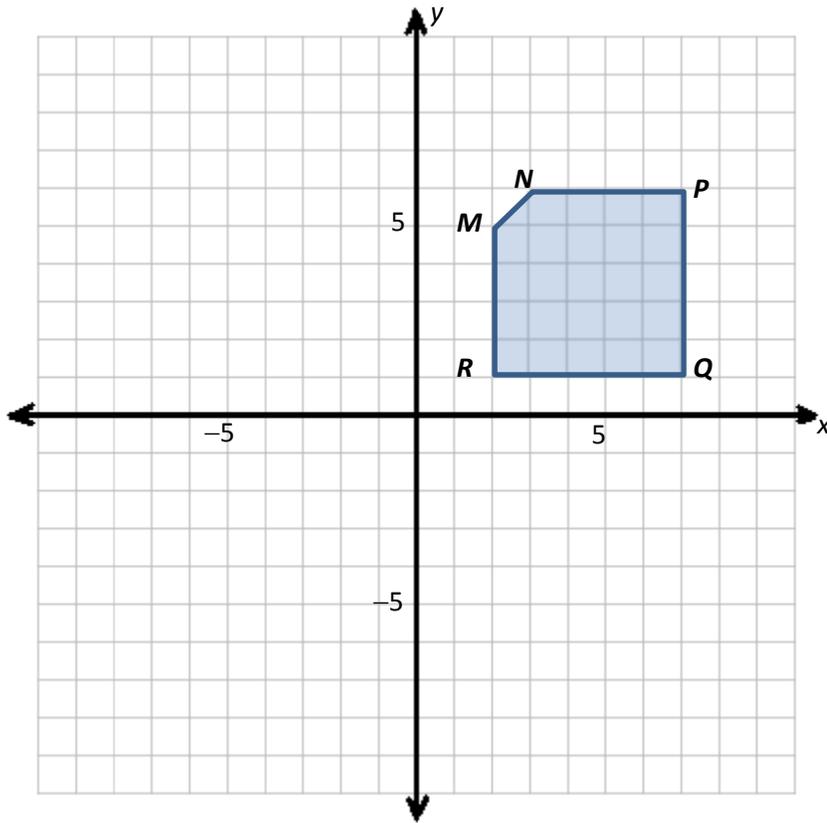
Apply the transformation  $G$  such that

$$G(x, y) = (-x, -y)$$

(i) Describe the type and direction of the transformation.

(ii) Use patty paper to trace the pre-image and make statements that compare it to the image relative to

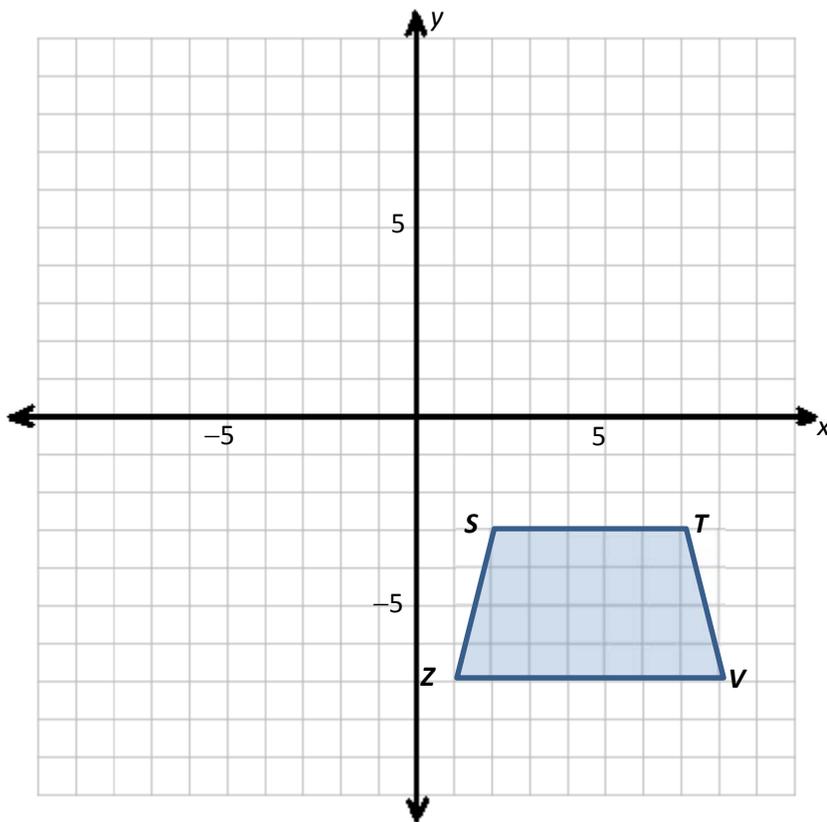
- The geometric figure,
- Side lengths, and
- Interior angle measures.



Apply the transformation  $G$  such that

$$G(x, y) = (8 - x, y)$$

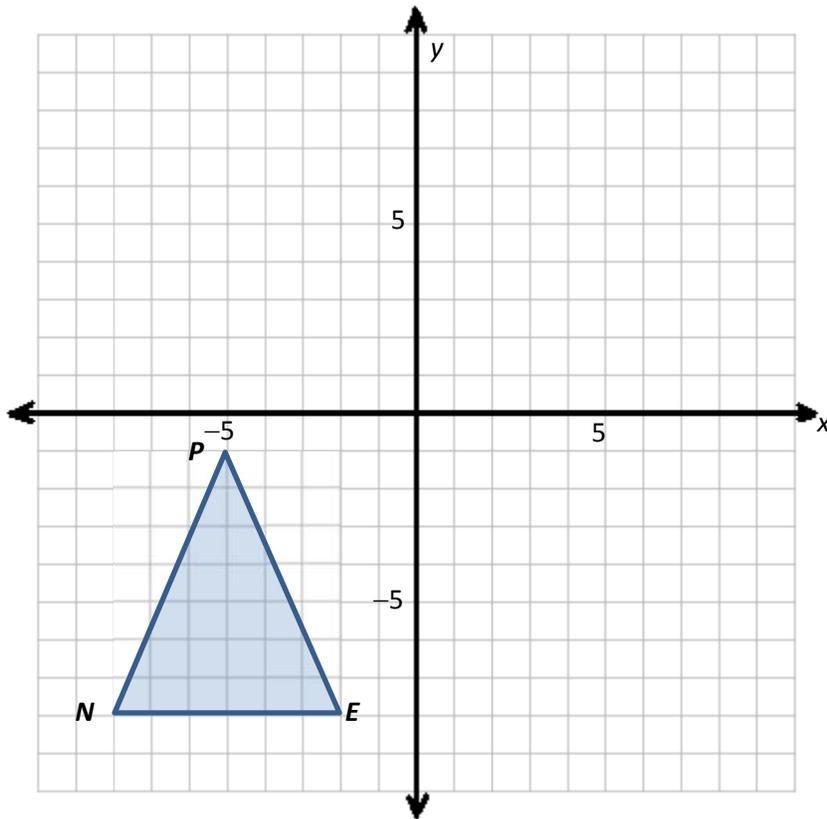
- (i) Describe the type and direction of the transformation.
- (ii) Use patty paper to trace the pre-image and make statements that compare it to the image relative to
  - The geometric figure,
  - Side lengths, and
  - Interior angle measures.



Apply the transformation  $G$  such that

$$G(x, y) = (x, y)$$

- (i) Describe the type and direction of the transformation.
- (ii) Use patty paper to trace the pre-image and make statements that compare it to the image relative to
  - The geometric figure,
  - Side lengths, and
  - Interior angle measures.



Apply the transformation  $G \circ H$  such that

$$G(x, y) = (x + 2, y)$$

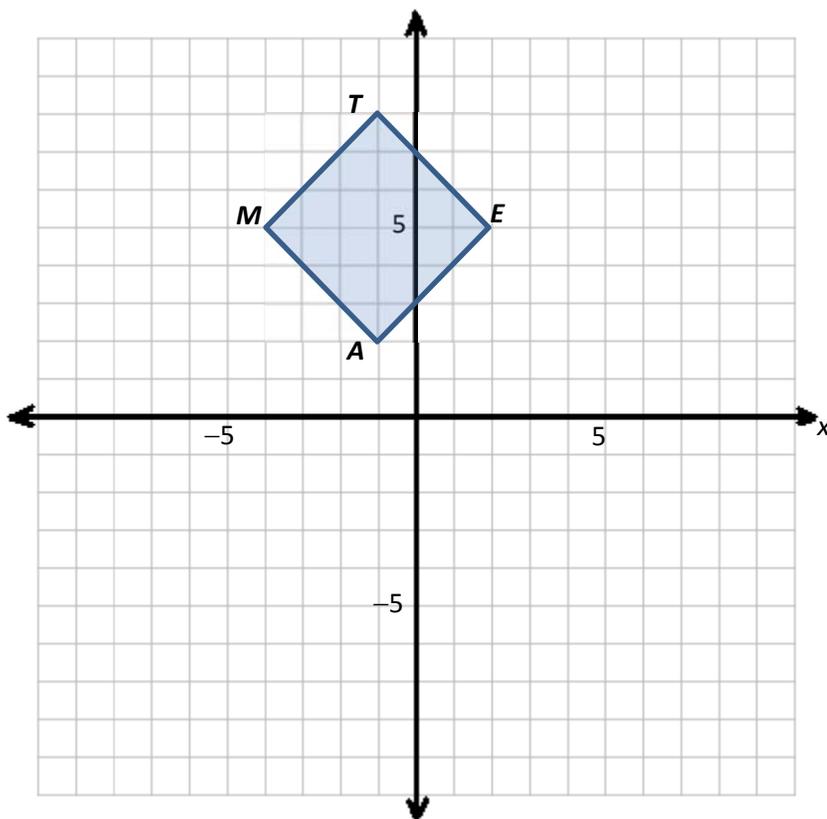
$$H(x, y) = (x, -y)$$

(i) Describe the type and direction of the transformation.

(ii) Use patty paper to trace the pre-image and make statements that compare it to the image relative to

- The geometric figure,
- Side lengths, and
- Interior angle measures.

(iii) Write the composition of transformations as one single transformation rule.



Apply the transformation  $G$  such that

$$G(x, y) = (x + y, y)$$

(i) Describe the type and direction of the transformation.

(ii) Use patty paper to trace the pre-image and make statements that compare it to the image relative to

- The geometric figure,
- Side lengths, and
- Interior angle measures.