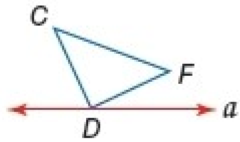
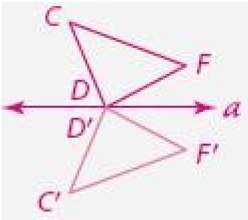
9-1 Reflections

Copy the figure and the given line of reflection. Then draw the reflected image in this line using a ruler.

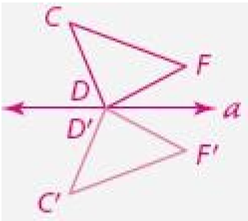
1. 

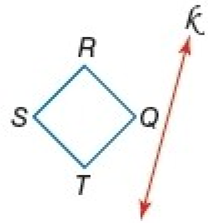
SOLUTION:

Step 1: Draw a line through each vertex that is perpendicular to line *a*.
Step 2: Measure the distance from point *C* to the line *a*. Then locate *C*' the same distance from line *a* on the opposite side.
Step 3: Repeat Step 2 to locate points *D*' and *F*'. Then connect the vertices, *C*', *D*', and *F'* to form the reflected image.



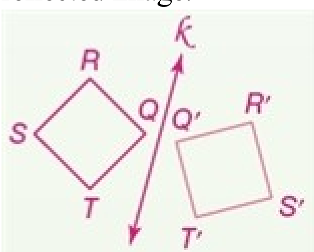
ANSWER:



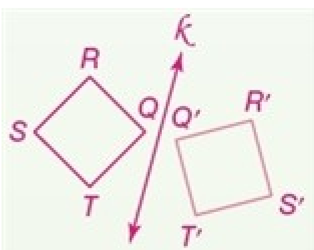
2. 

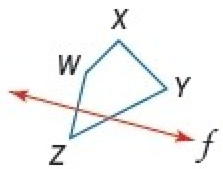
SOLUTION:

Step 1: Draw a line through each vertex that is perpendicular to line k.
Step 2: Measure the distance from point Q to the line k. Then locate Q' the same distance from line k on the opposite side.
Step 3: Repeat Step 2 to locate points R', S' and T'. Then connect the vertices, Q', R', S', and T' to form the reflected image.



ANSWER:





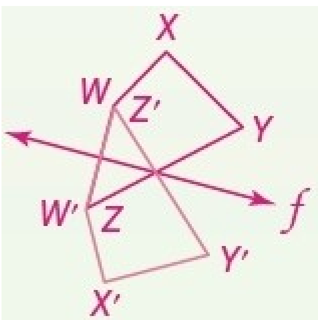
3.

SOLUTION:

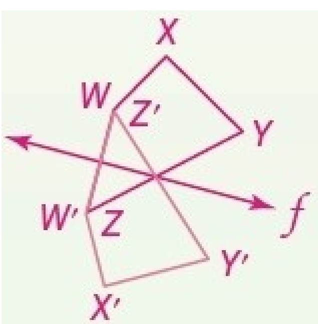
Step 1: Draw a line through each vertex that is perpendicular to line f.

Step 2: Measure the distance from point W to the line f. Then locate W' the same distance from line f on the opposite side.

Step 3: Repeat Step 2 to locate points X', Y' and Z'. Then connect the vertices, W', X', Y' and Z' to form the reflected image.



ANSWER:



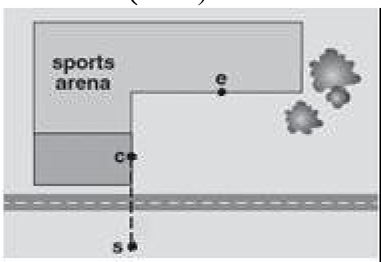
4. **SPORTING EVENTS** Toru is waiting at a café for a friend to bring him a ticket to a sold-out sporting event. At what point P along the street should the friend try to stop his car to minimize the distance Toru will have to walk from the café, to the car, and then to the arena entrance? Draw a diagram.

SOLUTION:

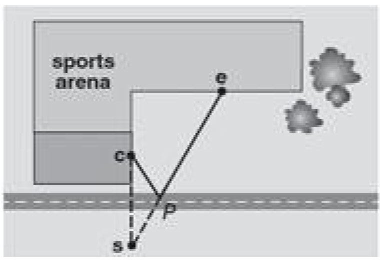
You are asked to locate a point P on line se such that $cP + Pe$ has the least possible value.

The total distance from s to P and then from P to e is least when these three points are collinear. Use the reflection of point c over the roadto find the location for point P.

Draw $c'e$ (or se).



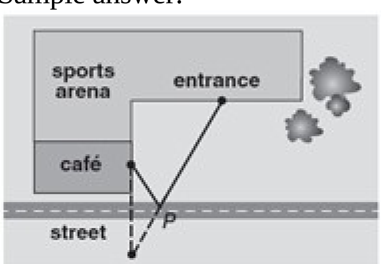
Locate P at the intersection of road and line se .



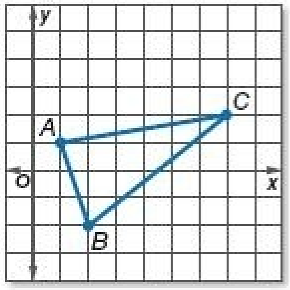
Compare the sum $cP + Pe$ for each case to verify that the location found for P minimizes this sum.

ANSWER:

Sample answer:



Graph ΔABC and its image in the given line.



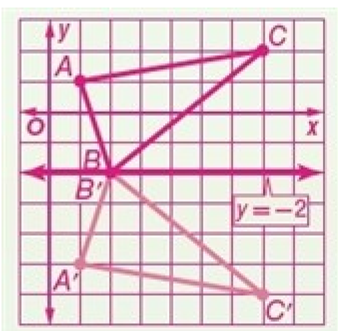
5. $y = –2$

SOLUTION:

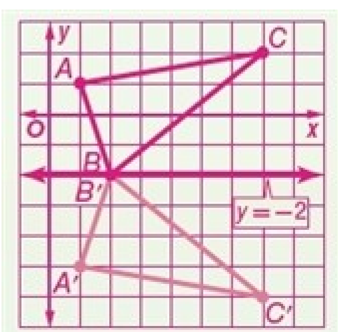
A is (1,1), B is at (2, –2) and C is at (7, 2). Find a corresponding point for each vertex so that a vertex and its image are equidistant from the line $y = –2$.

Vertex A is 3 units up from $y = –2$, locate the point 3 units down from $y = –2$. A' would be (1, –5).
Vertex B is on the line $y = –2$, so B' would be at the same point (2, –2).
Vertex C is 4 units up from $y = –2$, locate the point 4 units down from $y = –2$. C' would be (7, –6).

Then connect the vertices, A', B', and C' to form the reflected image.



ANSWER:



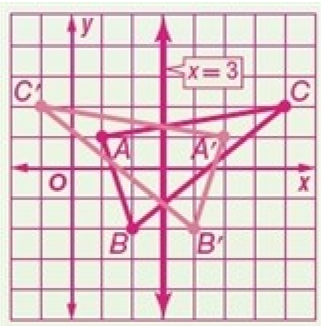
6. $x = 3$

SOLUTION:

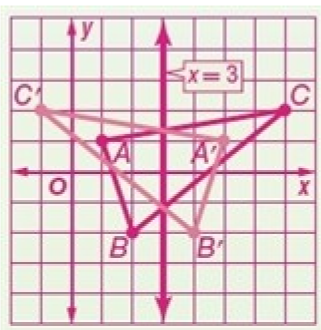
A is (1,1), B is at (2, –2) and C is at (7, 2). Find a corresponding point for each vertex so that a vertex and its image are equidistant from the line $x = 3$.

Vertex A is 2 units left from $x = 3$, locate the point 2 units right from $x = 3$. A' would be at (5, 1).
Vertex B is 1 unit left from $x = 3$, locate the point 1 unit right from $x = 3$. B' would be at (4, –2).
Vertex C is 4 units right from $x = 3$, locate the point 4 units left from $x = 3$. C' would be at (–1, 2).

Then connect the vertices, A', B', and C' to form the reflected image.



ANSWER:



Graph each figure and its image under the given reflection.

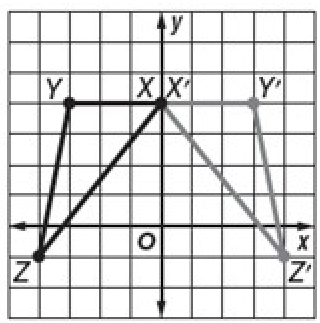
7. ΔXYZ with vertices $X(0, 4)$, $Y(–3, 4)$, and $Z(–4, –1)$ in the y-axis

SOLUTION:

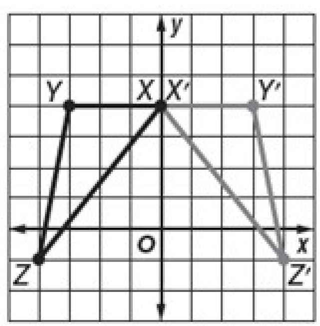
To reflect over the y-axis, multiply the x-coordinate of each vertex by –1.

$(x, y) \rightarrow (–x, y)$
$X(0, 4) \rightarrow X'(0, 4)$
$Y(–3, 4) \rightarrow Y'(3, 4)$
$Z(–4, –1) \rightarrow Z'(4, –1)$

Plot the points. Then connect the vertices, X', Y', and Z' to form the reflected image.



ANSWER:



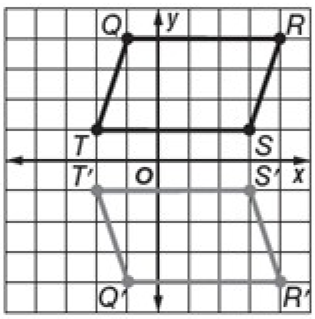
8. $\square QRST$ with vertices $Q(–1, 4)$, $R(4, 4)$, $S(3, 1)$, and $T(–2, 1)$ in the x-axis

SOLUTION:

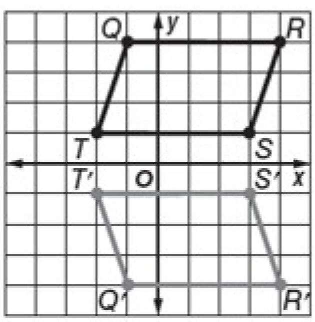
To reflect over the x-axis, multiply the y-coordinate of each vertex by –1.

$(x, y) \rightarrow (x, -y)$
$Q(–1, 4) \rightarrow Q'(–1, –4)$
$R(4, 4) \rightarrow R'(4, –4)$
$S(3, 1) \rightarrow S'(3, –1)$
$T(–2, 1) \rightarrow T'(–2, –1)$

Plot the points. Then connect the vertices, Q', R', S', and T' to form the reflected image.



ANSWER:



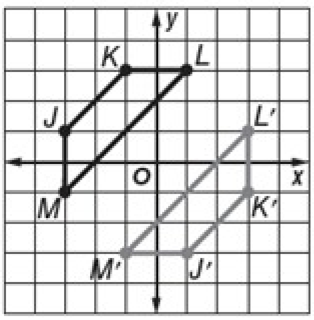
9. quadrilateral $JKLM$ with vertices $J(–3, 1)$, $K(–1, 3)$, $L(1, 3)$, and $M(–3, –1)$ in the line $y = x$

SOLUTION:

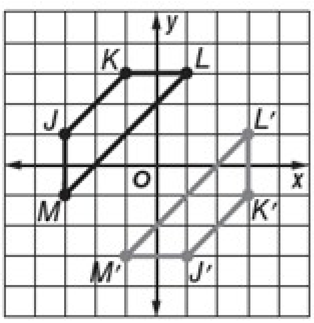
To reflect over the $y = x$ line, interchange the x- and y-coordinates of each vertex.

$(x, y) \rightarrow (y, x)$
$J(–3, 1) \rightarrow J'(1, –3)$
$K(–1, 3) \rightarrow K'(3, –1)$
$L(1, 3) \rightarrow L'(3, 1)$
$M(–3, –1) \rightarrow M'(–1, –3)$

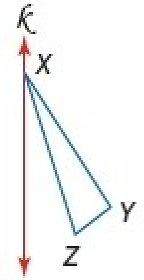
Plot the points. Then connect the vertices, J', K', L', and M' to form the reflected image.



ANSWER:



CCSS TOOLS Copy the figure and the given line of reflection. Then draw the reflected image in this line using a ruler.



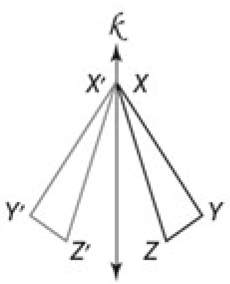
10.

SOLUTION:

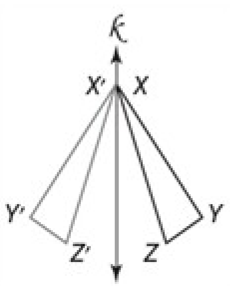
Step 1: Draw a line through each vertex that is perpendicular to line k.

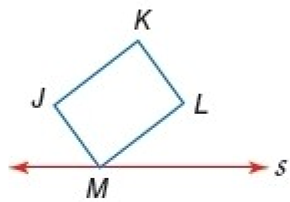
Step 2: Measure the distance from point X to the line k. Then locate X' the same distance from line k on the opposite side.

Step 3: Repeat Step 2 to locate points Y' and Z'. Then connect the vertices, X', Y', and Z' to form the reflected image.



ANSWER:

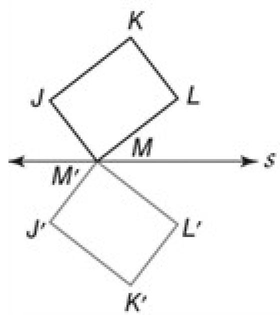




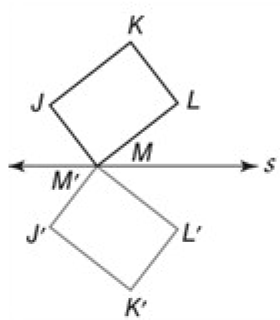
11.

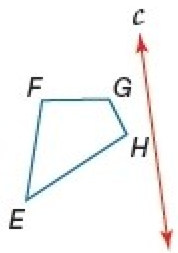
SOLUTION:

Step 1: Draw a line through each vertex that is perpendicular to line *s*.
Step 2: Measure the distance from point *J* to the line *s*. Then locate *J*' the same distance from line *s* on the opposite side.
Step 3: Repeat Step 2 to locate points *K*', *L*', and *M*'. Then connect the vertices *J*', *K*', *L*', and *M*' to form the reflected image.



ANSWER:





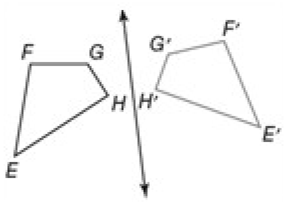
12.

SOLUTION:

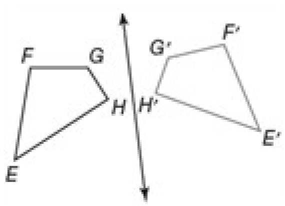
Step 1: Draw a line through each vertex that is perpendicular to line *c*.

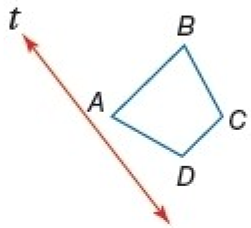
Step 2: Measure the distance from point *E* to the line *c*. Then locate *E*' the same distance from line *c* on the opposite side.

Step 3: Repeat Step 2 to locate points *F'*, *G'* and *H*'. Then connect the vertices, *E*', *F'*, *G'* and *H*' to form the reflected image.



ANSWER:





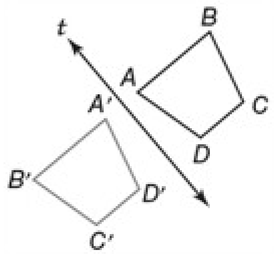
13.

SOLUTION:

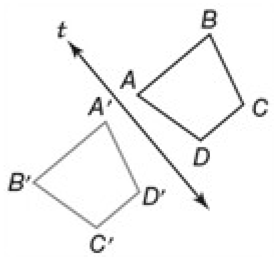
Step 1: Draw a line through each vertex that is perpendicular to line t.

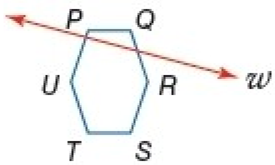
Step 2: Measure the distance from point A to the line t. Then locate A' the same distance from line t on the opposite side.

Step 3: Repeat Step 2 to locate points B', C' and D'. Then connect the vertices, A', B', C' and D' to form the reflected image.



ANSWER:

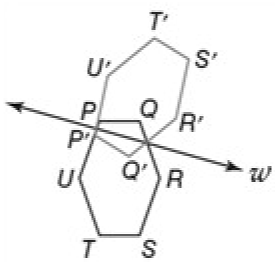




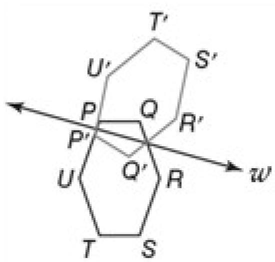
14.

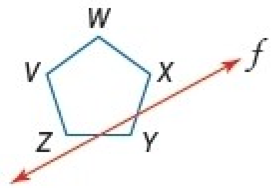
SOLUTION:

Step 1: Draw a line through each vertex that is perpendicular to line *w*.
Step 2: Measure the distance from point *P* to the line *w*. Then locate *P*' the same distance from line *w* on the opposite side.
Step 3: Repeat Step 2 to locate points *Q*', *R*', *S*', *T*,' and *U*'. Then connect the vertices *P*', *Q*', *R*', *S*', *T*', and *U*' to form the reflected image.



ANSWER:

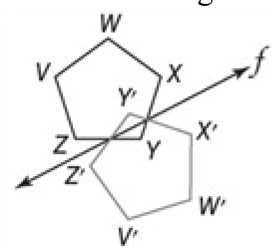




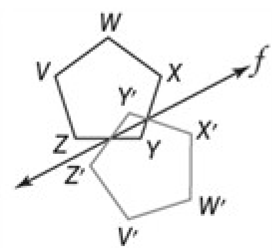
15.

SOLUTION:

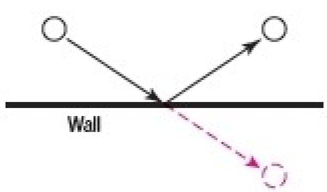
Step 1: Draw a line through each vertex that is perpendicular to line f.
Step 2: Measure the distance from point V to the line f. Then locate V' the same distance from line f on the opposite side.
Step 3: Repeat Step 2 to locate points W', X', Y' and Z'. Then connect the vertices, V', W', X', Y' and Z' to form the reflected image.



ANSWER:



SPORTS When a ball is rolled or struck without spin against a wall, it bounces off the wall and travels in a ray that is the reflected image of the path of the ball if it had gone straight through the wall. Use this information in Exercises 16 and 17.



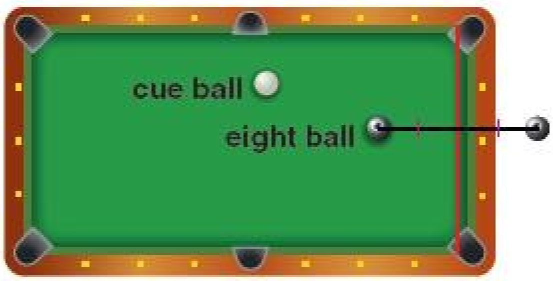
16. **BILLIARDS** Tadeo is playing billiards. He wants to strike the eight ball with the cue ball so that the eight ball bounces off the rail and rolls into the indicated pocket. If the eight ball moves with no spin, draw a diagram showing the exact point P along the right rail where the eight ball should hit after being struck by the cue ball.

9-1 Reflections

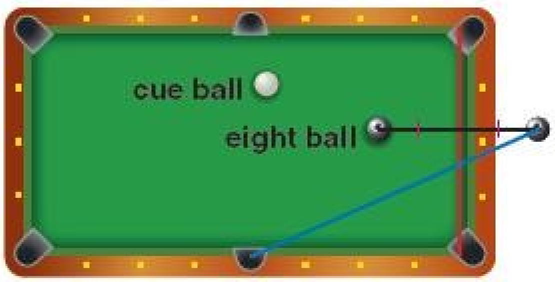
SOLUTION:

We want to determine where the 8 ball should hit the rail so that it goes into the side pocket. To do this, we will need to locate a point *P* on the rail of the table such that *P* is collinear with the side pocket and the reflection of the 8 ball.

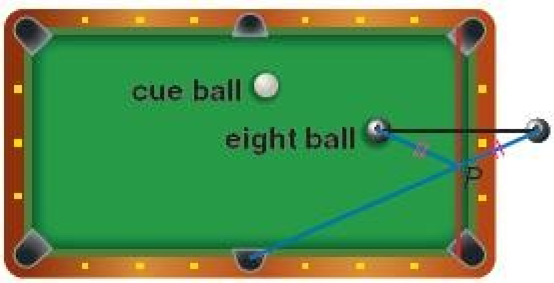
Step 1: Locate the reflection of the 8 ball. The rail (red line) is equidistant from the 8 ball and the reflection.



Step 2: Draw a line from the side pocket to the reflection. We now know the line along which the 8 ball should travel in order to go into the side pocket.

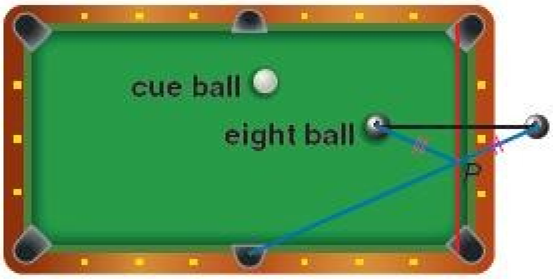


The intersection of the red and blue lines is the location of point *P*. The distance from *P* to the 8 ball and from *P* to the reflection are equal.

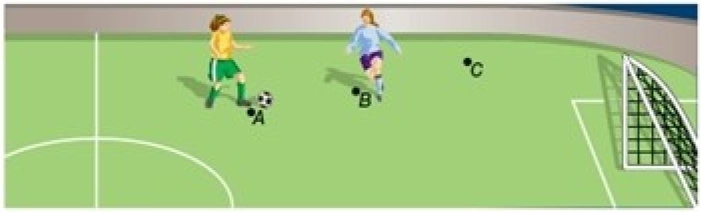


ANSWER:

9-1 Reflections



17. **INDOOR SOCCER** Abby is playing indoor soccer, and she wants to hit the ball to point C, but must avoid an opposing player at point B. She decides to hit the ball at point A so that it bounces off the side wall. Draw a diagram that shows the exact point along the top wall for which Abby should aim.



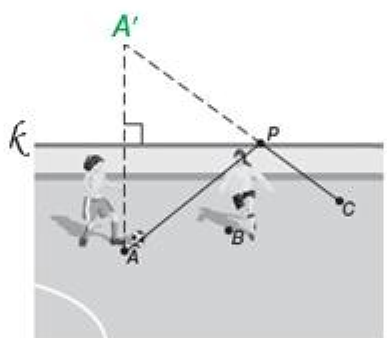
SOLUTION:

You are asked to locate a point P on line k such that $cP + A'P$ has the least possible value.

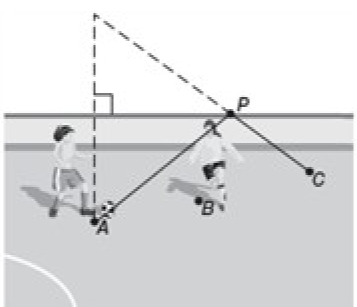
The total distance from c to P and then from A' to P is least when these three points are collinear. Use the reflection of point A in line k to find the location for point P.

Draw $A'c$. Locate P at the intersection of line k and line $A'c$.

Compare the sum $cP + A'P$ for each case to verify that the location found for P minimizes this sum

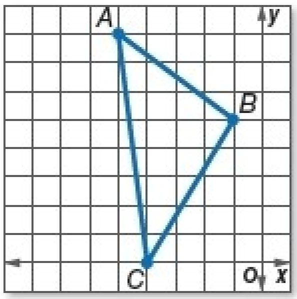


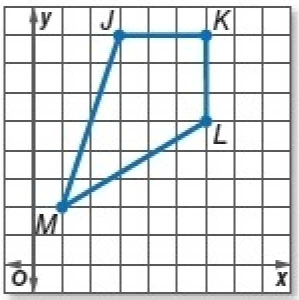
ANSWER:

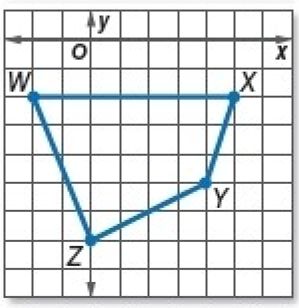


Graph each figure and its image in the given line.

9-1 Reflections







18. ΔABC; $y = 3$

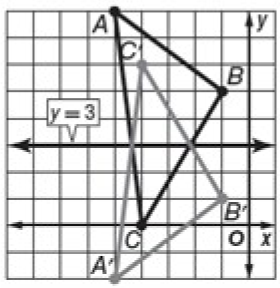
SOLUTION:

A is (–5, 8), B is at (–1, 5) and C is at (–4, 0). Find a corresponding point for each vertex so that a vertex and its image are equidistant from the line $y = 3$.

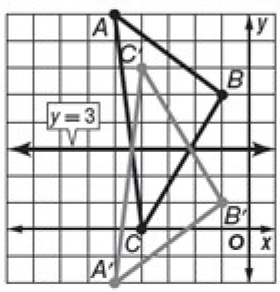
Draw $y = 3$.

Vertex A is 5 units up from $y = 3$, locate the point 5 units down from $y = 3$. A' would be (–5, –2).
Vertex B is 2 units up from the $y = 3$, locate the point 2 units down from $y = 3$. B' would be (–1, 1).
Vertex C is 3 units down from $y = 3$, locate the point 3 units up from $y = 3$. C' would be (–4, 6).

Then connect the vertices, A', B', and C' to form the reflected image.



ANSWER:



19. ΔABC; $x = -1$

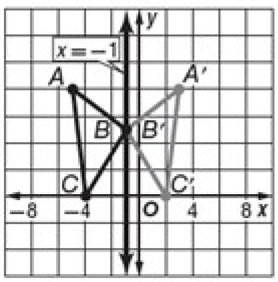
SOLUTION:

A is (–5, 8), B is at (–1, 5) and C is at (–4, 0). Find a corresponding point for each vertex so that a vertex and its image are equidistant from the line $x = -1$.

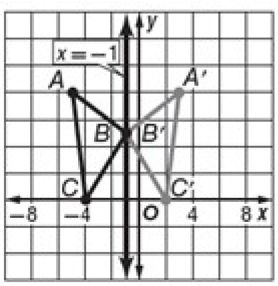
Draw $x = -1$.

Vertex A is 4 units left from $x = -1$, locate the point 4 units right from $x = -1$. A' would be (3, 8).
Vertex B is on the line $x = -1$, so B' would be (–1, 5).
Vertex C is 3 units left from $x = -1$, locate the point 3 units right from $x = -1$. C' would be (2, 0).

Then connect the vertices, A', B', and C' to form the reflected image.



ANSWER:



20. *JKLM*; $x = 1$

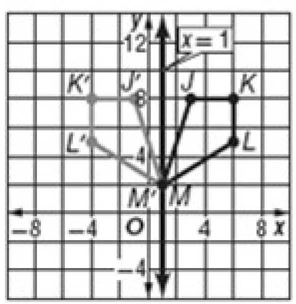
SOLUTION:

J is (3,8), *K* is at (6, 8), *L* is at (6, 5),and *M* is at (1, 2). Find a corresponding point for each vertex so that a vertex and its image are equidistant from the line $x = 1$.

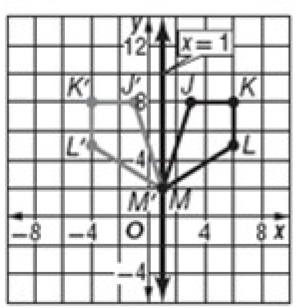
Draw the line $x = 1$.

Vertex *J* is at 2 units right from $x = 1$, locate the point 2 units left from $x = 1$. *J*' would be (–1, 8).
Vertex *K* is 5 units right from $x = 1$, locate the point 5 units left from $x = 1$. *K*' would be (–4, 8).
Vertex *L* is 5 units right from $x = 1$, locate the point 5 units left from $x = 1$. *L*' would be (–4, 5).
Vertex *M* is on $x = 1$, so *M*' would be (1, 2).

Then connect the vertices, *J*', *K*', *L*', and *M*' to form the reflected image.



ANSWER:



21. *JKLM*; $y = 4$

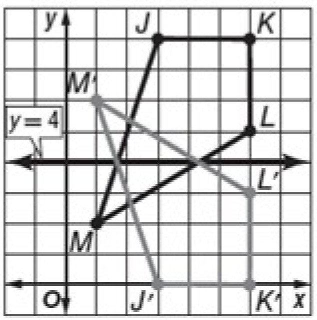
SOLUTION:

J is at (3,8), *K* is at (6, 8), *L* is at (6, 5),and *M* is at (1, 2). Find a corresponding point for each vertex so that a vertex and its image are equidistant from the line $y = 4$.

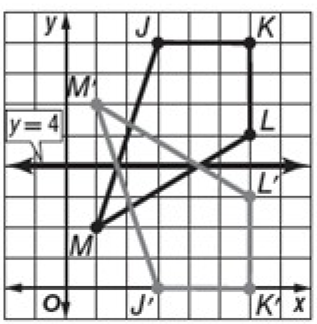
Draw the line $y = 4$.

Vertex *J* is 4 units up from $y = 4$, locate the point 4 units down from $y = 4$. *J*' would be (3, 0).
Vertex *K* is 4 units up from $y = 4$, locate the point 4 units down from $y = 4$. *K*' would be (6, 0).
Vertex *L* is 1 unit up from $y = 4$, locate the point 1 unit down from $y = 4$. *L*' would be (6, 3).
Vertex *M* is 2 units down from $y = 4$, locate the point 2 units up from $y = 4$. *M*' would be (1, 6).

Then connect the vertices *J*', *K*', *L*', and *M*' to form the reflected image.



ANSWER:



22. *WXYZ*; $y = -4$

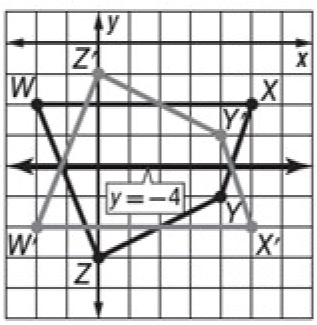
SOLUTION:

W is at (–2, –2), *X* is at (6, –2), *Y* is at (4, –5),and *Z* is at (0, –7). Find a corresponding point for each vertex so that a vertex and its image are equidistant from the line $y = -4$.

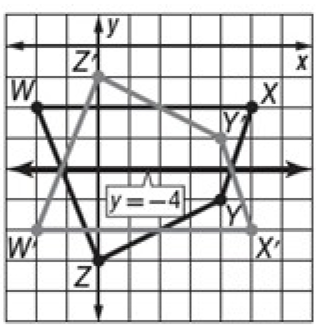
Draw the line $y = -4$.

Vertex *W* is 2 units up from $y = -4$, locate the point 2 units down from $y = -4$. *W*' would be (–2, –6).
Vertex *X* is 2 units up from $y = -4$, locate the point 2 units down from $y = -4$. *X*' would be (6, –6).
Vertex *Y* is 1 unit down from $y = -4$, locate the point 1 unit up from $y = -4$. *Y*' would be (4, –3).
Vertex *Z* is 3 units down from $y = -4$, locate the point 3 units up from $y = -4$. *Z*' would be (0, –1).

Then connect the vertices *W*', *X*', *Y*', and *Z*' to form the reflected image.



ANSWER:



23. *WXYZ*; $x = -2$

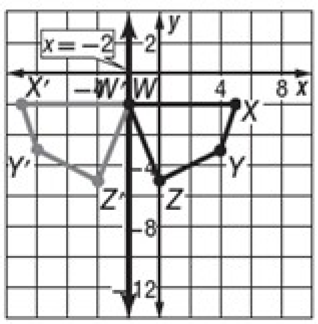
SOLUTION:

W is at (–2, –2), *X* is at (5, –2), *Y* is at (4, –5),and *Z* is at (0, –7). Find a corresponding point for each vertex so that a vertex and its image are equidistant from the line $x = -2$.

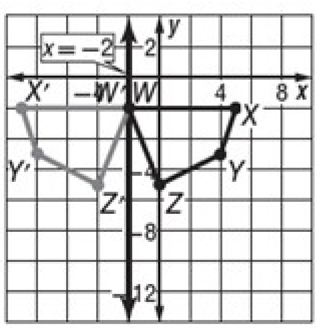
Draw the line $x = -2$.

Vertex *W* is on $x = -2$, so *W*' would be (–2, –2).
Vertex *X* is 7 units right from $x = -2$, locate the point 7 units left from $x = -2$. *X*' would be (–9, –2).
Vertex *Y* is 6 units right from $x = -2$, locate the point 6 units left from $x = -2$. *Y*' would be (–8, –5).
Vertex *Z* is 2 units right from $x = -2$, locate the point 2 units left from $x = -2$. *Z*' would be (–4, –7).

Then connect the vertices, *W*', *X*', *Y*', and *Z*' to form the reflected image.



ANSWER:



CCSS STRUCTURE Graph each figure and its image under the given reflection.

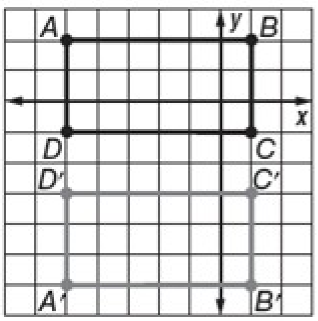
24. rectangle $ABCD$ with vertices $A(-5, 2)$, $B(1, 2)$, $C(1, -1)$, and $D(-5, -1)$ in the line $y = -2$

SOLUTION:

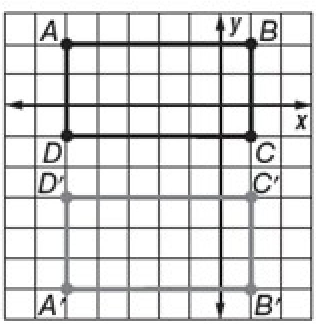
To reflect over the line $y = -2$, subtract from the y-coordinate the distance from the $y = -2$ line.

$(x, y) \rightarrow (x, y - \text{distance from } y = -2)$
$A(-5, 2) \rightarrow$ Distance: +4, $A'(-5, -6)$
$B(1, 2) \rightarrow$ Distance: +4, $B'(1, -6)$
$C(1, -1) \rightarrow$ Distance: +1, $C'(1, -3)$,
$D(-5, -1) \rightarrow$ Distance: +1, $D'(-5, -3)$

Plot the points. Then connect the vertices, A', B', C', and D' to form the reflected image.



ANSWER:



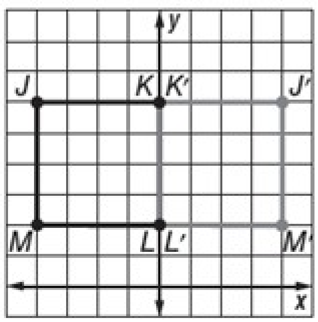
25. square $JKLM$ with vertices $J(–4, 6)$, $K(0, 6)$, $L(0, 2)$, and $M(–4, 2)$ in the y-axis

SOLUTION:

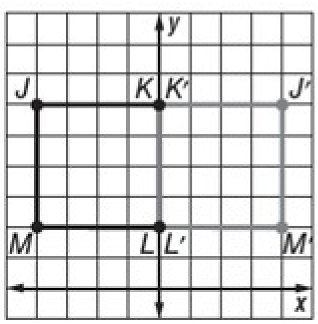
To reflect over the y-axis, multiply the x-coordinate of each vertex by –1.

$(x, y) \rightarrow (–x, y)$
$J(–4, 6) \rightarrow J'(4, 6)$
$K(0, 6), \rightarrow K'(0, 6)$
$L(0, 2) \rightarrow L'(0, 2)$
$M(–4, 2) \rightarrow M'(4, 2)$

Plot the points. Then connect the vertices, J, K', L', and M' to form the reflected image.



ANSWER:



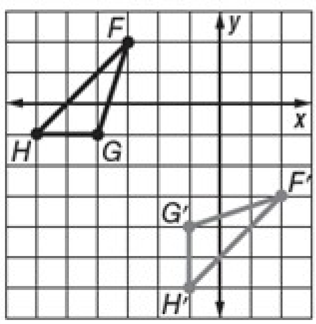
26. ΔFGH with vertices $F(-3, 2)$, $G(-4, -1)$, and $H(-6, -1)$ in the line $y = x$

SOLUTION:

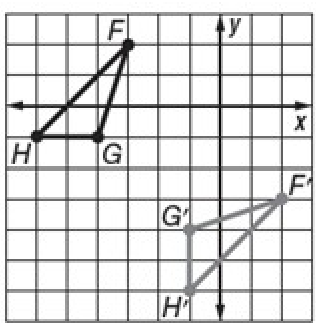
To reflect over line $y = x$, interchange the x- and y-coordinates.

$(x, y) \rightarrow (y, x)$
$F(-3, 2), \rightarrow F'(2, -3)$
$G(-4, -1) \rightarrow G'(-1, -4)$
$H(-6, -1) \rightarrow H'(-1, -6)$

Plot the points. Then connect the vertices, F', G', and H' to form the reflected image.



ANSWER:



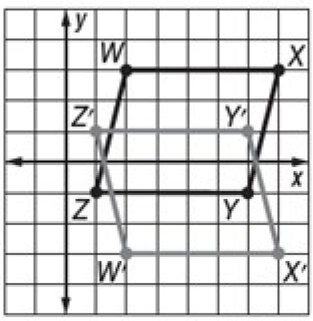
27. ▱$WXYZ$ with vertices $W(2, 3)$, $X(7, 3)$, $Y(6, –1)$, and $Z(1, –1)$ in the x-axis

SOLUTION:

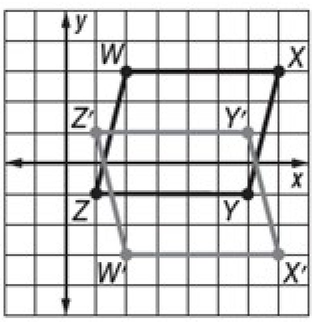
To reflect over the x-axis, multiply the y-coordinate of each vertex by –1.

$(x, y) \rightarrow (x, -y)$
$W(2, 3) \rightarrow W'(2, -3)$
$X(7, 3) \rightarrow X'(7, -3)$,
$Y(6, -1) \rightarrow Y'(6, 1)$
$Z(1, -1) \rightarrow Z'(1, 1)$

Plot the points. Then connect the vertices, W', X', Y', and Z' to form the reflected image.



ANSWER:



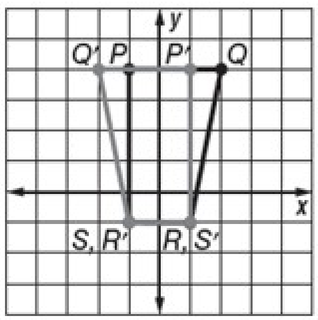
28. trapezoid *PQRS* with vertices $P(–1, 4)$, $Q(2, 4)$, $R(1, –1)$, and $S(–1, –1)$ in the y-axis

SOLUTION:

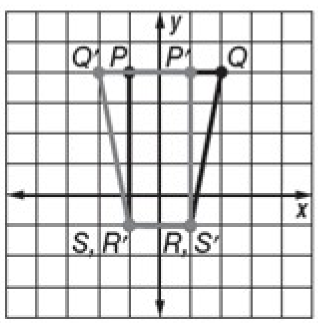
To reflect over the y-axis, multiply the x-coordinate of each vertex by –1.

$(x, y) \rightarrow (–x, y)$
$P(–1, 4) \rightarrow P'(1, 4)$
$Q(2, 4) \rightarrow Q'(–2, 4)$
$R(1, –1) \rightarrow R'(–1, –1)$
$S(–1, –1) \rightarrow S'(1, –1)$

Plot the points. Then connect the vertices, P', Q', R', and S' to form the reflected image.



ANSWER:



29. $\triangle STU$ with vertices $S(-3, -2)$, $T(-2, 3)$, and $U(2, 2)$ in the line $y = x$

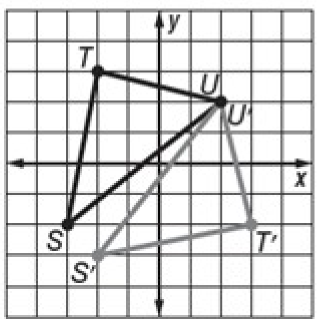
SOLUTION:

$S(-3, -2)$, $T(-2, 3)$, and $U(2, 2)$

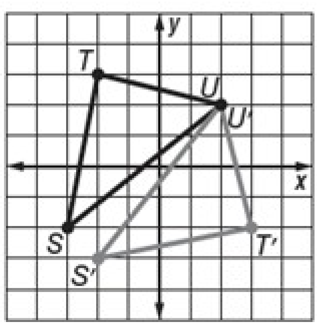
To reflect over line $y = x$, interchange the x- and y-coordinates.

$(x, y) \rightarrow (y, x)$
$S(-3, -2) \rightarrow S'(-2\ -3)$
$T(-2, 3) \rightarrow T'(3, -2)$
$U(2, 2) \rightarrow U'(2, 2)$

Plot the points. Then connect the vertices, S', T', and U' to form the reflected image.



ANSWER:

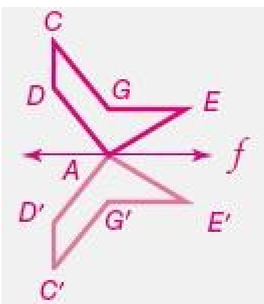


Each figure shows a preimage and its reflected image in some line. Copy each figure and draw the line of reflection.

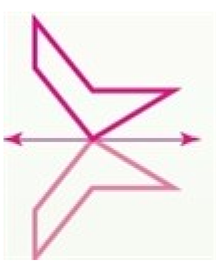
30. 

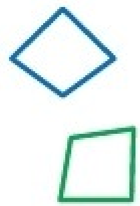
SOLUTION:

Step 1: Draw a line connecting each vertex with its image.
Step 2: Measure the distance between the preimage and its image.
Step 3: Divide the distance by 2 and place a point at the calculated midpoint.
Step 4: Connect the midpoints to create the line of reflection f .



ANSWER:



31. 

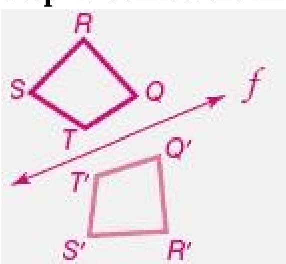
SOLUTION:

Step 1: Draw a line connecting each vertex with its image.

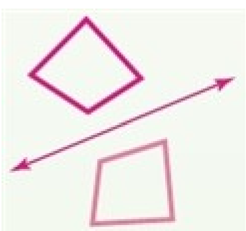
Step 2: Measure the distance between the preimage and its image.

Step 3: Divide the distance by 2 and place a point at the calculated midpoint.

Step 4: Connect the midpoints to create the line of reflection f .



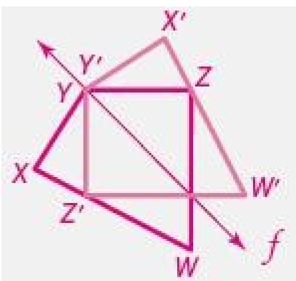
ANSWER:



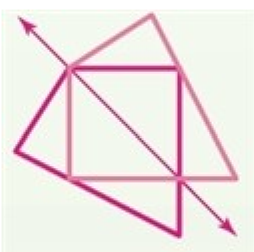
32.

SOLUTION:

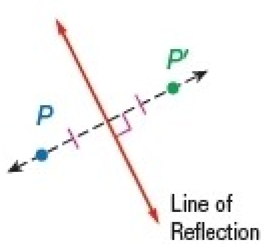
Step 1: Draw a line connecting each vertex with its image.
Step 2: Measure the distance between the preimage and its image.
Step 3: Divide the distance by 2 and place a point at the calculated midpoint.
Step 4: Connect the midpoints to create the line of reflection f .



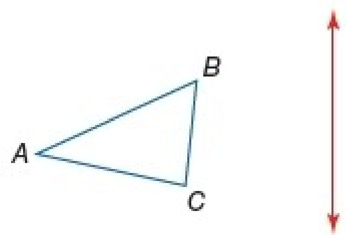
ANSWER:



CONSTRUCTION To construct the reflection of a figure in a line using only a compass and a straightedge,
you can use:
• the construction of a line perpendicular to a given line through a point not on the line (p. 55), and
• the construction of a segment congruent to a given segment (p. 17).



CCSS TOOLS Copy each figure and the given line of reflection. Then construct the reflected image.

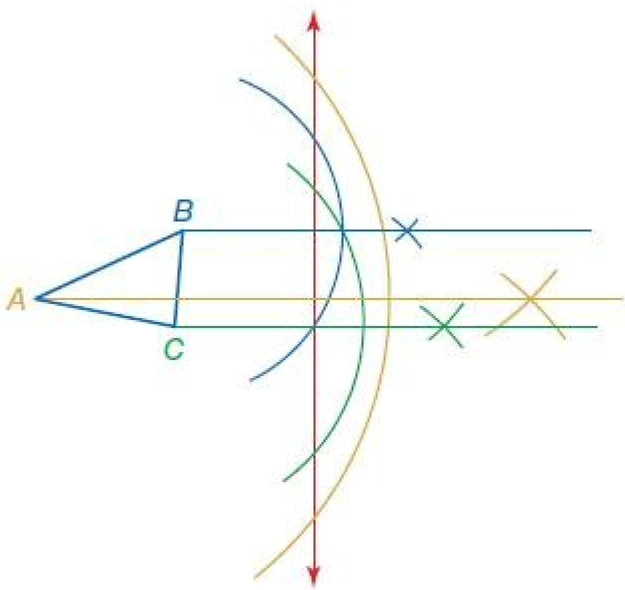


33.

SOLUTION:

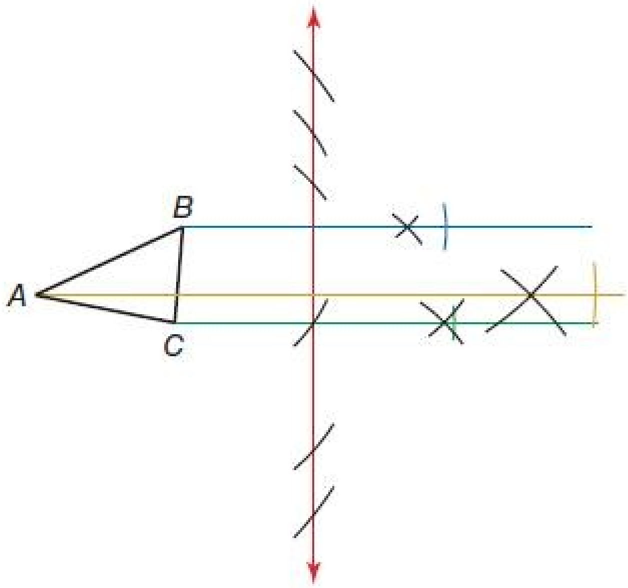
First construct lines that are perpendicular to the red line that pass through each vertex of the triangle. Next, use a compass to copy the segments from each vertex to the red line.

To construct a line perpendicular to a line through a point not on the line, first place the compass at *B* and draw a large arc that intersects the red line in two places. Then place the compass at the intersection of the arc and the red line and draw a small arc approximately where the line will be. Keep the same compass setting and make another arc from the other intersection point. These two small arcs should intersect. Draw a line from *B* to the intersection of the two small arcs. This line is perpendicular to the red line. Follow these steps for *A* and *C*.

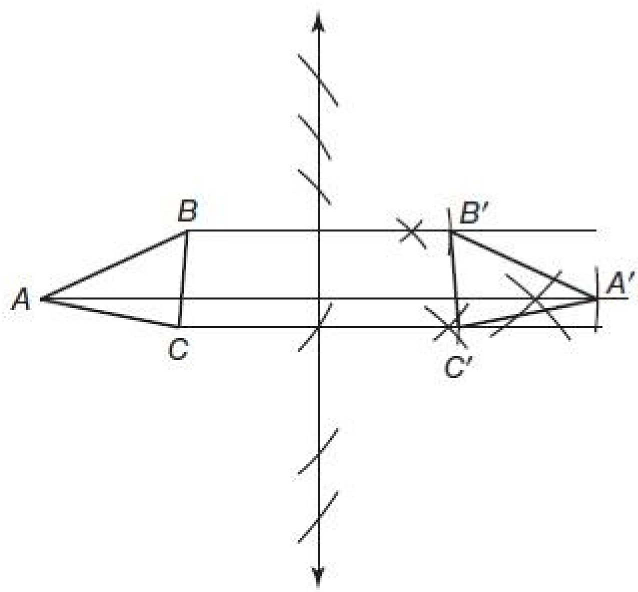


Next, copy the length of each segment from the vertex to the red line.

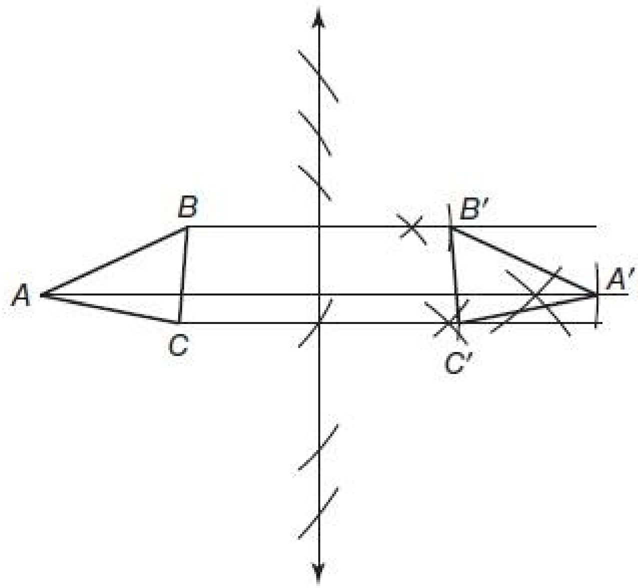
9-1 Reflections

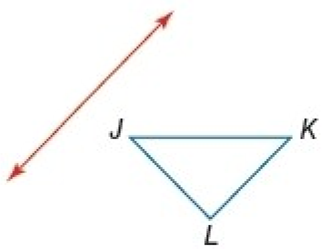


Label the vertices of the reflected image and connect them to form a triangle.



ANSWER:

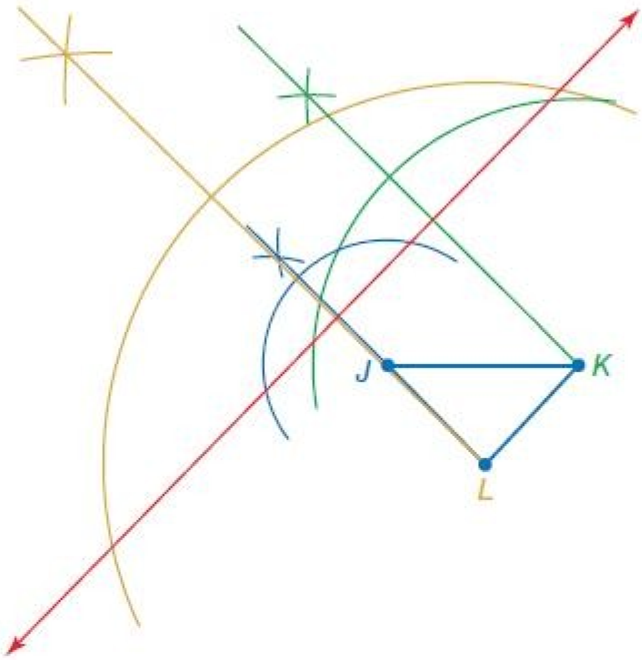


34. 

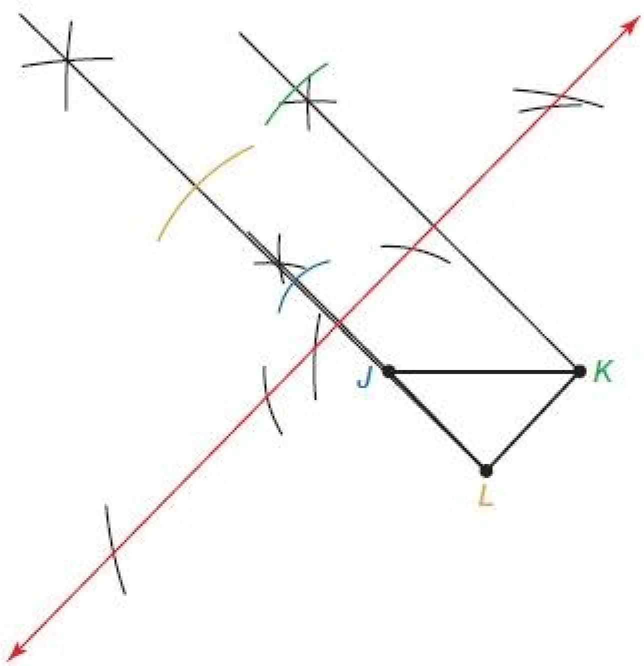
SOLUTION:

First construct lines that are perpendicular to the red line that pass through each vertex of the triangle. Next, use a compass to copy the segments from each vertex to the red line.

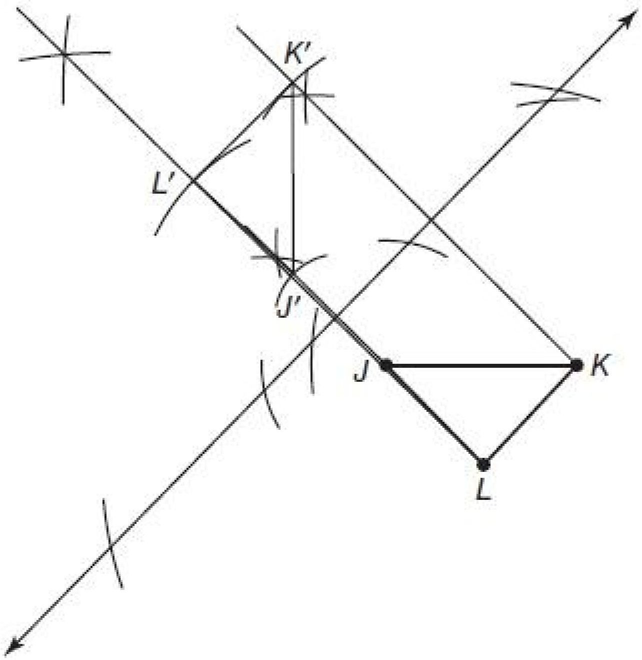
To construct a line perpendicular to a line through a point not on the line, first place the compass at K and draw a large arc that intersects the red line in two places. Then place the compass at the intersection of the arc and the red line and draw a small arc approximately where the line will be. Keep the same compass setting and make another arc from the other intersection point. These two small arcs should intersect. Draw a line from K to the intersection of the two small arcs. This line is perpendicular to the red line. Follow these steps for J and L.



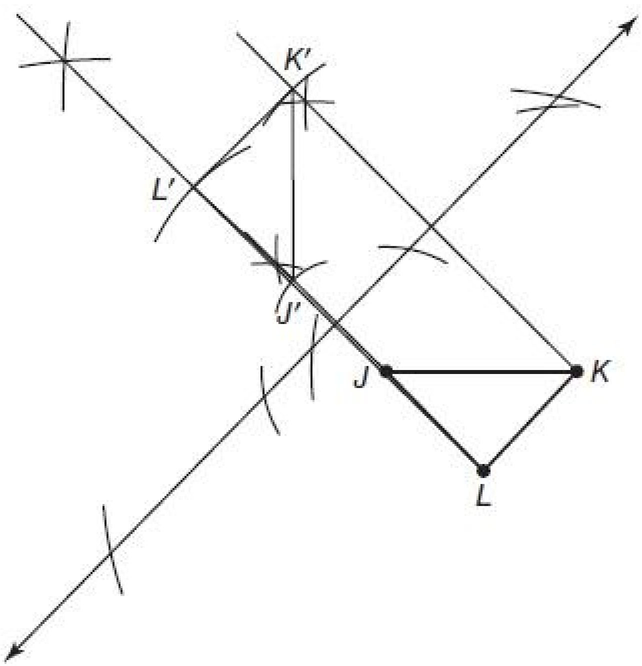
Next, copy the length of each segment from the vertex to the red line.



Label the vertices of the reflected image and connect them to form a triangle.



ANSWER:



35. **PHOTOGRAPHY** Refer to the photo on page 629.
a. What object separates the zebras and their reflections?
b. What geometric term can be used to describe this object?

SOLUTION:

a. The reflections of the zebras are shown in the water. So, the water separates the zebras and their reflections.
b. The water is a flat surface that extends in all directions. It represents a finite plane.

ANSWER:

a. the water
b. a finite plane

ALGEBRA Graph the line $y = 2x - 3$ and its reflected image in the given line. What is the equation of the reflected image?

36. x-axis

SOLUTION:

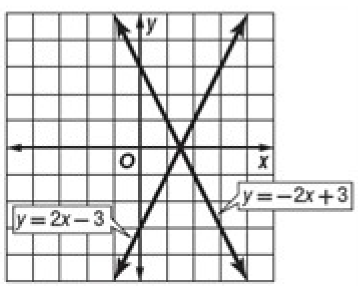
Find the x and y-intercepts of the line $y = 2x - 3$. The x-intercept is 1.5 and y-intercept is –3.

When you reflect over the x-axis, the x-intercept will be the same in the reflection. Use the y-intercept to find a second point on the reflected line. Since the y-intercept is –3, the y-intercept of the reflected line will be 3.

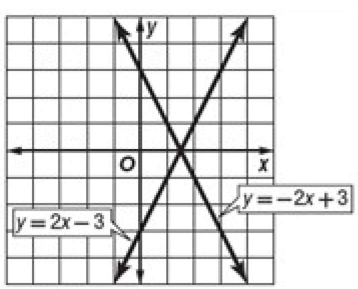
Use (1.5, 0) and (0, 3) to write an equation for the reflected line.

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$
$$m = \frac{3 - 0}{0 - 1.5}$$
$$m = -\frac{3}{1.5} \text{ or } -2$$

$$y - y_1 = m(x - x_1)$$
$$y - (0) = -2(x - 1.5)$$
$$y = -2x + 3$$



ANSWER:



37. y-axis

SOLUTION:

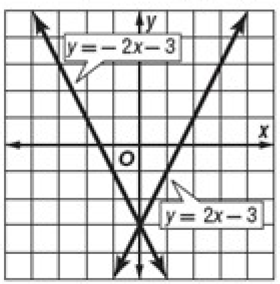
Find the x and y-intercepts of the line $y = 2x - 3$. The x-intercept is 1.5 and y-intercept is –3.

When you reflect over the y-axis, the y-intercept will be the same in the reflection. Use the x-intercept to find a second point on the reflected line. Since the x-intercept is 1.5, the x-intercept of the reflected line will be –1.5.

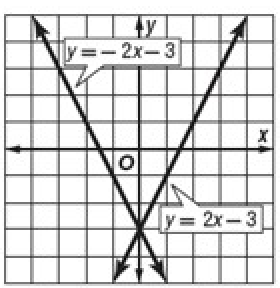
Use (–1.5, 0) and (0, –3) to write an equation for the reflected line.

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$
$$m = \frac{-3 - 0}{0 - (-1.5)}$$
$$m = -\frac{3}{1.5} \text{ or } -2$$

$$y - y_1 = m(x - x_1)$$
$$y - (0) = -2(x - (-1.5))$$
$$y = -2x - 3$$



ANSWER:



38. $y = x$

SOLUTION:

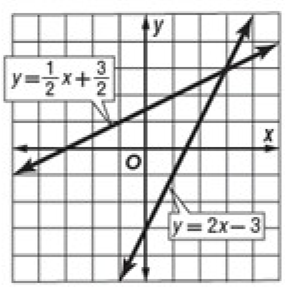
Find the x and y-intercepts of the line $y = 2x - 3$. The x-intercept is 1.5 and y-intercept is –3.

When you reflect over the $y = x$ line, the x- and y-coordinates are switched. Switch the coordinates for the intercepts. The y-intercept is (0, –3), so x-intercept of the reflected line would be (–3, 0). The x-intercept is (1.5, 0), so y-intercept of the reflected line would be (0, 1.5)

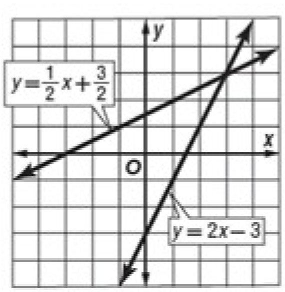
Use (0, 1.5) and (–3, 0) to write an equation for the reflected line.

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$
$$m = \frac{0 - 1.5}{-3 - 0}$$
$$m = \frac{1.5}{3} \, or \, \frac{1}{2}$$

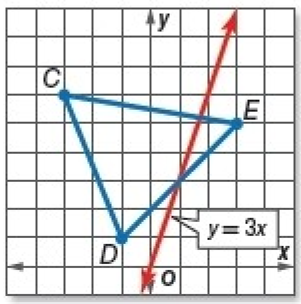
$$y - y_1 = m(x - x_1)$$
$$y - (1.5) = \frac{1}{2}(x - 0)$$
$$y - 1.5 = \frac{1}{2}x$$
$$y = \frac{1}{2}x + \frac{3}{2}$$



ANSWER:



39. Reflect ΔCDE shown below in the line $y = 3x$.



SOLUTION:

Each vertex and its image will be equidistant from $y = 3x$. To estimate the placement of the images of each vertex, first find the equation of the lines perpendicular to $y = 3x$ that pass through each vertex. Each of these lines will have the slope $-\frac{1}{3}$, which is the negative reciprocal of the slope in $y = 3x$.

Vertex *C*(-3, 6)

$$y - y_1 = m(x - x_1)$$
$$y - 6 = -\frac{1}{3}(x - (-3))$$
$$y - 6 = -\frac{1}{3}x - 1$$
$$y = -\frac{1}{3}x + 5$$

Graph this line. Use a ruler to find the distance between *C*(-3, 6) and the point of intersection with the line of reflection. Mark *C*' an equal distance along this line.

Vertex *D*(-1, 1)

$$y - y_1 = m(x - x_1)$$
$$y - 1 = -\frac{1}{3}(x - (-1))$$
$$y - 1 = -\frac{1}{3}x - \frac{1}{3}$$
$$y = -\frac{1}{3}x + \frac{2}{3}$$

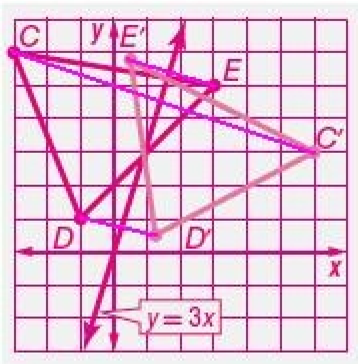
Graph this line. Use a ruler to find the distance between *D*(-1, 1) and the point of intersection with the line of reflection. Mark *D*' an equal distance along this line.

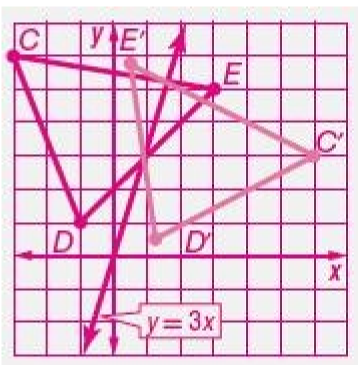
Vertex *E*(3, 5)

$$y - y_1 = m(x - x_1)$$
$$y - 5 = -\frac{1}{3}(x - 3)$$
$$y - 5 = -\frac{1}{3}x + 1$$
$$y = -\frac{1}{3}x + 6$$

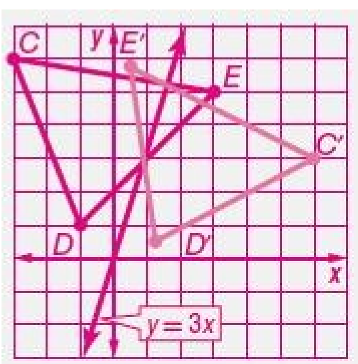
Graph this line. Use a ruler to find the distance between *E*(3, 5) and the point of intersection with the line of reflection. Mark *E*' an equal distance along this line.
Connect the vertices, *C*', *D*', and *E*' to form the reflected image.

9-1 Reflections

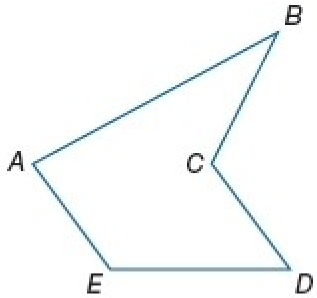




ANSWER:

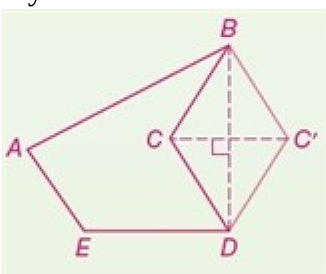


40. Relocate vertex C so that $ABCDE$ is convex, and all sides remain the same length.

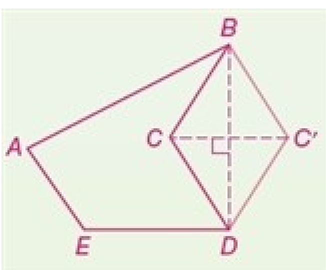


SOLUTION:

If you reflect vertex C over the BD line, the figure would become convex.



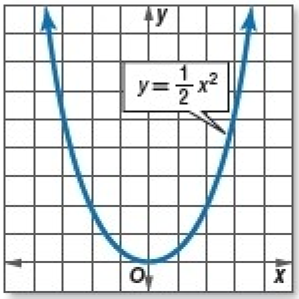
ANSWER:



9-1 Reflections

ALGEBRA Graph the reflection of each function in the given line. Then write the equation of the reflected image.

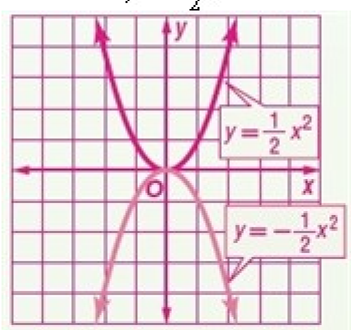
41. x-axis



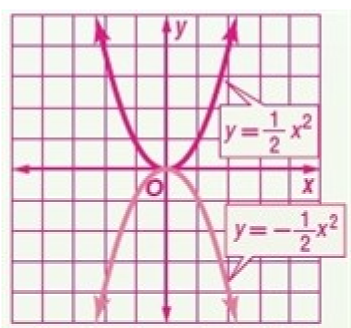
SOLUTION:

To reflect a point in the x-axis, multiply its y-coordinate by –1.

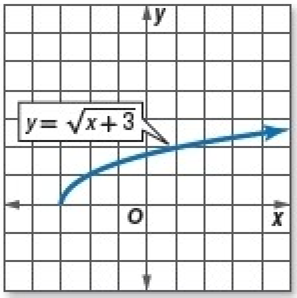
To reflect $y = \frac{1}{2}x^2$ in the x-axis multiply $\frac{1}{2}x^2$ by –1.



ANSWER:

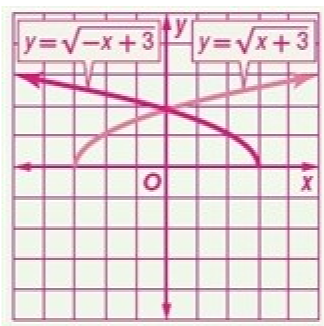


42. y-axis

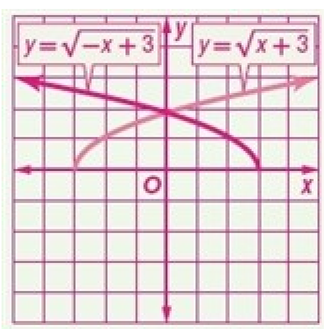


SOLUTION:

To reflect over the y-axis, multiply the x-coordinate of each vertex by –1.
To reflect $y = \sqrt{x+3}$ over the y-axis, multiply x by –1. The reflected equation will then be $y = \sqrt{-x+3}$.

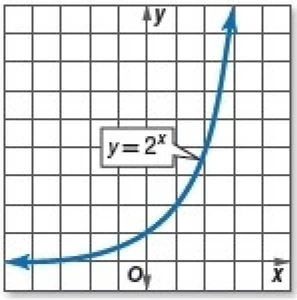


ANSWER:



9-1 Reflections

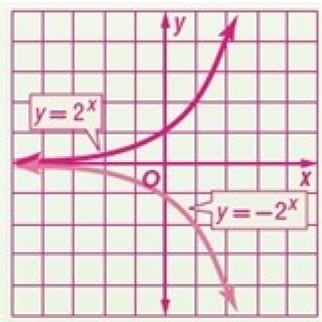
43. *x*-axis



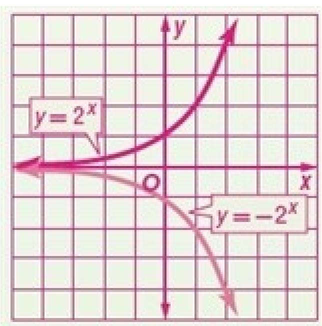
SOLUTION:

To reflect over the *x*-axis, multiply the *y*-coordinate of each vertex by –1.

To reflect $y = 2^x$ over the *x*-axis, multiply 2^x by –1. The reflected equation is then $y = -2^x$.



ANSWER:



44. **MULTIPLE REPRESENTATIONS** In this problem, you will investigate a reflection in the origin.

a. Geometric Draw ΔABC in the coordinate plane so that each vertex is a whole-number ordered pair.

b. Graphical Locate each reflected point A', B', and C' so that the reflected point, the original point, and the origin are collinear, and both the original point and the reflected point are equidistant from the origin.

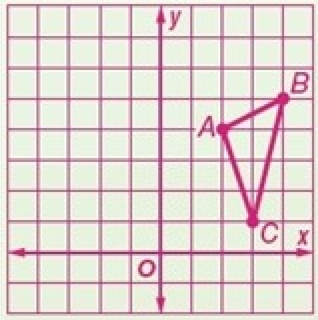
c. Tabular Copy and complete the table below.

	$\triangle ABC$		$\triangle A'B'C'$	
Coordinates	A		A'	
	B		B'	
	C		C'	

d. Verbal Make a conjecture about the relationship between corresponding vertices of a figure reflected in the origin.

SOLUTION:

a. The vertices of $\triangle ABC$ are A(2, 4), B (4, 5), and C (3,1).

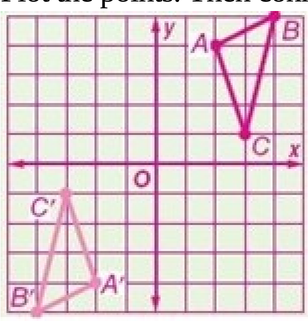


b. We need to find points such that the reflected point, the original point, and the origin are collinear, and both the original point and the reflected point are equidistant from the origin.

To reflect $\triangle ABC$ about the origin, multiply both the x- and y-coordinates by -1.

$(x, y) \rightarrow (-x, -y)$
$A(2, 4) \rightarrow A'(-2, -4)$
$B(4, 5) \rightarrow B'(-4, -5)$
$C\ (3, 1) \rightarrow C'\ (-3, -1)$

Plot the points. Then connect the vertices, A', B', and C' to form the reflected image.



c.

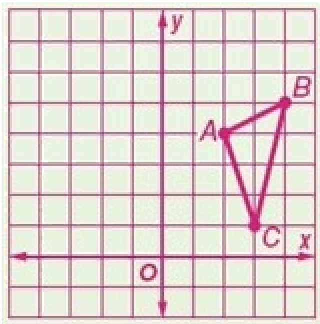
	$\triangle ABC$		$\triangle A'B'C'$	
Coordinates	A	(2, 4)	A'	(−2, −4)
	B	(4, 5)	B'	(−4, −5)
	C	(3, 1)	C'	(−3, −1)

d. Sample answer: The coordinates of the reflective image are the additive inverses of the coordinates of the original image.

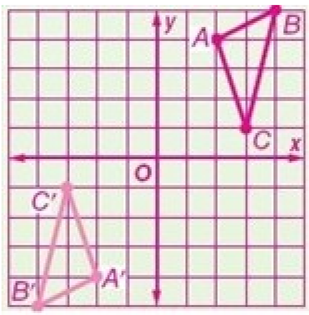
ANSWER:

a.

9-1 Reflections



b.



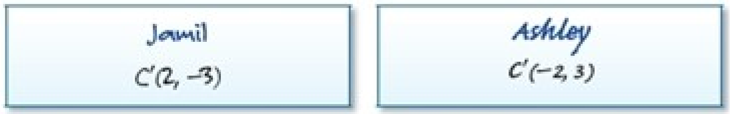
c.

	$\triangle ABC$		$\triangle A'B'C'$	
Coordinates	A	(2, 4)	A'	(−2, −4)
	B	(4, 5)	B'	(−4, −5)
	C	(3, 1)	C'	(−3, −1)

d.

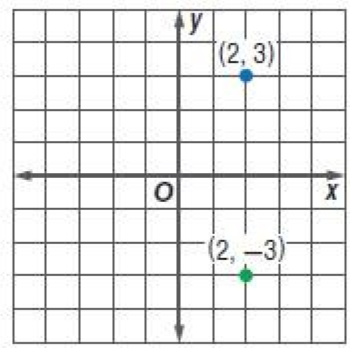
Sample answer: The coordinates of the reflective image are the additive inverses of the coordinates of the original image.

45. **ERROR ANALYSIS** Jamil and Ashley are finding the coordinates of the image of (2, 3) after a reflection in the *x*-axis. Is either of them correct? Explain.



SOLUTION:

Jamil; sample answer: When you reflect a point across the *x*-axis, the reflected point is in the same place horizontally, but not vertically. When (2, 3) is reflected across the *x*-axis, the coordinates of the reflected point are (2, –3) since it is in the same location horizontally, but the other side of the *x*-axis vertically.



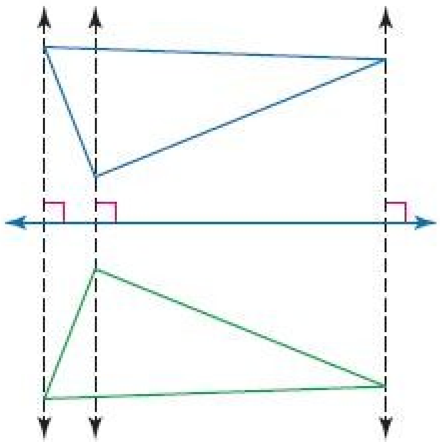
ANSWER:

Jamil; sample answer: When you reflect a point across the *x*-axis, the reflected point is in the same place horizontally, but not vertically. When (2, 3) is reflected across the *x*-axis, the coordinates of the reflected point are (2, –3) since it is in the same location horizontally, but the other side of the *x*-axis vertically.

46. **WRITING IN MATH** Describe how to reflect a figure not on the coordinate plane across a line.

SOLUTION:

Draw a line through each vertex of the image that is perpendicular to the line of reflection. Next, measure the distance from each vertex to the line of reflection.
Locate each vertex the same perpendicular distance from the opposite side of the line. Connect each of the vertices to form the reflected image.



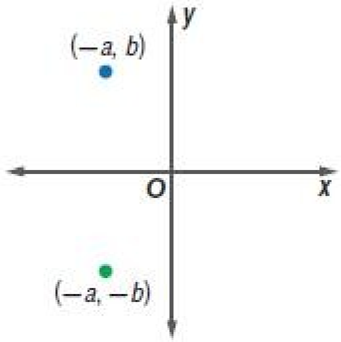
ANSWER:

Draw a line through each vertex of the image that is perpendicular to the line of reflection. Next, measure the distance from each vertex to the line of reflection.
Locate each vertex the same perpendicular distance from the opposite side of the line. Connect each of the vertices to form the reflected image.

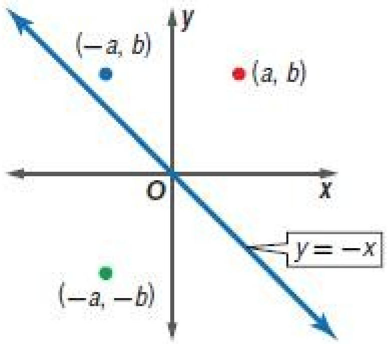
47. **CHALLENGE** A point in the second quadrant with coordinates $(-a, b)$ is reflected in the x-axis. If the reflected point is then reflected in the line $y = -x$, what are the final coordinates of the image?

SOLUTION:

The reflection of the point $(-a, b)$ about the x-axis will be $(-a, -b)$.



If you reflect the point $(-a, -b)$ about the line $y = -x$, then the coordinates of the point will be (a, b).



ANSWER:

(a, b)

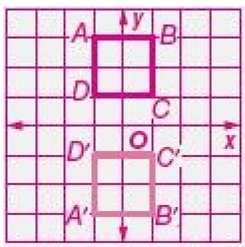
48. **OPEN ENDED** Draw a polygon on the coordinate plane that when reflected in the x-axis looks exactly like the original figure.

SOLUTION:

Reflect over the x-axis. Multiply the y-coordinate of each vertex by –1.

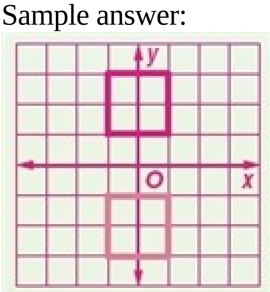
$(x, y) \rightarrow (x, -y)$
$A(-1, 3) \rightarrow A'(-1, -3)$
$B(1, 3) \rightarrow B'(1, -3)$
$C(1, 1) \rightarrow C'(1, -1)$
$D(-1, 1) \rightarrow D'(-1, -1)$

Plot the points. Then connect the vertices, A', B', C', and D' to form the reflected image.



ANSWER:

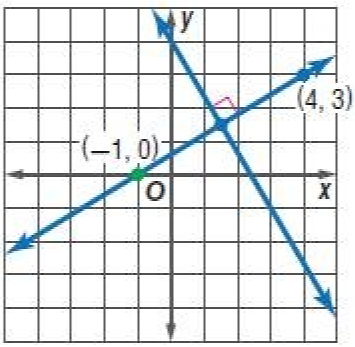
Sample answer:



49. **CHALLENGE** When $A(4, 3)$ is reflected in a line, its image is $A'(-1, 0)$. Find the equation of the line of reflection. Explain your reasoning.

SOLUTION:

The slope of the line connecting the two points is $\frac{3}{5}$. The Midpoint Formula can be used to find the midpoint between the two points, which is $\left(\frac{3}{2}, \frac{3}{2}\right)$. Using the point-slope form, the equation of the line is $y = -\frac{5}{3}x + 4$. (The slope of the bisector is $-\frac{5}{3}$ because it is the negative reciprocal of the slope $\frac{3}{5}$.)

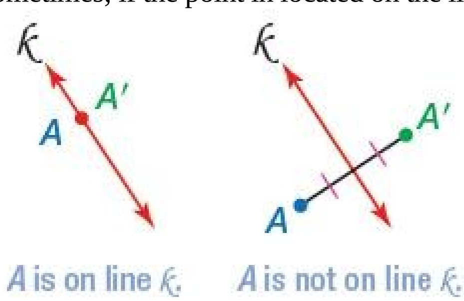


ANSWER:

The slope of the line connecting the two points is $\frac{3}{5}$. The Midpoint Formula can be used to find the midpoint between the two points, which is $\left(\frac{3}{2}, \frac{3}{2}\right)$. Using the point-slope form, the equation of the line is $y = -\frac{5}{3}x + 4$. (The slope of the bisector is $-\frac{5}{3}$ because it is the negative reciprocal of the slope $\frac{3}{5}$.)

50. **CCSS PRECISION** The image of a point reflected in a line is *sometimes*, *always*, or *never* located on the other side of the line of reflection.

SOLUTION:
Sometimes; if the point in located on the line of reflection, then the point will remain in its same location.

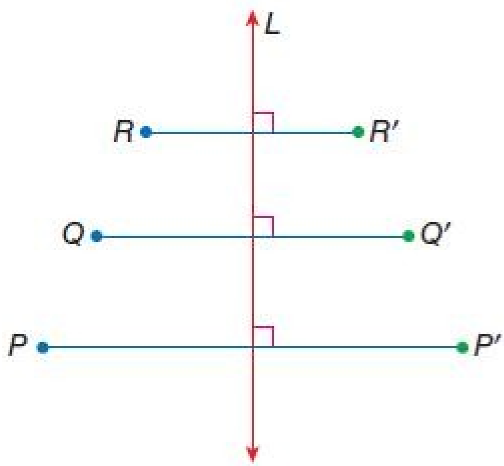


ANSWER:
Sometimes; if the point in located on the line of reflection, then the point will remain in its same location.

51. **WRITING IN MATH** Suppose points *P*, *Q*, and *R* are collinear, with point *Q* between points *P* and *R*. Describe a plan for a proof that the reflection of points *P*, *Q*, and *R* in a line preserves collinearity and betweenness of points.

SOLUTION:

It is given that *P*, *Q*, and *R* are collinear and that *Q* is between *P* and *R*. These points are reflected in a line. We are to show that the image preserves collinearity and betweenness of points by showing that *P*', *Q*', and *R*' are collinear and that *Q*' is between *P*' and *R*'.
First, construct *P*, *Q*, and *R* collinear with *Q* between *P* and *R*. Draw line *L*, then construct perpendicular lines from *P*, *Q*, and *R* to line *L*.

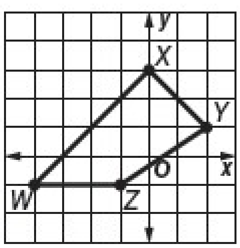


To show that the points are collinear, find and compare the slopes of $\overline{PR}$ and $\overline{P'R'}$ and $\overline{QR}$ and $\overline{Q'R'}$. Next, show the betweenness of points. By definition, if *P*'*Q*' + *Q*'*R*' = *P*'*R*' then *Q*' is between *P*' and *R*'.Find and compare the lengths of each segment.

ANSWER:

Construct *P*, *Q*, and *R* collinear with *Q* between *P* and *R*. Draw line *L*, then construct perpendicular lines from *P*, *Q*, and *R* to line *L*. Show equidistance or similarity of slope.

52. **SHORT RESPONSE** If quadrilateral *WXYZ* is reflected across the *y*-axis to become quadrilateral $W'X'Y'Z'$ what are the coordinates of X'?



SOLUTION:

The coordinates of *X* in the quadrilateral *WXYZ* is (0, 3). Since the point *X* lies on the *y*-axis the image of *X* will be the same when reflected about the *y*-axis. Therefore, the coordinates of X' will be (0, 3).

ANSWER:

(0, 3)

53. **ALGEBRA** If the arithmetic mean of 6*x*, 3*x*, and 27 is 18, then what is the value of *x*?
A 2
B 3
C 5
D 6

SOLUTION:

$$\frac{6x+3x+27}{3}=18$$

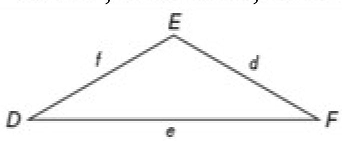
Solve for *x*.

$$6x+3x+27=54$$
$$9x=27$$
$$x=3$$

Therefore, the correct choice is B.

ANSWER:
B

54. In ΔDEF, $m\angle E=108$, $m\angle F=26$, and f = 20. Find *d* to the nearest whole number.



F 26
G 33
H 60
J 65

SOLUTION:

The sum of the angles of a triangle is 180. So, $m\angle D=180-(108+26)=46$.

By the Law of Sines, $\frac{\sin 26}{20}=\frac{\sin 46}{d}$.

$$d\sin 26=20\sin 46$$

$$d=\frac{20\cdot\sin 46}{\sin 26}$$

Use a calculator.
$d\approx 33$
Therefore, the correct choice is G.

ANSWER:
G

55. **SAT/ACT** In a coordinate plane, points A and B have coordinates (–2, 4) and (3, 3), respectively. What is the value of AB?
A $\sqrt{50}$
B (1, 7)
C (5, –1)
D (1, –1)
E $\sqrt{26}$

SOLUTION:
Use the Distance Formula.

$$D = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

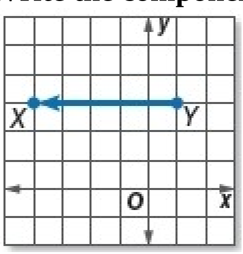
Substitute.

$$\begin{aligned} AB &= \sqrt{(3-(-2))^2 + (3-4)^2} \\ &= \sqrt{(5)^2 + (-1)^2} \\ &= \sqrt{25+1} \\ &= \sqrt{26} \end{aligned}$$

Therefore, the correct choice is E.

ANSWER:
E

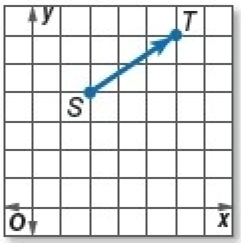
Write the component form of each vector.

56. 

SOLUTION:
The component form of a vector with initial point (x_1, y_1) and terminal point (x_2, y_2) is $\langle x_2 - x_1, y_2 - y_1 \rangle$.

The initial point is (1, 3) and the terminal point is (–4, 3). Therefore, the component form is $\langle -4-1, 3-3 \rangle = \langle -5, 0 \rangle$.

ANSWER:
$\langle -5, 0 \rangle$

57. 

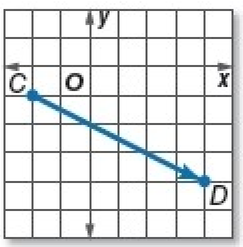
SOLUTION:

The component form of a vector with initial point (x_1, y_1) and terminal point (x_2, y_2) is $\langle x_2 - x_1, y_2 - y_1 \rangle$.

The initial point is (2, 4) and the terminal point is (5, 6). Therefore, the component form is $\langle 5-2, 6-4 \rangle = \langle 3, 2 \rangle$.

ANSWER:

$\langle 3, 2 \rangle$

58. 

SOLUTION:

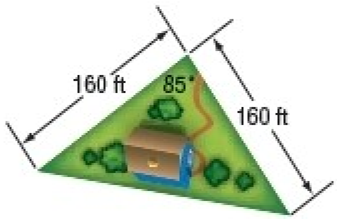
The component form of a vector with initial point (x_1, y_1) and terminal point (x_2, y_2) is $\langle x_2 - x_1, y_2 - y_1 \rangle$.

The initial point is (–2, –1) and the terminal point is (4, –4). Therefore, the component form is $\langle 4-(-2), -4-(-1) \rangle = \langle 6, -3 \rangle$.

ANSWER:

$\langle 6, -3 \rangle$

59. **REAL ESTATE** A house is built on a triangular plot of land. Two sides of the plot are 160 feet long, and they meet at an angle of 85°. If a fence is to be placed along the perimeter of the property, how much fencing material is needed?



SOLUTION:
Use the Law of Cosines to find the length of the third side of the plot. Let *x* be the length.

$$x^2 = (160)^2 + (160)^2 - 2(160)(160)\cos 85°$$
$$x^2 \approx 46737.63$$
$$x \approx \sqrt{46737.63}$$
$$x \approx 216$$

The perimeter of the plot is about 216 + 160 + 160 or 536 feet. Therefore, about 536 feet of fencing material is required.

ANSWER:
about 536 ft

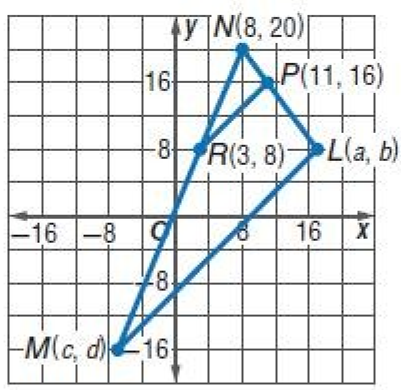
60. **COORDINATE GEOMETRY** In ΔLMN, $\overline{PR}$ divides $\overline{NL}$ and $\overline{MN}$ proportionally. If the vertices are $N(8, 20)$, $P(11, 16)$, and $R(3, 8)$ and $\frac{LP}{PN} = \frac{2}{1}$, find the coordinates of L and M.

SOLUTION:

If a point $P(x, y)$ divides the line joining the points (x_1, y_1) and (x_2, y_2) in the ratio $m : n$ then,

$$(x, y) = \left(\frac{mx_1 + nx_2}{m+n}, \frac{my_1 + ny_2}{m+n}\right).$$

Let the coordinates of L be (a, b) and that of M be (c, d).



For line LN containing point P, $x = 11$, $y = 16$, $m = 2$, $n = 1$, $x_1 = 8$, $y_1 = 20$, $x_2 = a$, and $y_2 = b$.
For line MN containing point R, $x = 3$, $y = 8$, $m = 2$, $n = 1$, $x_1 = 8$, $y_1 = 20$, $x_2 = c$, and $y_2 = d$.

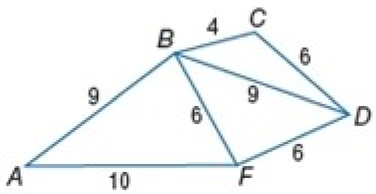
$$11 = \frac{2 \cdot 8 + 1(a)}{2+1} \Rightarrow a = 17$$
$$16 = \frac{2 \cdot 20 + 1(b)}{2+1} \Rightarrow b = 8$$
$$3 = \frac{2 \cdot 8 + 1(c)}{2+1} \Rightarrow c = -7$$
$$8 = \frac{2 \cdot 20 + 1(d)}{2+1} \Rightarrow d = -16$$

Therefore, the coordinates of L are (17, 8) and that of M are (–7, –16).

ANSWER:

$L(17, 8)$; $M(-7, -16)$

Use the figure at the right to write an inequality relating the given pair of angle or segment measures.



61. *AB*, *FD*

SOLUTION:
Since 9 > 6, *AB* > *FD*.

ANSWER:
AB > *FD*

62. $m\angle BDC$, $m\angle FDB$

SOLUTION:
If two sides of a triangle are congruent to two sides of another triangle, and the third side in the first is longer than the third side in the second triangle, then the included angle measure of the first triangle is greater than the included angle measure in the second triangle.

$\overline{BF} \cong \overline{DC}$,$\overline{BD} \cong \overline{BD}$ and $BC < FD$

Therefore, $m\angle BDC < m\angle FDB$.

ANSWER:
$m\angle BDC < m\angle FDB.$

63. $m\angle FBA$, $m\angle DBF$

SOLUTION:
If two sides of a triangle are congruent to two sides of another triangle, and the third side in the first is longer than the third side in the second triangle, then the included angle measure of the first triangle is greater than the included angle measure in the second triangle.

$\overline{AB} \cong \overline{BD}$,$\overline{BF} \cong \overline{BF}$ and $FD < AF$

Therefore, $m\angle DBF < m\angle FBA$.

ANSWER:
$m\angle FBA > m\angle DBF$

Find the magnitude and direction of each vector.

64. $\overrightarrow{RS}$: $R(-3, 3)$ and $S(-9, 9)$

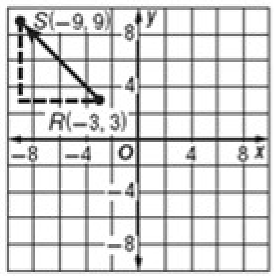
SOLUTION:

Use the distance formula to find the magnitude of the vector.

$$\overrightarrow{RS} = \sqrt{\left(-9-(-3)\right)^2 + (9-3)^2} = \sqrt{72} = 6\sqrt{2} \approx 8.5$$

Use trigonometry to find the vector's direction.

Draw a right triangle with $\overrightarrow{RS}$ as its hypotenuse.



$$\begin{aligned}\tan R &= \left|\frac{y_2 - y_1}{x_2 - x_1}\right| \\ &= \left|\frac{9-3}{-9-(-3)}\right| \\ &= |-1| \\ &= 1\end{aligned}$$

$$m\angle R = \tan^{-1} 1 = 45°$$

When repositioned so that its initial point is at the origin, $\overrightarrow{RS}$ lies in the second quadrant and forms an angle with the negative x-axis equal to $m\angle R$

The direction of $\overrightarrow{RS}$ is the angle it makes with the positive x-axis, which is $180 - m\angle R$ or 135º.

Therefore, $\overrightarrow{RS}$ has a magnitude of about 8.5 units and a direction of 135°.

ANSWER:

$6\sqrt{2}$
≈ 8.5, 135°

65. $\overrightarrow{JK}$: $J(8, 1)$ and $K(2, 5)$

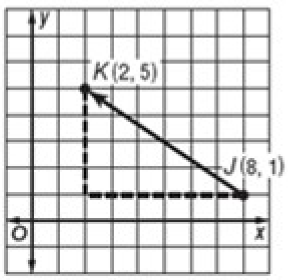
SOLUTION:

Use the distance formula to find the magnitude of the vector.

$$\overrightarrow{JK}=\sqrt{(2-8)^2+(5-1)^2}=\sqrt{52}=2\sqrt{13}\approx 7.2$$

Use trigonometry to find the vector's direction.

Draw a right triangle with $\overrightarrow{JK}$ as its hypotenuse.



$$\begin{aligned}\tan J&=\left|\frac{y_2-y_1}{x_2-x_1}\right|\\&=\left|\frac{1-5}{8-2}\right|\\&=\left|\frac{-4}{6}\right|\\&=\frac{2}{3}\end{aligned}$$

$$m\angle J=\tan^{-1}\left(\frac{2}{3}\right)\approx 33.7°$$

When repositioned so that its initial point is at the origin, $\overrightarrow{JK}$ lies in the second quadrant and forms an angle with the negative *x*-axis equal to $m\angle J$.

The direction of $\overrightarrow{JK}$ is the angle it makes with the positive *x*-axis, which is $180-m\angle J$ or 146.3º.
Therefore, $\overrightarrow{JK}$ has a magnitude of about 7.2 units and a direction of about 146.3°.

ANSWER:

$2\sqrt{13}\approx 7.2,\ 146.3^o$

66. $\overrightarrow{FG}$: $F(-4, 0)$ and $G(-6, -4)$

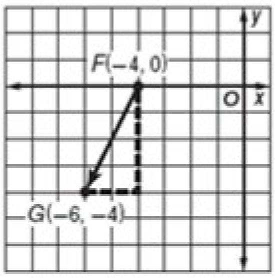
SOLUTION:

Use the distance formula to find the magnitude of the vector.

$$\overrightarrow{FG} = \sqrt{(-6-(-4))^2 + (-4-0)^2} = \sqrt{20} = 2\sqrt{5} \approx 4.5$$

Use trigonometry to find the vector's direction.

Draw a right triangle with $\overrightarrow{FG}$ as its hypotenuse.



$$\begin{aligned}\tan F &= \left|\frac{y_2 - y_1}{x_2 - x_1}\right| \\ &= \left|\frac{-4-0}{-6-(-4)}\right| \\ &= \left|\frac{-4}{-2}\right| \\ &= 2\end{aligned}$$

$$m\angle F = \tan^{-1} 2 \approx 63.4°$$

When repositioned so that its initial point is at the origin, $\overrightarrow{FG}$ lies in the third quadrant and forms an angle with the negative x-axis equal to $m\angle F$.

The direction of $\overrightarrow{FG}$ is the angle it makes with the positive x-axis, which is $180 + m\angle F$ or about 243.4º. Therefore, $\overrightarrow{FG}$ has a magnitude of about 4.5 units and a direction of about 243.4°.

ANSWER:

$2\sqrt{5}, \approx 4.5,\ 243.4^o$

9-1 Reflections

67. $\overrightarrow{AB}$: $A(-1, 10)$ and $B(1, -12)$

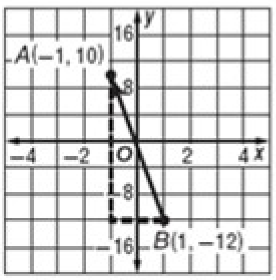
SOLUTION:

Use the distance formula to find the magnitude of the vector.

$$\overrightarrow{AB} = \sqrt{(1-(-1))^2 + (-12-10)^2} = \sqrt{488} = 2\sqrt{122} \approx 22.1$$

Use trigonometry to find the vector's direction.

Draw a right triangle with $\overrightarrow{AB}$ as its hypotenuse.



$$\tan A = \left|\frac{y_2 - y_1}{x_2 - x_1}\right| = \left|\frac{-12-10}{1-(-1)}\right| = \left|\frac{-22}{2}\right| = 11$$

$$m\angle A = \tan^{-1} 11 \approx 84.8°$$

When repositioned so that its initial point is at the origin, $\overrightarrow{AB}$ lies in the fourth quadrant and forms an angle with the negative y-axis equal to $m\angle A$.

The direction of $\overrightarrow{AB}$ is the angle it makes with the positive x-axis, which is $270 + m\angle A$ or about 354.8º.
Therefore, $\overrightarrow{AB}$ has a magnitude of about 22.1 units and a direction of about 354.8°.

ANSWER:

$2\sqrt{122} \approx 22.1, 275.2^o$