Transformations in the Coordinate Plane **Name: _________________**

Date: ________________

MCC9-12.G.CO.1 Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.

MCC9-12.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).

MCC9-12.G.CO.3 Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.

MCC9-12.G.CO.4 Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.

MCC9-12.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.

SELECTED TERMS AND SYMBOLS

For practice look at: http://www.amathsdictionaryforkids.com/

This web site has activities to help students more fully understand and retain new vocabulary.

http://intermath.coe.uga.edu/dictnary/homepg.asp

• Angle: A figure created by two distinct rays that share a common endpoint (also known as a vertex).

• Angle of Rotation: The amount of rotation (in degrees) of a figure about a fixed point such as the origin.

• Bisector: A point, line or line segment that divides a segment or angle into two equal parts.

• Circle: The set of all points equidistant from a point in a plane.

• Congruent: Having the same size, shape and measure. Indicates that angle A is congruent to angle B.

• Corresponding angles: Angles that have the same relative position in geometric figures.

• Corresponding sides: Sides that have the same relative position in geometric figures.

• Endpoint: The point at each end of a line segment or at the beginning of a ray.

• Image: The result of a transformation.

• Intersection: The point at which two or more lines intersect or cross.

• Isometry: a distance preserving map of a geometric figure to another location using a reflection, rotation or translation. Indicates an isometry of the figure M to a new location M’. M and M’ remain congruent.

• Line: One of the undefined terms of geometry that represents an infinite set of points with no thickness and its length continues in two opposite directions indefinitely. Indicates a line that passes through points A and B.

• Line segment: A part of a line between two points on the line. Indicates the line segment between points A and B.

• Parallel lines: Two lines are parallel if they lie in the same plane and do not intersect. indicates that line AB is parallel to line CD.

• Perpendicular lines: Two lines are perpendicular if they intersect to form right angles. indicates that line AB is perpendicular to line CD.

• Point: One of the basic undefined terms of geometry that represents a location. A dot is used to symbolize it and it is thought of as having no length, width or thickness.

• Pre-image: A figure before a transformation has taken place.

• Ray: A part of a line that begins at a point and continues forever in one direction. indicates a ray that begins at point A and continues in the direction of point B indefinitely.

• Reflection: A transformation of a figure that creates a mirror image, "flips," over a line.

• Reflection Line (or line of reflection): A line that acts as a mirror so that corresponding points are the same distance from the mirror.

• Rotation: A transformation that turns a figure about a fixed point through a given angle and a given direction, such as 90° clockwise.

• Segment: See line segment.

• Transformation: The mapping, or movement, of all points of a figure in a plane according to a common operation, such as translation, reflection or rotation.

• Translation: A transformation that slides each point of a figure the same distance in the same direction.

• Vertex: The location at which two lines, line segments or rays intersect.

PROBLEMS

Choose the term from the box below that best completes each statement

distance formula	transformation	image	rigid motion
translation	pre-image	congruent line segment	congruent
arc	copying a line segment		

1. A(n) ________________________ is a transformation of points in space.

2. The new figure created from a translation is called the ___________________________________.

3. A(n) ______________________________ is a part of a circle and can be thought of as the curve between two points on a circle.

4. The ____________________ can be used to calculate the distance between two pints on a coordinate plane.

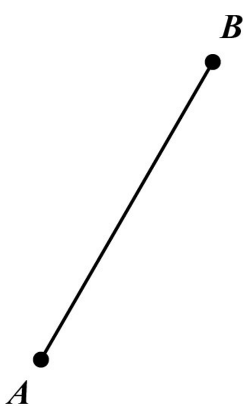
5. In a translation the original figure is called the ______________________________________.

6. Line segments that have the same length are called _____________________.

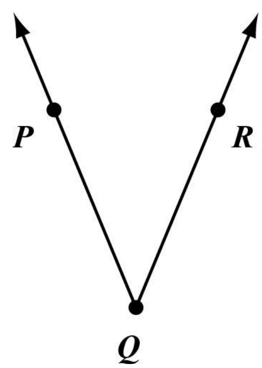
Lesson 5.1 Introduction to Translations, Reflections, and Rotations

DEFINITIONS

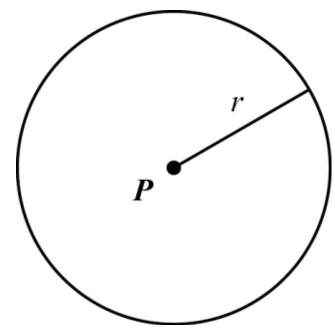
A **line segment** is part of a line; it consists of two points and all points between them. An **angle** is formed by two rays with a common endpoint. A **circle** is the set of all points in a plane that are a fixed distant from a given point, called the center; the fixed distance is the **radius**. **Parallel lines** are lines in the same plane that do not intersect. **Perpendicular lines** are two lines that intersect to form right angles.



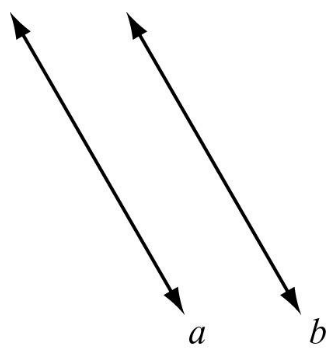
Line segment AB



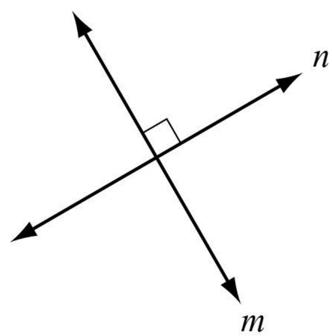
Angle PQR



Circle P with radius r



Parallel lines a and b



Perpendicular lines m and n

PROBLEMS

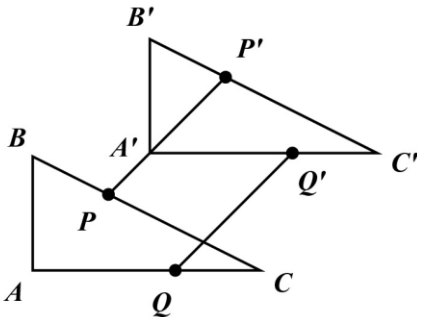
1. Draw a ray

2. Draw a line segment

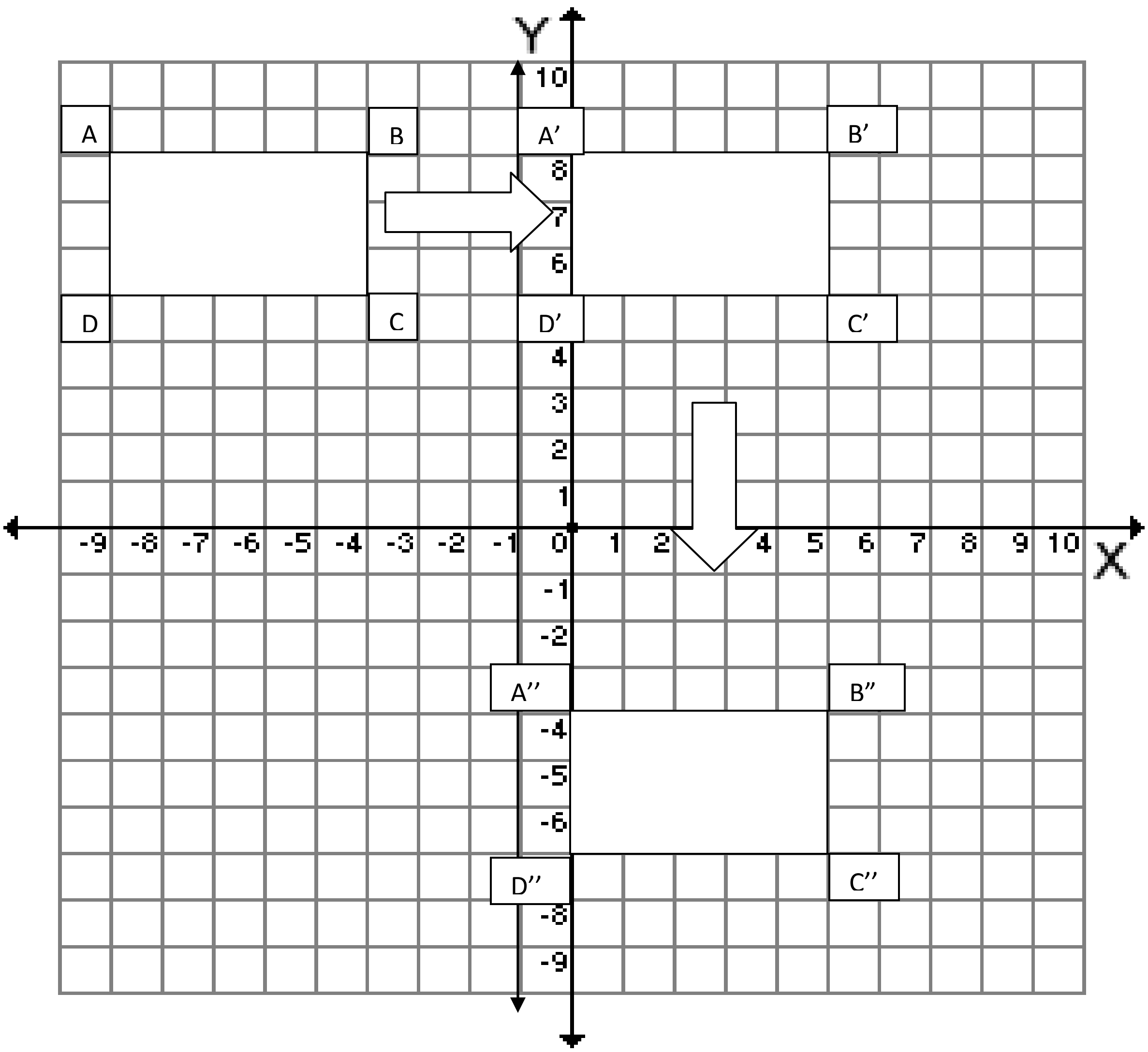
3. Draw a line

TRANSLATION

A **transformation** is an operation that maps, or moves, a pre-image onto an image. In each transformation defined below, it is assumed that all points and figures are in one plane. In each case, △ABC is the pre-image and △A'B'C' is the image.

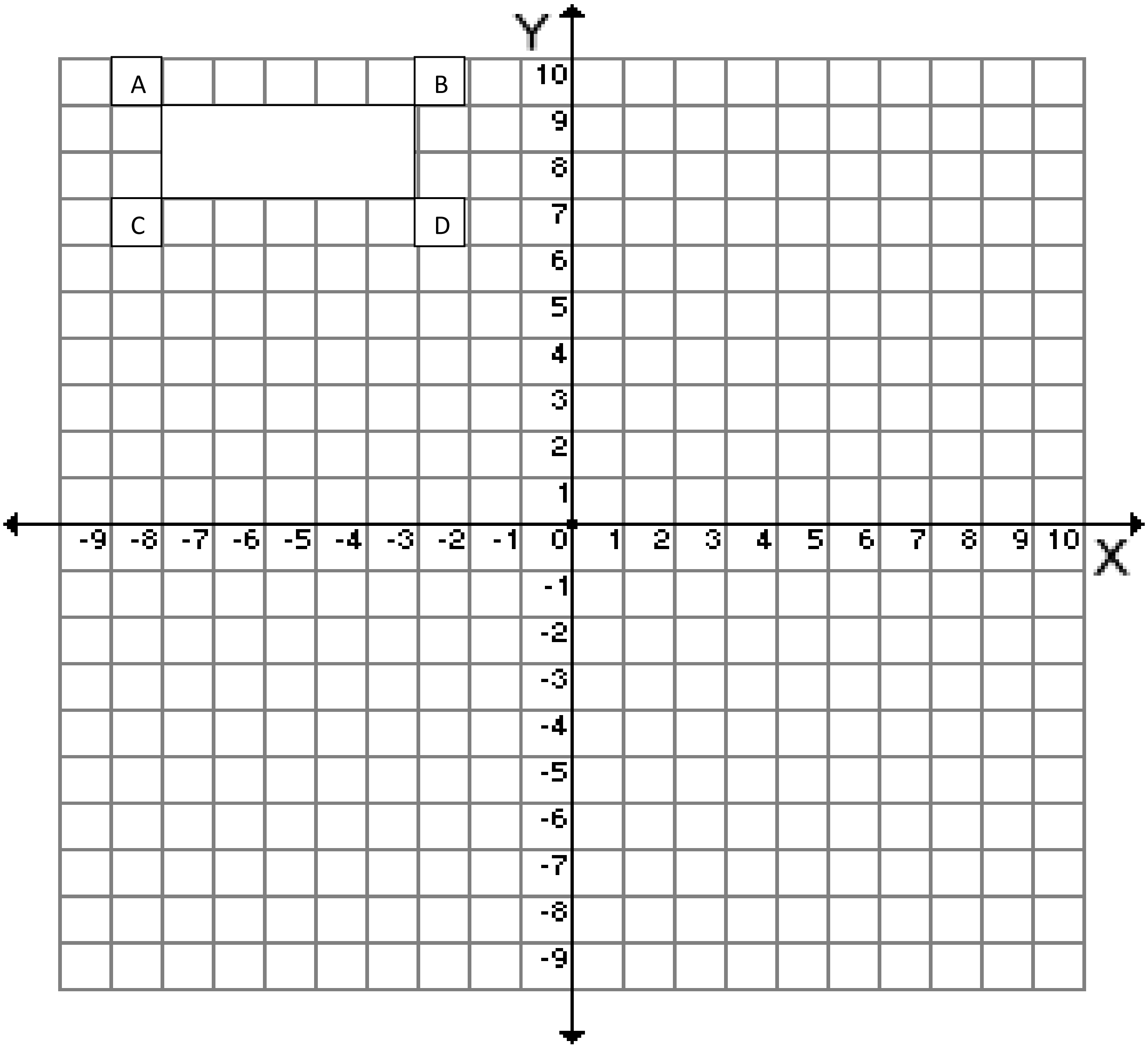


A **translation** maps every two points P and Q to points P' and Q' so that the following properties are true:
PP' = QQ' (PP' is congruent to QQ')
PP II QQ (PP is parallel to QQ)
A **translation** is a transformation that slides each point of a figure the same distance in the same direction.
Example: Translate the rectangle below by 9 units to the right and then 12 units down.



PROBLEMS:

1. Translate the shape below 10 units to the right and then 7 units down. Label all of the vertices the correct way (A', A'', etc.).



2. List the coordinates for A' (,), B' (,), C' (,), and D' (,).

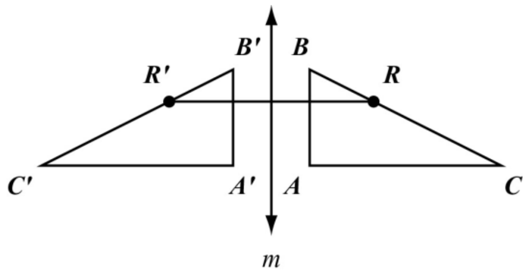
3. List the coordinates for A'' (,), B'' (,), C'' (,), and D'' (,).

REFLECTION

A **reflection** across a line m maps every point R to R' so that the following properties are true:

● If R is not on m, then m is the perpendicular bisector of RR' .

● If R is on m, then R and R' are the same point.

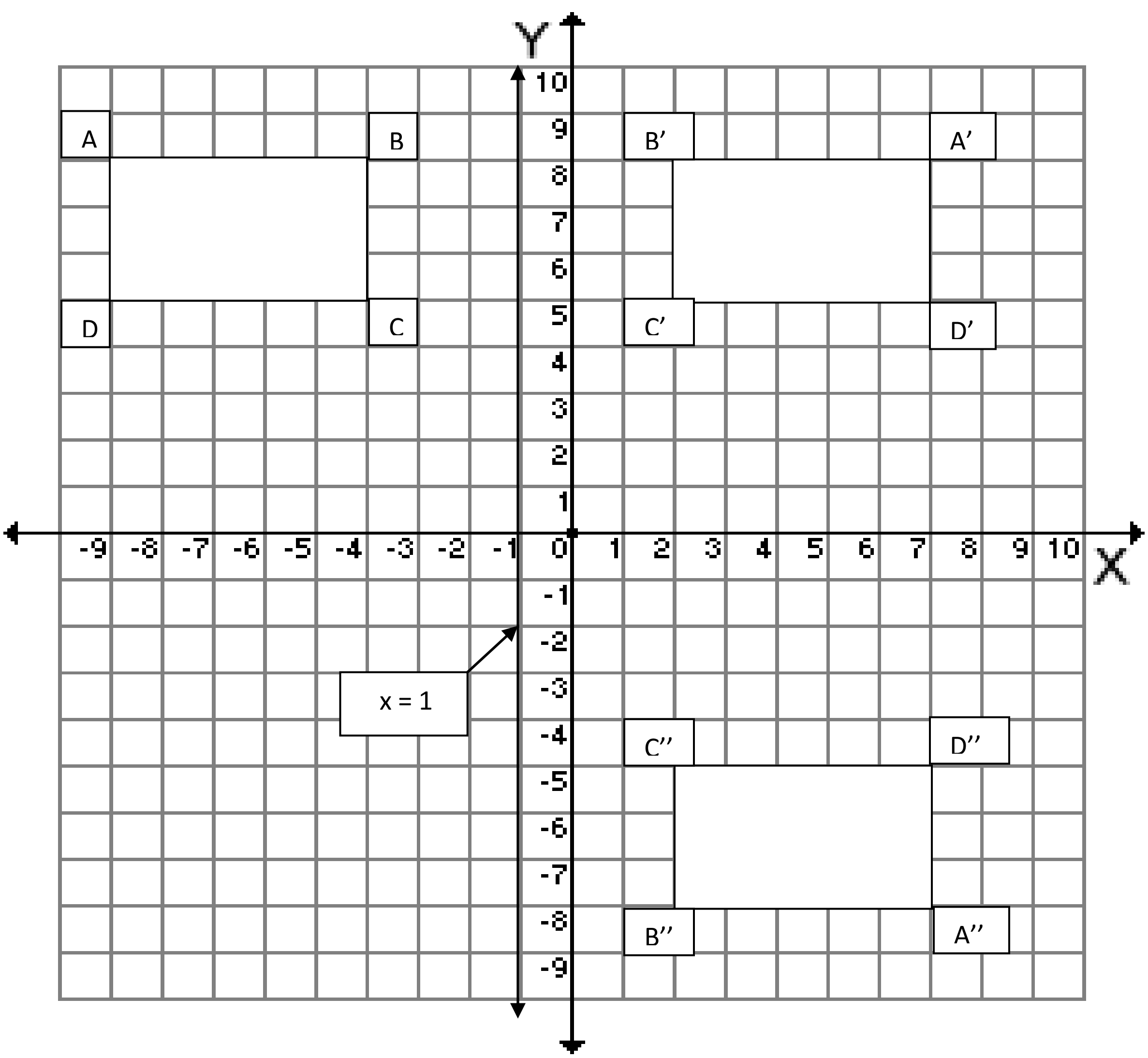


A **Reflection** is a transformation of a figure that creates a mirror image, "flips," over a line.

In the example below we reflect a rectangle over the line x = -1 and thus create a mirror image. The mirror image is indicated by labeling the vertices with a prime: A', B', C', D'.

Then we reflect the mirror image across the x-axis. The new image is indicated with a double-prime: A'', B'', C'', D''.

<u>Pay attention to the vertices. When you reflect or "flip" a shape the vertices "flip" as well.</u>



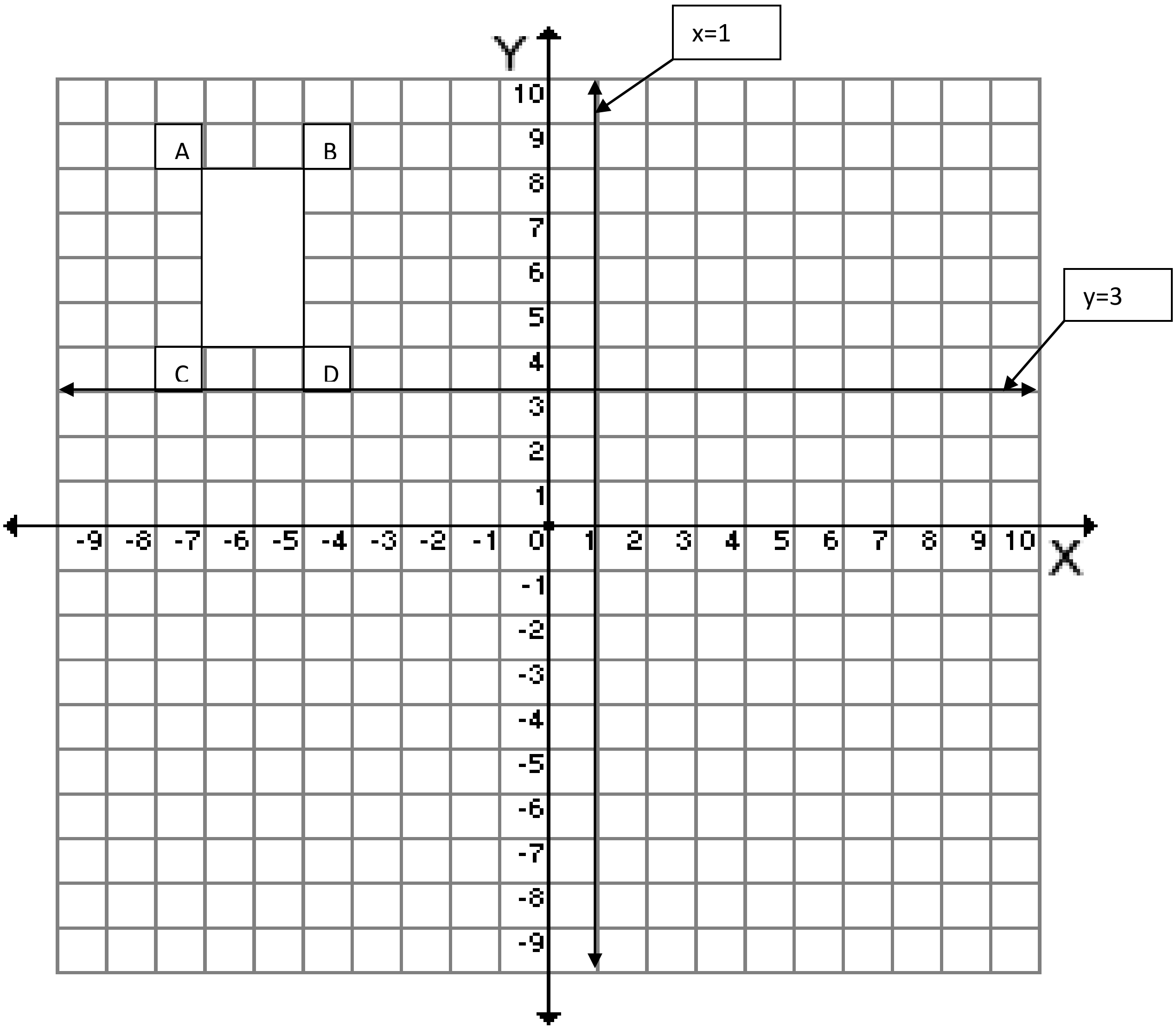
PROBLEMS:

4. Reflect the shape across the line x = 1.

5. List the coordinates for A’ (,), B’ (,), C’ (,), and D’ (,).

6. Then reflect the image across the line y = 3.

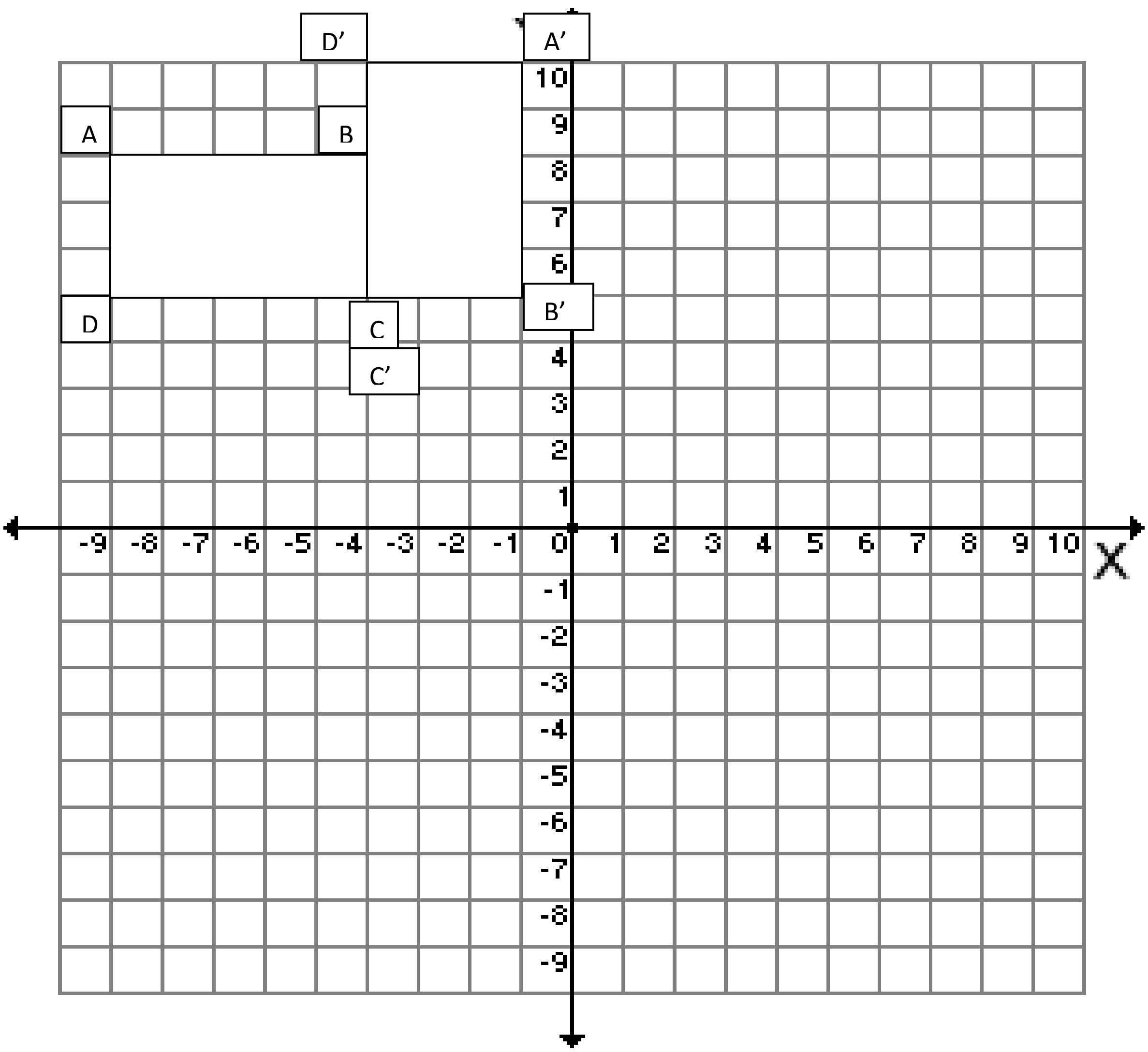
7. List the coordinates for A’’ (,), B’’ (,), C’’ (,), and D’’ (,).



ROTATION

A r**otation** is a transformation that turns a figure about a fixed point through a given angle and a given direction, such as 90° clockwise.

Rotate the rectangle A,B,C,D below by 90˚ clockwise around the vertex C.
Pay attention to the location of the vertices when you rotate the shape.



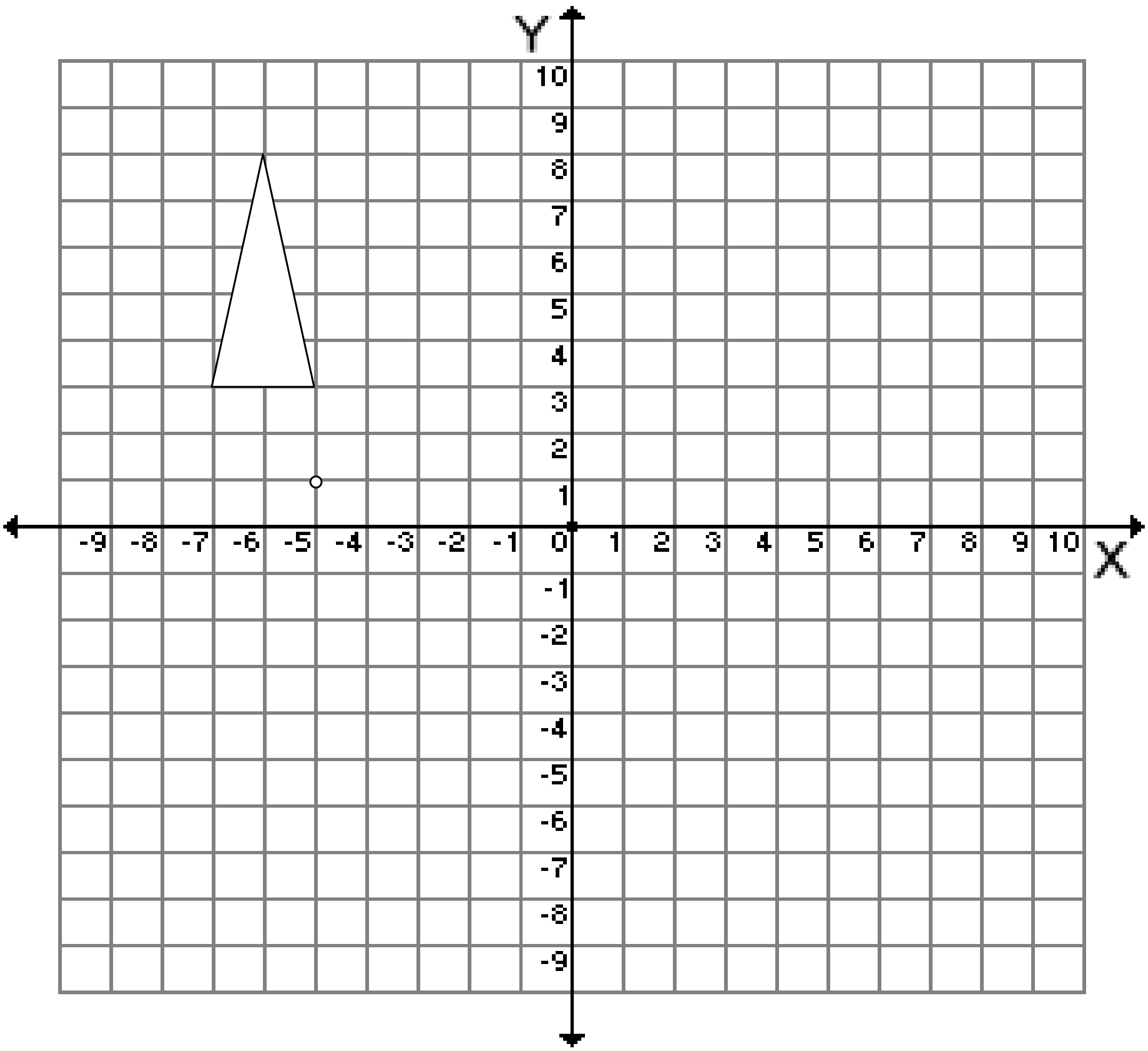
PROBLEMS

8. Label the vertices A, B, and C. Then Rotate the shape below 90˚ clockwise through the point (-5,1).

9. List the coordinates for A' (,), B' (,), and C' (,).

10. Rotate the original shape 180˚ through the point (-5,1).

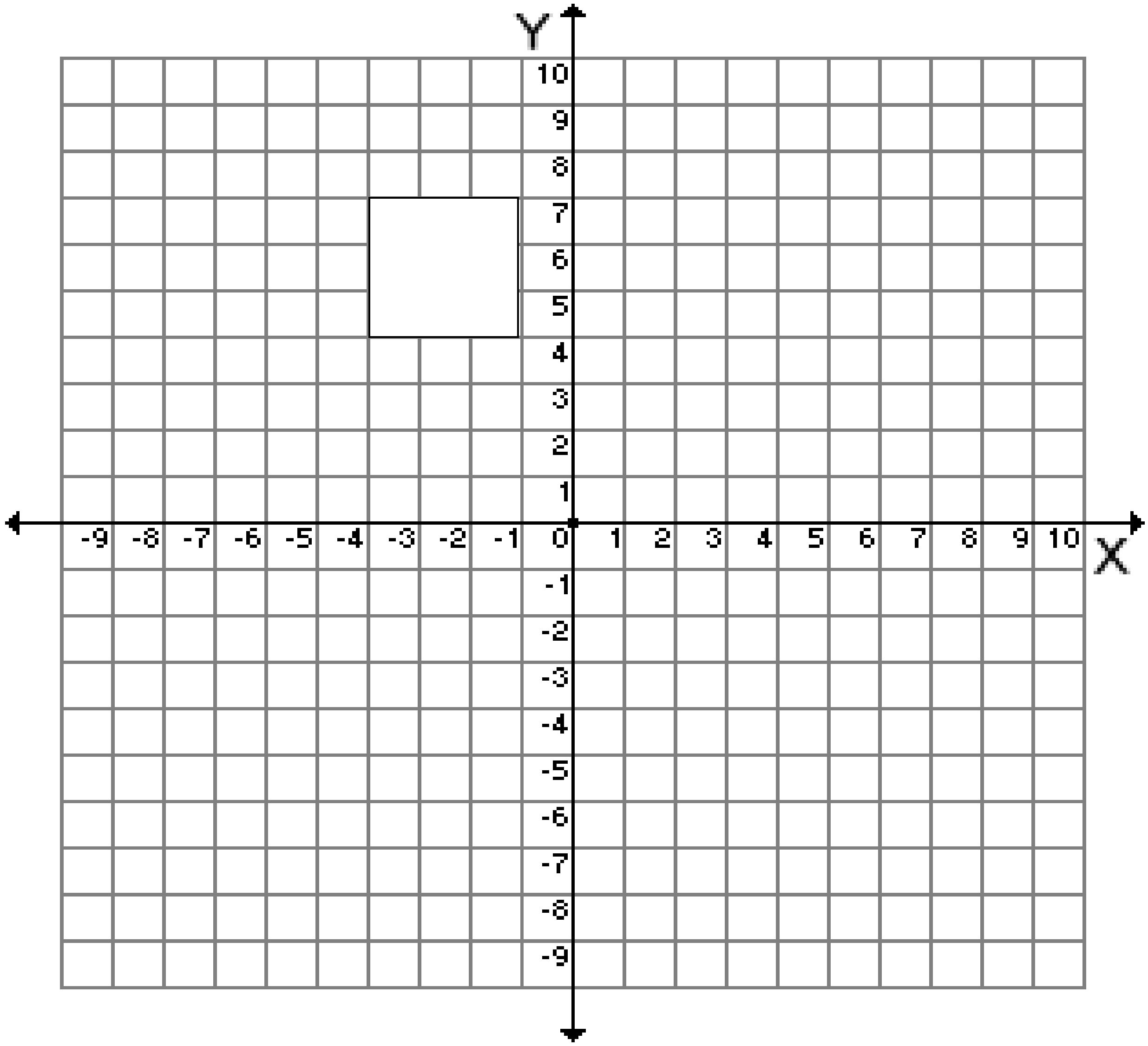
11. List the coordinates for A'' (,), B'' (,), C'' (,), and D'' (,).



PROBLEMS

12. **a**. On your graph paper label the square below with. A, B, C, and D.

b. List the coordinates for every point: A(,), B(,), C(,), and D(,).



c. Rotate it 90 degrees clockwise through the point (0,4).
Label the vertices A' (,), B' (,), C' (,), and D' (,).

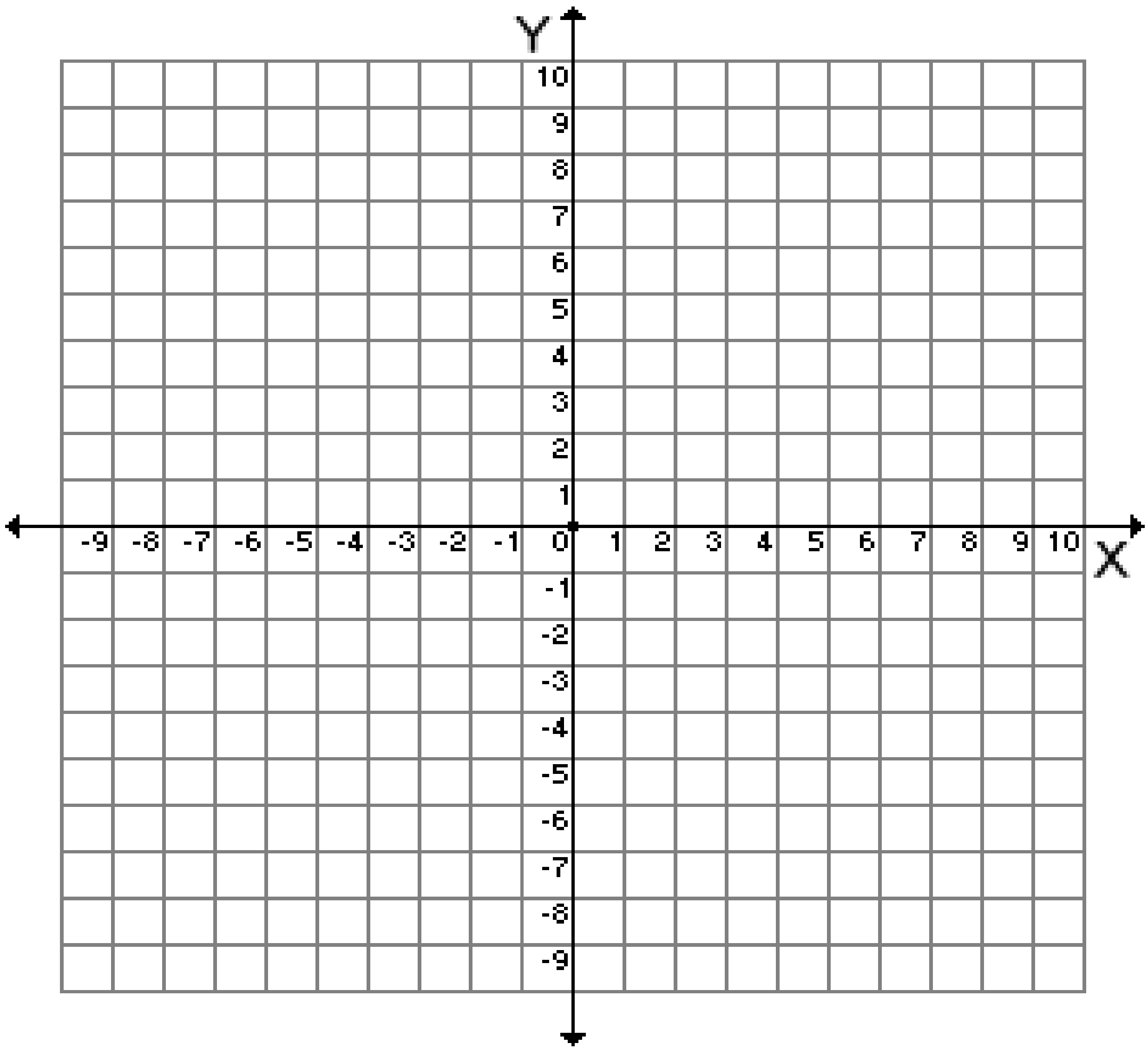
d. Translate it so that it is in the 4th quadrant.

e. Reflect it over a line x="a number" so that the square is in the 3rd quadrant.
Label the vertices A'' (,), B'' (,), C'' (,), and D'' (,).

f. Write down a distinctly different way that you can get the shape back in its original position (using translation, rotation or reflection)

13. **a.** On your graph paper draw and label a **rectangle** of your choice.

b. Describe its original position. A(,), B(,), C(,), and D(,).



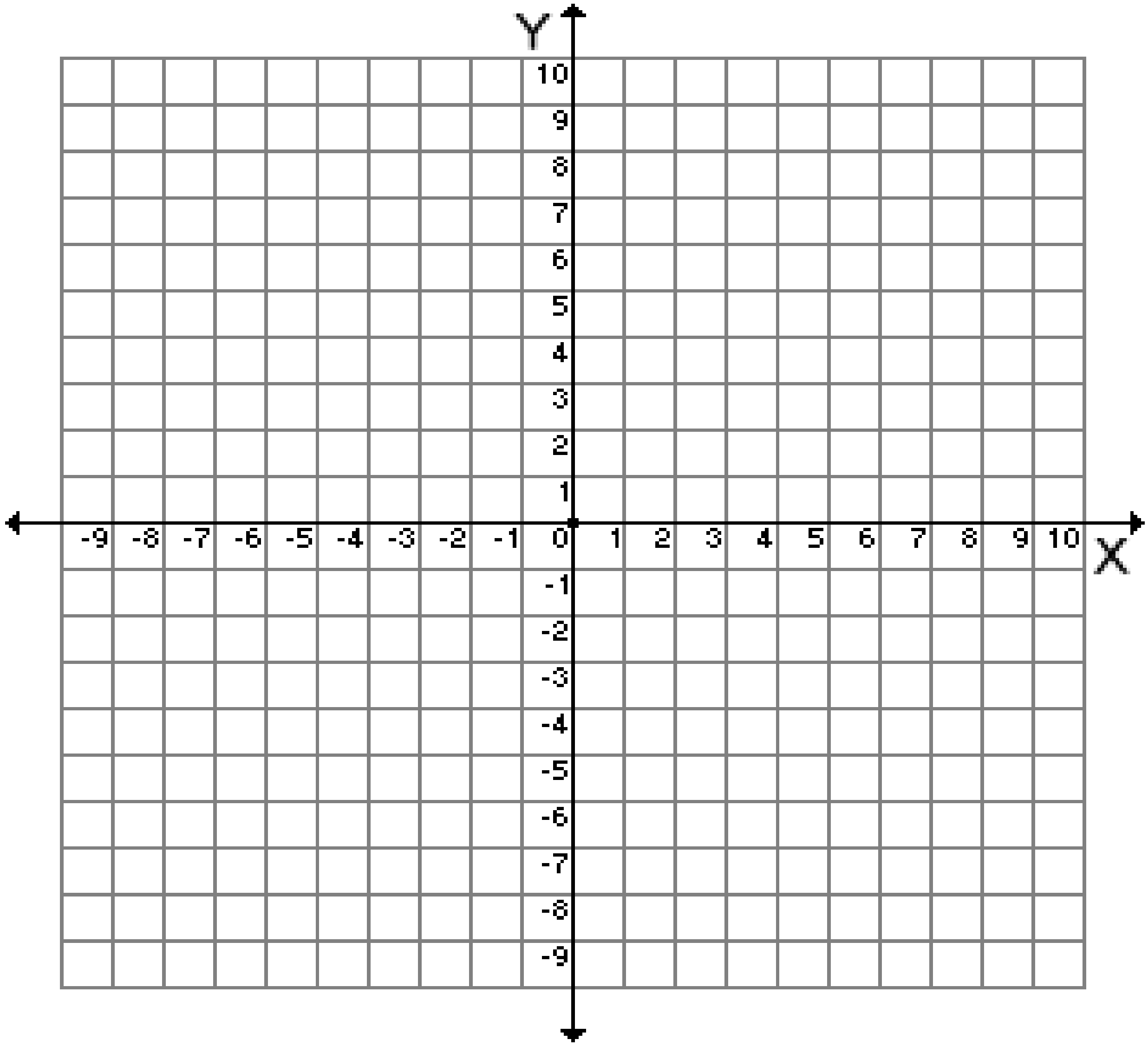
c. Rotate it 90 degrees. Label the vertices A' (,), B' (,), C' (,), and D' (,).

d. Translate it so that it is in the 4th quadrant.

e. Reflect it over a line y="a number" so that the square is in the 1st quadrant.
Label the vertices A'' (,), B'' (,), C'' (,), and D'' (,).

f. Write a distinctly different way that you can get the shape back in its original position (using translation, rotation or reflection)

14. **a.** On your graph paper draw and label the **triangle** A(-5, 8), B(-6, 4), C(-4, 4).

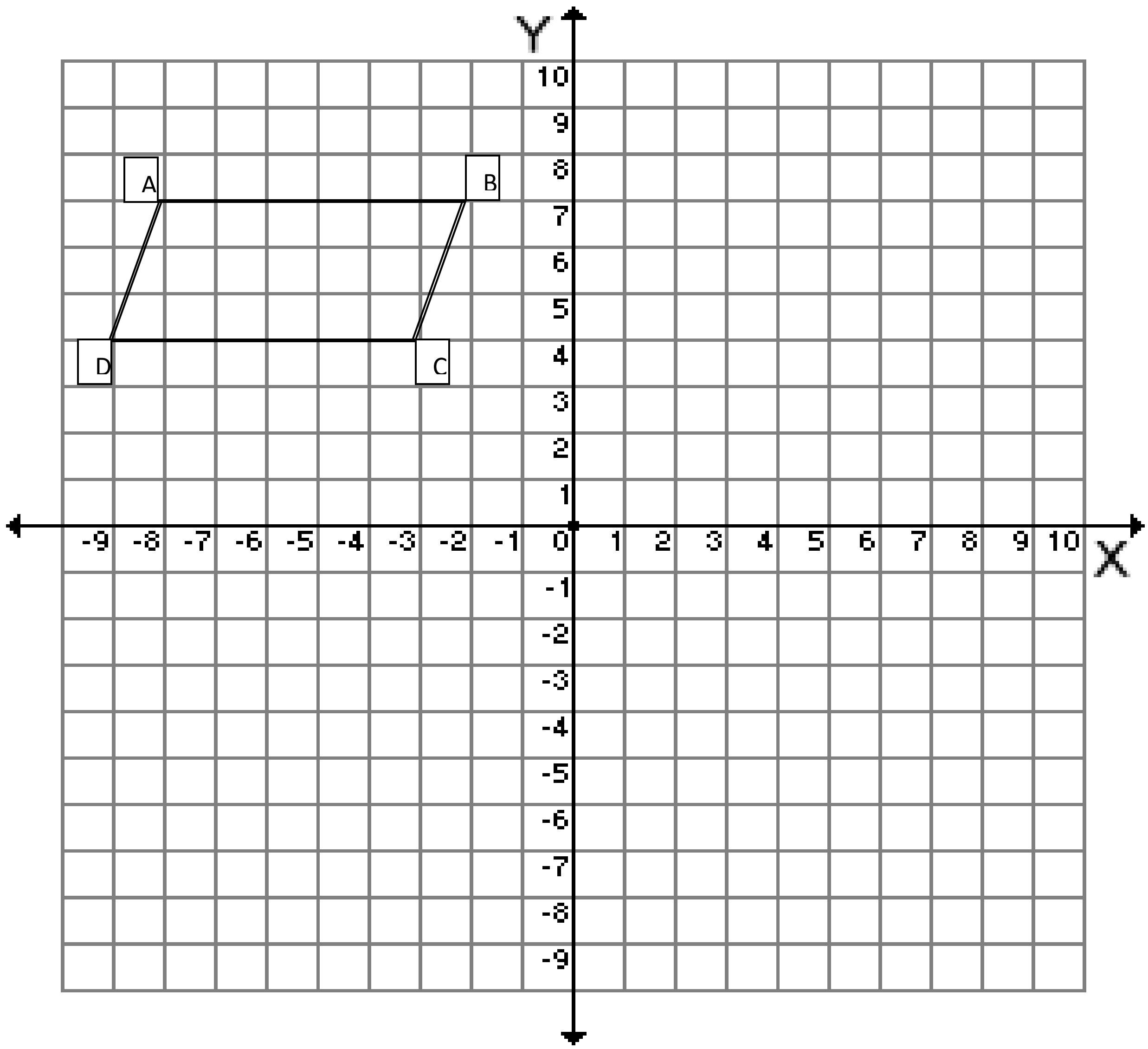


b. Rotate, Translate, and/or Reflect the triangle so that the one side is touching an original side in such a way that it forms a parallelogram. List your steps below and show it on the graph above.

STEPS:

15. **a.** Locate the parallelogram on the graph below.

b. Describe its original position. A(,), B(,), C(,), and D(,).

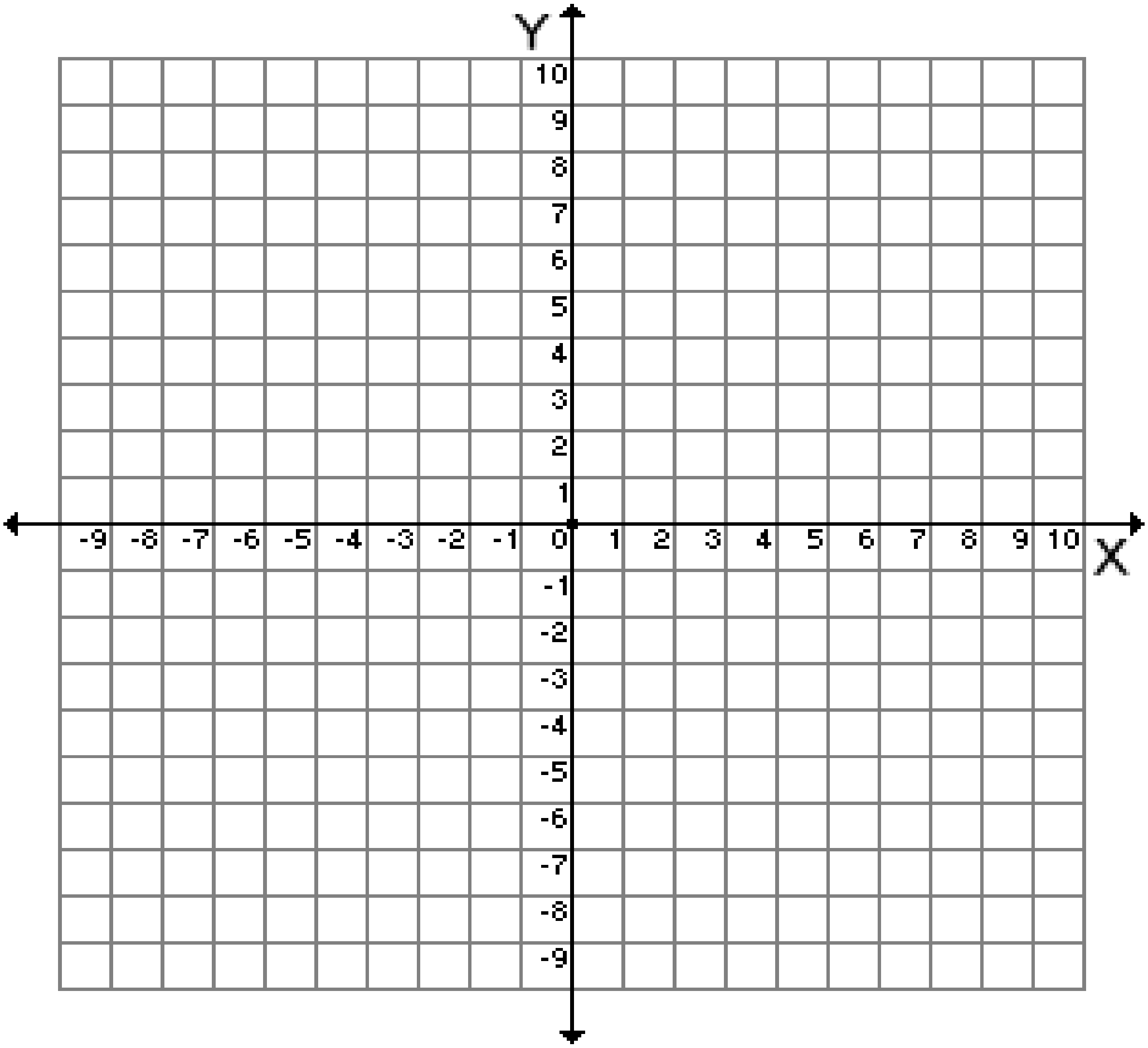


c. Rotate, Translate, and Reflect the parallelogram several times so that it will end up in the forth quadrant touching the x-axis, listing your steps here and showing it on the graph above.

STEPS:

16. On a piece of graph paper, graph the following points to create Square CDEF: C = (3, 0); D = (4, 1); E = (5, 0); F = (4, -1)

a. Draw the line: x = 2.



b. Using either Mira, patty paper or a transparency reflect the square over the x = 2 line.

c. How have the new points changed? ____

____

d. Using the original square, now reflect it over the y-axis.

e. What has happened? ____

Why is this reflection further away than the last one? ____________________________

____

What effect did changing the reflection line have? _______________________________

____

f. Write out the coordinates of each square.

Original Square		Reflection over x=2		Reflection of y-axis	
C	(,)	C’	(,)	C’’	(,)
D	(,)	D’	(,)	D’’	(,)
E	(,)	E’	(,)	E’’	(,)
F	(,)	F’	(,)	F’’	(,)

g. How far apart are the original square and the first reflection? ____

h. The original square and the second reflection? ____

i. How far is the original square from x=2 and how far is the first reflection from x=2?

____

j. How far is the original square from the y-axis and the second reflection and the y-axis?

____

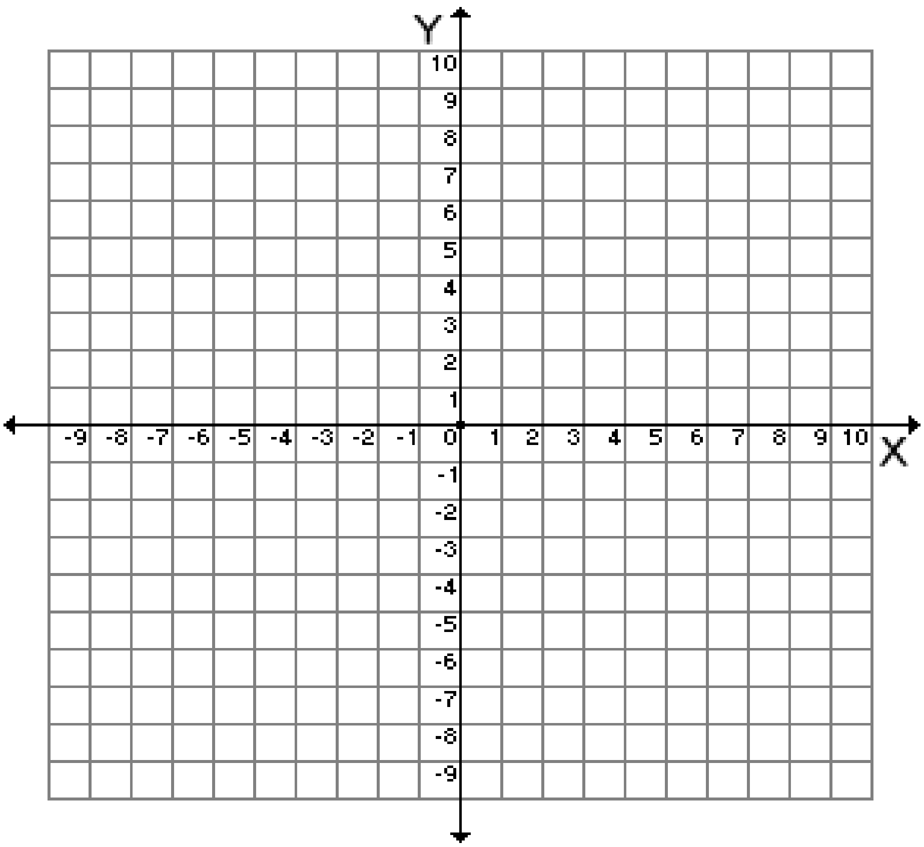
17. Draw the line y = ½x – 5. If you were to reflect the original square (from problem 16) over y =½x – 5, predict where would the new vertices be?

Original Square		**Prediction of Reflection over y=½x-5**	
C	(,)	C’	(,)
D	(,)	D’	(,)
E	(,)	E’	(,)
F	(,)	F’	(,)

a. <u>After</u> you have made your prediction, using the Mira, patty paper, or transparency reflect the original square over the y = ½x – 5 line. How does your prediction compare with the actual reflection?

____

____



b. Make a general conclusion about what happens to coordinates of a point when they are reflected over a line.

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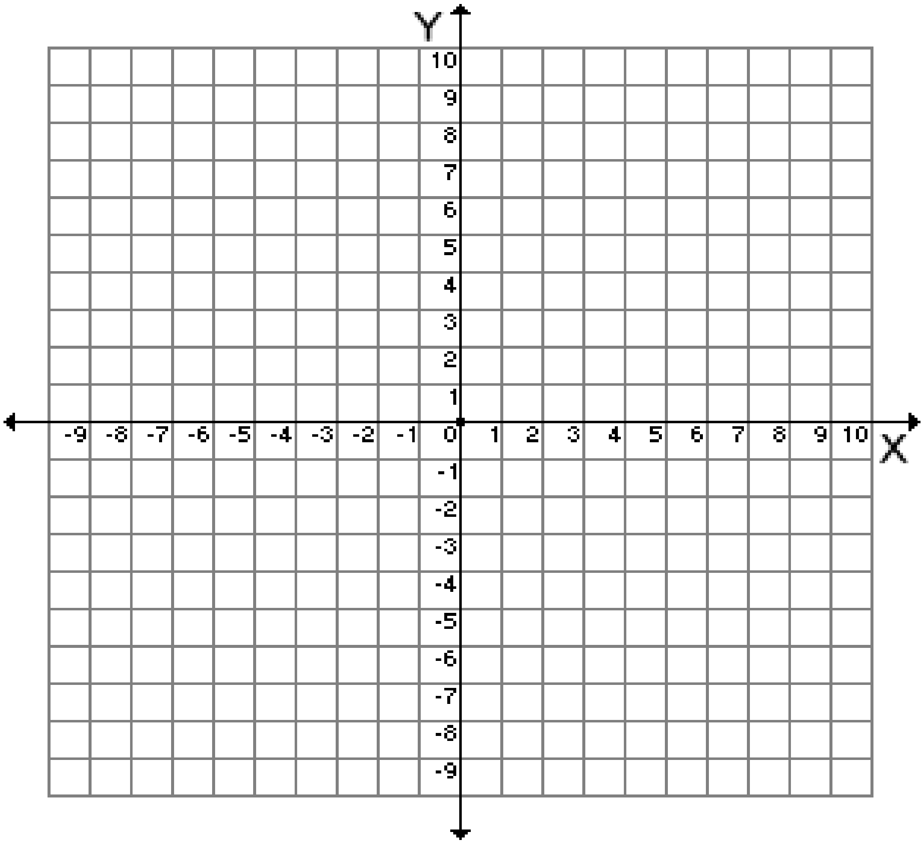
18. Return to the original square. Plot the point B (2,0). Point B is now your point of rotation.



a. Rotate the square, about point B, 270 degrees counterclockwise. Write down the new coordinates and compare them to the old coordinates.

Original Square		**Rotation around B**	
C	(,)	C’	(,)
D	(,)	D’	(,)
E	(,)	E’	(,)
F	(,)	F’	(,)

b. Now take the slope between B and D. The slope is ½ . What is the slope between B and D’?

c. Now take the slope between B and F. The slope is -½ . What is the slope between B and F’?

d. Do you see a pattern in your answers for b and c?

MAPPING

If vertices are not named, then there might be more than one transformation that will accomplish a specified mapping. If vertices are named, then they must be mapped in a way that corresponds to the order in which they are named.

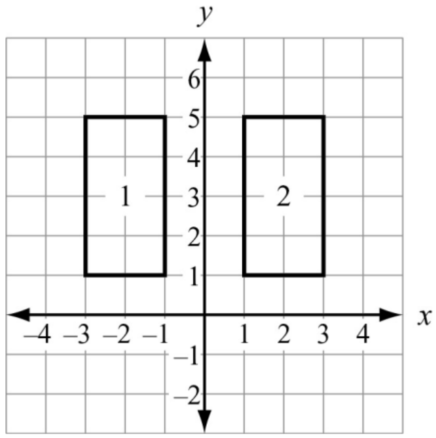
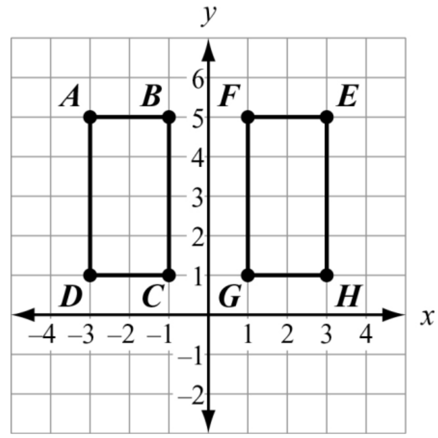


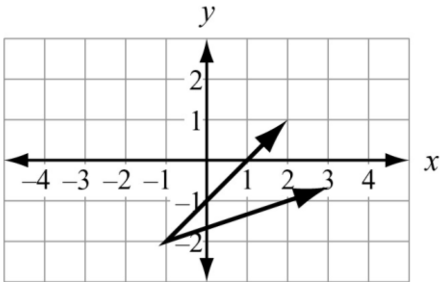
Figure 1 can be mapped to figure 2 by either of these transformations:
1. a reflection across the *y*-axis
(The upper left vertex in figure 1 is mapped to the upper right vertex in figure 2.), or
2. a translation 4 units to the right
(The upper left vertex in figure 1 is mapped to the upper left vertex in figure 2.



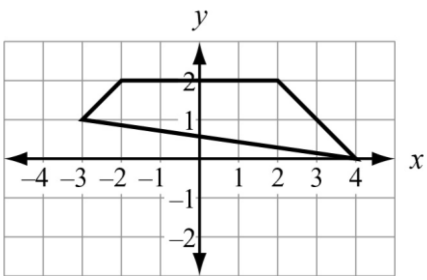
ABCD can be mapped to EFGH by a reflection across the y-axis, but not by a translation.
The mapping of ABCD → EFGH requires these vertex mappings:
A → E, B → F, C → G, and D → H.

REVIEW PROBLEMS

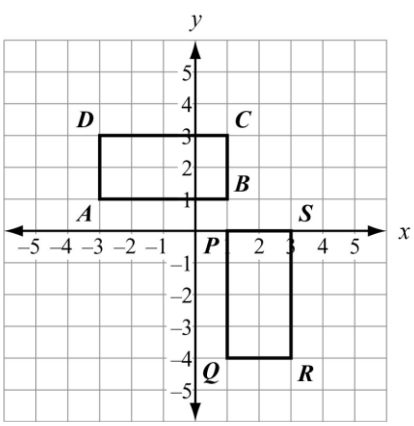
19. Draw the image of each figure, using the given transformation. Use the translation (x, y) → (x – 3, y + 1).



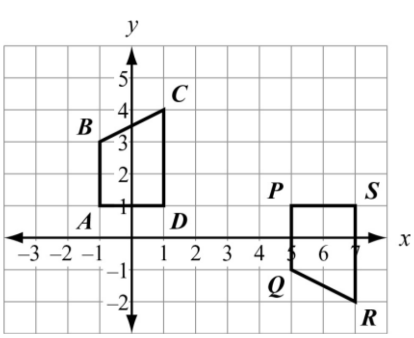
20. Draw the image of each figure, using the given transformation. Reflect across the x-axis.



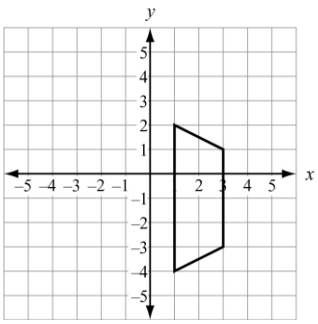
21. Specify a sequence of transformations that will map ABCD to PQRS.



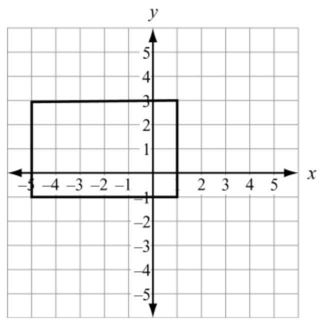
22. Specify a sequence of transformations that will map ABCD to PQRS.



23.

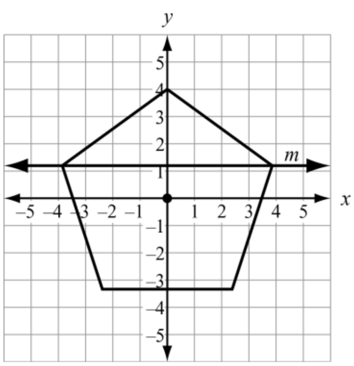


24.



Describe every transformation that maps the given figure to itself (Show the axis of reflection).

25. A regular pentagon is centered about the origin.



Which transformation maps the pentagon to itself?

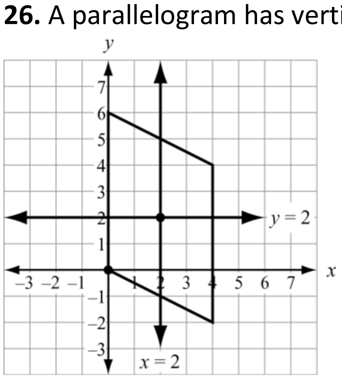
A. a reflection across line m

B. a reflection across the x-axis

C. a clockwise rotation of 100° about the origin

D. a clockwise rotation of 144° about the origin

26. A parallelogram has vertices at (0, 0), (0, 6), (4, 4), and (4, –2).



Which transformation maps the parallelogram to itself?

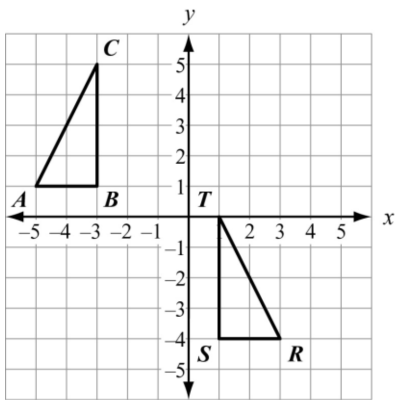
A. a reflection across the line x = 2

B. a reflection across the line y = 2

C. a rotation of 180° about the point (2, 2)

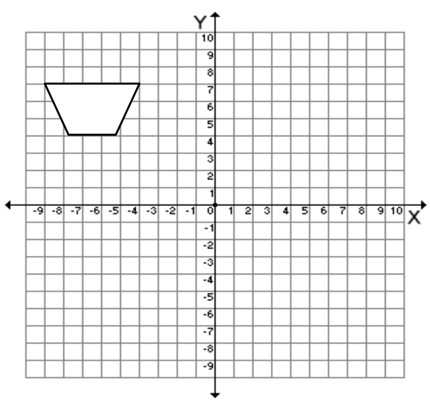
D. a rotation of 180° about the point (0, 0)

27. Which sequence of transformations maps △ABC to △RST ?

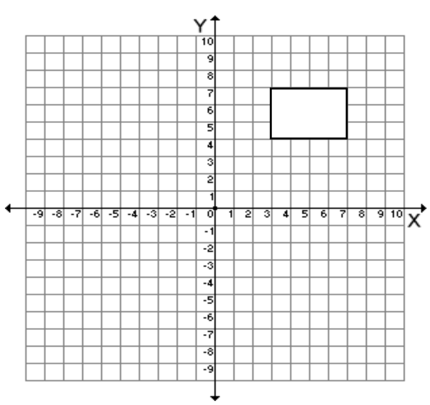


A. Reflect △ABC across the line x = –1. Then translate the result 1 unit down.
B. Reflect △ABC across the line x = –1. Then translate the result 5 units down.
C. Translate △ABC 6 units to the right. Then rotate the result 90° clockwise about the point (1, 1).
D. Translate △ABC 6 units to the right. Then rotate the result 90° counterclockwise about the point (1, 1).

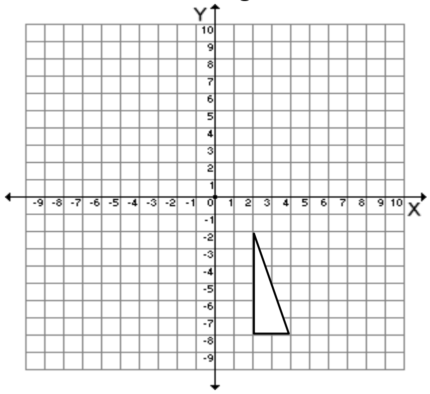
28. Translate the trapezoid 11 units to the right. Label the vertices.



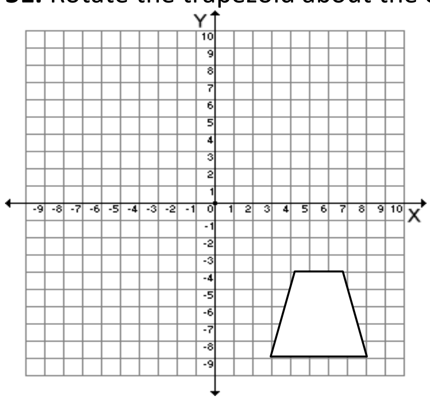
29. Rotate the rectangle about the origin 90˚ clockwise. Label the vertices.



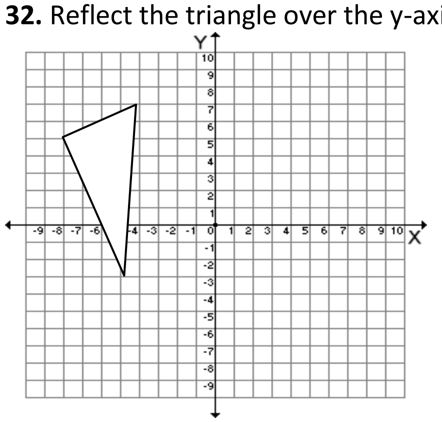
30. Rotate the triangle about the origin 180˚ counterclockwise. Label the vertices.



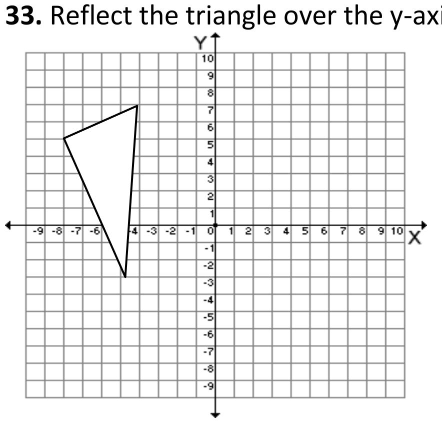
31. Rotate the trapezoid about the origin 90˚ counterclockwise. Label the vertices.



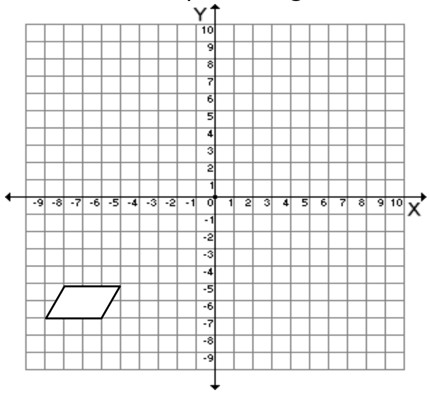
32. Reflect the triangle over the y-axis. Label the vertices.



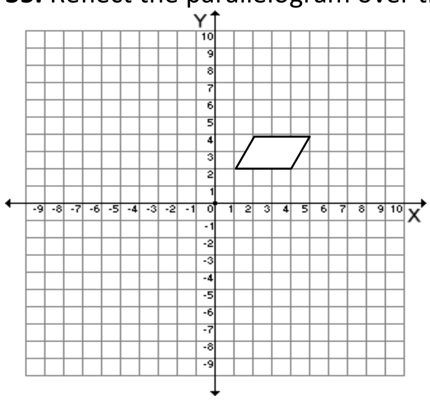
33. Reflect the triangle over the y-axis. Label the vertices.



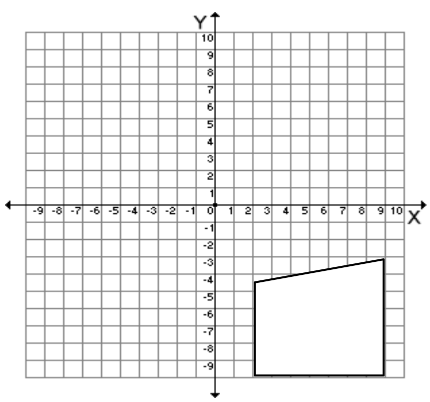
34. Reflect the parallelogram over the x-axis. Label the vertices.



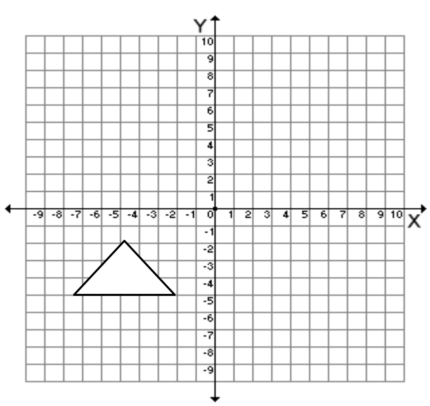
35. Reflect the parallelogram over the y-axis. Label the vertices.



36. Reflect the quadrilateral over the y-axis.

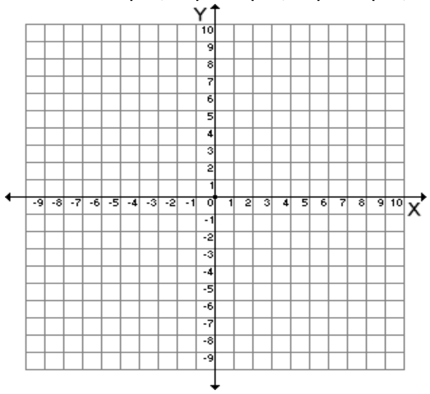


37. Reflect the triangle over the x-axis. Label the vertices.



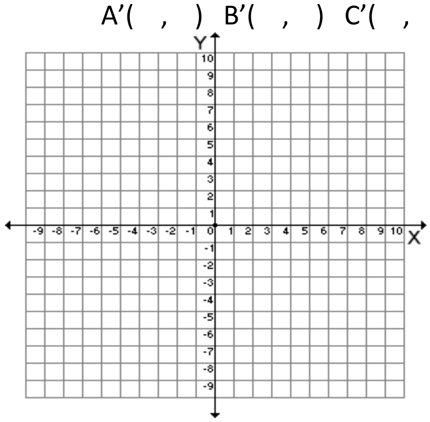
38. The vertices of triangle ABC are A(5,3), B(2,8), and C(-4,5). Rotate the triangle about the origin 90˚ counterclockwise to form triangle A',B', and C'. What are the vertices of triangle A',B',C'?

A'(,) B'(,) C'(,)



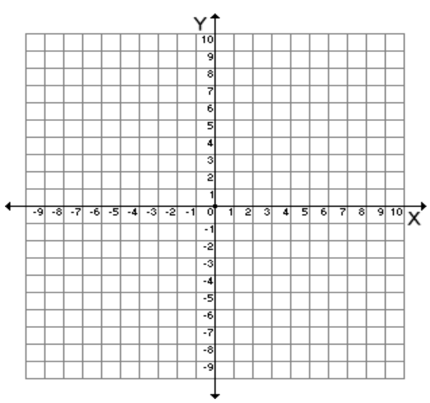
39. The vertices of triangle ABC are A(5,3), B(2,8), and C(-4,5). Translate the triangle 6 units to the left to form triangle A',B', and C'. What are the vertices of triangle A',B',C'?

A'(,) B'(,) C'(,)



40. The vertices of parallelogram HJKL are H(2,-6), J(3,-1), K(7,1), L(6,-6). Reflect the parallelogram over the x-axis to form parallelogram H',J',K',L'. What are the vertices of H',J',K',L'?

H'(,) J'(,) K'(,) L'(,)



Lesson 5.2 Prove Triangles Congruent by SSS

Goal: Use side lengths to prove triangles are congruent.

Vocabulary: For two shapes to be called **congruent** they need to have the same size and same shape. The symbol for congruency is ≅.

In two **congruent figures** all the parts of one figure are congruent to the **corresponding parts** of the other figure. In congruent polygons this means that the corresponding sides and the corresponding angles are congruent and in corresponding (the same) order. There is more than one way (order) to write a congruency statement, but it is important to list the corresponding angles in the same order.

A **coordinate proof** involves placing geometric figures in a coordinate plane.

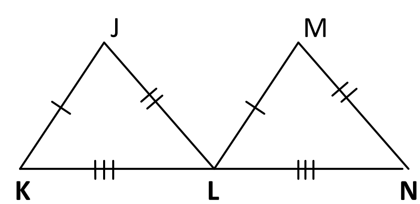
Side-Side-Side (SSS) Congruence Postulate: If three sides of one triangle are congruent to three sides of another triangle, then the two triangles are congruent.

Example 1 Show that $\Delta JKL \cong \Delta MLN$.

Solution

It is given that $\overline{JK} \cong \overline{ML},\ \overline{KL} \cong \overline{LN},\ \overline{JL} \cong \overline{MN}$.

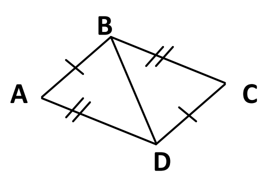
By SSS Congruence Postulate, $\Delta JKL \cong \Delta MLN$.



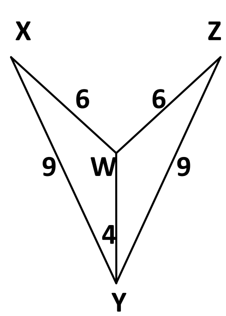
PROBLEMS:

Decide whether the congruence statement is true. Explain your reasoning.

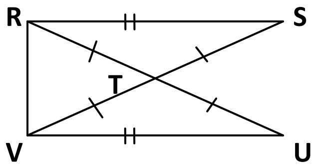
1. $\Delta ABD \cong \Delta CDB$



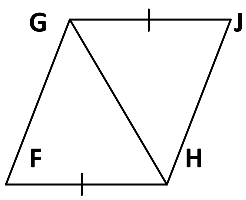
2. $\Delta XWY \cong \Delta WZY$



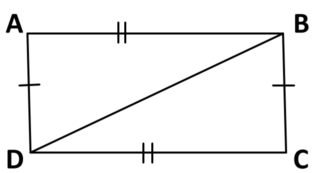
3. $\Delta RST \cong \Delta VUT$



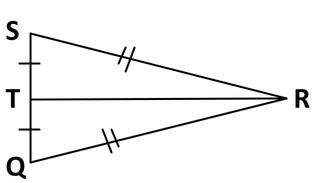
4. $\Delta FGH \cong \Delta JHG$



5. $\Delta ABD \cong \Delta CDB$



6. $\Delta RST \cong \Delta RQT$



Lesson 5.3 Prove Triangles Congruent by SAS and HL

Goal: Use sides and angles to prove congruence.

Vocabulary:

In a right angle the sides adjacent to the right angle are called **legs**.

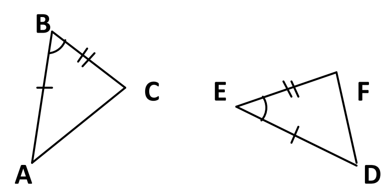
The side opposite the right angle is called the **hypotenuse** of the right angle.

Side-Angle-Side (SAS) Congruence Postulate: If two sides and the included angle of one triangle are congruent to two sides and the included angle of a second triangle, then the two triangles are congruent.

Theorem 3.12 Hypotenuse-Leg (HL) Congruence Theorem: If the hypotenuse and a leg of a right angle are congruent to the hypotenuse and a leg of a second triangle, then the two triangles are congruent.

Example 1 **Use the SAS Postulate**

Show that $\Delta ABC \cong \Delta DEF$.



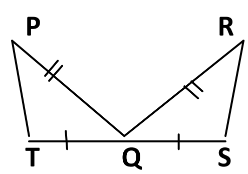
Solution

It is given that $\overline{AB} \cong \overline{DE}$, $\overline{BC} \cong \overline{EF}$, $\angle B \cong \angle E$.

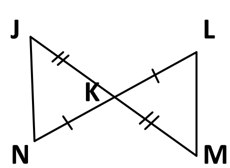
By SAS Congruence Postulate, $\Delta ABC \cong \Delta DEF$.

PROBLEMS: Decide whether enough information is given to prove that the triangles are congruent using the SAS Congruence Postulate.

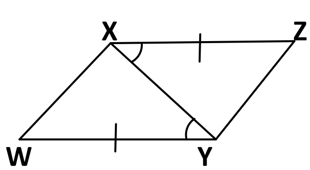
1. $\Delta TQP \cong \Delta QSR$



2. $\Delta NKJ \cong \Delta LKM$



3. $\Delta WXY \cong \Delta ZXY$



Lesson 5.4 Prove Triangles Congruent by ASA and AAS

Goal: Use two or more methods to prove congruence.

Vocabulary:

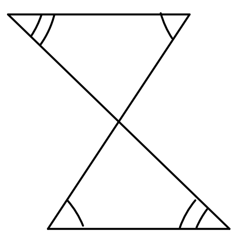
Angle-Side-Angle (ASA) Congruence Postulate: If two angles and the inclined side of one triangle are congruent to two angles and the included side of a second triangle, then the two triangles are congruent.

Angle-Angle-Side (AAS) Congruence Theorem: If two angles and the non-included side of one triangle are congruent to two angles and the corresponding non-included side of a second triangle, then the two triangles are congruent.

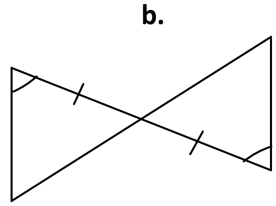
Example 1 **Identify congruent triangles**

Can the triangles be proven congruent with the information given in the diagram? If so, state the postulate or theorem you would use.

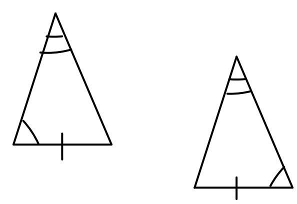
a.



b.



c.

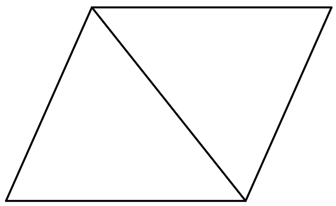


Solution

a. The vertical angles are congruent, so three pairs of angles are congruent. There is not enough information to prove the triangles are congruent, because no sides are known to be congruent.
b. The vertical angles are congruent, so two pairs of angles and their included sides are congruent. Therefore, the triangles are congruent by ASA.
c. Two pairs of angles and a non-included pair of sides are congruent. The triangles are congruent by the AAS theorem.

PROBLEMS: Can the triangles be proven congruent with the information given in the diagram? If so, state the postulate or theorem.

1.



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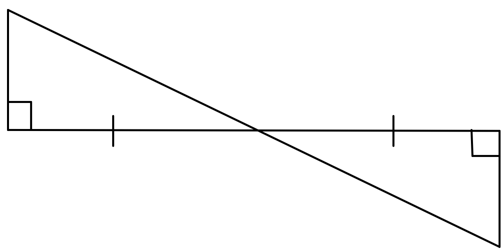

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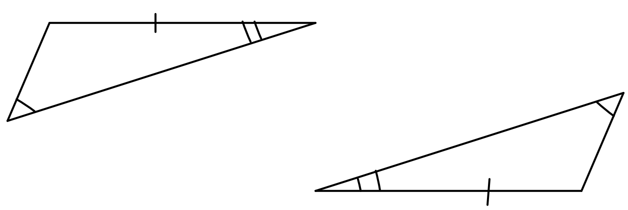

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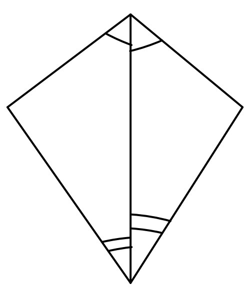

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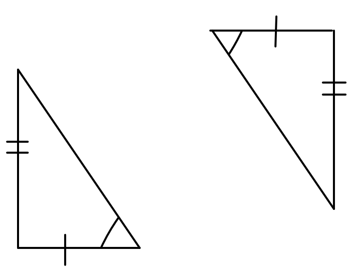


Lesson 5.5 Apply the Distance and Midpoint Formulas

Goal: Use distance and midpoint formulas.

Vocabulary:

The Distance Formula

The distance d between two points (x_1, y_1) and (x_2, y_2) is

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

The **midpoint** of a line segment is the point on the segment that is equidistant from the endpoints. The midpoint of a segment divides the segment into two congruent segments.

The Midpoint Formula

The midpoint M of the line segment with endpoints A(x_1, y_1) and B(x_2, y_2) is

$$\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right).$$

Example 1 **Find the distance between $(3,-2)$ and $(-2,4)$.**

Solution Let $(x_1, y_1) = (3,-2)$ and $(x_2, y_2) = (-2,4)$.

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} = \sqrt{(-2-3)^2 + (4-(-2))^2} = \sqrt{(-5)^2 + (6)^2} = \sqrt{61}$$

PROBLEMS

Find the distance between the two points.

1. $(5,2),(3,8)$

2. $(-2,0),(-4,5)$

3. $(7,-1),(-5,3)$

Example 2 **Find the midpoint of the line segment with endpoints $(7,-1)$ and $(5,7)$.**

Solution Let $(x_1, y_1) = (7,-1)$ and $(x_2, y_2) = (5,7)$.

$$\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right) = \left(\frac{7+5}{2}, \frac{-1+7}{2}\right) = (6,3)$$

PROBLEMS:

Find the midpoint of the line segment with the given endpoints.

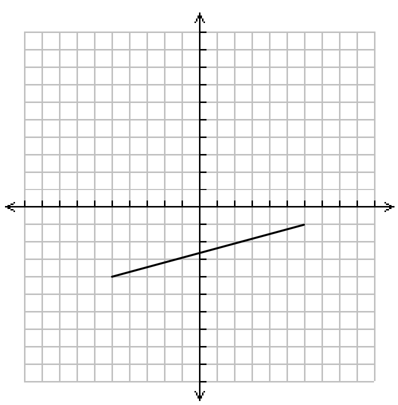
4. $(14,3),(6,9)$

5. $(-11,-3),(2,-5)$

6. $(2,5),(4,12)$

7. $(-7,2),(0,-5)$

8. Find the length and the midpoint of the line shown (Hint: Label the points and then use distance and midpoint formulas).



Length:

Midpoint:

Lesson 5.6 Parallel and Perpendicular Lines

Vocabulary:

Two lines are **parallel** if they have the same slope.

Two lines are **perpendicular** if the slope of one line is the negative inverse of the slope of the other line.

Example: Line n is $y = -2x - 4$ and line m is $y = -2x + 8$

Are the lines parallel?

Solution: Yes they are parallel because the slope of both lines are the same (slope = -2).

Example: Line n is $y + 3x = 2$ and line m is $2y = -6x + 8$

Are the lines parallel?

Solution: Solve each equation so that only y is on the left side (slope-intercept form):

Line n: $y = -3x + 2$

Line m: $y = -3x + 4$

Both lines have a slope of -3, therefore they are parallel.

Example: Line n is $y = 3x + 5$ and line m is $y = -\frac{1}{3}x + 2$

Are the lines perpendicular?

Solution: Yes, the lines are perpendicular because $-\frac{1}{3}$ is the negative inverse of 3.

Example: Line n is $4y = x + 12$ and line m is $y = 4x + 2$

Are the lines perpendicular?

Solution: Solve each equation so that only y is on the left side (slope-intercept form):

Line n: $y = \frac{1}{4}x + 12$

Line m: $y = 4x + 2$

Since $\frac{1}{4}$ is not the negative inverse of 4 the lines are not perpendicular.

PROBLEMS:

Are the lines parallel, parallel or neither?

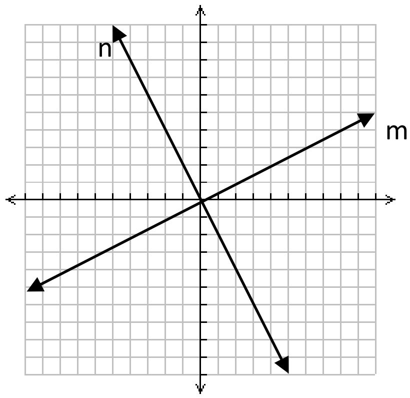
1. Line n is $y = -5x + 12$ and line m is $y = \frac{1}{5}x - 6$.

2. Line n is $y - x = 4$ and line m is $2x + y = 8$.

3. Line n is $2y + x = 6$ and line m is $3x + 6y = 12$.

4. Line n is $y - 2x = 4$ and line m is $2x + y = 8$.

Example: Determine whether the lines shown are parallel, perpendicular, or neither. Explain your reasoning.



Solution: Find the slope of each line:

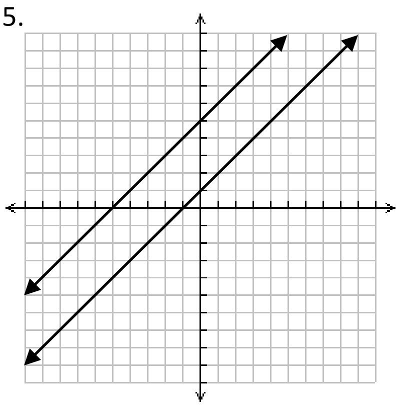
Slope of line m: 2

Slope of line n: - ½

Since 2 is the negative inverse of – ½ the lines are perpendicular.

Determine whether the lines shown are parallel, perpendicular, or neither. Explain your reasoning.

5.



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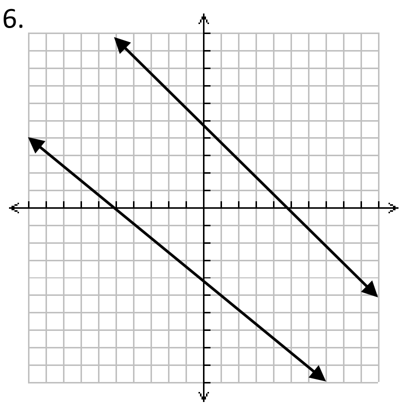

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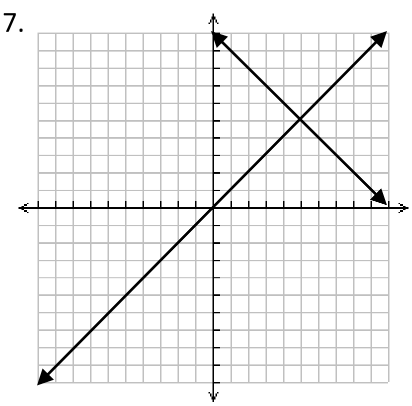


Example: What is the equation of a line parallel to $y=\frac{4}{5}x+2$ that passes through (1,2)? Draw both lines.

Solution: The new line must have the same slope (since parallel) and pass through (1,2). Therefore, we use the point slope form:

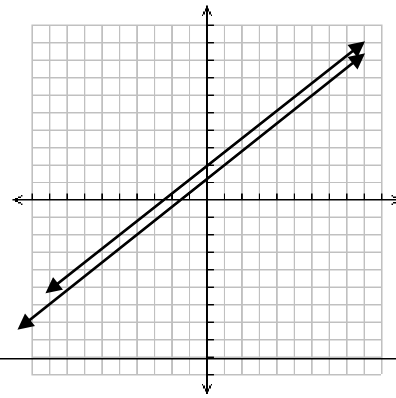
$(y-y_1)=m(x-x_1)$, where m is the slope ($\frac{4}{5}$), x_1 and y_1 the coordinates of the point (1,2). Just plug in and then solve.

$(y-2)=\frac{4}{5}(x-1)$ Plug in corresponding values

$y=\frac{4}{5}x-\frac{4}{5}+2$ Distribute and add 2 to both sides

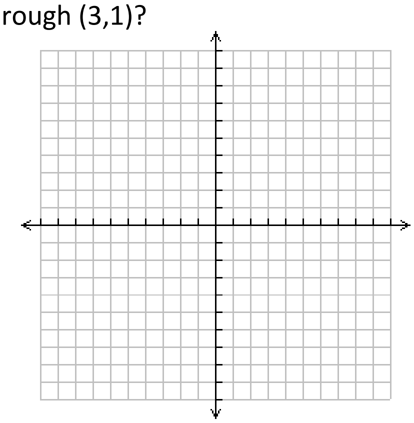
$y=\frac{4}{5}x+\frac{6}{5}$ Simplify.

Draw both lines:

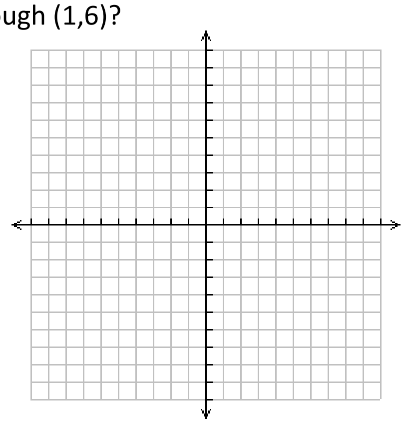


PROBLEMS

8. What is the equation of a line parallel to $y=-5x+3$ that passes through (3,1)? Draw both lines.



9. What is the equation of a line parallel to $y=2x-3$ that passes through (1,6)? Draw both lines.



Example: What is the equation of a line perpendicular to $y = 2x - 6$ that passes through (5,4)? Draw both lines.

Solution: The slope of the new line must be the negative inverse (perpendicular) of the existing line.

The negative inverse of 2 is $-\frac{1}{2}$. Use the point slope form:

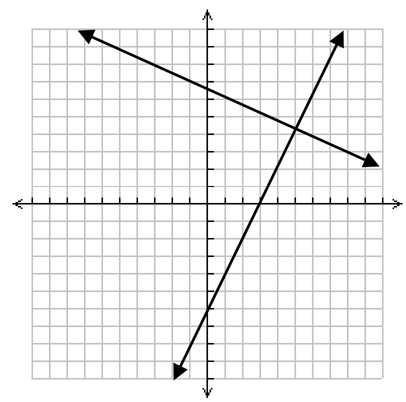
$(y - y_1) = m(x - x_1)$, where m is the slope ($-\frac{1}{2}$), x_1 and y_1 the coordinates of the point (5,4). Just plug in and then solve.

$(y-4) = -\frac{1}{2}(x-5)$ Plug in corresponding values

$y = -\frac{1}{2}x + \frac{5}{2} + 4$ Distribute and add 4 to both sides

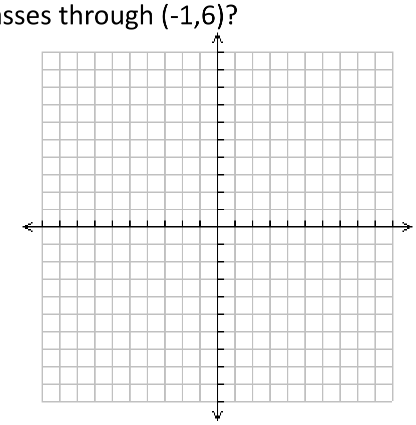
$y = -\frac{1}{2}x + \frac{13}{2}$ Simplify.

Draw both lines:



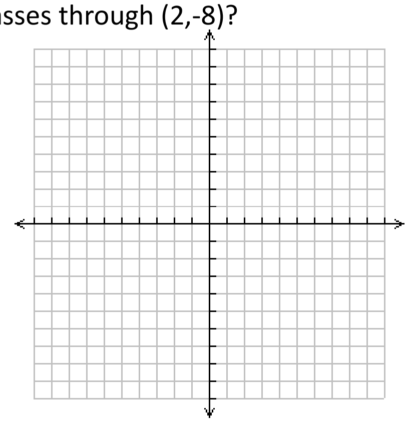
PROBLEMS

8. What is the equation of a line perpendicular to $y = -3x + 4$ that passes through (-1,6)? Draw both lines.



9. What is the equation of a line perpendicular to $y = -\frac{2}{5}x - 1$ that passes through (2,-8)?

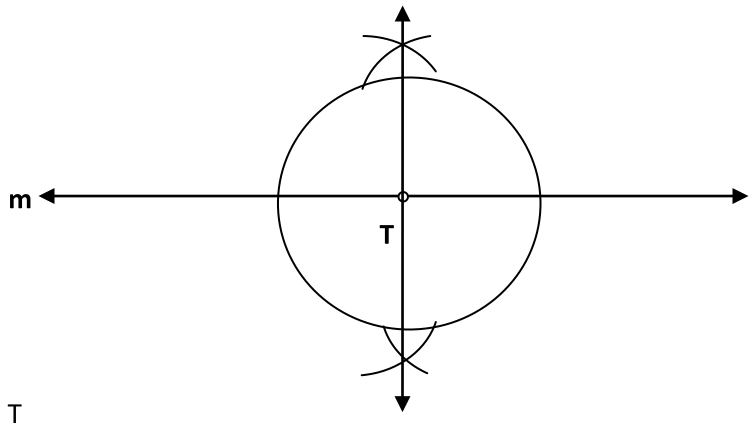
Draw both lines.



Lesson 5.7 Constructing Perpendicular Lines, Parallel Lines and Polygons

You need a compass, ruler and pencil. Ask your teacher for assistance when unsure.

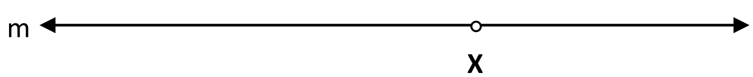
Example:
Construct a line that is perpendicular to line m and passes through point T.



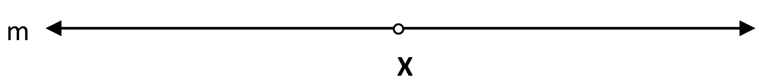
1. Draw an arc around T
2. Use the intersections of the arc around T and the line CD to draw arcs which intersect above and below T.
3. Connect the intersections of the arcs to draw a line which goes through T and is perpendicular to line CD.

PROBLEMS:
Construct a line that is perpendicular to line m and passes through point X.

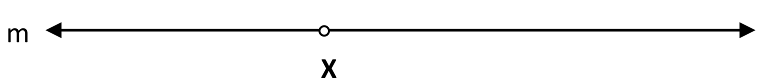
1.



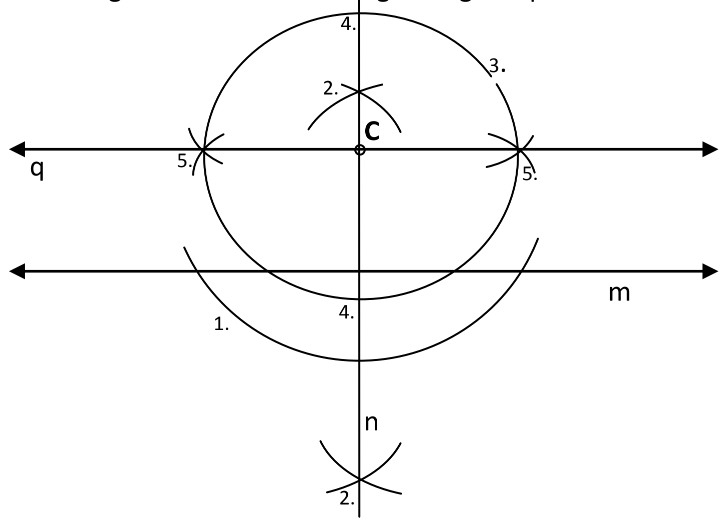
2.



3.



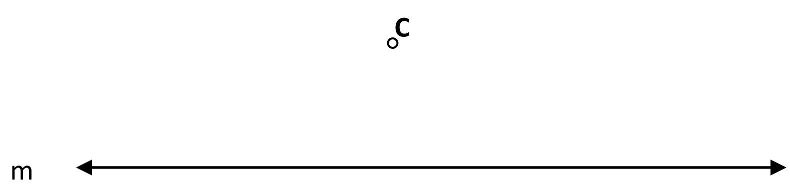
Example:
Construct a line parallel to the given line m and through the given point C.



1. Draw an arc from C so that it passes through line m.
2. Use the intersection points and draw intersecting arcs so that you can construct the line n. Line n should be perpendicular to line m and intersect Point C.
3. Draw a circle around C.
4. Use the intersection points of the circle and the line, m, to draw arcs.
5. Connect the intersection points of the arcs. This line (q) should be parallel to line m and go through point C.

PROBLEMS:
Construct a line parallel to the given line m and through the given point C.

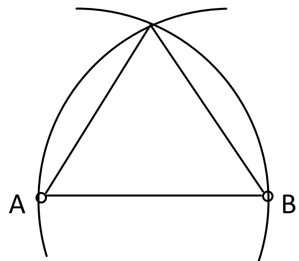
4.



5.

Example:

Construct an equilateral triangle using one side given.

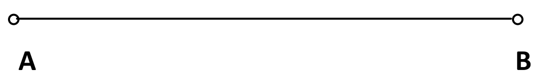


1. Draw an arc with center A. Draw an arc with center B
2. The intersection of the two arcs is the third vertex of the equilateral triangle.

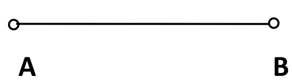
PROBLEMS:

Construct an equilateral triangle using one side given.

6.



7.



8.