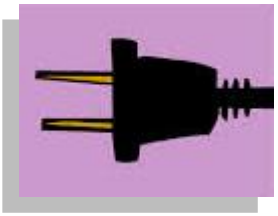
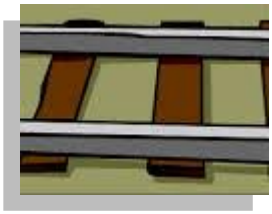
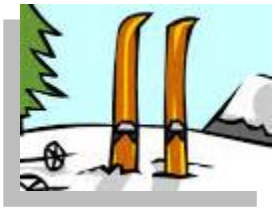
Section 8.1 – Parallel Lines

What are Parallel Lines?

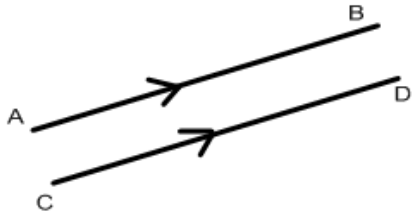
Parallel lines are lines on the same flat surface that will never meet and are same distance apart over their entire length.

For example,



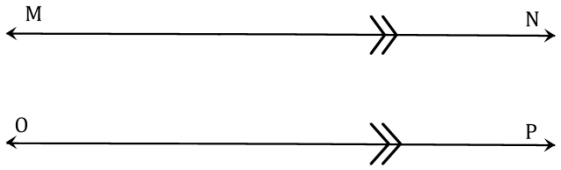



To show that lines are parallel, we draw small arrows on them as seen below:



Segment $\overline{AB}$ above is parallel to segment $\overline{CD}$.

We write $\overline{AB} \parallel \overline{CD}$

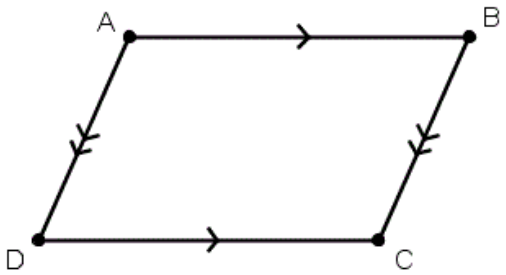


Segment $\overline{MN}$ above is parallel to segment $\overline{OP}$.

We write $\overline{MN} \parallel \overline{OP}$

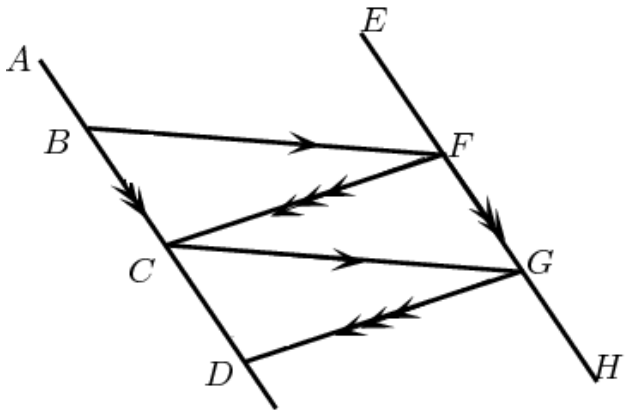
Example 1:

List the parallel lines in the figure below:



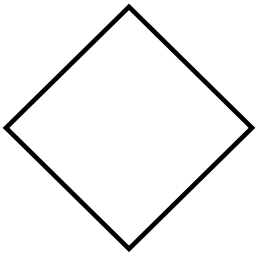
Example 2:

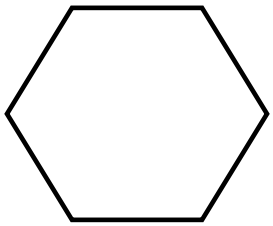
List the pairs of parallel lines in the diagram below:

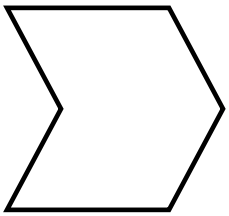


Example 3:

Mark the parallel lines on the shapes provided below:

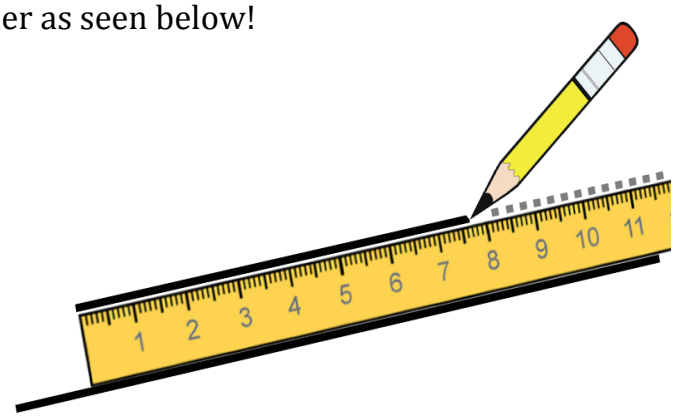
a) 

b) 

c) 

Drawing Parallel Lines

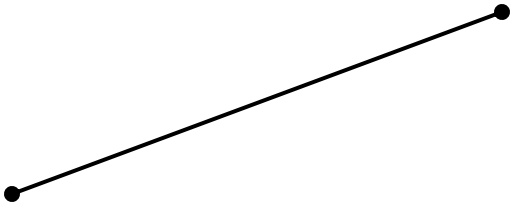
There are several ways we can draw parallel lines, the easiest of which is by using the sides of a ruler as seen below!



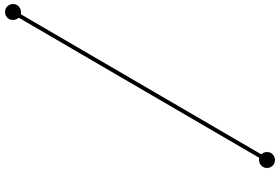
Examples:

1. Draw parallel lines to the following lines.

a)



b)



2. Draw a line segment AB that measures 6.5 cm. Draw a line parallel to AB.

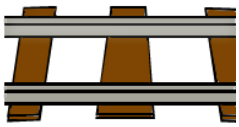
3. Simon sees two lines drawn on his desk that look parallel. How can he check to make sure that they actually are parallel?

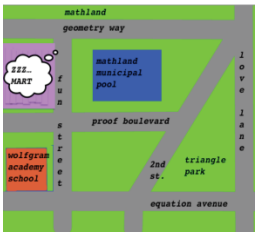
Section 8.2 – Perpendicular Lines

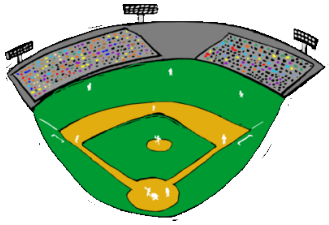
What are Perpendicular Lines?

Perpendicular lines are lines that intersect at 90 degree angles.

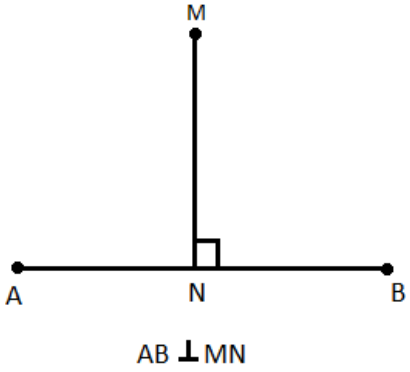
For example,







To show that lines are perpendicular, a small square should be placed where the two lines intersect to indicate a 90° angle is formed.



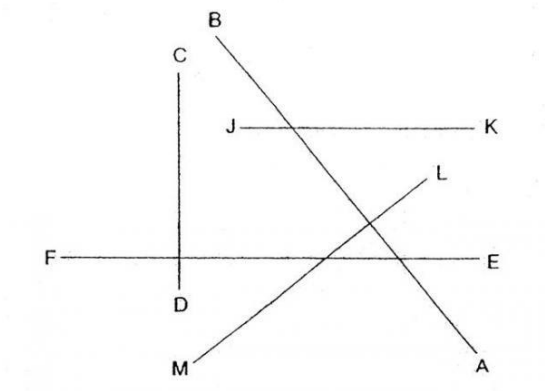
AB ⊥ MN

Segment $\overline{AB}$ to the right is perpendicular to segment $\overline{MN}$.

We write $\overline{AB} \perp \overline{MN}$

Example 1:

List the pairs of perpendicular lines in the diagram below:

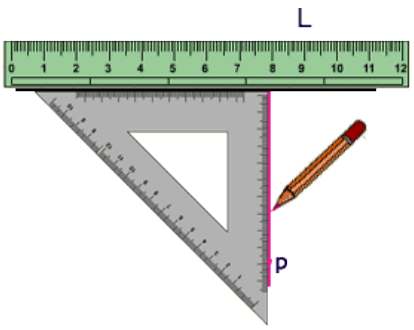


Drawing Perpendicular Lines

There are several ways to draw perpendicular lines. Two of the easiest are:

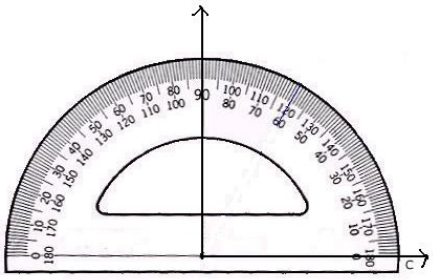
#1 Using a Ruler and a Triangle

Draw a straight line. Place a triangle against the line as shown in the picture below and draw a line on the other side.



#2 Using a Ruler and a Protractor

Draw a straight line using a ruler and mark the center of the line. Using your protractor, line the center of your protractor up with the center of your line. Make a mark at the 90° angle. Join this mark with the center you marked on your line.



Examples:

1. Draw perpendicular lines to the following lines using whichever method you prefer.

a)

b)

2. Draw a line segment $\overline{JK}$ that measures 5.2 cm. Using a triangle, draw a line perpendicular to $\overline{JK}$ and label it $\overline{MN}$.

3. Draw a line segment $\overline{PQ}$ that measures 4.8 cm. Using a protractor, draw a line perpendicular to $\overline{PQ}$ and label it $\overline{RS}$.

4. Is it possible for two lines to be both perpendicular and parallel? Explain.

5. Is it possible for a line to be perpendicular to more than one line? Explain.

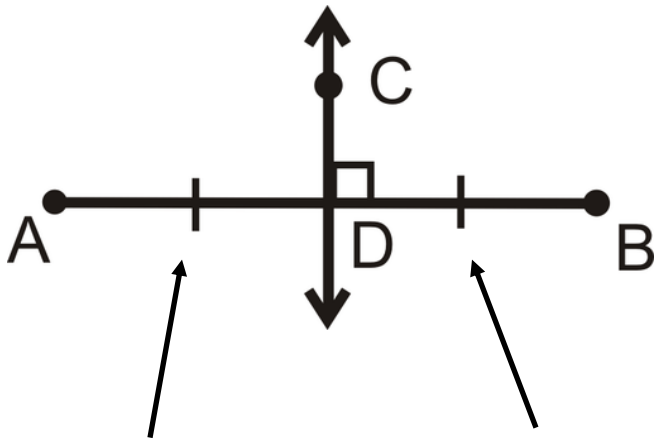
6. After learning about perpendicular lines in math class, Jeremy pointed out a picture to his brother which he believed demonstrated perpendicular lines. His brother said the lines were not perpendicular. How could Jeremy prove that his brother was wrong?

Section 8.3 – Perpendicular Bisector

What is a Perpendicular Bisector?

To **bisect** means to divide into two equal parts.

A **perpendicular bisector** is a line that intersects another line at a 90° angle and divides it into two equal pieces.



We indicate that two or more lines are equal by marking the lines with the same symbol.

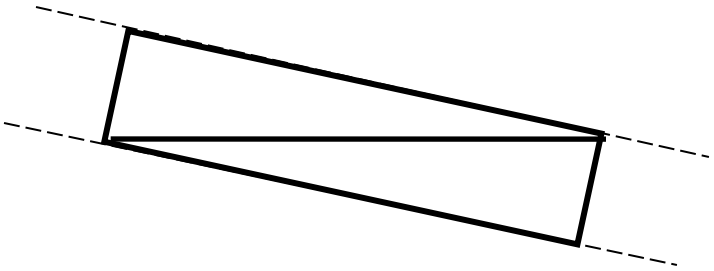
There are several ways to construct perpendicular bisectors.

#1 Paper Folding

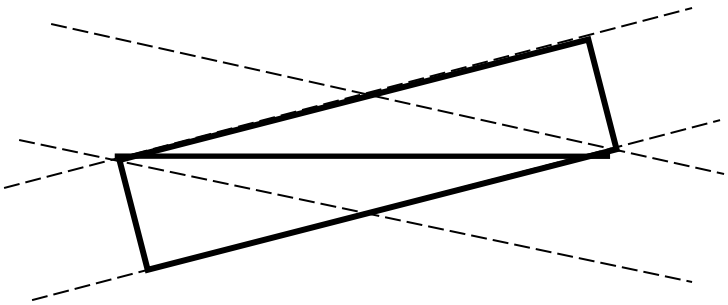
Draw a line segment using a ruler. Label the segment $\overline{XY}$. Fold your paper so that endpoint X falls directly on endpoint Y (holding your paper up to the light may help). Lay your paper flat and trace the fold line you just created with your pencil using a ruler.

#2 Using Only a Ruler

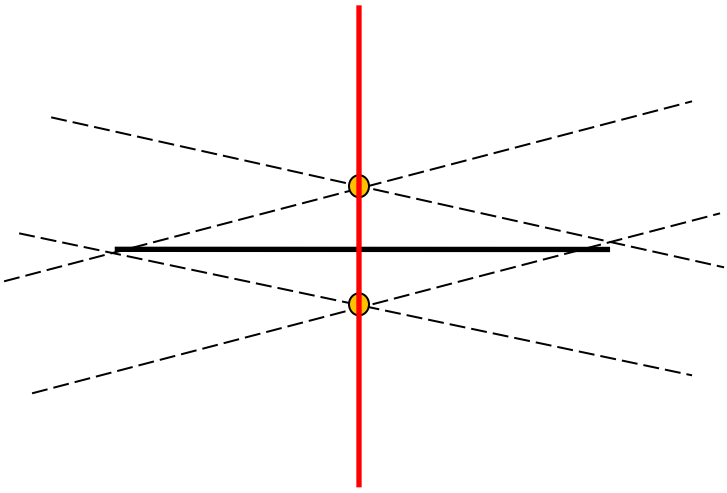
Draw a line segment. Place your ruler so that the bottom of your ruler touches the top of one endpoint and the top of your ruler touches the bottom of the other endpoint as shown in the picture. Draw a line along both edges.



Repeat in the opposite direction. Draw two more lines along both edges.



You will notice that you just created two new points. Draw a line through the center connecting these points.

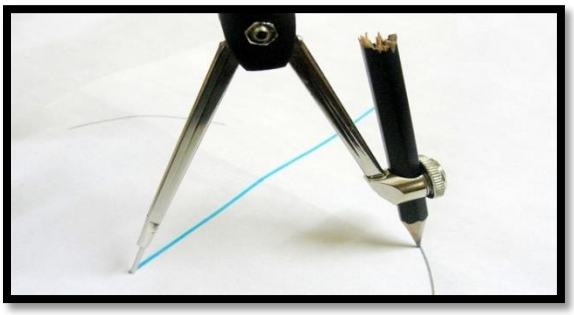


This new line is perpendicular to the original line (measure with a protractor to be sure). It also divides the original line in half. You can check this with a ruler.

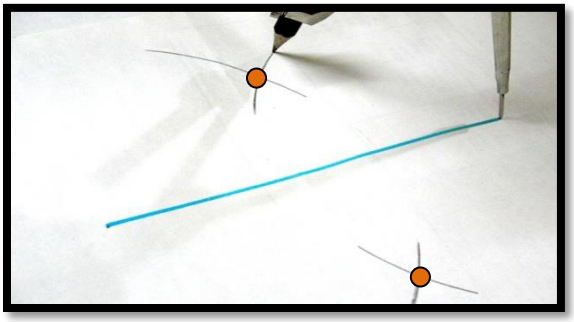
Try it!

#3 Using a Ruler and a Compass

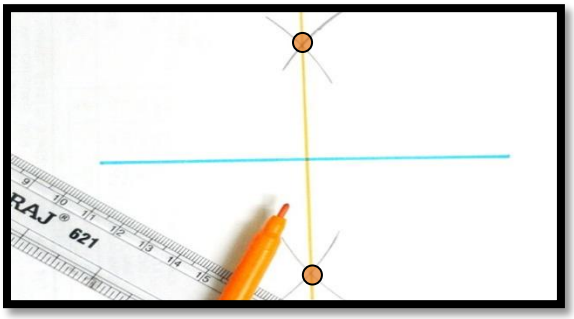
Draw a line segment and label it $\overline{EF}$. Place the pointer of your compass on one endpoint and move the compass so that it is open more than half the length of the line. Make an arc from the top to the bottom of the line.



Move your compass to the other endpoint and repeat.



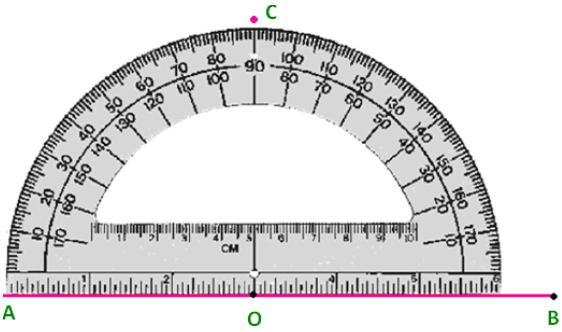
Connect the two points you just created.



Try It!!

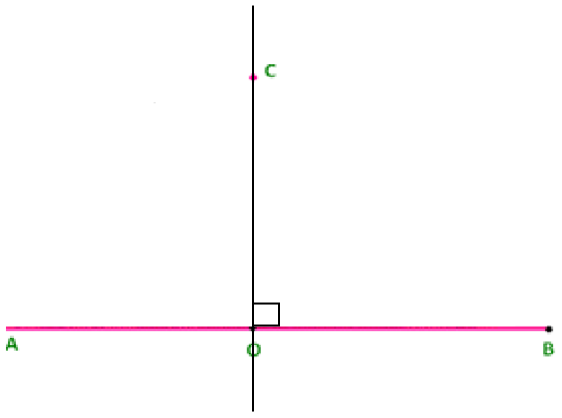
#4 Using a Ruler and a Protractor

Using a ruler, draw a line segment and label it $\overline{AB}$. Mark the midpoint as O.



Place the center of the protractor on the midpoint O and mark the 90°angle.

Using the ruler, draw a line connecting this mark to the midpoint of the line. Label this segment $\overline{OC}$.



Try It!!

Examples:

Draw a perpendicular bisector for a line that is:

12 cm

7.2 cm

What is an Angle Bisector?

An **angle bisector** is a line that divides an angle into two equal parts.

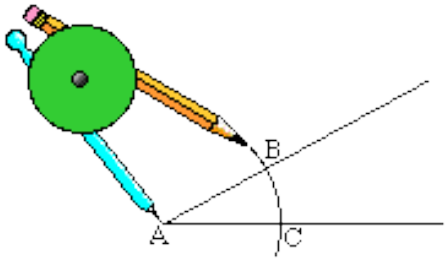
There are several ways to construct perpendicular bisectors.

#1 Paper Folding

Draw an angle of any size. Fold your paper so that one side of the angle falls directly on the other side. Lay your paper flat and trace the fold line you just created with your pencil using a ruler.

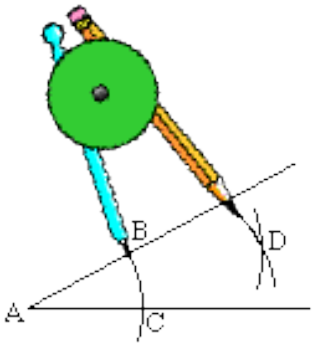
#2 Using a Ruler and a Compass

Draw an angle of any size. Place the pointer of your compass on vertex.

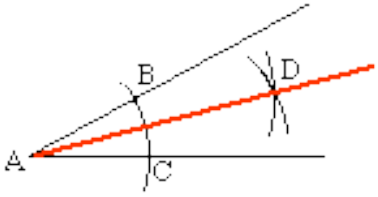


Make an arc from the top to the bottom of the line. Call these new points B and C.

Move your compass to point A where the arc you drew intersects the angle. Do the same with point C. You will notice a new point.



Draw a line connecting the vertex to the new point you just created.



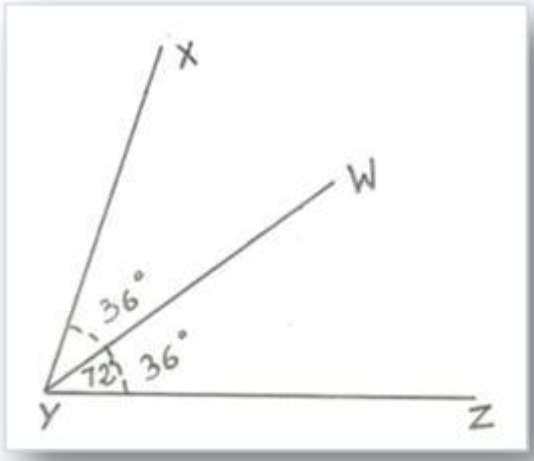
#4 Using a Ruler and a Protractor

Using a ruler, draw an angle of any size.

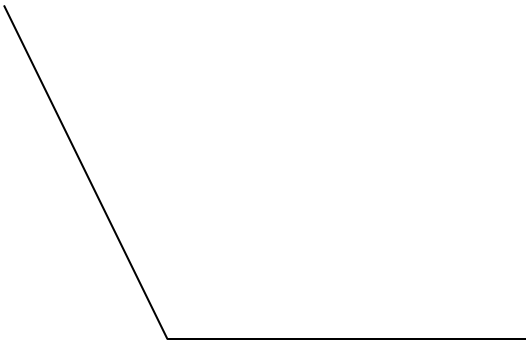
Using your protractor, measure the angle. Divide this measure by 2.

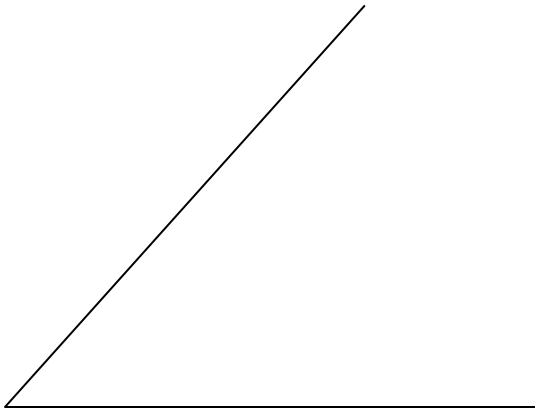
Keep your protractor on the vertex of the angle as you did to measure it, and mark the angle you just calculated.

Using the ruler, draw a line connecting the vertex to the point.



Examples: Bisect the angles below using any method.





Examples:

1. Draw an angle that is:

   a) 72^0 b) 108^0

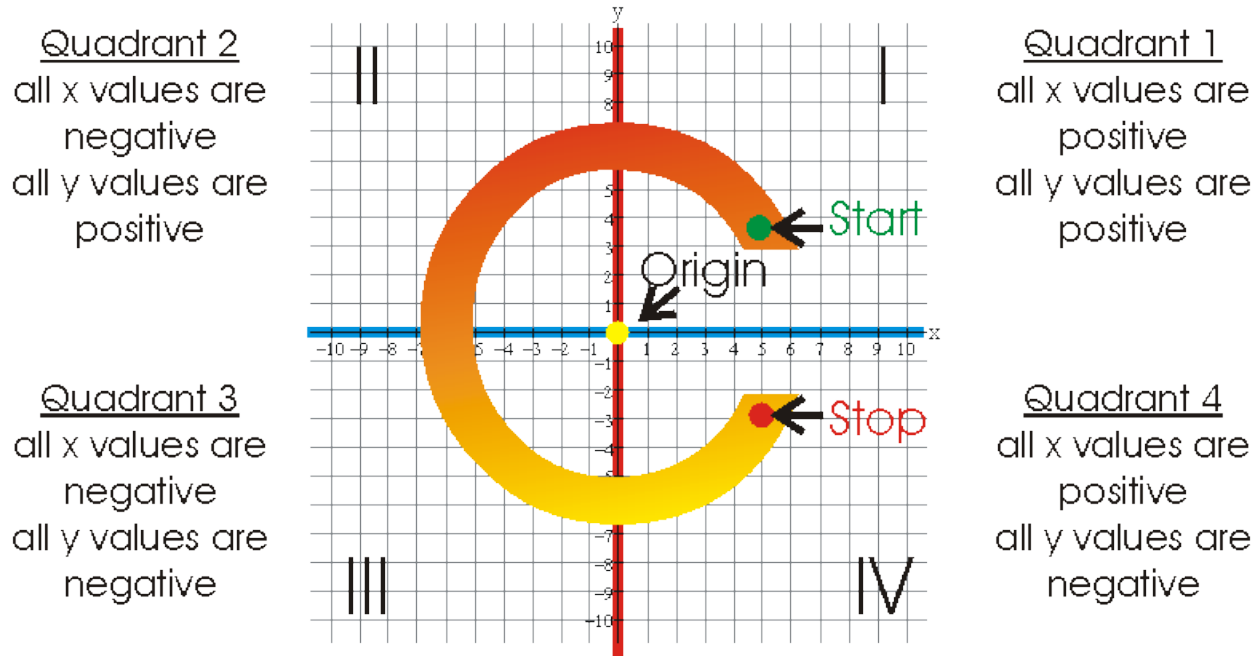
2. Draw a 96^0 angle. Bisect it using any method.

Section 8.5 – Graphing on a Coordinate Grid

A coordinate grid or plane consists of a vertical and a horizontal line that intersect at a 90^{o} angle.

The horizontal axis (left to right) is also known as the *x*-axis. The vertical axis (up and down) is also known as the *y*-axis. The point where the *x* and *y* axis intersect is called the origin. This is point (0,0).

Each coordinate grid is divided into 4 quadrants.



Every point on a coordinate grid has coordinates (*x,y*). Points are also known as ordered pairs. The first number represents number of spaces you move left or right. The second number represents the number of spaces you move up or down.

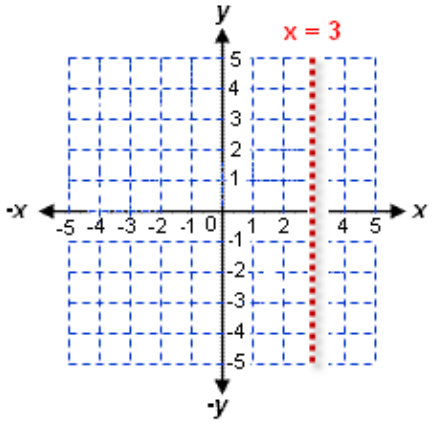
Always start at (0,0) and follow the directions of the coordinates.

To plot the point (3,4):

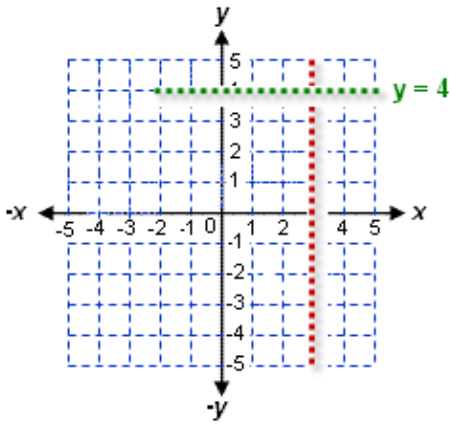
The first number is the *x* coordinate. We find this number on the *x* axis (left to right). In this case *x* = 3.

The second number is the *y* coordinate. We find this number on the *y* axis (up or down). In this case *y* = 4.

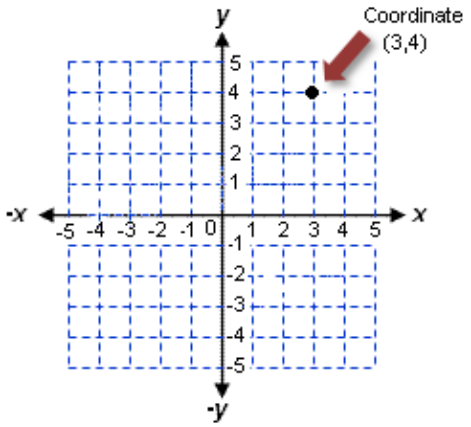
Where these lines intersect is where we plot our point.



Step 1: Find x = 3



Step 2: Find y = 4



Step 3: Plot a point where lines x = 3 and y = 4 intersect

Examples:

1. Plot the points and state the quadrant they are located in:

   A (2,5)

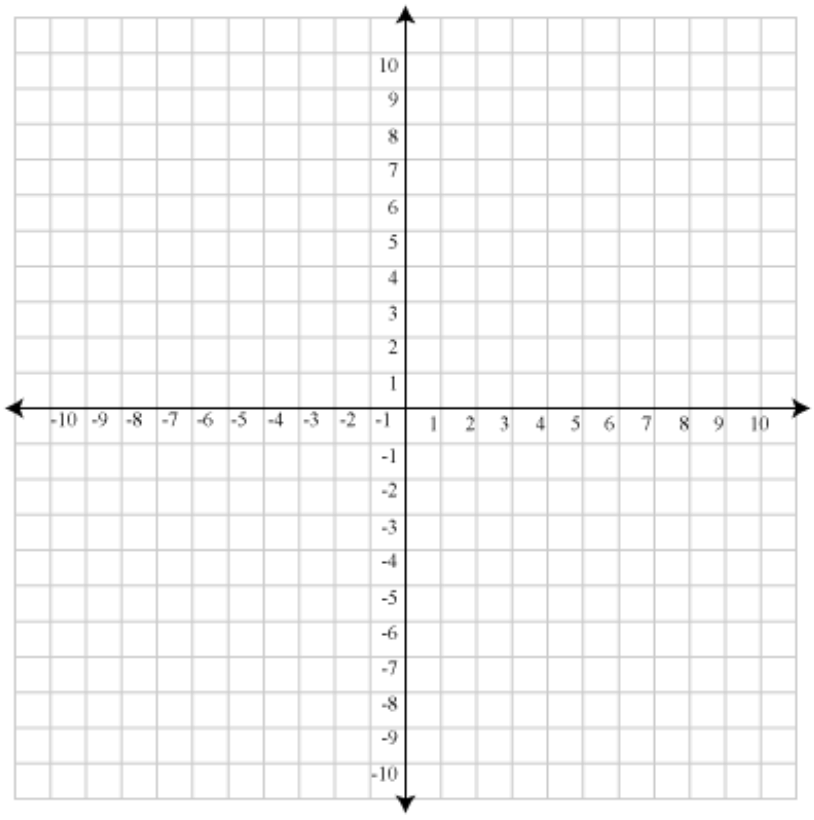
   B(-3, 1)

   C (0, 5)

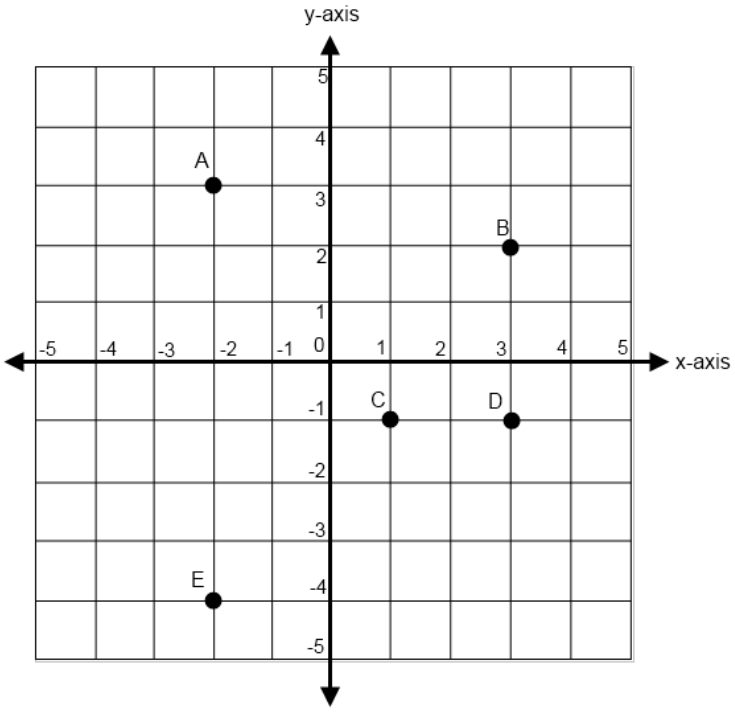
   D(-2,-6)

   E(-8,0)

   F (4,-6)



2. Write the coordinates of each point.



A _____

B _____

C _____

D _____

E _____

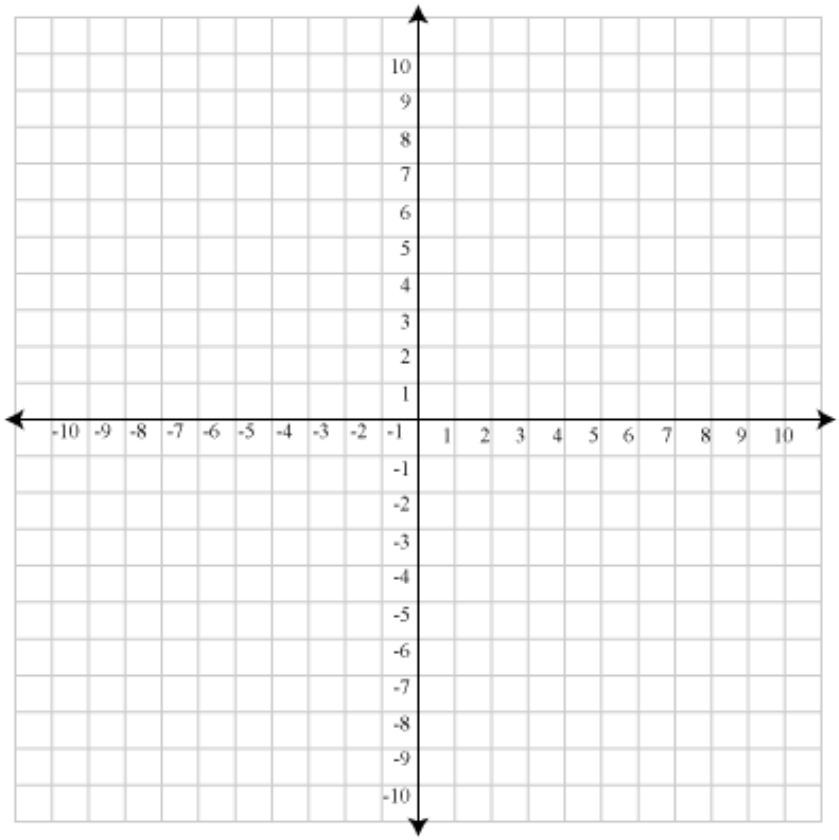
3. Plot the following:

L (-6, 1)

M (5, -2)

N (1, 7)

O (0, -4)

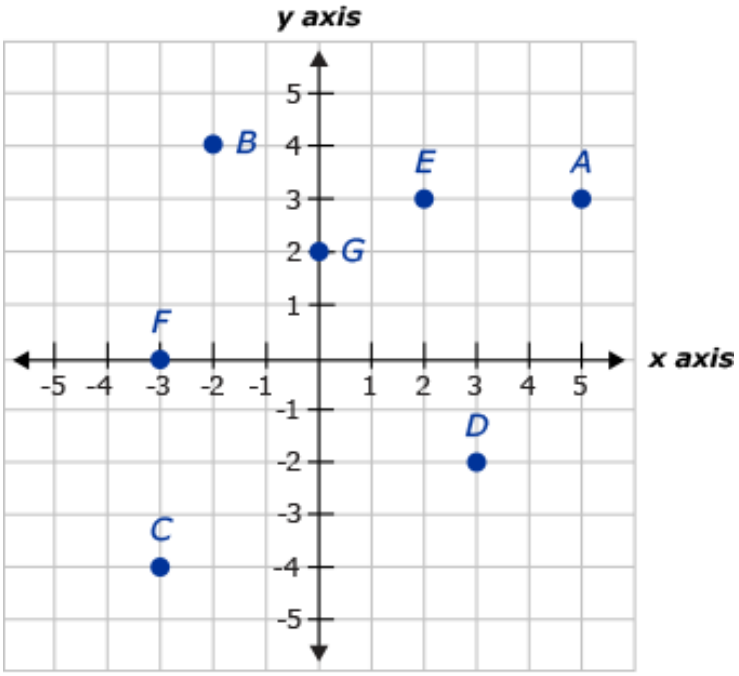


4. In which quadrant does each point lie?

A _____ D _____

B _____ E _____

C _____ F _____



5. In which quadrant does each point lie?

a) P (-3, 7) Quadrant _____

b) Q (8, -6) Quadrant _____

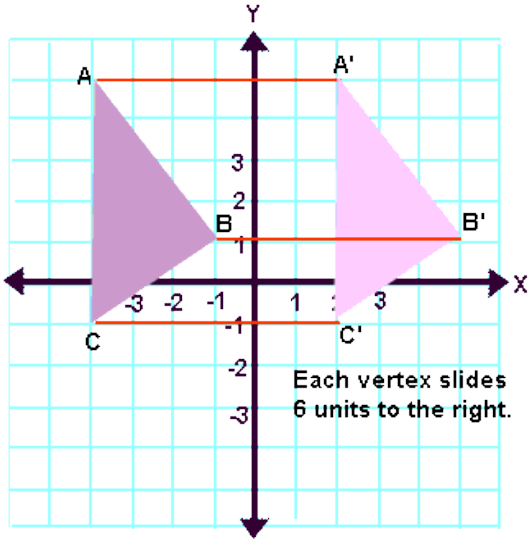
c) R (-5, -7) Quadrant _____

d) S (6, 4) Quadrant _____

Section 8.6 – Graphing Translations and Reflections

A **translation** is also known as a slide – it takes a figure and slides it to a new position. A translation tells you to move the object left or right, up or down. You take each figure and move it according to the directions.

For example, if we want to translate △ABC 6 units right, we simply move each vertex of the triangle 6 units to the right by counting 6 spaces on the grid.



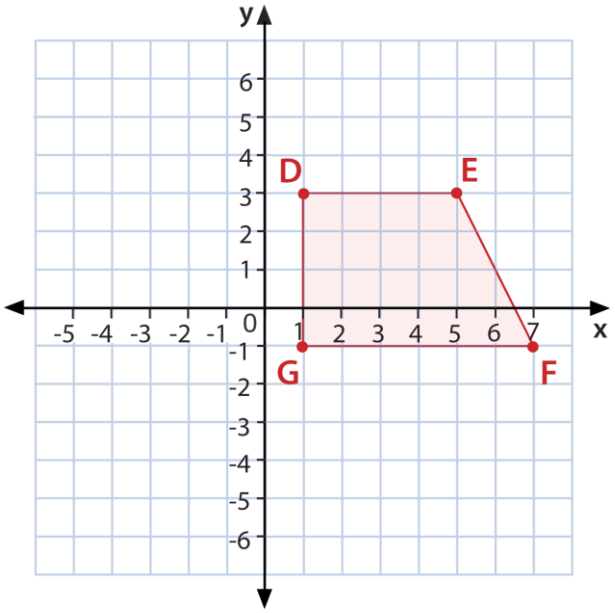
Each time we move a vertex, we indicate the new point with a **prime marking**. Here the new vertices are indicated as **A' B' C'.** The original object is the pre-image. The new object is called the image

Example:

Slide quadrilateral DEFG

4 units left and 3 units down or [4L, 3D]

Give the coordinates of the new vertices.



D' _____

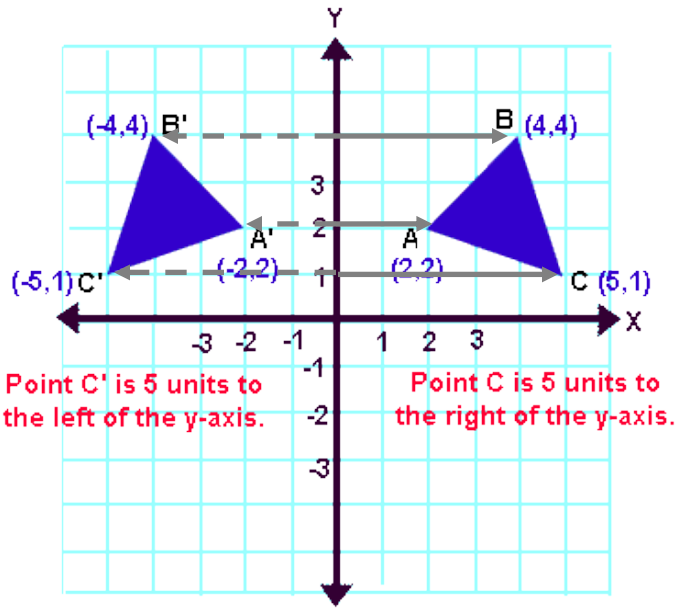
E' _____

F' _____

G' _____

A **reflection** is also known as a flip – it produces a mirror image when reflected across the **line of reflection** which could be the ***x*** or ***y* axis** or another indicated line. The object will fall directly on top of itself if you fold it along the line of reflection.

For example, if we want to reflect △ABC across the *y* axis we count the number of spaces from each vertex to the *y* axis. We then count the same number of spaces from the *y* axis on the other side and plot our new point.



Example:

Reflect triangle ABC

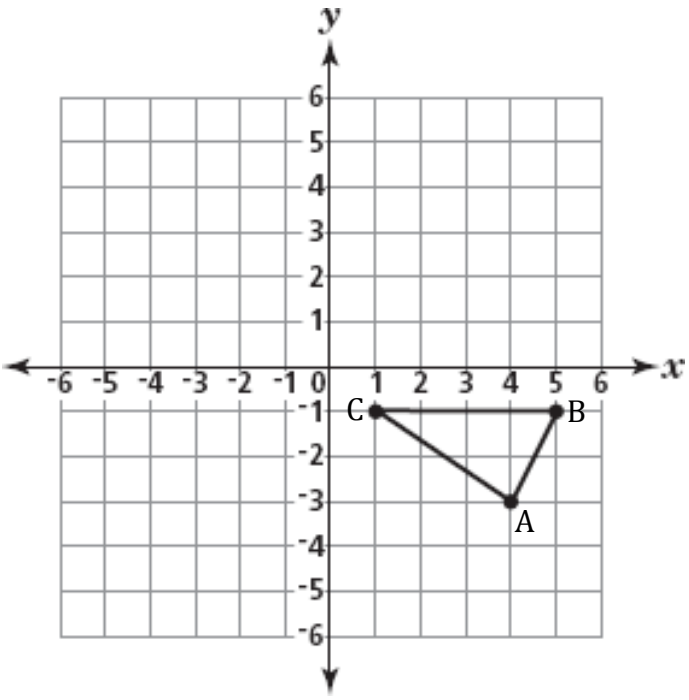
across the *x* axis.

Give the coordinates of the new vertices.

A' _____

B' _____

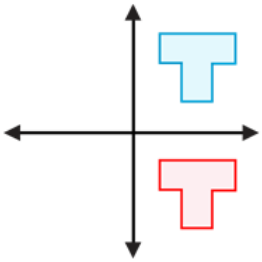
C' _____



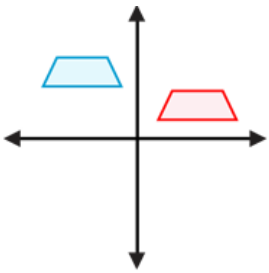
Examples:

1. Describe the transformations below:

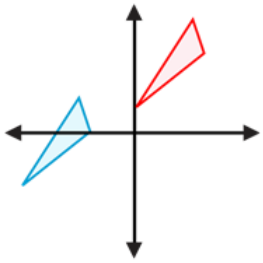
A)



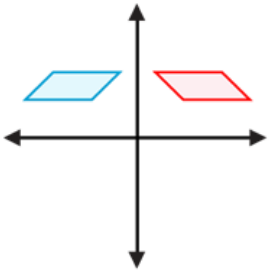
B)



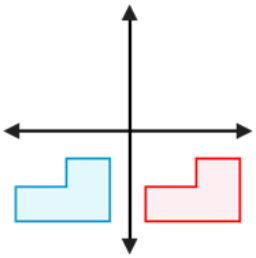
C)



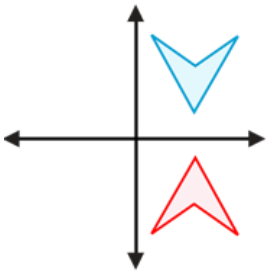
D)



E)

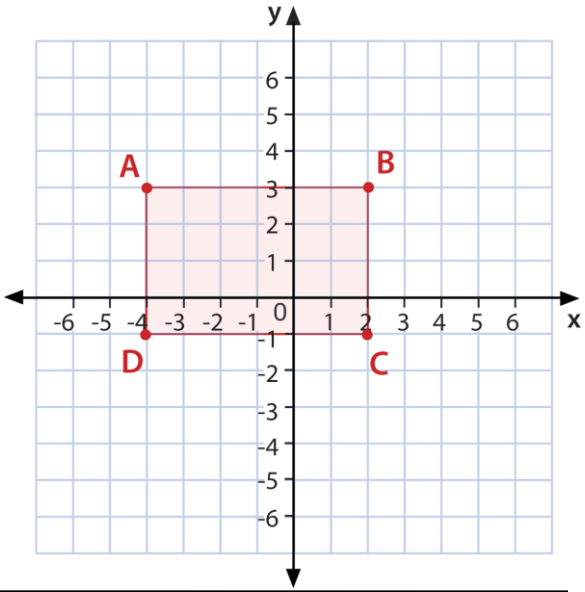


F)



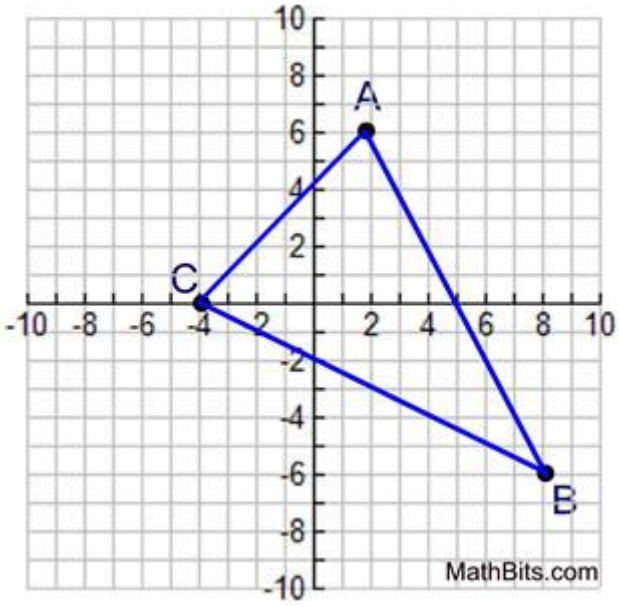
2. Translate the rectangle ABCD [5R, 5D]

   List the coordinates of the pre-image and the image.



3. Reflect the triangle across the *x* axis.

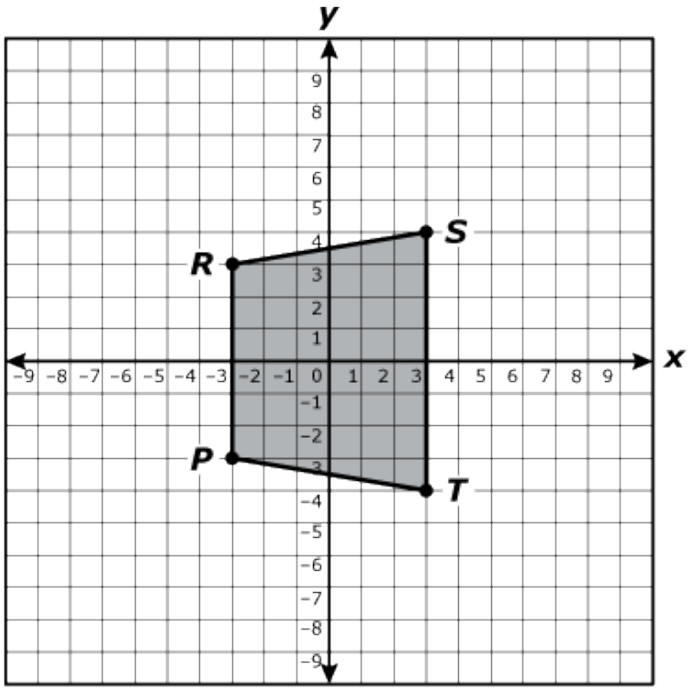
   List the coordinates of the pre-image and the image.



4. Translate the figure 5 left and 5 down.

   Reflect your image across the *x* axis.

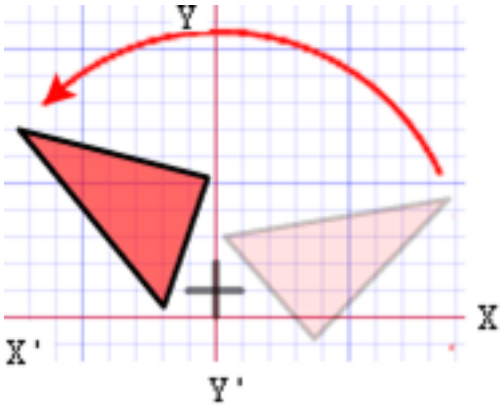
   Record the coordinates of the figure after each transformation.



Section 8.7 – Graphing Rotations

A **rotation** is also known as a turn – it takes a figure and rotates it around a given point. A rotation tells you to move the figure clockwise or counterclockwise 90°, 180° or 270°.

For example, the triangle to the right has been rotated 90° counterclockwise around the point indicated. We can use tracing paper to do this.



Example:

Rotate the figure to the right 180° clockwise.

List the coordinates of the new vertices.

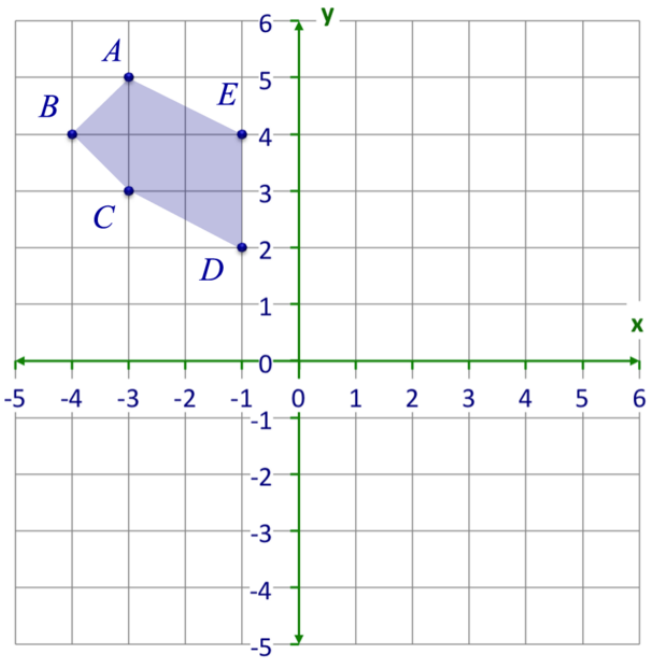
A' _____

B' _____

C' _____

D' _____

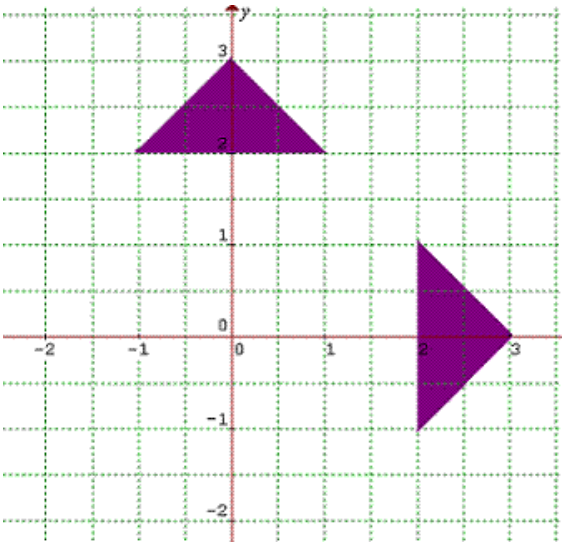
E' _____



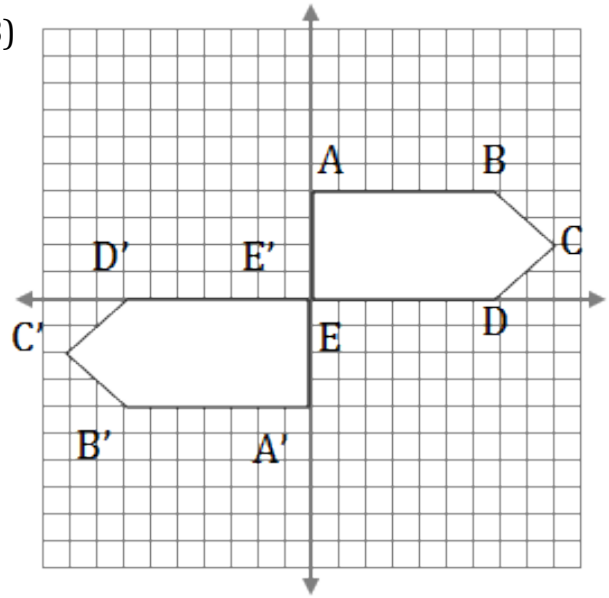
Examples:

1. Identify the angle and direction of rotation for each diagram below.

A)



B)



2. Rotate the figure 270^{o} counterclockwise.

   List the coordinates of the image.