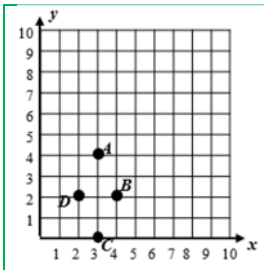
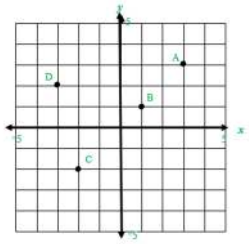
GRADE 6 - MODULE 7 - COORDINATE PLANE

Big Idea
Mathematical relationships and real-world situations with positive and negative rational numbers can be represented on the number line and the coordinate plane
Vocabulary
Coordinate plane, quadrants, ordered pair, *x*-axis, *y*-axis, origin, scale, points , axes, rational numbers, opposites, absolute value, greater than, >, less than, <, greater than or equal to, ≥, less than or equal to, ≤, horizontal, vertical, number line
Prior Learning
In Grade 5, students graphed ordered pairs of positive numbers (first quadrant pairs). In Grade 6, Module 5, students were introduced to negative numbers, opening up the coordinate plane to all four quadrants.
Essential Questions
• How can one extend the coordinate grid to represent positive and negative coordinates? • How does graphing points on the coordinate system help in solving problems? • How does absolute value help us to understand distance on a coordinate plane and support a deeper understanding of the relationship between positive and negative rational numbers? • What is the coordinate plane and what does an ordered pair represent? • How do we identify or draw points on the coordinate plane? • What does it mean when a point is reflected over the *x*-axis or *y*-axis?
Competencies
• Students will recognize the different parts of the coordinate plane. • Students will practice and learn how to graph an ordered pair. • Students will solve problems involving distance between two points. • Students will identify and graph ordered pairs in all four quadrants of the coordinate plane. • Students will draw polygons defined using ordered pairs in the coordinate plane. • Students will determine the coordinates of a point or polygon reflected over either the *x*-axis or *y*-axis. • Students will determine horizontal or vertical distances between points on the coordinate plane.
Misconceptions
• Students commonly mistake the order of the *x* and *y* coordinates and may confuse (3,2) and (2,3). • Students may have difficulty graphing in all four quadrants of the coordinate plane..
Resources from The Key Elements to Mathematics Success - KEMS Grade 6 for Building the Conceptual Understanding of this Module
LESSON 18 – PLOTTING POINTS IN THE COORDINATE PLANE AND ON THE NUMBER LINE Additional Activities: Quiz – T425-T427, Chain Reaction T895-T898 LESSON 19 – SOLVING PROBLEMS IN THE COORDINATE PLANE Additional Activities: Quiz – T450-T451, Scavenger Hunt T899-T902

Mathematics Content Standards	Examples
6.NS.6 Understand a rational number as a point on the number line. Extend number line diagrams and coordinate axes familiar from previous grades to represent points on the line and in the plane with negative number coordinates. b. Understand signs of numbers in ordered pairs as indicating locations in quadrants of the coordinate plane; recognize that when two ordered pairs differ only by signs, the locations of the points are related by reflections across one or both axes. c. Find and position integers and other rational numbers on a horizontal or vertical number line diagram; find and position pairs of integers and other rational numbers on a coordinate plane.	Students extend the number line to represent all rational numbers and recognize that number lines may be either horizontal or vertical (i.e. thermometer) which facilitates the movement from number lines to coordinate grids. Students recognize that a number and its opposite are equidistance from zero (reflections about the zero). The opposite sign (–) shifts the number to the opposite side of 0. For example, $^{-}4$ could be read as "the opposite of 4" which would be negative 4. In the example, $^{-}(^{-}6.4)$ would be read as "the opposite of the opposite of 6.4" which would be 6.4. Zero is its own opposite. Students worked with Quadrant I in elementary school. As the *x*-axis and *y*-axis are extending to include negatives, students begin to with the Cartesian Coordinate system. Students recognize the point where the *x*-axis and *y*-axis intersect as the origin. Students identify the four quadrants and are able to identify the quadrant for an ordered pair based on the signs of the coordinates. For example, students recognize that in Quadrant II, the signs of all ordered pairs would be (–, +). Students understand the relationship between two ordered pairs differing only by signs as reflections across one or both axes. For example, in the ordered pairs $(^{-}2, 4)$ and $(^{-}2, ^{-}4)$, the *y*-coordinates differ only by signs, which represents a reflection across the *x*-axis. A change is the *x*-coordinates from $(^{-}2, 4)$ to (2, 4), represents a reflection across the y-axis. When the signs of both coordinates change, $[(2, ^{-}4)$ changes to $(^{-}2, 4)]$, the ordered pair has been reflected across both axes. Example 1: Graph the following points in the correct quadrant of the coordinate plane. If the point is reflected across the x-axis, what are the coordinates of the reflected points? What similarities are between coordinates of the original point and the reflected point? $\left(\frac{1}{2},-3\frac{1}{2}\right)$, $\left(-\frac{1}{2},-3\right)$, $(0.25,0.75)$ Solution: The coordinates of the reflected points would be $\left(\frac{1}{2},3\frac{1}{2}\right)$, $\left(-\frac{1}{2},3\right)$, $(0.25, ^{-}0.75)$. Note that the y-coordinates are opposites. Example 2: Students place the following numbers would be on a number line: $^{-}4.5, 2, 3.2, ^{-}3\frac{3}{5}, 0.2, ^{-}2, \frac{11}{2}$. Based on number line placement, numbers can be placed in order. Solution: The numbers in order from least to greatest are: $^{-}4.5, ^{-}3\frac{3}{5}, ^{-}2, 0.2, 2, 3.2, \frac{11}{2}$. Students place each of these numbers on a number line to justify this order.
Questions for 6.NS.6b,c	
1. Look at the graph below. Which letter corresponds to the ordered pair (3, 4)? Explain how you determined your answer.	



2. What are the coordinates for A_1 and C_1 if Point A is reflected across the *y*-axis and Point C is reflected across the *x*-axis?



3. Identify which quadrant for each of the following coordinate pairs:

(4.5, 5) _____ (2, $-\frac{3}{4}$) _____ (7, 3.4) _____

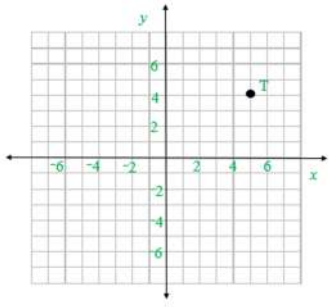
(-1, $-\frac{1}{2}$) _____ (-6, 8)_____ (1.7, -4) _____

4. Identify which quadrant for each of the following coordinate pairs:

(2, 10) _____ (1, -5) _____ (3, 8) _____

(-4, -7) _____ (-6, 12)_____ (11, -3) _____

5. Plot the points below on the coordinate graph. Point S (1, 4), Point U (5, 1), Point V (1, 1)



6. Explain the relationship between the two points (5, 5) and (-5, 5).

Answer Key for Questions for 6.NS.6b,c

1. Point A is at (3,4). Start at the origin (0,0). The first value tells you how many spaces to move on the *x*-axis (3). The second value tells you how many spaces to move up from the point on the x-axis (4).

2. Point A_1 (-3, 3) Point C_1 (-2, 2)

3.

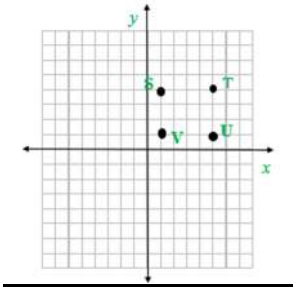
(4.5, 5) QI **(2, $-\frac{3}{4}$) Q4** **(7, 3.4) QI**

($^{-}$1, $-\frac{1}{2}$)Q3 **($^{-}$6, 8) Q2** **(1.7, $^{-}$4) Q4**

4. (2, 10) __1__ (1, $^{-}$5) __4__ (3, 8) __1__

($^{-}$4, $^{-}$7) \_\_3\_\_ ($^{-}$6, 12) __2__ (11, $^{-}$3) __4__

5.



6. The 2 points are both located 5 units above the *x*-axis.
(5,5) is located 5 units to the right of the *y*-axis, while ($^{-}$5, 5) is located 5 units to the left

Tasks for 6.NS.6b,c

*Teacher Note: Please read the Commentary section for the Illustrative Math Tasks. Some tasks will be instructional requiring more teacher modeling and direction. Others will provide the opportunity for students to demonstrate their knowledge of a concept.

Illustrative Math Task: Plotting Points in the Coordinate Plane

https://tasks.illustrativemathematics.org/content-standards/6/NS/C/6/tasks/1999

Illustrative Math Task: Reflecting points over coordinate axes

https://tasks.illustrativemathematics.org/content-standards/6/NS/C/6/tasks/1998

Task: Reflecting Points on the Coordinate Plane

Plot 1 point in each of the four quadrants of the coordinate plane. Exchange papers with your partner and have your partner plot the reflected point for each of your points (Quadrant 1 and III – reflect the points across the *y*-axis. Quadrants II and IV – Reflect the points across the *x*-axis.) Discuss any patterns you see between the *x* and *y* coordinates in the reflected points.

Extra Questions for Warm-ups and Homework for 6.NS.6b,c

1. Explain the relationship between two points when a point reflected across the *y*-axis? the *x*-axis?

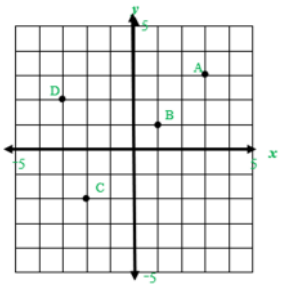
2. Explain how to draw a horizontal and vertical number line. Choose 4 values (2 positive and 2 negative) and plot them on the number line.

3. On a map, Jeannie's house is 4 units up and 3 units to the left of the school. If Jeannie's house is located at the point (9, 5) on the coordinate plane, what are the coordinates of the school?

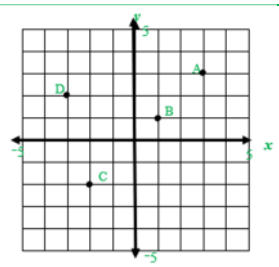
Mathematics Content Standards	**Examples**
6.NS.8 Solve real-world and mathematical problems by graphing points in all four quadrants of the coordinate plane. Include use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate.	Example 1: What is the distance between (⁻5, 2) and (⁻9, 2)? Solution: The distance would be 4 units. This would be a horizontal line since the y-coordinates are the same. In this scenario, both coordinates are in the same quadrant. The distance can be found by using a number line to find the distance between –5 and –9. Students could also recognize that –5 is 5 units from 0 (absolute value) and that –9 is 9 units from 0 (absolute value). Since both of these are in the same quadrant, the distance can be found by finding the difference between the distances 9 and 5. (| 9 | - | 5 |). Coordinates could also be in two quadrants and include rational numbers. Example 2: What is the distance between $\left(3,-5\frac{1}{2}\right)$ and $\left(3,2\frac{1}{4}\right)$? Solution: The distance between $\left(3,-5\frac{1}{2}\right)$ and $\left(3,2\frac{1}{4}\right)$ would be $7\frac{3}{4}$ units. This would be a vertical line since the x-coordinates are the same. The distance can be found by using a number line to count from $-5\frac{1}{2}$ to $2\frac{1}{4}$ or by recognizing that the distance (absolute value) from $-5\frac{1}{2}$ to 0 is $5\frac{1}{2}$ units and the distance (absolute value) from 0 to $2\frac{1}{4}$ is $2\frac{1}{4}$ units so the total distance would be $5\frac{1}{2}+2\frac{1}{4}$ or $7\frac{3}{4}$ units. Students graph coordinates for polygons and find missing vertices based on properties of triangles and quadrilaterals.

Questions for 6.NS.8

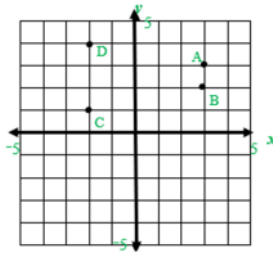
1. Tom's school is at Point A on the coordinate plane. He walks to the playground. To get to the playground he walks 5 units down and 5 units to the left. What point on the coordinate plane represents the playground?



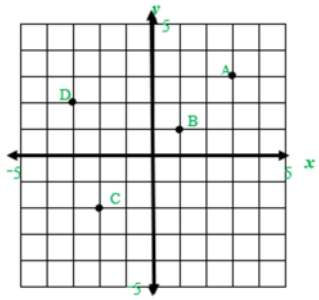
2. What is the horizontal distance between Point A and Point D?



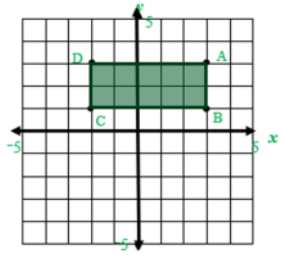
3. What shape is formed when the points are connected on the coordinate plane below? What is the perimeter of the figure?



4. What is the vertical distance between Point B and Point A? Explain how you found the distance.



5. What is the area of the figure plotted on the coordinate plane?



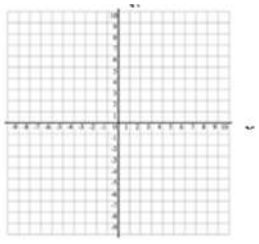
6. The Novel Book Club charges a yearly $15 membership fee. Then members can buy as many books as they want for $7 each. The chart below shows the yearly cost (*c*) for a member dependent upon how many books (*b*) they buy that year. Which of the following ordered pairs (*b*, *c*) would not be part of a graph of the data?

Books (b)	0	1	2	3
Yearly cost (c)	$15	$22	$29	$36

A. (4, 43) B. (5, 51) C. (6, 57) D. (10, 85)

7. Plot the following points on the coordinate plane. Identify the shape that is formed by connecting the points.

Point A: (2, 2) Point B: (⁻2, 2) Point C: (⁻2, ⁻2) Point D: (2, ⁻2)



Answer Key for Questions for 6.NS.8

1. Point C is the location of the playground.

2. The horizontal distance between Point A and Point D is units.

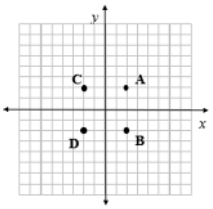
3. The perimeter of the figure is 14 units.

4. The vertical distance between Point B and Point A is 2 units. You can either subtract the y-values of the two points (3 – 1) or count the units on the coordinate plane.

5. The area of the figure is 10 units squared.

6. B. (5, 15)

7. The shape that is formed by these points is a square.



Tasks for 6.NS.8

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Illustrative Math Task: Distance Between Points

https://tasks.illustrativemathematics.org/content-standards/6/NS/C/8/tasks/290

Extra Questions for Warm-ups and Homework for 6.NS.8

1. Explain how to find the distance between two points on the coordinate plane. Choose one point in Quadrant 1 and Quadrant 4 to defend your response.

2. Plot 5 points on the coordinate plane and label the points: A, B, C, D and E (Exchange graphs with your partner and have your partner identify the coordinates of the five points and the Quadrants of each point.)

3. Plot the following points on the coordinate plane: Point A (⁻4, 4), Point B (⁻4, ⁻4), Point C (4, 4), Point D (4, ⁻4) Identify the figure that is created and determine the perimeter of the figure.

4. The local traffic reporter for the news station uses a computer program to identify the location of traffic accidents.

5. The program is a coordinate grid that represents the area of the city. On Monday morning, there were accidents at the following points: (4, 2), (2, 6), (⁻1, 3) and (⁻4, 5). What are the quadrants where the accidents are located?

6. Plot the following points on a coordinate graph: Point J (4, 5), Point K (3, 0), Point L (⁻3, ⁻2), Point M (0, 4)

What is the shape created when you connect the points? What is the perimeter of the figure?

7. A rectangle has an area of 20 square units. Its vertices are not in the same quadrant. What might be the coordinates of the vertices of the rectangle? Explain how you found the vertices of the rectangle.

Works Referenced in the Development of the Module	
Common Core State Standards Initiative www.corestandards.org	Ohio Department of Education http://education.ohio.gov/Topics/Learning-in-Ohio/Mathematics
Illustrative Mathematics Project https://illustrativemathematics.org/	North Carolina Math Tools for Teachers https://tools4ncteachers.com/
Mathematics Assessment Project https://www.map.mathshell.org/index.php	Smarter Balanced Assessment Consortium https://smarterbalanced.org/
PARCC http://parcconline.org/	Utah Education Network https://www.uen.org/core/math/
NOYCE Foundation: https://www.insidemathematics.org/	