

Unit **7**

Positive and Negative Numbers

Think back to when you first learned about whole numbers and used them to count. Later, you saw there were numbers between them: fractions and decimals. Up until now, many numbers you've encountered have been greater than zero. There is an entire set of numbers (just as many, in fact), lurking on the other side of every number line.

Essential Questions

- What does it mean for a value to be less than zero?
- How do we represent all the numbers that are less than or greater than a value?
- How do we represent points with negative numbers on a coordinate plane?



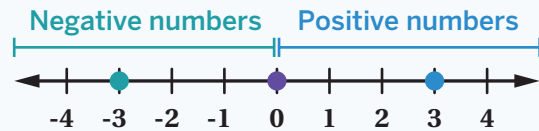
Positive numbers are numbers that are greater than 0. **Negative numbers** are numbers that are less than 0. Zero is neither positive nor negative.

You can extend a number line to the right of 0 to show positive numbers, and you can extend a number line to the left of 0 to show negative numbers.

For example:

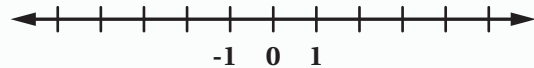
The number 3 is 3 units to the right of 0 on the number line.

The number -3 is 3 units to the left of 0 on the number line.



Try This

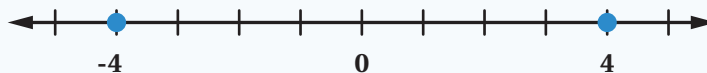
- a** Draw a star at -2 on the number line.



- b** Label each of the remaining tick marks on the number line.

- c** Sora says he is thinking of a number that is 3 units away from -2. What number could it be? Explain your thinking.

Two numbers are **opposites** if they are the same distance from 0 on different sides of the number line. For example, -4 and 4 are opposites because they are both 4 units away from 0.



Every number has an opposite, including fractions and decimals. 0 is its own opposite. The opposite of the opposite of a number is the number itself. For example, $-(-2) = 2$.

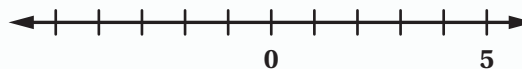
All positive and negative whole numbers and 0 are a group of numbers called *integers*. All positive and negative numbers that can be written as fractions, including whole numbers, are called *rational numbers*.

2 and -2 are both integers and rational numbers.

8.3, -8.3, $\frac{3}{2}$, and $-\frac{3}{2}$ are rational numbers, but *are not* integers.

Try This

Here is a number line.



a Plot point *A* at 2.5.

b Plot point *B* at $-\frac{3}{4}$.

c Plot point *C* at $-(-4)$.

Explain your thinking.

You can use a vertical number line to represent positive and negative numbers. On a vertical number line, points above 0 are positive and points below 0 are negative.

When talking about elevation, 0 feet represents sea level. This means that a positive elevation is above sea level and a negative elevation is below sea level.

When talking about temperature, 0°C means the temperature is freezing. If the temperature in Mt. Olympus is -10°C , that means it has a temperature of 10°C below 0°C , or below freezing.

If the temperature in Cotopaxi is -3°C , you can write $-10 < -3$, which means that it is colder in Mt. Olympus than it is in Cotopaxi.

Try This

Order these cities in California from *lowest* to *highest* elevation.

City	Coachella	El Centro	Imperial	Niland
Elevation (ft)	-72	-39	-59	-141

--	--	--	--

Lowest

Highest

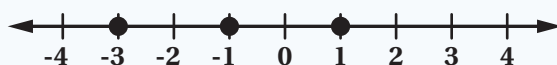
Summary | Lesson 4

You can use a number line to compare numbers with different **signs** (like -4 and 3) or numbers with the same sign (like -4 and -3).

The order of numbers from least to greatest is the same order as they appear on the number line from left to right. This means that negative numbers farther from 0 are less than negative numbers that are closer to 0.

For example, let's say you want to compare -3 and -1. On a number line, -1 is to the right of -3. This means that -1 is greater than -3, or $-3 < -1$. This also makes sense because -1 is closer to 0 than -3 is.

A number line can also help you order numbers from least to greatest. 1 is greater than -1 and -3 because it is the farthest to the right on the number line.



Try This

- a** Complete each number sentence using $>$ or $<$.

$$2.5 \text{ _____ } -0.4$$

$$-2\frac{2}{3} \text{ _____ } -\frac{5}{4}$$

- b** Order these numbers from *least* to *greatest*.

-0.4	$-\frac{5}{4}$	$-2\frac{2}{3}$	2.5
------	----------------	-----------------	-----

--	--	--	--

Least

Greatest

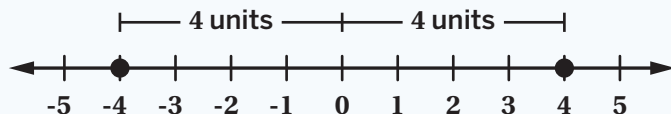
The **absolute value** of a number is a way to describe its distance from 0. For example:

The absolute value of -4 is 4,
because it is 4 units away from 0.

$$|-4| = 4$$

The absolute value of 4 is also 4,
because it is 4 units away from 0.

$$|4| = 4$$



The distance from 0 to itself is 0, so $|0| = 0$.

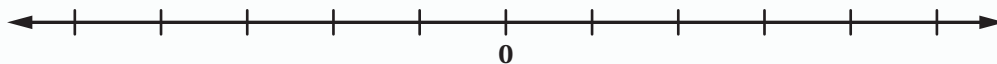
Absolute values are helpful when you are interested in the size of a difference or measurement but its direction is not important.

Try This

Determine the value of each expression.

Use the number line if it helps with your thinking.

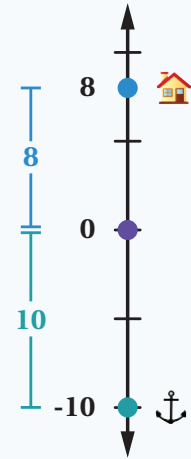
Expression	Value
$ -4 $	
$ 2.5 $	
$ \frac{7}{20} $	



You can use absolute value to compare quantity changes or distances.

For example, suppose an anchor has an elevation of -10 meters and a house has an elevation of 8 meters.

- To compare their elevations and describe the anchor as having a lower elevation than the house, you can write $-10 < 8$.
- To compare their distances from sea level and describe the anchor as being farther away from sea level than the house, you can write $|-10| > |8|$.



Try This

The table shows the amount in Oscar's bank account from January through June.

- When was Oscar's account balance the lowest?
- When was Oscar's balance closest to zero?

Month	Account Balance (\$)
January	55
February	121
March	-23
April	20
May	-17
June	45

You can use variables, verbal descriptions, symbols, and number lines to represent inequalities related to real-world situations.

To represent an inequality on a number line, you can shade part of the number line to indicate that every point covered by the shaded region is a solution. Then draw an arrow on one end of the number line to show the possible solutions continue on in that direction.

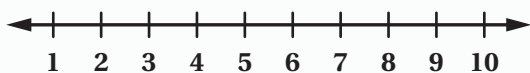
Here is an example.

Situation	Verbal Description	Inequality	Number Line
A two-year-old sleeps more than 9 hours a day.	Any value greater than 9.	$x > 9$	

Try This

Nyanna made a game for players over 3 years old.

- List three possible ages game players could be.
- Write an inequality to represent the age of game players, a .
- Graph all the possible ages of game players.



A **solution to an inequality** is any value that makes the inequality true. You can use a number line to represent the solutions to an inequality.

For example, for the inequality $c < 10$, you could say:

- 5 is a solution because $5 < 10$ is a true statement.
- 12 is not a solution because $12 < 10$ is not a true statement.

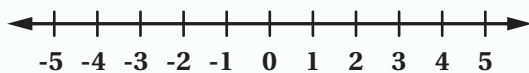
Some inequalities like $c < 10$ have an infinite number of solutions. We use inequality statements with variables and the symbols $<$ or $>$ to represent all the solutions.

Here is an example.

Inequality	Description	Possible Solutions	Number Line
$x > 9$	Any value greater than 9.	9.75, 10, 11.3, 82	

Try This

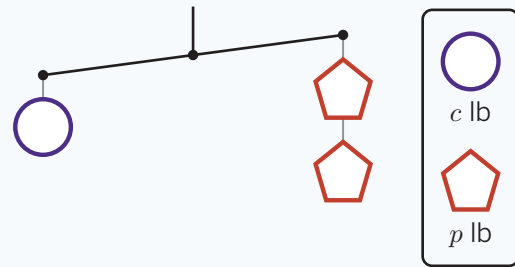
- a** Make a graph of all the solutions to the inequality $-3.5 < x$.



- b** Is -3.5 a solution to $-3.5 < x$?
Explain your thinking.

You can represent inequalities with unbalanced hangers. Inequalities may include a variable as a placeholder for an unknown value.

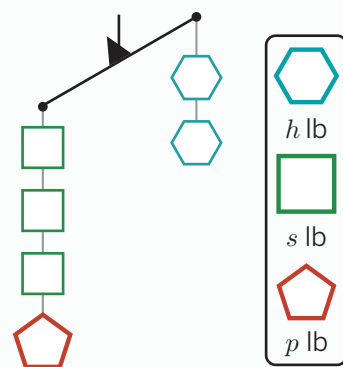
This hanger shows that the weight of the circle, c , is heavier than the weight of two pentagons, $2p$. This relationship can be represented by the inequality $c > 2p$ because these symbols mean that the circle has a greater weight than 2 pentagons.



Try This

Here is an unbalanced hanger.

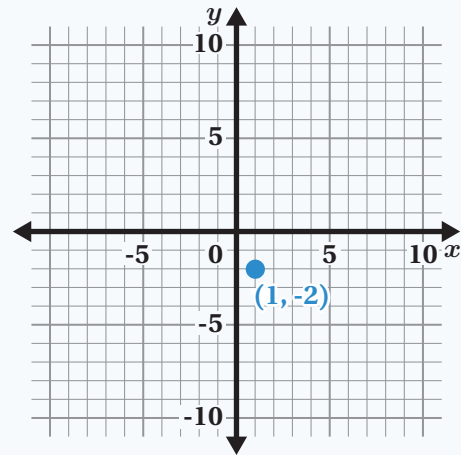
Write an inequality that represents the hanger.



Summary | Lesson 10

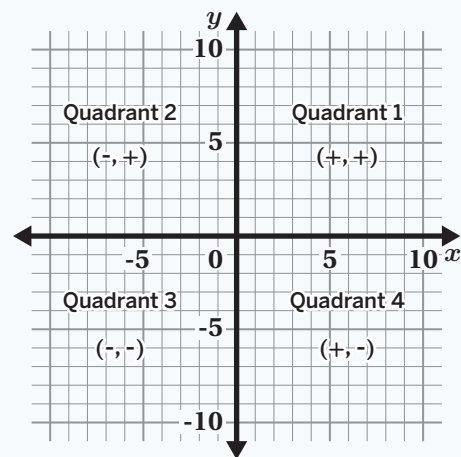
You can include positive and negative numbers along the x - and y -axes, just like on a number line. The x - and y -axes cross at the *origin*, or the point $(0, 0)$.

Ordered pairs are written (x, y) , where the x -value is the horizontal location (left and right) and the y -value is the vertical location (up and down). For example, the point $(1, -2)$ is 1 unit to the right and 2 units down from the origin.



The four regions of the coordinate plane are called **quadrants**. They are numbered 1–4 starting with the top right quadrant and going in a circle counter-clockwise.

The image shows each quadrant, along with the sign of the x - and y -values in that quadrant.



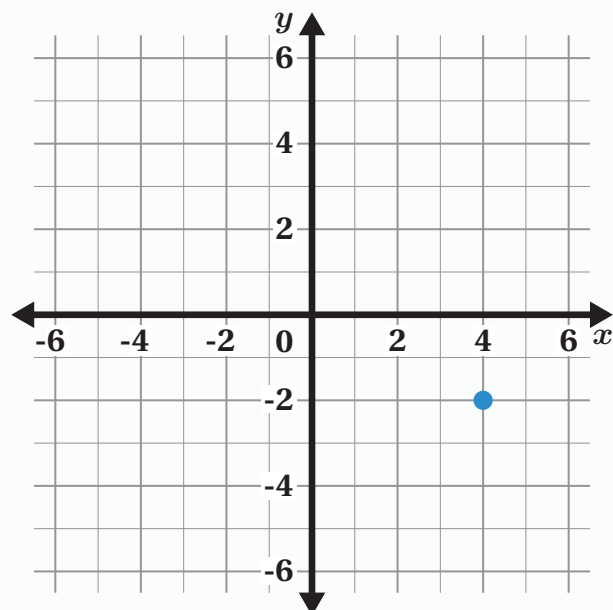
Try This

Renata found a sand dollar on the beach.

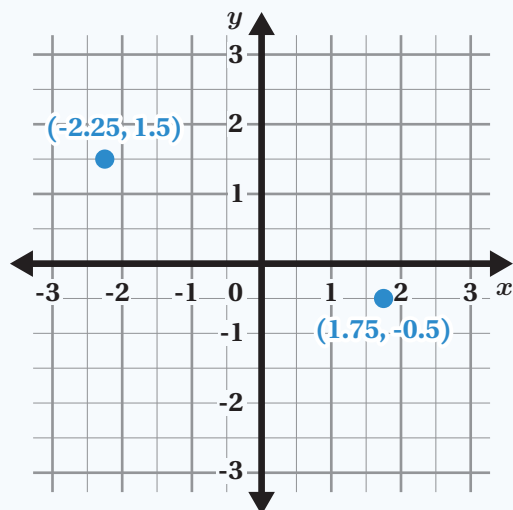
She marked the spot where she found it on this map with a dot.

What are the coordinates of the sand dollar?

Explain your thinking.

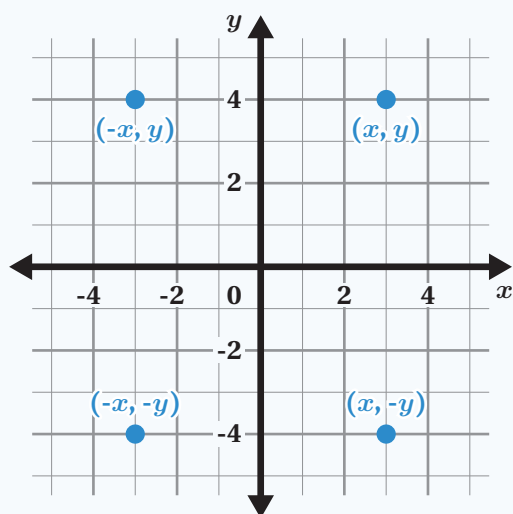


You can use different scales to show very big or very small numbers on a coordinate plane. In these cases, the interval is still consistent (e.g., goes by 2s or 0.5s). Sometimes points are plotted in between tick marks. Consider the points $(1.75, -0.5)$ and $(-2.25, 1.5)$ and where they appear on the graph shown.



The points $(3, 4)$ and $(3, -4)$ have the same x -coordinate and the y -coordinates only differ by their sign. We can see on the graph that those points are a reflection, or a mirror, of each other across the x -axis.

The points $(-3, -4)$ and $(3, -4)$ have the same y -coordinate and the x -coordinates only differ by their sign. We can see on the graph that those points are a reflection, or a mirror, of each other across the y -axis.



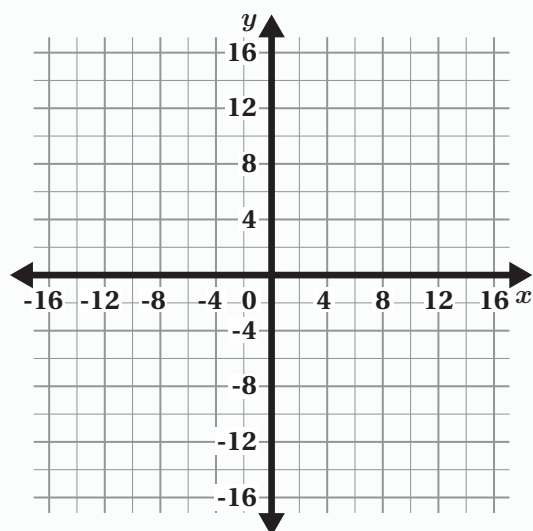
Try This

Plot and label each point on the graph.

$A(6, 8)$

$B(-6, 8)$

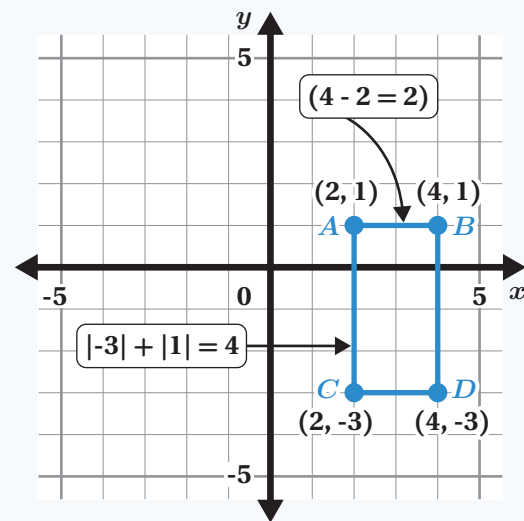
$C(-12, -10)$



You can plot points on the coordinate plane to create *polygons*. When the vertices of a polygon are horizontally or vertically aligned on the graph, you can count the number of units between them to determine the length of that side.

You can also calculate the side lengths using the coordinates of each vertex. Here are two calculation strategies:

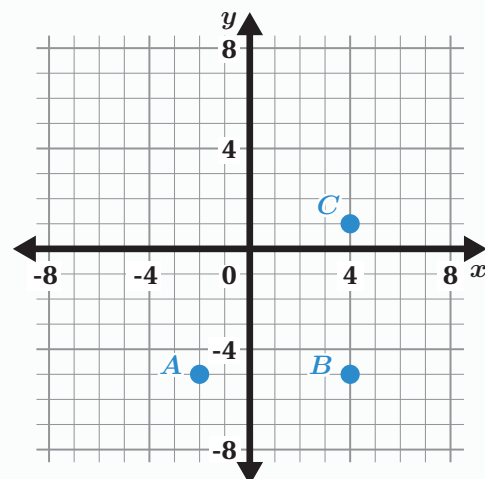
- If the coordinates are in the same quadrant, like points *A* and *B*, find the length by subtracting the coordinates that are different.
- If the coordinates are in different quadrants, like points *A* and *C*, use the absolute value to determine the distance each point is from the axis between them.



Try This

Here are three of the four coordinates that make a square.

Point	Coordinates
<i>A</i>	(-2, -5)
<i>B</i>	(4, -5)
<i>C</i>	(4, 1)
<i>D</i>	

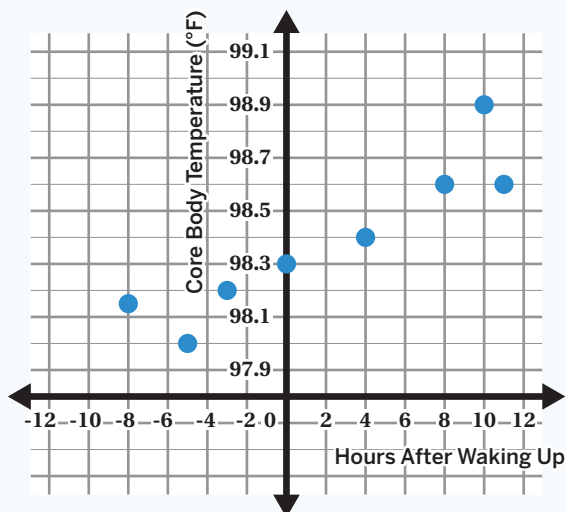


- Write the coordinates of point *D*.
- What is the side length of the square?
Explain your thinking.

You can use points with positive and negative coordinates on a graph to make sense of different situations. Common contexts include elevation, time, temperature, and money.

Here's an example:

- Santino used a device to track his temperature before and after waking up at 8:00 AM. He plotted his data on the graph.
- Time is represented on the x -axis. Temperature is represented on the y -axis.
- The points to the left of the y -axis represent temperatures recorded while Santino was sleeping. The points to the right of the y -axis represent temperatures recorded after he woke up.



Coordinates on the graph tell different parts of the story. For example, the point $(-5, 98)$ indicates that 5 hours before Santino woke up, his temperature was 98°F .

Try This

Use the data from Santino's watch, displayed in the graph above, to answer these questions.

- What was Santino's temperature when he woke up?
- At what time was Santino's temperature the highest?
- What does the point $(-3, 98.2)$ tell us?
- Tell a story about Santino's temperature throughout the day.

Lesson 1



- c** -5 or 1. *Explanations vary.* -5 is three units to the left of the star, and 1 is three units to the right of the star.

Lesson 2



- c** *Explanations vary.* Another way of saying $-(-4)$ is “the opposite of -4.” The opposite of a negative number is a positive number, so $-(-4) = 4$.

Lesson 3

Niland	Coachella	Imperial	El Centro
--------	-----------	----------	-----------

Lowest

Highest

Lesson 4

a $2.5 > -0.4$ $-2\frac{2}{3} < -\frac{5}{4}$

b

$-2\frac{2}{3}$	$-\frac{5}{4}$	-0.4	2.5
-----------------	----------------	------	-----

Least Greatest

Lesson 5

Expression	Value
$ -4 $	4
$ 2.5 $	2.5
$ \frac{7}{20} $	$\frac{7}{20}$

Lesson 6

- a March
- b May

Lesson 7

- a Responses vary. 4, 7, 13
- b $a > 3$



Lesson 8

- a
- b No. Explanations vary. Solutions to $-3.5 < x$ are numbers that are greater than -3.5. -3.5 is not greater than itself. $-3.5 < -3.5$ is a false statement.

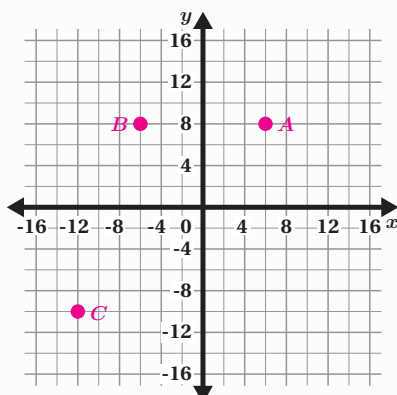
Lesson 9

$$3s + p > 2h$$

Lesson 10

(4, -2). Explanations vary. It is 4 units to the right of the y -axis and 2 units below the x -axis. If this were two number lines, then it would be at 4 on the horizontal one and -2 on the vertical one.

Lesson 11



Lesson 12

- a $(-2, 1)$
- b 6 units. *Explanations vary.* For the top side of the square, it is 2 units from -2 to 0 and another 4 units from 0 to 4.

Lesson 13

- a 98.3°F
- b 6:00 PM (10 hours after he woke up)
- c 3 hours before waking up, Santino's body temperature was 98.2°F .
- d *Responses vary.* Before waking up, Santino's temperature was at its coldest. He got warmer as he woke up and throughout the day. Then around 6:00 PM, Santino's body temperature started to decrease again.

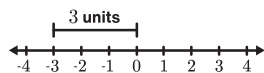
Grade 6 Unit 7 Glossary/6.º grado Unidad 7 Glosario

English

Español

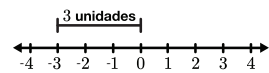
A

absolute value The distance from 0 to a number on a number line is its absolute value.



For example, the absolute value of -3 is 3 because -3 is 3 units away from 0. This is written as $|-3| = 3$.

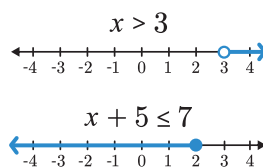
valor absoluto La distancia del 0 a un número en una recta numérica es su valor absoluto.



Por ejemplo, el valor absoluto de -3 es 3 porque -3 está a 3 unidades del 0. Esto se escribe $|-3| = 3$.

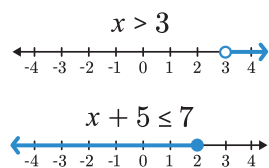
B

boundary point The point on a number line or graph that separates solutions of an inequality from non-solutions. If the boundary point is a solution to the inequality (e.g., $\geq$ or $\leq$), it's represented with a closed circle on the graph. If it's not a solution (e.g., $>$ or $<$), it's represented with an open circle on the graph.



The boundary point of $x > 3$ is 3. The boundary point of $x \leq 2$ is 2.

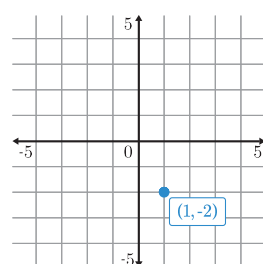
punto límite Punto en una recta numérica o una gráfica que separa las soluciones de una desigualdad de los valores que no son soluciones. Si el punto límite es una solución de la desigualdad (p. ej., $\geq$ o $\leq$), se representa con un círculo cerrado en la gráfica. Si no es una solución (p. ej., $>$ o $<$), se representa con un círculo abierto en la gráfica.



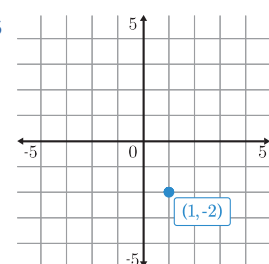
El punto límite de $x > 3$ es 3. El punto límite de $x \leq 2$ es 2.

C

coordinate plane The coordinate plane consists of two axes that intersect at 0: one horizontal (often called the x -axis) and one vertical (often called the y -axis).

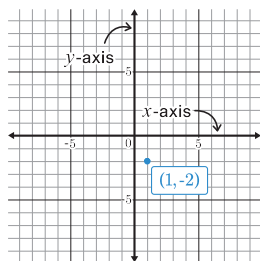


plano de coordenadas El plano de coordenadas consta de dos ejes que se intersectan en 0: uno horizontal (a menudo llamado el eje x) y uno vertical (a menudo llamado el eje y).



English

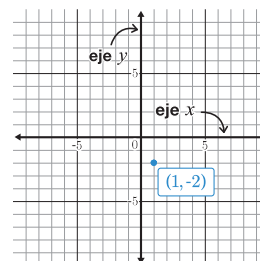
coordinates A pair of numbers that shows an exact position on the coordinate plane. The first number represents a position on the x -axis and is called the x -coordinate. The second number represents a position on the y -axis and is called the y -coordinate.



The coordinates of the point on the graph are (1, -2).

Español

coordenadas Un par de números que muestran una posición exacta en el plano de coordenadas. El primer número representa una posición en el eje x y se denomina coordenada x . El segundo número representa una posición en el eje y y se denomina coordenada y .



Las coordenadas del punto en la gráfica son (1, -2).

I

inequality A comparison statement that uses the symbols $<$ or $>$. Inequalities are used to represent the relationship between numbers, variables, or expressions that are not always equal.

For example, the inequality $y > 30$ means that the value of the expression y is any number greater than 30.

integer All positive whole numbers, all negative whole numbers, and zero are called integers.

For example, 35, -15, and 1 are integers. 0.3 and $\frac{1}{3}$ are not.

desigualdad Un enunciado de comparación que utiliza los símbolos $<$ o $>$. Las desigualdades se usan para representar la relación entre números, variables o expresiones que no siempre son iguales.

Por ejemplo, la desigualdad $y > 30$ significa que el valor de la expresión y es cualquier número mayor que 30.

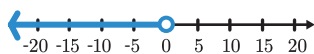
número entero Todos los números naturales, todos los números enteros negativos y el cero se llaman números enteros.

Por ejemplo, 35, -15 y 1 son números enteros. 0.3 y $\frac{1}{3}$ no lo son.

N

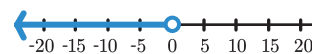
negative number

A number that is less than 0. On a horizontal number line, negative numbers are to the left of 0.



número negativo

Un número que es menor que 0. En una recta numérica horizontal, los números negativos están a la izquierda del 0.



Grade 6 Unit 7 Glossary/6.º grado Unidad 7 Glosario

English

Español

O

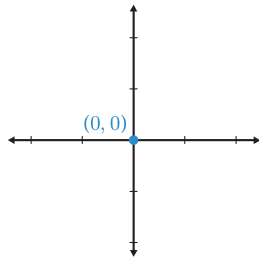
opposite Two numbers that are the same distance from 0 and on different sides of 0 on the number line are opposites.

For example, 4 and -4 are opposites.

ordered pair Two values of x and y , written as (x, y) , that represent a point on the coordinate plane.

For example, $(3, 5)$ represents the point where $x = 3$ and $y = 5$.

origin The point $(0, 0)$ on the coordinate plane. This is where the x -axis and the y -axis intersect.



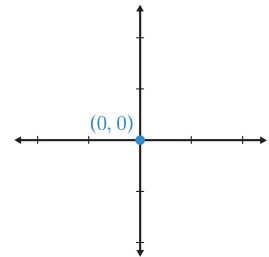
opuesto Dos números son opuestos si están a la misma distancia del 0 y en diferentes lados del 0 en la recta numérica.

Por ejemplo, 4 y -4 son opuestos.

par ordenado Dos valores de x y y , escritos como (x, y) , que representan un punto en el plano de coordenadas.

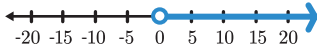
Por ejemplo, $(3, 5)$ representa el punto donde $x = 3$ y $y = 5$.

origen El punto $(0, 0)$ en el plano de coordenadas. El punto en el que se intersecan los ejes x y y .

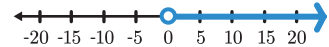


P

positive number A number that is greater than 0. On a horizontal number line, positive numbers are to the right of 0.



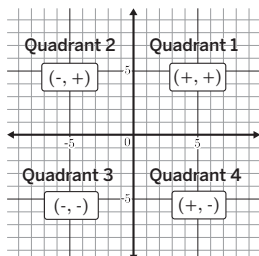
número positivo Un número que es mayor que 0. En una recta numérica horizontal, los números positivos están a la derecha del 0.



Q

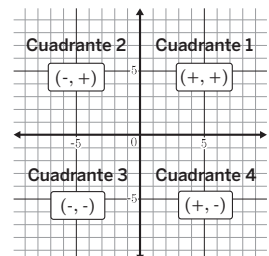
quadrant The coordinate plane is divided into 4 regions called quadrants.

The image shows each quadrant, along with the sign of the x - and y -values in that quadrant.



cuadrante El plano de coordenadas se divide en 4 regiones llamadas cuadrantes.

La imagen muestra cada cuadrante junto con el signo de los valores x y y del cuadrante correspondiente.



English

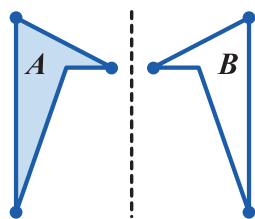
Español

R

rational number All positive and negative numbers that can be written as fractions, including whole numbers, are called rational numbers.

For example, -10 , 2.5 , $\frac{3}{7}$, and 82 are all rational numbers.

reflection A reflection moves each point on a figure across a line of reflection to a point on the opposite side of the line. The new point is the same distance from the line as it was in the original figure.

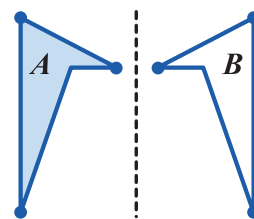


This diagram shows a reflection of A over a line that makes the mirror image B .

número racional Todos los números positivos y negativos que pueden escribirse como fracciones, incluidos los números enteros, se llaman números racionales.

Por ejemplo, -10 , 2.5 , $\frac{3}{7}$ y 82 son números racionales.

reflexión Una reflexión mueve cada punto de una figura sobre una línea de reflexión a un punto en el lado opuesto de la línea. El nuevo punto está a la misma distancia de la línea que estaba en la figura original.



Este diagrama muestra una reflexión de A sobre una línea que produce la imagen espejo B .

S

sign The sign of a number (other than 0) is either positive or negative.

For example, the sign of 4 or $+4$ is positive. The sign of -4 is negative.

solution to an inequality Any value of a variable that makes the inequality true.

For example, 5 is a solution to the inequality $x < 10$ because $5 < 10$. Some other solutions to $x < 10$ are 9.99, 0, and -4 .

signo El signo de un número (que no sea 0) es positivo o negativo.

Por ejemplo, el signo de 4 o $+4$ es positivo. El signo de -4 es negativo.

solución de una desigualdad Cualquier valor de una variable que hace que la desigualdad sea verdadera.

Por ejemplo, 5 es una solución de la desigualdad $x < 10$ porque $5 < 10$. Algunas otras soluciones de $x < 10$ son 9.99, 0 y -4 .

V

variable A letter or symbol that represents a value or set of values.

In the expression $10 - x$, the variable is x .

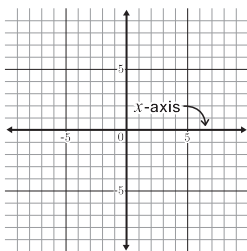
variable Una letra o un símbolo que representa un valor o un conjunto de valores.

En la expresión $10 - x$, la variable es x .

Grade 6 Unit 7 Glossary/6.º grado Unidad 7 Glosario

English

x -axis One of the perpendicular number lines that form the coordinate plane. The x -axis is the horizontal number line.

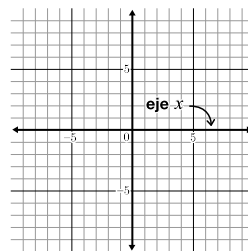


x -coordinate See *coordinates*.

X

Español

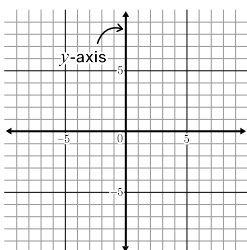
eje x Una de las rectas numéricas perpendiculares que forman el plano de coordenadas. El eje x es la recta numérica horizontal.



coordenada x Ver *coordenadas*.

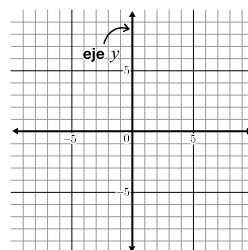
Y

y -axis One of the perpendicular number lines that form the coordinate plane. The y -axis is the vertical number line.



y -coordinate See *coordinates*.

eje y Una de las rectas numéricas perpendiculares que forman el plano de coordenadas. El eje y es la recta numérica vertical.



coordenada y Ver *coordenadas*.