Unit 4: Coordinate Grids and Geometry

This unit extends the knowledge of coordinate grids through plotting, transformations of images on a grid, and graphing and solving linear equations.

Unit Focus

Number Sense, Concepts, and Operations

- Understand concrete and symbolic representations of real numbers in real-world situations. (MA.A.1.4.3)
- Understand and use the real number system. (MA.A.2.4.2)
- Add, subtract, multiply, and divide real numbers, including square roots and exponents, using appropriate methods of computing, such as mental mathematics, paper and pencil, and calculator. (MA.A.3.4.3)
- Use estimation strategies in complex situations to predict results and to check the reasonableness of results. (MA.A.4.4.1)

Measurement

- Solve real-world problems involving rated measures (miles per hour, feet per second). (MA.B.2.4.2)
- Solve real-world and mathematical problems involving estimates of measurements, including length, time, weight/mass, temperature, money, perimeter, area, and volume and estimate the effects of measurement errors on calculations. (MA.B.3.4.1)

Geometry and Spatial Sense

- Understand geometric concepts such as perpendicularity, parallelism, congruency, similarity, and symmetry. (MA.C.2.4.1)

- Using a rectangular coordinate system (graph), apply and algebraically verify properties of two-dimensional figures, including distance, midpoint, slope, parallelism, and perpendicularity. (MA.C.3.4.2)

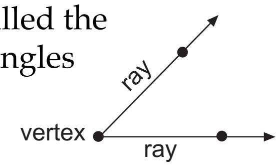
Algebraic Thinking

- Describe, analyze, and generalize relationships, patterns, and functions using words, symbols, variables, tables, and graphs. (MA.D.1.4.1)
- Represent real-world problem situations using finite graphs. (MA.D.2.4.1)
- Use equations and inequalities to solve real-world problems graphically and algebraically. (MA.D.2.4.2)

Vocabulary

Use the vocabulary words and definitions below as a reference for this unit.

angle (∠) .... two rays extending from a common endpoint called the vertex; measures of angles are described in degrees (°)



axes (of a graph) .... the horizontal and vertical number lines used in a coordinate plane system; (singular: *axis*)

bisect .... to cut or divide into two equal parts

coefficient .... the number part in front of an algebraic term signifying multiplication
Example: In the expression $8x^2 + 3xy - x$,

- the coefficient of x^2 is 8 (because $8x^2$ means $8 \bullet x^2$)
- the coefficient of xy is 3 (because $3xy$ means $3 \bullet xy$)
- the coefficient of $-x$ is 1 (because $-1 \bullet x = -x$).

In general algebraic expressions, coefficients are represented by letters that may stand for numbers. In the expression $ax^2 + bx + c = 0$, a, b, and c are coefficients, which can take any number.

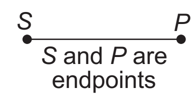
coordinate grid or plane .... a two-dimensional network of horizontal and vertical lines that are parallel and evenly-spaced; especially designed for locating points, displaying data, or drawing maps

coordinate plane .... the plane containing the x- and y-axes

coordinates .... numbers that correspond to points on a coordinate plane in the form (x, y), or a number that corresponds to a point on a number line

degree (°) .... common unit used in measuring angles

endpoint .... either of two points marking the end of a line segment



equation .... a mathematical sentence in which two expressions are connected by an equality symbol
Example: $2x = 10$

equidistant .... equally distant

flip .... see *reflection*

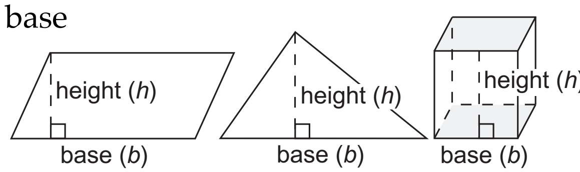
formula .... a way of expressing a relationship using variables or symbols that represent numbers

graph .... a drawing used to represent data
Example: bar graphs, double bar graphs, circle graphs, and line graphs

graph of an equation .... all points whose coordinates are solutions of an equation

graph of a point .... the point assigned to an ordered pair on a coordinate plane

height (*h*) .... a line segment extending from the vertex or *apex* (highest point) of a figure to its base and forming a right angle with the base or plane that contains the base



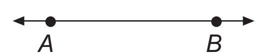
infinite .... having no boundaries or limits

intersect .... to meet or cross at one point

intersection .... the point at which lines or curves meet; the line where planes meet

length (*l*) .... a one-dimensional measure that is the measurable property of line segments

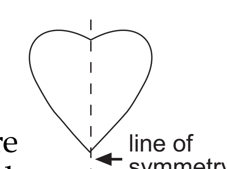
line (↔) .... a collection of an infinite number of points in a straight pathway with unlimited length and having no width



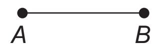
linear equation .... an algebraic equation in which the variable quantity or quantities are raised to the zero power or first power and the graph is a straight line
Example: $20 = 2(w + 4) + 2w$; $y = 3x + 4$

line of reflection .... the line over which a figure is flipped in a reflection; also called a *flipline*

line of symmetry .... a line that divides a figure into two congruent halves that are mirror images of each other



line segment (—) .... a portion of a line that consists of two defined endpoints and all the points in between



Example: The line segment *AB* is between point *A* and point *B* and includes point *A* and point *B*.

measure (m) of an angle (∠) .... the number of degrees (°) of an angle

negative numbers .... numbers less than zero

ordered pair .... the location of a single point on a rectangular coordinate system where the first and second values represent the position relative to the *x*-axis and *y*-axis, respectively
Example: (*x*, *y*) or (3, -4)

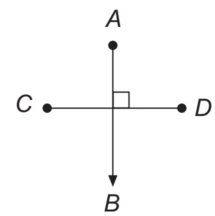
origin .... the point of intersection of the *x*- and *y*-axes in a rectangular coordinate system, where the *x*-coordinate and *y*-coordinate are both zero (0)

parallel (||) .... being an equal distance at every point so as to never intersect

pattern (relationship) .... a predictable or prescribed sequence of numbers, objects, etc.; may be described or presented using manipulatives, tables, graphics (pictures or drawings), or algebraic rules (functions)
Example: 2, 5, 8, 11 … is a pattern. Each number in this sequence is three more than the preceding number. Any number in this sequence can be described by the algebraic rule, $3n - 1$, using the set of counting numbers for *n*.

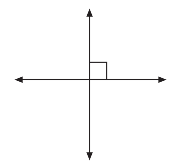
perimeter (*P*) .... the distance around a polygon

perpendicular (⊥) .... two lines, two line segments, or two planes that intersect to form a right angle



$\overrightarrow{AB}$ is a perpendicular bisector of $\overline{CD}$

perpendicular bisector (of a segment) .... a line that divides a line segment in half and meets the segment at right angles



perpendicular lines....................... two lines that intersect to form right angles

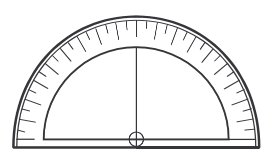
plane .... an infinite, two-dimensional geometric surface defined by three non-linear points or two distinct parallel or intersecting lines

point .... a specific location in space that has no discernable length or width

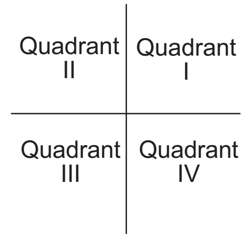
positive numbers .... numbers greater than zero

product .... the result of multiplying numbers together
Example: In 6 x 8 = 48,
48 is the product.

protractor .... an instrument used for measuring and drawing angles



quadrant .... any of four regions formed by the axes in a rectangular coordinate system



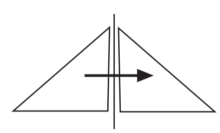
quotient .... the result of dividing two numbers
Example: In $42 \div 7 = 6$, 6 is the quotient.

rate of change .... how a quantity is changing over time

ratio .... the comparison of two quantities
Example: The ratio of a and b is a:b or $\frac{a}{b}$, where $b \neq 0$.

ray (→) .... a portion of a line that begins at an endpoint and goes on indefinitely in one direction

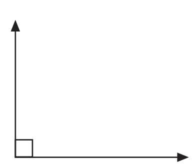
reflection .... a transformation that produces the mirror image of a geometric figure over a line of reflection; also called a *flip*



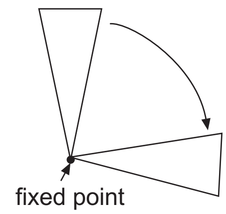
reflectional symmetry .... when a figure has at least one line which splits the image in half, such that each half is the mirror image or reflection of the other; also called *line symmetry* or *mirror symmetry*

relationship (relation) .... see *pattern*

right angle .... an angle whose measure is exactly 90°

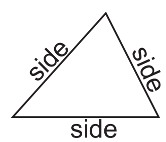


rotation .... a transformation of a figure by turning it about a center point or axis; also called a *turn*
Example: The amount of rotation is usually expressed in the number of degrees, such as a 90° rotation.

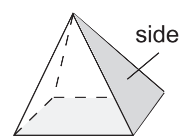


rotational symmetry .... when a figure can be turned less than 360 degrees about its center point to a position that appears the same as the original position; also called *turn symmetry*

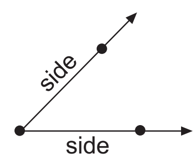
side .... the edge of a polygon, the face of a polyhedron, or one of the rays that make up an angle
Example: A triangle has three sides.



edge of a polygon



face of a polyhedron



ray of an angle

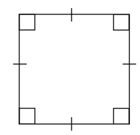
slide .... see *translation*

slope .... the ratio of change in the vertical axis (y-axis) to each unit change in the horizontal axis (x-axis) in the form $\frac{\text{rise}}{\text{run}}$ or $\frac{\Delta y}{\Delta x}$; the constant, m, in the linear equation for the slope-intercept form $y = mx + b$

solution .... any value for a variable that makes an equation or inequality a true statement
Example: In $y = 8 + 9$
$y = 17$ 17 is the solution.

solve .... to find all numbers that make an equation or inequality true

square .... a rectangle with four sides the same length



substitute .... to replace a variable with a numeral
Example: $8(a) + 3$
$8(5) + 3$

symmetry .... a term describing the result of a line drawn through the center of a figure such that the two halves of the figure are reflections of each other across the line

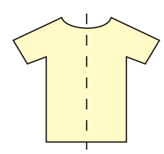
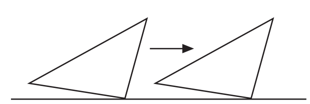


table (or chart) .... a data display that organizes information about a topic into categories

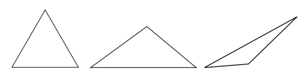
transformation .... an operation on a geometric figure by which another image is created
Example: Common transformations include reflections (flips), translations (slides), rotations (turns), and dilations.

translation .... a transformation in which every point in a figure is moved in the same direction and by the same distance; also called a *slide*



translational symmetry .... when a figure can slide on a plane (or flat surface) without turning or flipping and with opposite sides staying congruent

triangle .... a polygon with three sides; the sum of the measures of the angles is 180°

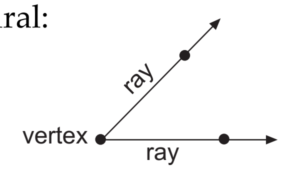


turn .... see *rotation*

value (of a variable) .... any of the numbers represented by the variable

variable .... any symbol, usually a letter, which could represent a number

vertex .... the point common to the two rays that form an angle; the point common to any two sides of a polygon; the point common to three or more edges of a polyhedron; (plural: *vertices*); vertices are named clockwise or counterclockwise



***x*-axis** .... the horizontal number line on a rectangular coordinate system

***x*-coordinate** .... the first number of an ordered pair

***x*-intercept** .... the value of x at the point where a line or graph intersects the x-axis; the value of y is zero (0) at this point

***y*-axis** .... the vertical number line on a rectangular coordinate system

***y*-coordinate** .... the second number of an ordered pair

***y*-intercept** .... the value of y at the point where a line or graph intersects the y-axis; the value of x is zero (0) at this point

Unit 4: Coordinate Grids and Geometry

Introduction

Geometry provides opportunities to draw and build models, to sort and classify, to conjecture and test, and to improve spatial visualization and reasoning skills. It can increase our appreciation of the physical world and our ability to function in it. As you work through this unit, think about ways you can apply these skills to solve real-world problems graphically and algebraically.

Lesson One Purpose

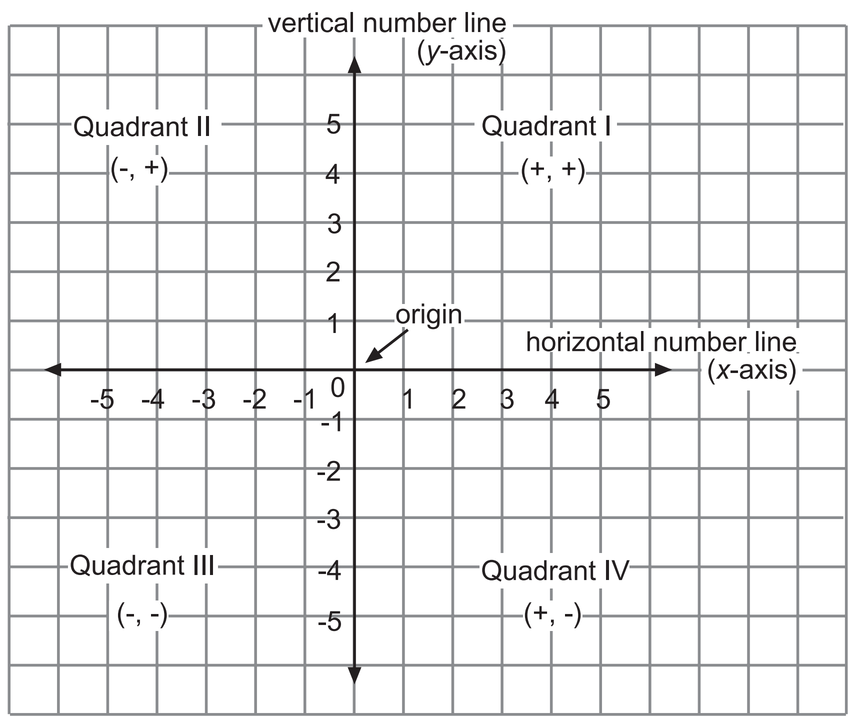
- Understand concrete and symbolic representations of real numbers in real-world situations. (MA.A.1.4.3)
- Understand and use the real number system. (MA.A.2.4.2)
- Understand geometric concepts such as perpendicularity, parallelism, congruency, similarity, and symmetry. (MA.C.2.4.1)
- Using a rectangular coordinate system (graph), apply and algebraically verify properties of two-dimensional figures, including distance, midpoint, slope, parallelism, and perpendicularity. (MA.C.3.4.2)
- Describe, analyze, and generalize relationships, patterns, and functions using words, symbols, variables, tables, and graphs. (MA.D.1.4.1)
- Represent real-world problem situations using finite graphs. (MA.D.2.4.1)
- Use equations and inequalities to solve real-world problems graphically and algebraically. (MA.D.2.4.2)

Graphing on the Coordinate Plane

Think about This!

A **coordinate plane** is a **plane** containing both the ***x*-axis** and ***y*-axis**. A *plane* is a flat surface with no boundaries. When drawing a *coordinate plane*, the **coordinate grid or plane** will have a horizontal (⟷) **axis** that is usually referred to as the *x-axis* and a vertical (↕) axis that is usually referred to as the *y-axis* (see below).

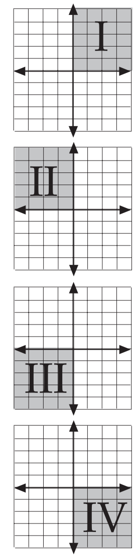
The point at which the *axes* **intersect** is known as the **origin**. The **coordinates** of the *origin* are (0, 0). The two axes at that **intersection** form four regions or **quadrants**. However, the origin and the axes are *not* in any *quadrant*.



coordinate grid or system

The Four Quadrants

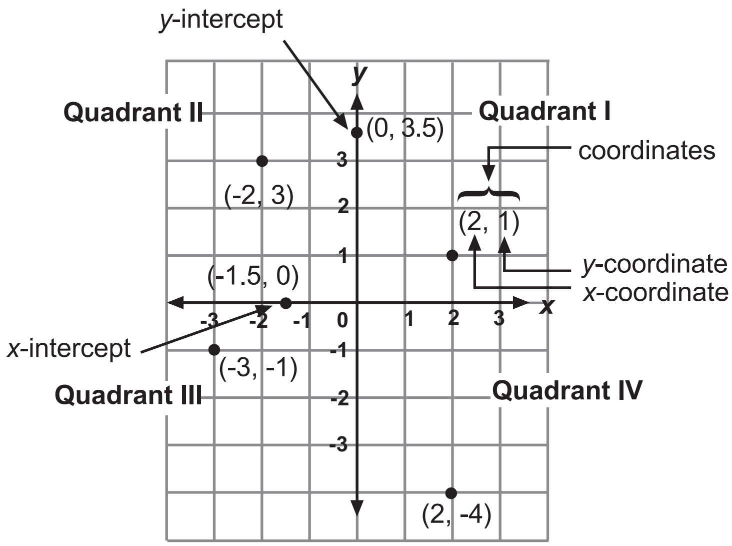
Each **point** on the *coordinate grid* has a *coordinate* pair (*x*, *y*), also known as the **ordered pair**.



- If both coordinates are **positive numbers**, such as (2, 1), the *point* is in Quadrant I.
- If the first coordinate, the ***x*-coordinate**, is a **negative number** (-2) and the second coordinate, the ***y*-coordinate**, is a *positive number* (3), the point is in Quadrant II.
- If both coordinates are *negative numbers* (-3, -1), the point is in Quadrant III.
- If the first coordinate, the *x-coordinate*, is a *positive number* (2) and the second coordinate, the *y-coordinate* is a *negative number* (-4), the point is in Quadrant IV.

The *x*-Intercept and *y*-Intercept

- If the second coordinate, the *y*-coordinate, is zero, the *point* is on the *x*-axis and is called the ***x*-intercept** (-1.5, 0).
- If the first coordinate, the *x*-coordinate, is zero, the *point* is on the *y*-axis and is called the ***y*-intercept** (0, 3.5).

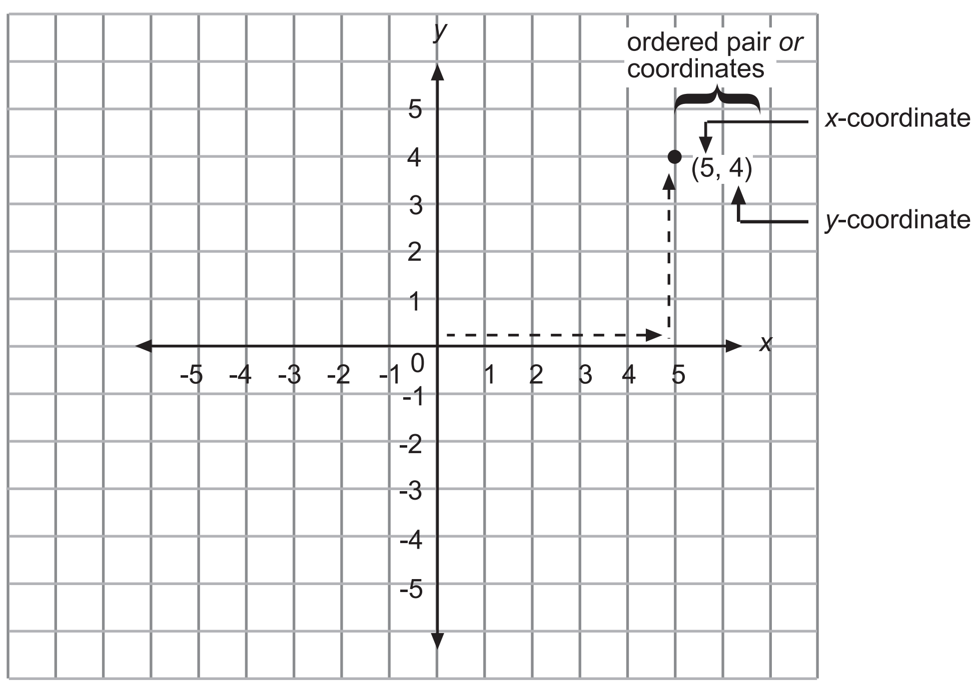


coordinate grid or system

Locating Points

To locate *ordered pairs* or coordinates such as (5, 4) on a coordinate grid or plane, do the following.

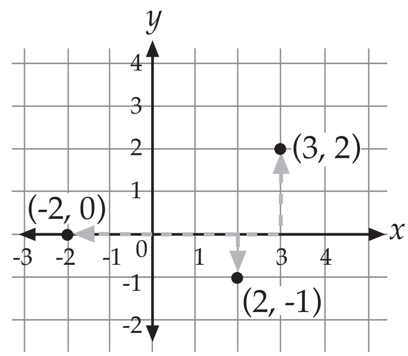
- Start at the origin (0, 0) of the grid.
- Locate the first number of the ordered pair or the *x*-coordinate on the *x*-axis (⟷). The first number tells us whether to move left or right from the origin. If the number is *positive* we move *right*. If the number is *negative* we move *left*.
- Then move **parallel (||)** to the *y*-axis and locate the second number of the ordered pair or the *y*-coordinate on the *y*-axis (↕) and draw a point. The second number tells us whether to move up or down. If the number is *positive* we move *up*. If the number is *negative* we move *down*.



locating ordered pairs

Study how to plot or draw a **graph of a point** named by ordered pairs on a coordinate plane.

Graph (3, 2). Then graph (2, -1) and (-2, 0).



Start at the origin.

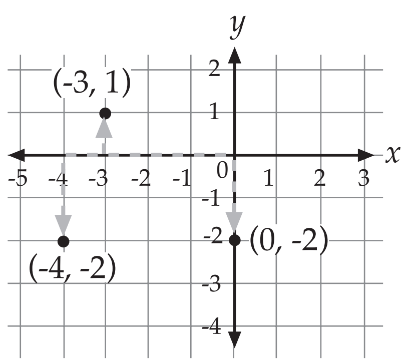
x-coordinate — *y*-coordinate

(3, 2): right 3, up 2

(2, -1): right 2, down 1

(-2, 0): left 2, do *not* move up or down

Graph (-3, 1). Then graph (-4, -2) and (0, -2).



Start at the origin.

x-coordinate — *y*-coordinate

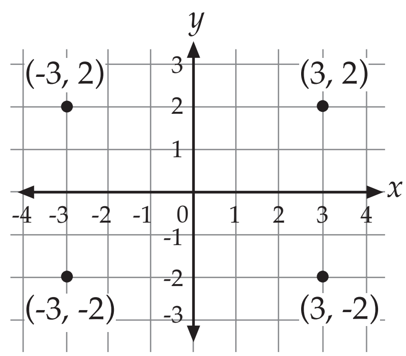
(-3, 1): left 3, up 1

(-4, -2): left 4, down 2

(0, -2): do *not* move left or right, down 2

Notice how the signs of the coordinates tell us which directions we should move from the origin.

(3, 2)	(-3, 2)	(-3, -2)	(3, -2)
(+, +)	(- , +)	(- , -)	(+, -)
(right, up)	(left, up)	(left, down)	(right, down)



Note that the point (0, 0) is the origin.

Practice

Use the list below to write the correct term for each definition on the line provided.

axes (of a graph)	**ordered pair**
coordinate grid or plane	**origin**
coordinates	***x*-axis**
intersect	***y*-axis**

________________________ 1. the location of a single point on a rectangular coordinate system where the first and second values represent the position relative to the x-axis and y-axis, respectively

________________________ 2. numbers that correspond to points on a coordinate plane in the form (x, y)

________________________ 3. the vertical number line on a rectangular coordinate system

________________________ 4. the horizontal and vertical number lines used in a coordinate grid plane

________________________ 5. the point of intersection of x- and y-axes in a rectangular coordinate system, where the x-coordinate and y-coordinate are both zero (0)

________________________ 6. to meet or cross at one point

________________________ 7. a two-dimensional network of horizontal and vertical lines that are parallel and evenly-spaced

________________________ 8. the horizontal number line on a rectangular coordinate system

Practice

Match each definition with the correct term. Write the letter on the line provided.

_______ 1. the point assigned to an ordered pair on a coordinate plane

_______ 2. numbers less than zero

_______ 3. any of four regions formed by the axes in a rectangular coordinate system

_______ 4. the first number of an ordered pair

_______ 5. the second number of an ordered pair

_______ 6. the value of y at the point where a line or graph intersect the x-axis; the value of x is zero (0) at this point

_______ 7. the plane containing the x- and y-axes

_______ 8. being an equal distance at every point so as to never intersect

_______ 9. the value of x at the point where a line or graph intersect the y-axis; the value of y is zero (0) at this point

_______ 10. the point at which lines or curves meet

_______ 11. numbers greater than zero

A. coordinate plane

B. graph of a point

C. intersection

D. negative numbers

E. parallel (||)

F. positive numbers

G. quadrant

H. x-coordinate

I. x-intercept

J. y-coordinate

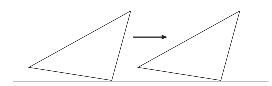
K. y-intercept

Transformations

People sometimes create new geometric figures by moving a figure according to a set of rules. When each point on the original figure can be paired with exactly one point on the new figure, and vice versa, a **transformation** results. The new figure is called the *image*.

Transformations include **translations** or **slides**, **rotations** or **turns**, and **reflections** or **flips**.

Translations or Slides

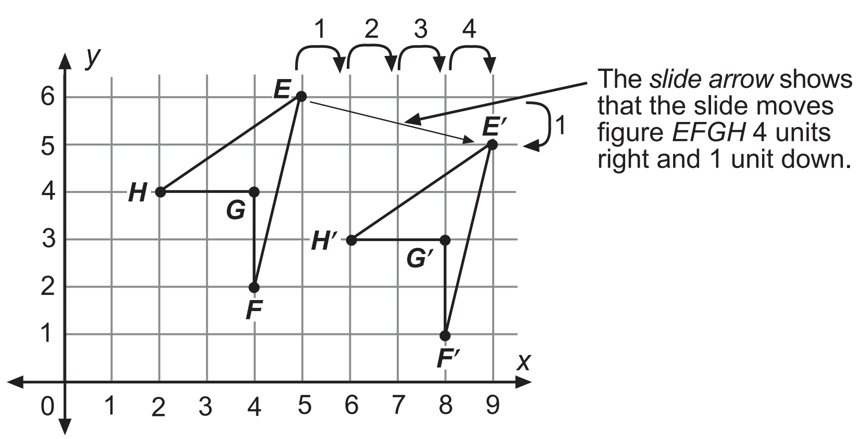


If you draw a figure on a piece of paper and slide it a certain distance in a certain direction, you have modeled a *translation*, or *slide*. If you move it again the same distance and in the same direction, you continue the translation. The distance and direction define the slide. When you use a *coordinate grid*, an *ordered pair* provides this information.

Example: You can slide a figure by moving it along a surface. The slide may be in a vertical (↕), horizontal (↔), or diagonal (↘) direction.

In a translation or slide, every point in the figure slides the *same distance* and in the *same direction*. Use a *slide arrow* to show the direction of the movement. The slide arrow has its **endpoint** on one point of the first figure and its arrow on the corresponding point in the second figure.

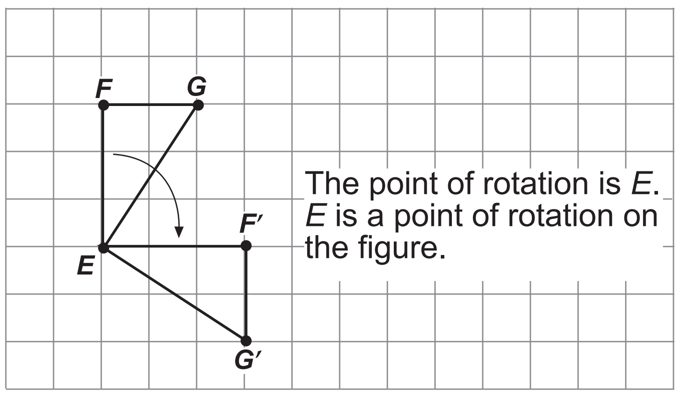
The figure to be moved is labeled with letters *EFGH*. It has moved 4 units to the right and 1 unit down. The transformed image (the second figure) is labeled with the same letters and a prime sign (‘). You read the second figure *E* prime, *F* prime, *G* prime, *H* prime.

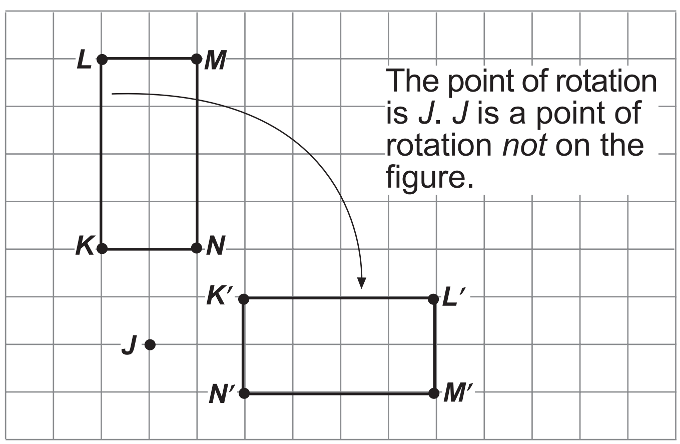


Rotations or Turns

Draw a **triangle** on a sheet of paper, then place a dot or point on the paper. Using your pen or pencil, rotate the page about the *point*. You are modeling a *rotation or turn*. Points in the original figure turn a specific number of **degrees (°)** about a *fixed* center point. The center of rotation, the direction of rotation (clockwise or counterclockwise), and the number of *degrees* define a rotation.

Examples: You can rotate a figure by turning the figure around a point. The point can be on the figure, or it can be some other point. This point is called the *turn center* or *point of rotation*.

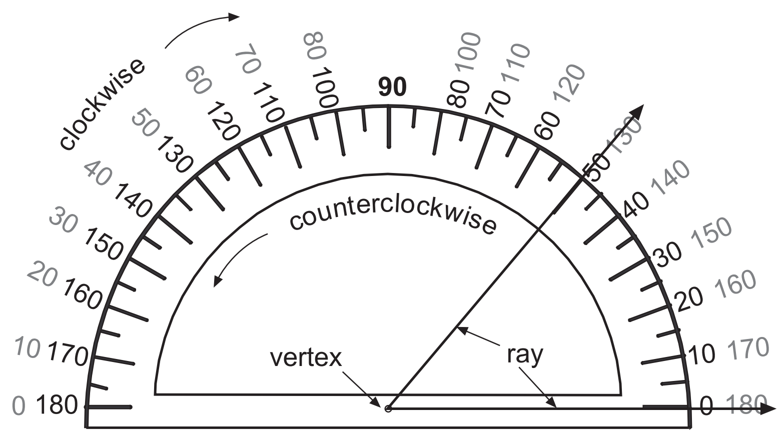




Measuring Degree of Rotation around a Point

Figures can be *rotated* around a point. The rotation leaves the figure looking exactly the same. Use a **protractor** to measure the **angle (∠)** of rotation.

Look at the figure below to remind yourself how *protractors* measure *angles*. You can see that protractors are marked from 0 to 180 degrees in a clockwise manner, as well as a counterclockwise manner. Notice that 10 and 170 are in the same position. The 55 and 125 are also in the same position.



Whether you are using a protractor to find the **measure (m) of an angle (∠)** or to measure the degree of rotation around a point, you use similar strategies. To measure the degree of rotation around a point, do the following.

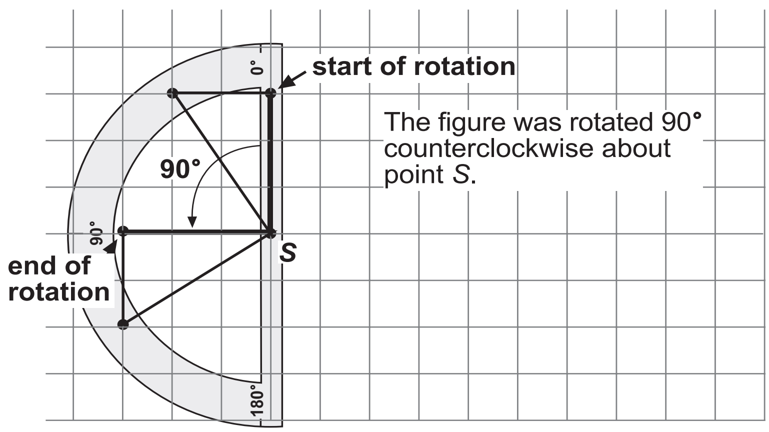
- Place the center of the protractor on the point of the rotation.
- Line up the 0 degree mark with the start of the rotation.
- Use a straightedge to extend the line for easier reading of the measure.
- Rotate the figure and mark the place the rotated figure (the new image) matches the original figure.
- Extend the line with a straightedge and note the degree on the protractor.

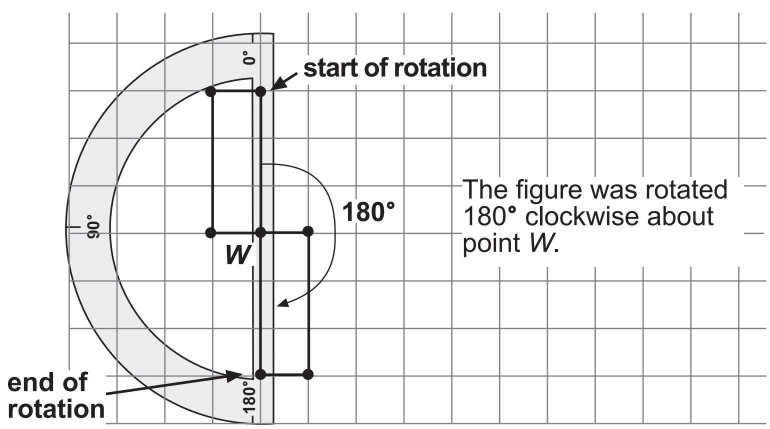
The point of rotation represents the **vertex** of the angle. The *vertex* is the common *endpoint* from which the two **rays (→)** begin. The *ray* through

0 degrees lines up with a point on the original figure. The ray through its corresponding point on the image passes through the measure of the *angle of rotation*.

Note that the measure of the angle of rotation for the first figure below is 90 degrees, and the second figure below is 180 degrees.

When you rotate a figure, you can describe the rotation. Tell the direction (clockwise or counterclockwise) and the angle that the figure is rotated around the point of rotation. The amount of rotation is expressed in the number of degrees it was rotated from its starting point.





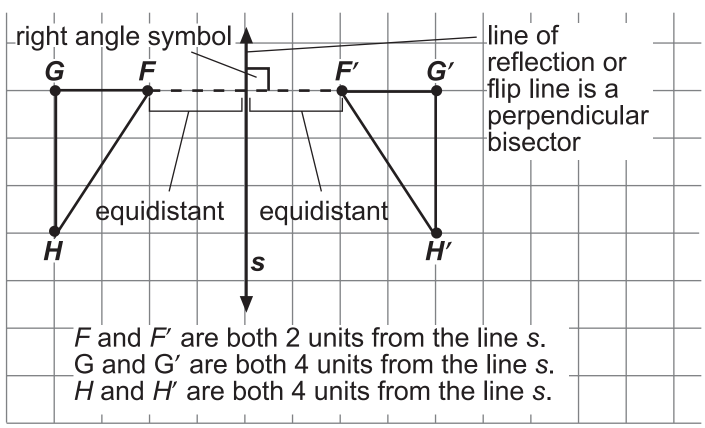
Reflections or Flips

When you draw a *triangle* on a sheet of paper, place the edge of a mirror on your paper and look at the image of the triangle in your mirror. You are modeling a *reflection* or *flip*. A **line of reflection** defines a reflection. The *line of reflection*, called a *flip line*, is a **perpendicular bisector** of any **line segment (—)** connecting a point on the original figure to its corresponding point on the reflected figure. A *perpendicular bisector* is a **line (⟷)** that **bisects** or *divides* a *line segment* in half and meets the segment at a **right angle**.

Remember: Perpendicular (⊥) means forming a *right angle*. **Perpendicular lines** are two lines that *intersect* to form right angles.

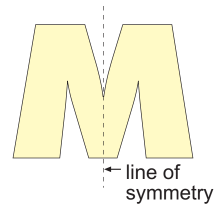
Example: The reflection you see in a mirror is the reverse image of what you are looking at. In geometry, a reflection is a transformation in which a figure is flipped over a line. That is why a *reflection* is also called a *flip*. You flip the figure over a line.

Each point in a reflection image is **equidistant** (the same distance) from the line of reflection as the corresponding point in the original figure.



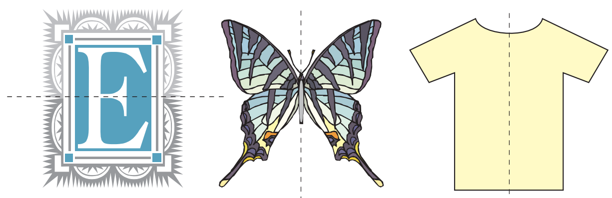
Symmetry

If a figure can be folded along a line so that it has two parts that are **congruent** and match exactly, that figure has *line symmetry*. Line symmetry is often just called **symmetry**. The *fold line* is called the **line of symmetry**. Sometimes more than one *line of symmetry* can be drawn.

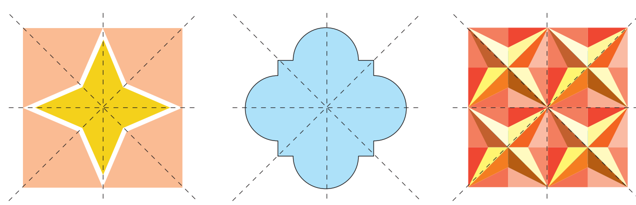


A figure can have no lines of symmetry,

one line of symmetry,

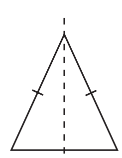


or more than one line of symmetry.

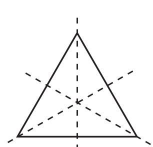


Consider the following polygons and their line(s) of symmetry.

isosceles triangle



equilateral triangle



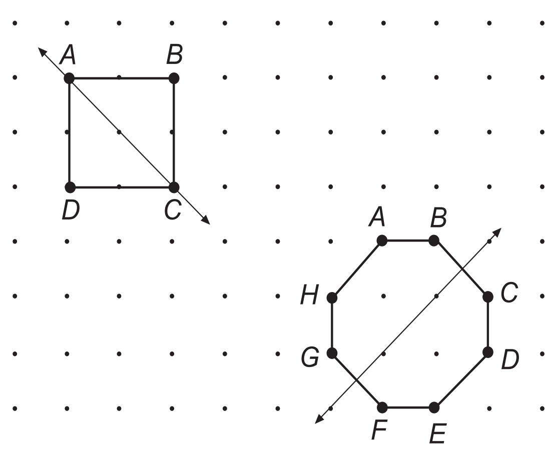
Notice 3 lines of symmetry.

Types of Symmetry: Reflectional, Rotational, and Translational

- A figure can have **reflectional symmetry**. If a figure has at least one line of symmetry, a figure has *reflectional symmetry*. Once split, one **side** is the *mirror image* or *reflection* of the other. It is even possible to have more than one line of reflectional symmetry.
- A figure can have **rotational symmetry** or *turn symmetry*. If a figure can *rotate* about its center point to a position that appears the same as the original position, it has *rotational symmetry* or turn symmetry. The amount of rotation is usually expressed in degrees.
- A figure can have **translational symmetry**. If a figure can *slide* on a *plane* (or *flat surface*) without turning or flipping and have its opposite *sides* stay congruent, it has *translational symmetry*. The distance and direction of the slide are important.

Which figures on the previous page do you think have reflectional symmetry? Which have turn or rotational symmetry? Which one could have translational symmetry?

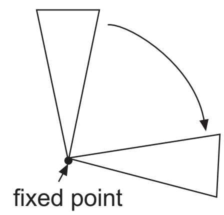
Remember: Lines of symmetry lines do *not* have to be horizontal (↔) or vertical (↕). Lines of symmetry can also be diagonal (↘).

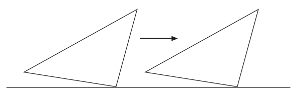


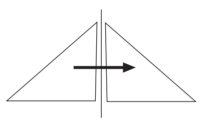
Let's continue to explore symmetry with the practice that follows.

Practice

Match each **illustration** *with the* **most** *correct term. Write the letter on the line provided.*

______ 1. 

______ 2. 

______ 3. 

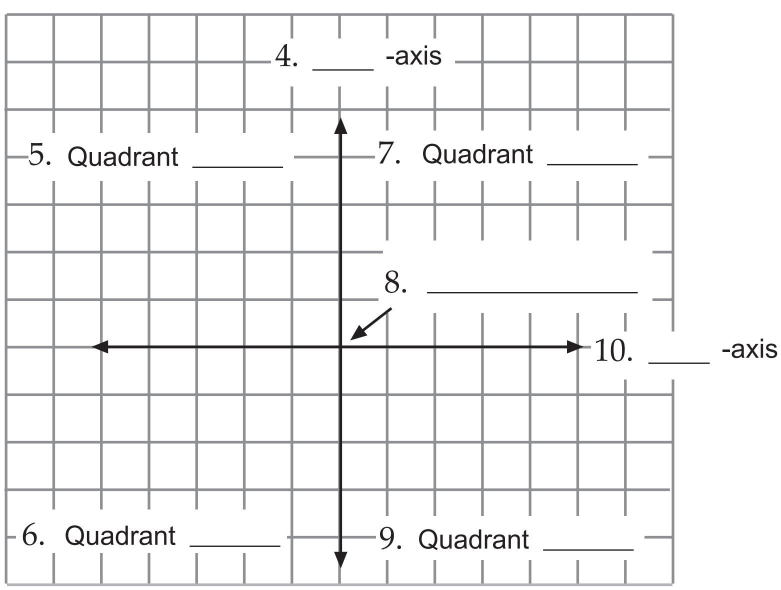
A. reflection or flip

B. rotation or turn

C. translation or slide

Use the list below to label the two **axes***, the* **origin***, and the four* **quadrants** *on the coordinate grid provided.*

I	**origin**
II	***x***
III	***y***
IV	



Practice

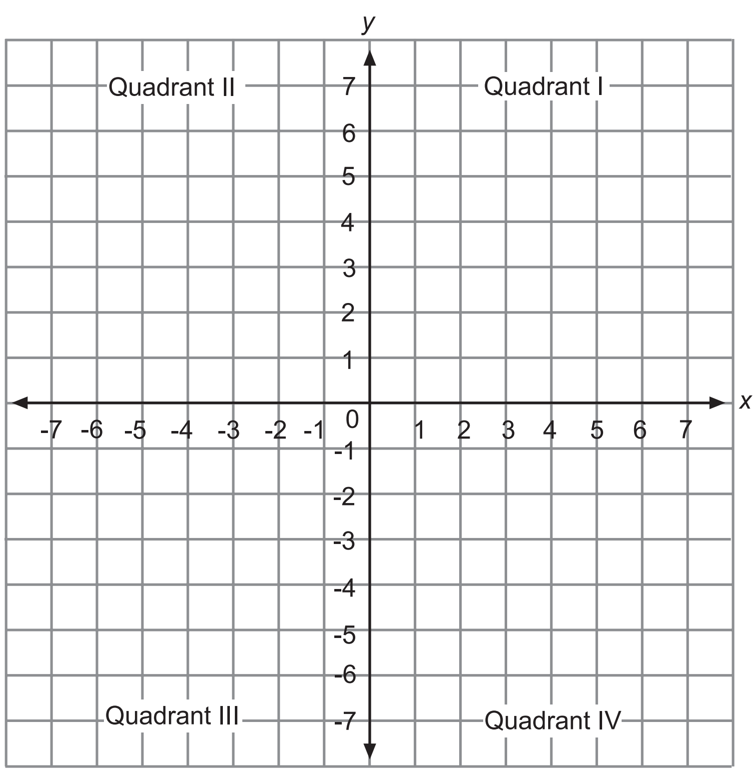
The **sets of points** *you are asked to* **plot** *will result in examples of* **transformations**.

1. Complete the following.

    a. On the grid provided, plot the following sets of points. Connect the points in each set.

    Set One: (0, 3), (0, 5), (2, 4)
    Set Two: (-3, 0), (-5, 0), (-4, 2)
    Set Three: (0, -3), (0, -5), (-2, -4)
    Set Four: (3, 0), (5, 0), (4, -2)

Graph of Set One, Two, Three, and Four



b. Give the coordinates of the *x*-intercepts on your grid.

Remember: The *x*-intercept is the value of *x* on a **graph** when *y* is zero (0).

____

c. Give the coordinates of the *y*-intercepts on your grid.

Remember: The *y*-intercept is the value of *x* on a *graph* when *x* is zero (0).

____

d. If the triangle in Quadrant I is rotated counterclockwise ____________ degrees using the origin (0, 0) as the point of rotation, it will exactly cover the triangle in Quadrant II.

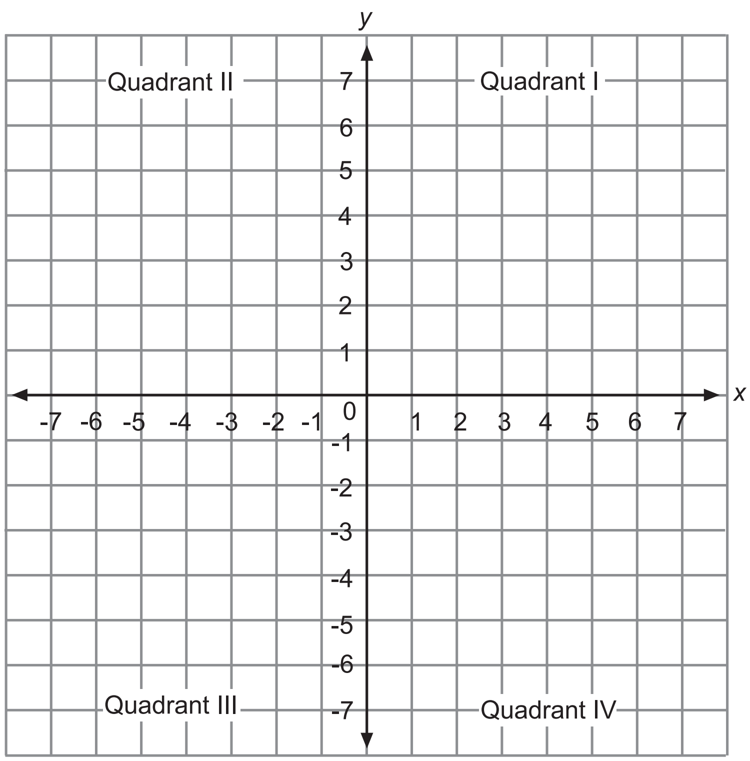
Note: The origin (0, 0) is a point of rotation *not* on the figure. (Additional rotations of the same number of degrees and the same point of rotation would result in coverage of triangles in Quadrants III and IV, if your points were plotted correctly.)

2. Complete the following.

   a. On the grid provided, plot the following sets of points. Connect the points in each set.

      Set One: (5, 5), (5, 3), (3, 3)
      Set Two: (-5, 5), (-5, 3), (-3, 3)

Graph of Set One and Two

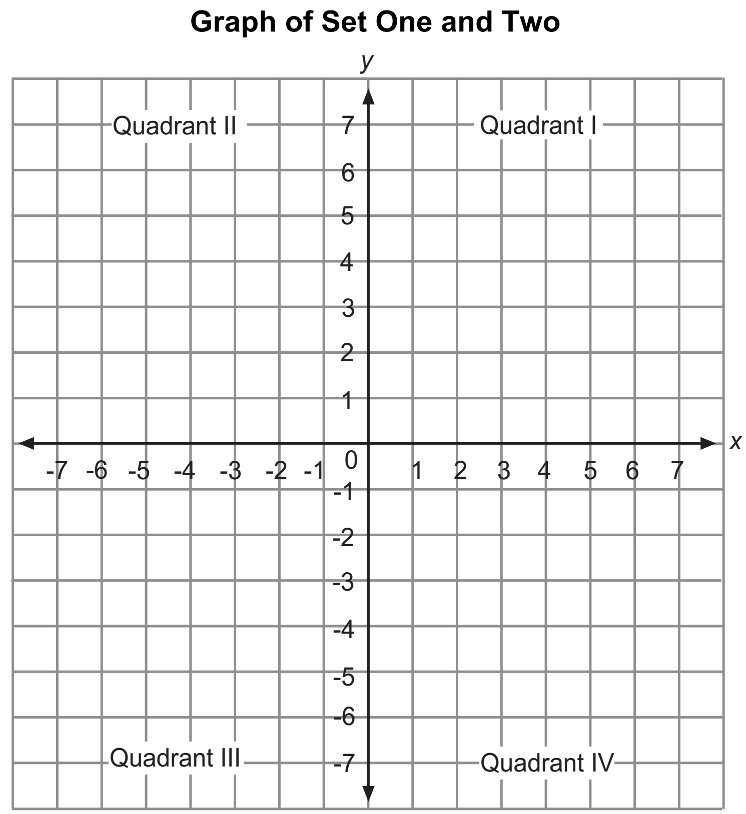


   b. Each *x*-coordinate in *Set Two* is the *opposite* of the *x*-coordinate in *Set One* and the *y*-coordinates are the *same* in both sets. We could say that the triangle in Quadrant II is a reflection of the triangle in Quadrant I and that the line of reflection or flip line is the ____________ -axis.

3. Complete the following.

   a. On the grid provided, plot the following sets of points. Connect the points in each set.

      Set One: (5, 5), (5, 3), (3, 3)
      Set Two: (5, -5), (5, -3), (3, -3)



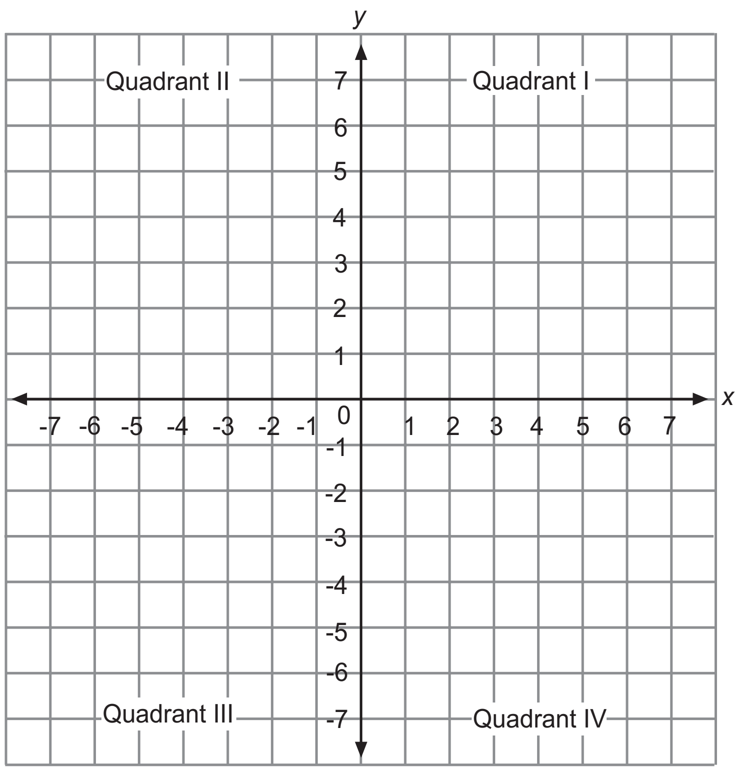
   b. Each *y*-coordinate in *Set Two* is the *opposite* of its corresponding *y*-coordinate in *Set One* and the corresponding *x*-coordinates are the *same* in both sets. We could say that the triangle in Quadrant IV is a reflection of the triangle in Quadrant I and that the line of reflection or flip line is the ____________ -axis.

4. Complete the following.

   a. On the grid provided, plot the following sets of points. Connect the points in each set.

      Set One: (-4, 0), (-3, -1), (-4, -2)
      Set Two: (0, 2), (1, 1), (0, 0)
      Set Three: (4, 4), (5, 3), (4, 2)

Graph of Set One, Two, and Three



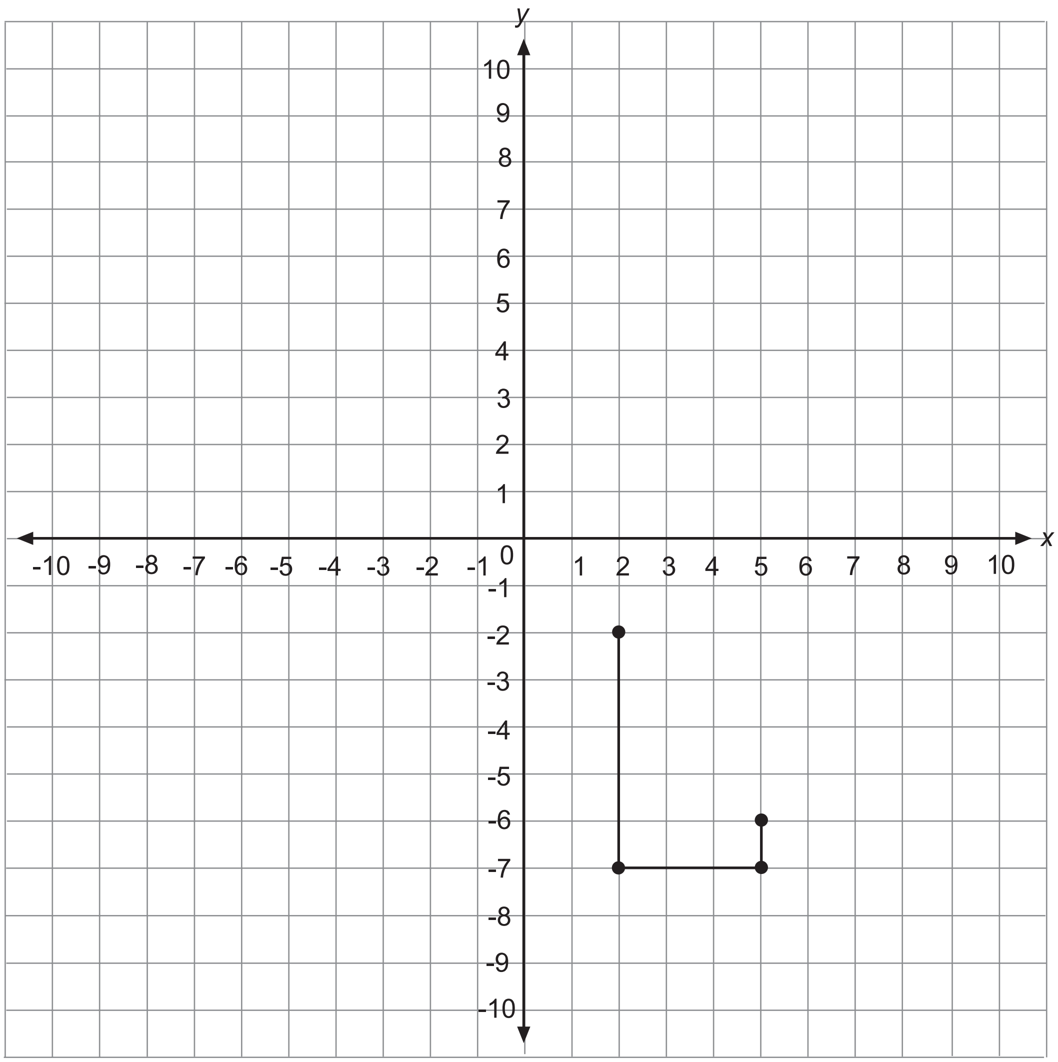
   b. The *x*-coordinate in the first ordered pair of *Set Three* is ____________ more than the *x*-coordinate in the first ordered pair of *Set Two*. The *x*-coordinate in the first ordered pair of *Set Two* is ____________ more than the *x*-coordinate in the first ordered pair of *Set One*. The same ____________ (is, is not) true for the second and third ordered pairs in each set.

c. The *y*-coordinate in the first ordered pair of *Set Three* is ____________ more than the *y*-coordinate in the first ordered pair of *Set Two*. The *y*-coordinate in the first ordered pair of *Set Two* is ____________ more than the *y*-coordinate in the first ordered pair of *Set One*. The same ____________ (is, is not) true for the second and third ordered pairs in each set.

d. If you were to slide the triangle in Quadrant III 4 units to the right and 2 units up, it would exactly cover the triangle with a vertex on the origin. Another slide of 4 units to the right and 2 units up would exactly cover the triangle resulting from plotting and connecting the points in *Set Three*. Another name for a slide is a ________________________ (reflection, rotation, translation).

5. The letter L can be seen in Quadrant IV of the grid provided.

Graph of a Slide of Letter L



a. Perform a slide of the letter 3 units to the right and 5 units up.

b. What are the resulting coordinates?

____

c. Reflect the image of the "L" created with a flip over the *y*-axis. What are the resulting coordinates?

____

Practice

Match each definition with the correct term. Write the letter on the line provided.

______ 1. equally distant

______ 2. two rays extending from a common endpoint called the vertex

______ 3. a portion of a line that consists of two defined endpoints and all the points in between

______ 4. the line over which a figure is flipped in a reflection; also called a *flipline*

______ 5. a portion of an endpoint that begins at a point and goes on indefinitely in one direction

______ 6. to cut or divide into two equal parts

______ 7. the point common to the two rays that form an angle

______ 8. a line that divides a line segment in half and meets the segment at right angles

______ 9. either of two points marking the end of a line segment

______ 10. a term describing the result of a line drawn through the center of a figure such that the two halves of the figure are reflections of each other across the line

A. angle (∠)

B. bisect

C. endpoint

D. equidistant

E. line of reflection

F. line segment (—)

G. perpendicular bisector

H. ray (→)

I. symmetry

J. vertex