

# Applications

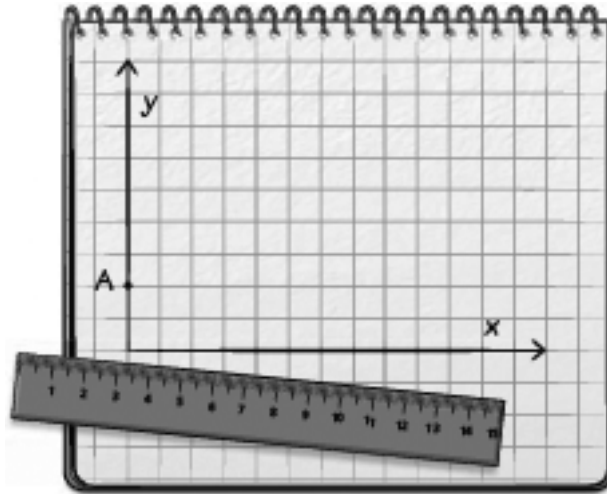
- The table below gives key coordinates for drawing Mug Wump's mouth and nose. It also gives rules for finding the corresponding points for four other characters—some members of the Wump family and some impostors.

**Coordinates of Characters**

	Mug Wump	Glum	sum	Tum	Crum
Rule	$(x, y)$	$(1.5x, 1.5y)$	$(3x, 2y)$	$(4x, 4y)$	$(2x, y)$
Point	Mouth				
<i>M</i>	(2, 2)	■	■	■	■
<i>N</i>	(6, 2)	■	■	■	■
<i>O</i>	(6, 3)	■	■	■	■
<i>P</i>	(2, 3)	■	■	■	■
<i>Q</i>	(2, 2) (connect <i>Q</i> to <i>M</i> )	■	■	■	■
	Nose (Start Over)				
<i>R</i>	(3, 4)	■	■	■	■
<i>S</i>	(4, 5)	■	■	■	■
<i>T</i>	(5, 4)	■	■	■	■
<i>U</i>	(3, 4) (connect <i>U</i> to <i>R</i> )	■	■	■	■

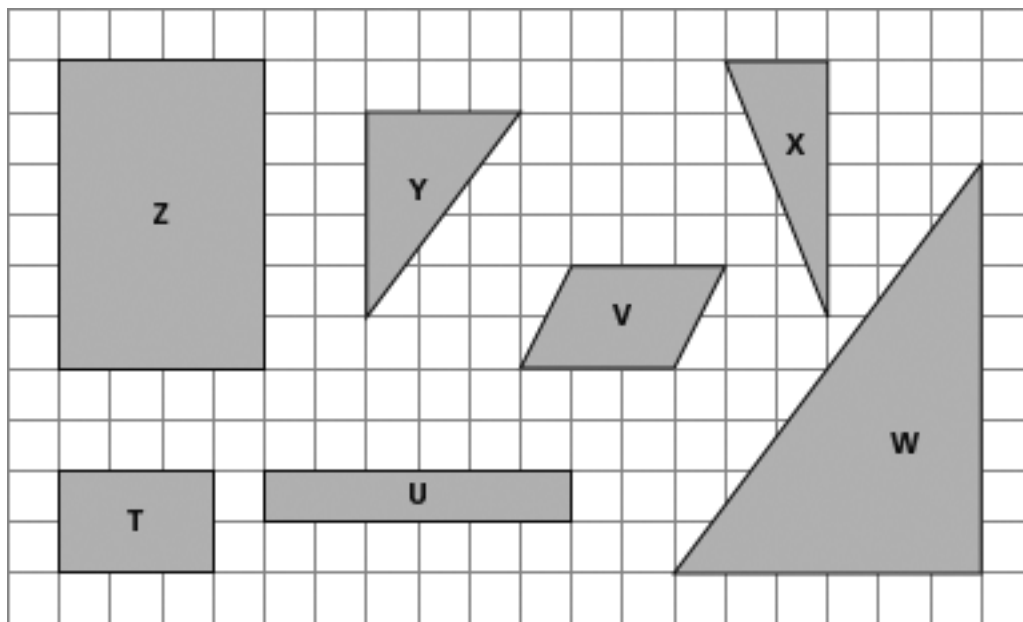
- Before you find the coordinates or plot points, predict which characters are the impostors.
- Copy and complete the table. Then, plot the figures on grid paper. Label each figure.
- Which of the new characters (Glum, Sum, Tum, and Crum) are members of the Wump family? Which are impostors?
- Choose one of the new Wumps. How do the mouth and nose measurements (side lengths, perimeter, area, angle measures) compare with those of Mug Wump?
- Choose one of the impostors. What are the dimensions of this impostor's mouth and nose? How do the mouth and nose measurements compare with those of Mug Wump?
- Do your findings in parts (b)–(e) support your prediction from part (a)? Explain.

2.
  - a. Design a Mug-like character of your own on grid paper. Give your character eyes, a nose, and a mouth.
  - b. Give coordinates so that someone else could draw your character.
  - c. Write a rule for finding coordinates of a member of your character's family. Check your rule by plotting the figure.
  - d. Write a rule for finding the coordinates of an impostor. Check your rule by plotting the figure.
  
3.
  - a. On grid paper, draw triangle  $ABC$  with vertex coordinates  $A(0, 2)$ ,  $B(6, 2)$ , and  $C(4, 4)$ .

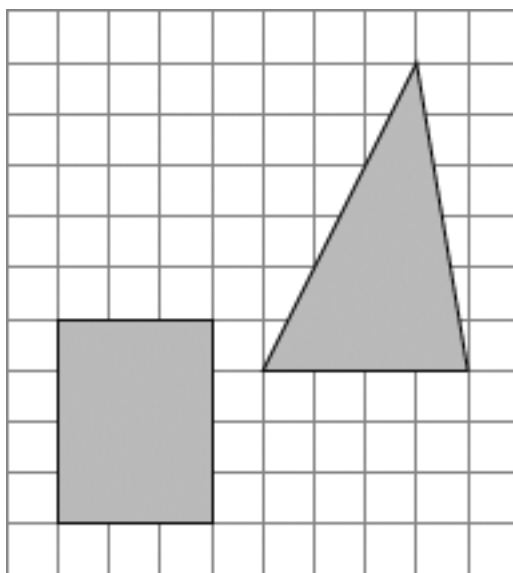


- b. Apply the rule  $(1.5x, 1.5y)$  to the vertices of triangle  $ABC$  to get triangle  $PQR$ . Compare the corresponding measurements (side lengths, perimeters, areas, area, angle measures) of the two triangles.
    - c. Apply the rule  $(2x, 0.5y)$  to the vertices of triangle  $ABC$  to get triangle  $FGH$ . Compare the corresponding measurements (side lengths, perimeters, areas, angle measures) of the two triangles.
    - d. Which triangle,  $PQR$  or  $FGH$ , seems similar to triangle  $ABC$ ? Why?
  
4.
  - a. On grid paper, draw parallelogram  $ABCD$  with vertex coordinates  $A(0, 2)$ ,  $B(6, 2)$ ,  $C(8, 6)$ , and  $D(2, 6)$ .
  - b. Write a rule to find the vertex coordinates of a parallelogram  $PQRS$  that is larger than, but similar to,  $ABCD$ . Test your rule to see if it works.
  - c. Write a rule to find the vertex coordinates of a parallelogram  $TUVW$  that is smaller than, but similar to,  $ABCD$ . Test your rule to see if it works.

For Exercises 5 and 6, study the size and shape of the polygons below.



5. **Multiple Choice** Choose the pair of similar figures.
- A. Z and Y      B. V and T      C. X and Y      D. Y and W
6. Find another pair of similar figures. Explain your reasoning.
7. Copy the figures below accurately onto your own grid paper.



- a. Draw a figure similar, but not identical, to the rectangle.
- b. Draw a figure similar, but not identical, to the triangle.
- c. How do you know your scale drawings are similar to the given figures?

8. The diagram below shows two similar polygons.

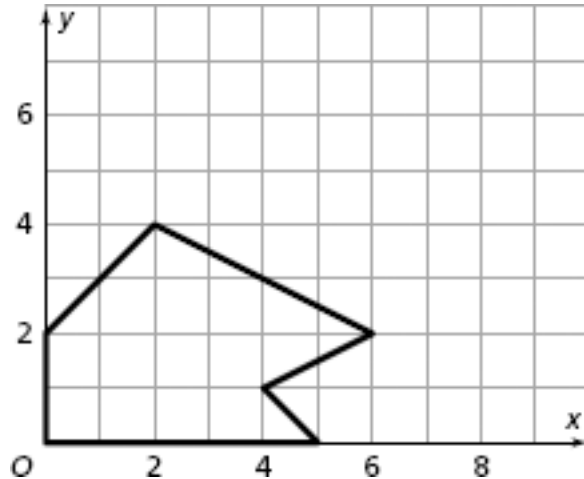


Figure A

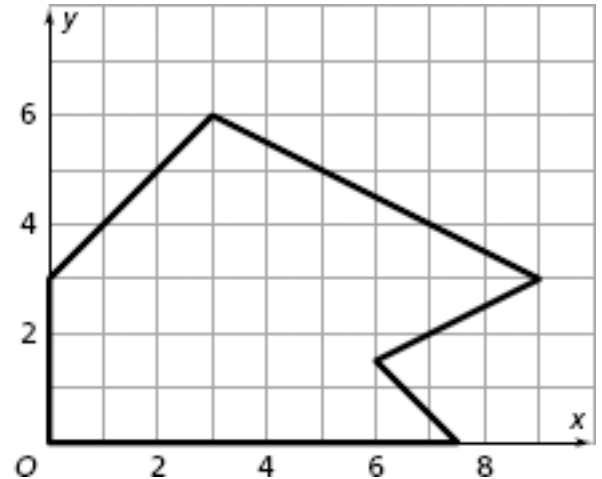
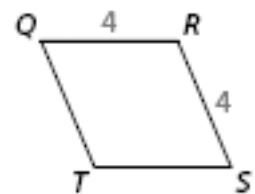
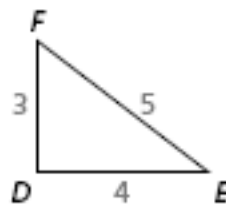
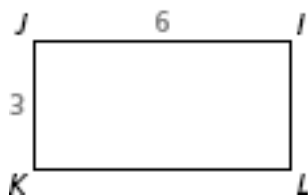
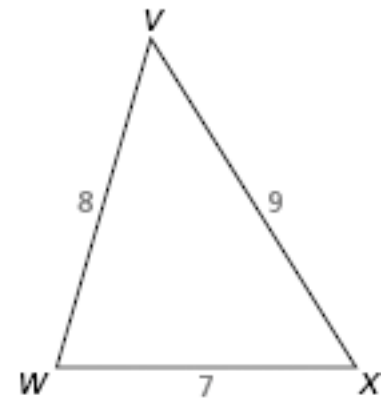
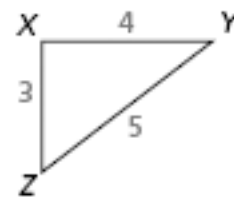
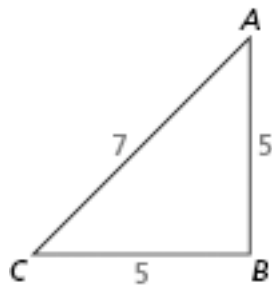
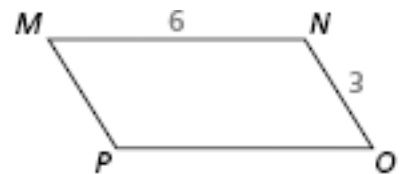
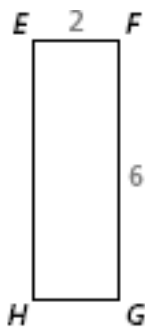
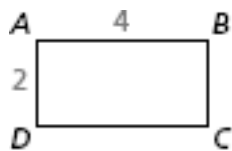


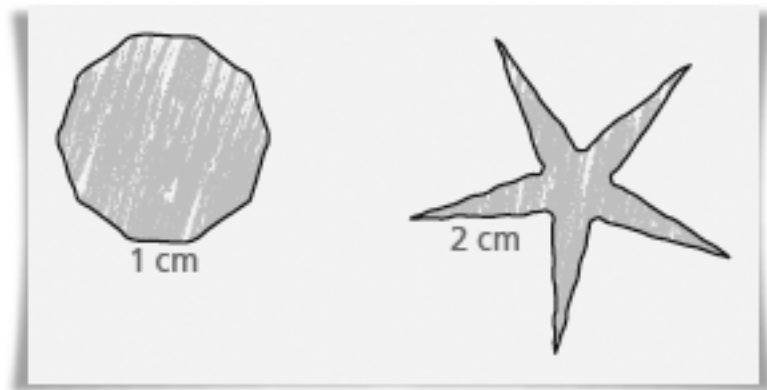
Figure B

- a. Write a rule for finding the coordinates of a point on Figure B from the corresponding point on Figure A.
  - b. Write a rule for finding the coordinates of a point on Figure A from the corresponding point on Figure B.
  - c.
    - i. What is the scale factor from Figure A to Figure B?
    - ii. Use the scale factor to describe how the perimeter and area of Figure B are related to the perimeter and area of Figure A.
  - d.
    - i. What is the scale factor from Figure B to Figure A?
    - ii. Use the scale factor to describe how the perimeter and area of Figure A are related to the perimeter and area of Figure B.
9. a. Suppose you make Figure C by applying the rule  $(2x, 2y)$  to the points on Figure A from Exercise 8. Find the coordinates of the vertices of Figure C.
- b.
    - i. What is the scale factor from Figure A to Figure C?
    - ii. Use the scale factor to describe how the perimeter and area of Figure C are related to the perimeter and area of Figure A.
  - c.
    - i. What is the scale factor from Figure C to Figure A?
    - ii. Use the scale factor to describe how the perimeter and area of Figure A are related to the perimeter and area of Figure C.
    - iii. Write a coordinate rule of the form  $(mx, my)$  that can be used to find the coordinates of any point of Figure A from the corresponding points of Figure C.

10. What is the scale factor from an original figure to its image if the image is made using the given method?
- a two-rubber-band stretcher
  - a copy machine with size factor 150%
  - a copy machine with size factor 250%
  - the coordinate rule  $(0.75x, 0.75y)$
11. a. Use the polygons below. Which pairs of polygons are similar figures?
- b. For each pair of similar figures, list corresponding sides and angles.
- c. For each pair of similar figures, find the scale factor that relates side lengths of the larger figure to the corresponding side lengths of the smaller figure.



12. On grid paper, draw a rectangle with an area of 14 square centimeters. Label it  $ABCD$ .
- Write and use a coordinate rule that will make a rectangle similar to rectangle  $ABCD$  that is three times as long and three times as wide. Label it  $EFGH$ .
  - How does the perimeter of rectangle  $EFGH$  compare to the perimeter of rectangle  $ABCD$ ?
  - How does the area of rectangle  $EFGH$  compare to the area of rectangle  $ABCD$ ?
  - How do your answers to parts (b) and (c) relate to the scale factor from rectangle  $ABCD$  to rectangle  $EFGH$ ?
13. A student drew the figures below. The student says the two shapes are similar because there is a common scale factor for all of the sides. The sides of the figure on the right are twice as long as those of the figure on the left. What do you say to the student to explain why the figures are *not* similar?



## Connections

For Exercises 14 and 15, the rule  $(x, \frac{3}{4}y)$  is applied to a polygon.

14. Is the image similar to the original polygon? Explain.
15. Each of the following points is on the original polygon. Find the coordinates of each corresponding point on the image.

a.  $(6, 8)$

b.  $(9, 8)$

c.  $(\frac{3}{2}, \frac{4}{3})$

**Multiple Choice For Exercises 16 and 17, what is the percent reduction or enlargement that will result if the rule is applied to a figure on a coordinate grid?**

16.  $(1.5x, 1.5y)$   
 A. 150%                      B. 15%                      C. 1.5%                      D. None of these
17.  $(0.7x, 0.7y)$   
 F. 700%                      G. 7%                      H. 0.7%                      J. None of these
18. The rule  $(x + \frac{2}{3}, y - \frac{3}{4})$  is applied to a polygon. For each vertex below of the polygon, find the coordinates of the corresponding vertex on the image.
- a.  $(5, 3)$                       b.  $(\frac{1}{6}, \frac{11}{12})$                       c.  $(\frac{9}{12}, \frac{4}{5})$
19. An accurate map is a scale drawing of the place it represents. Below is a map of South Africa.



- a. Use the scale to estimate the distance from Cape Town to Port Elizabeth.
- b. Use the scale to estimate the distance from Johannesburg to East London.
- c. What is the relationship between the scale for the map and a “scale factor”?

Find each quotient.

20.  $\frac{1}{2} \div \frac{1}{4}$

21.  $\frac{1}{4} \div \frac{1}{2}$

22.  $\frac{3}{7} \div \frac{4}{7}$

23.  $\frac{4}{7} \div \frac{3}{7}$

24.  $\frac{3}{2} \div \frac{3}{5}$

25.  $1\frac{1}{2} \div \frac{3}{8}$

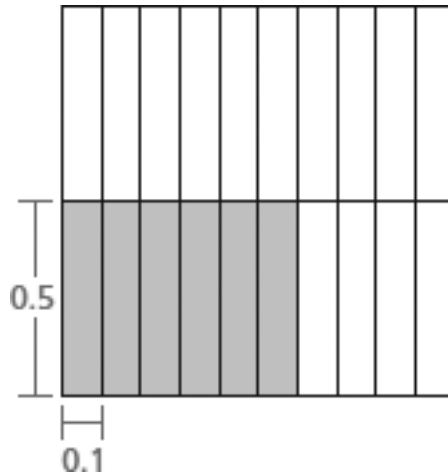
26. At a bake sale, 0.72 of a pan of corn bread has not been sold. A serving is 0.04 of a pan.

- a. How many servings are left?
- b. Use a hundredths grid to show your reasoning.

27. Each pizza takes 0.3 of a large block of cheese. Charlie has 0.8 of a block of cheese left.

- a. How many pizzas can he make?
- b. Use a diagram to show your reasoning.

28. a. What part of the grid below is shaded?



- b. The grid shows the part of a pan of spinach appetizers remaining. How many servings are left if a serving is 0.04?
- c. Draw a picture to confirm your answer to part (b).

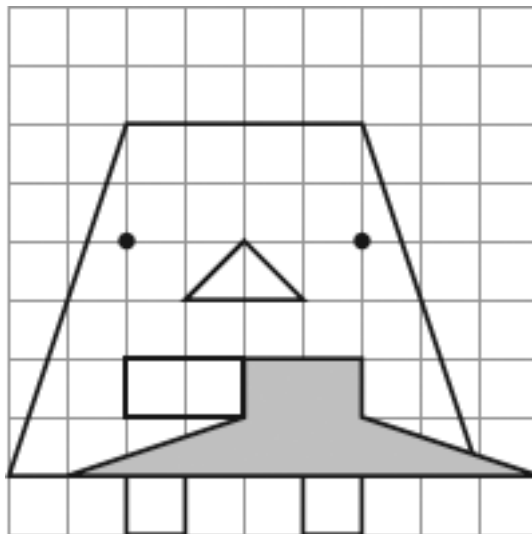
## Extensions

29. Select a drawing of a comic strip character from a newspaper or magazine. Draw a grid over the figure or tape a transparent grid on top of the figure. Identify key points on the figure and then enlarge it using each of these rules. Which figures are similar? Explain.

- a.  $(2x, 2y)$
- b.  $(x, 2y)$
- c.  $(2x, y)$



- 30.** Suppose you use the rule  $(3x + 1, 3y - 4)$  to transform Mug Wump into a new figure.
- How will the angle measures in the new figure compare to corresponding angle measures in Mug?
  - How will the side lengths of the new figure compare to corresponding side lengths of Mug?
  - How will the area and perimeter of this new figure compare to the area and perimeter of Mug?
- 31.** The vertices of three similar triangles are given.
- triangle  $ABC$ :  $A(1, 2), B(4, 3), C(2, 5)$
  - triangle  $DEF$ :  $D(3, 6), E(12, 9), F(6, 15)$
  - triangle  $GHI$ :  $G(5, 9), H(14, 12), I(8, 18)$
- Find a rule that changes the vertices of triangle  $ABC$  to the vertices of triangle  $DEF$ .
  - Find a rule that changes the vertices of triangle  $DEF$  to the vertices of triangle  $GHI$ .
  - Find a rule that changes the vertices of triangle  $ABC$  to the vertices of triangle  $GHI$ .
- 32.** If you drew Mug and his hat on the same grid, his hat would be at his feet instead of on his head.

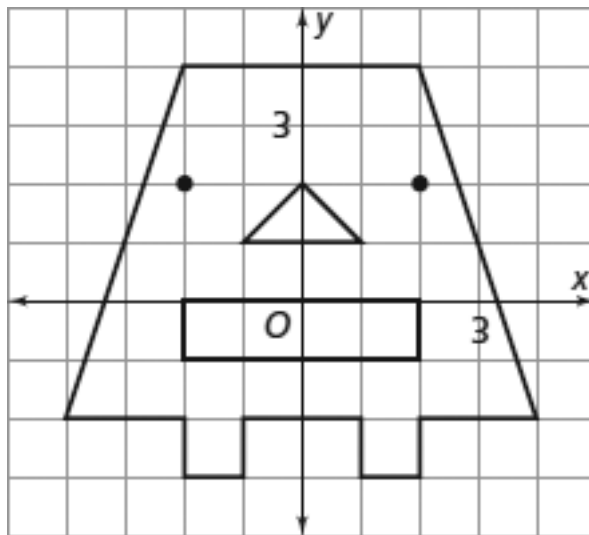


- Write a rule that puts Mug's hat centered on his head.
- Write a rule that changes Mug's hat to fit Zug and puts the hat on Zug's head.
- Write a rule that changes Mug's hat to fit Lug and puts the hat on Lug's head.

33. Films are sometimes modified to fit a TV screen. Find out what that means. What exactly is modified? If Mug is in a movie, is he still a Wump when you see the video on TV?



34. The diagram below shows Mug Wump drawn on a coordinate grid. Use this diagram to answer the questions on the next page.

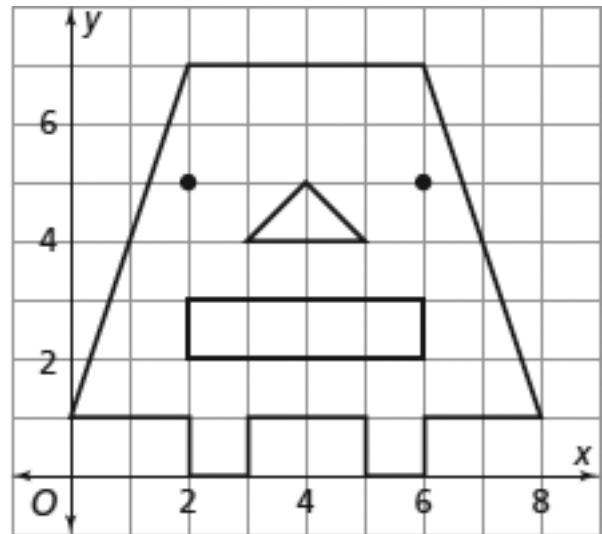


- a. Use the diagram on the previous page. Complete the first column of a table like the one shown to record coordinates of key points needed to draw Mug. (You will need to determine the number of points needed for each body part.)
- b. Suppose you make scale drawings with rules  $(2x, 2y)$  and  $(-2x, -2y)$ . Complete the table to give coordinates for the images of Mug.
- c. On graph paper, plot the images of Mug Wump produced by the new sets of coordinates in part (b).
- d. Compare the length, width, and area of Mug's mouth to those of the figures drawn in part (c). Explain how you could have predicted those results by studying the coordinate rules for the drawings.

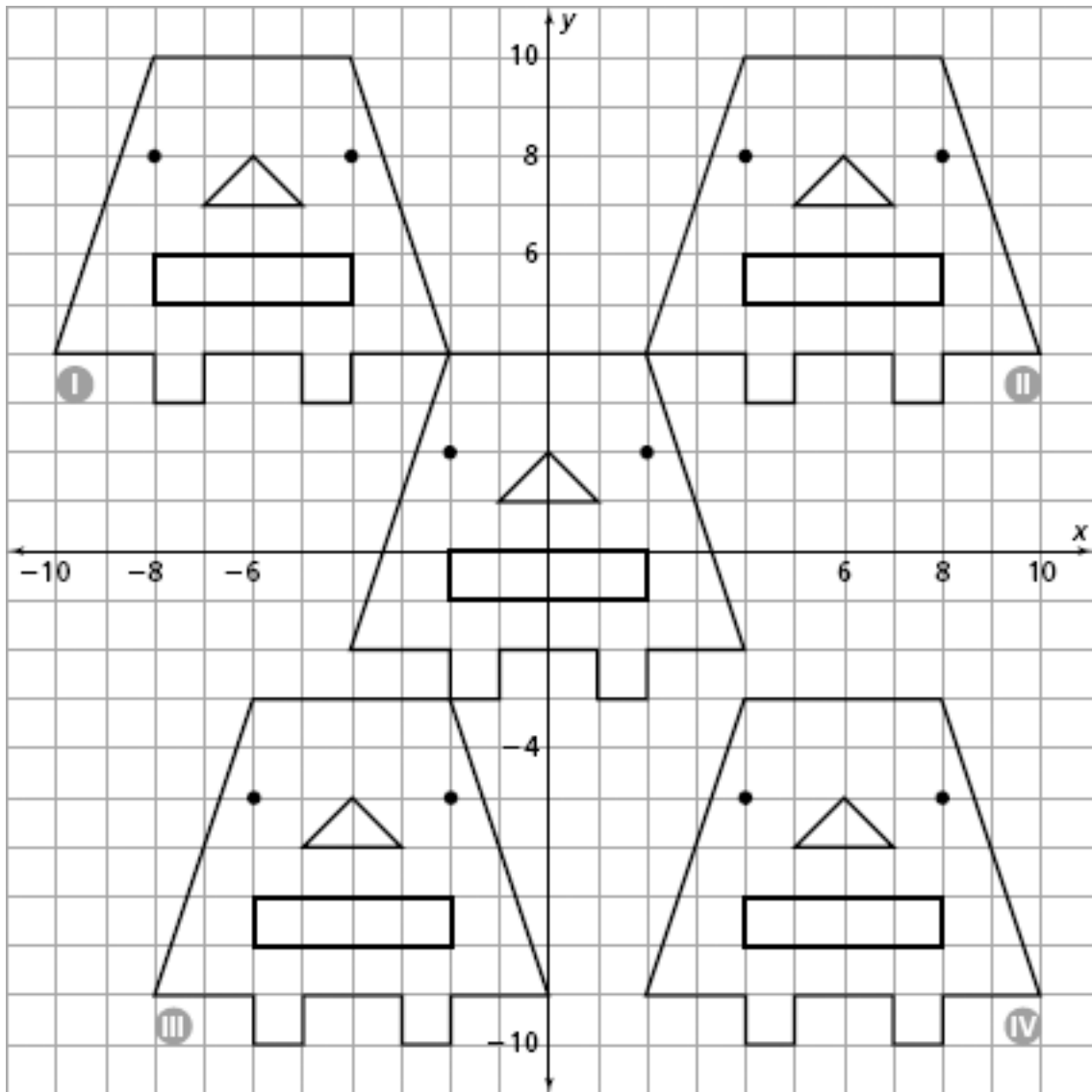
**Coordinates for Mug and Variations**

Rule	$(x, y)$	$(2x, 2y)$	$(-2x, -2y)$
Head Outline	$(-4, -2)$	■	■
	$(-2, -2)$	■	■
	$(-2, 3)$	■	■
	■	■	■
	■	■	■
Nose	$(-1, 1)$	■	■
	■	■	■
	■	■	■
Mouth	$(-2, -1)$	■	■
	■	■	■
	■	■	■
	■	■	■
Eyes	$(-2, 2)$	■	■
	■	■	■

35. Explain how each rule changes the original shape, size, and location of Mug Wump.
  - a.  $(-x, y)$
  - b.  $(x, -y)$
  - c.  $(-0.5x, -0.5y)$
  - d.  $(-0.5x, y)$
  - e.  $(-3x, -3y)$
  - f.  $(3x + 5, -3y - 4)$



36. The diagram below shows Mug Wump drawn at the center of a coordinate grid and in four other positions.



- Find a sequence of coordinates to draw Mug's body at the center of the grid. Make a table to keep track of the points. For parts (b) and (c) below, use this Mug as the original Mug.
- You can write a coordinate rule to describe the movement of points from one location to another. For example, the coordinate rule  $(x - 2, y + 3)$  moves a point  $(x, y)$  to the left 2 units and up 3 units from its original location. Which of the other drawings is produced by the coordinate rule  $(x + 6, y - 7)$ ?
- Find coordinate rules for moving the original Mug to the other positions on the grid.