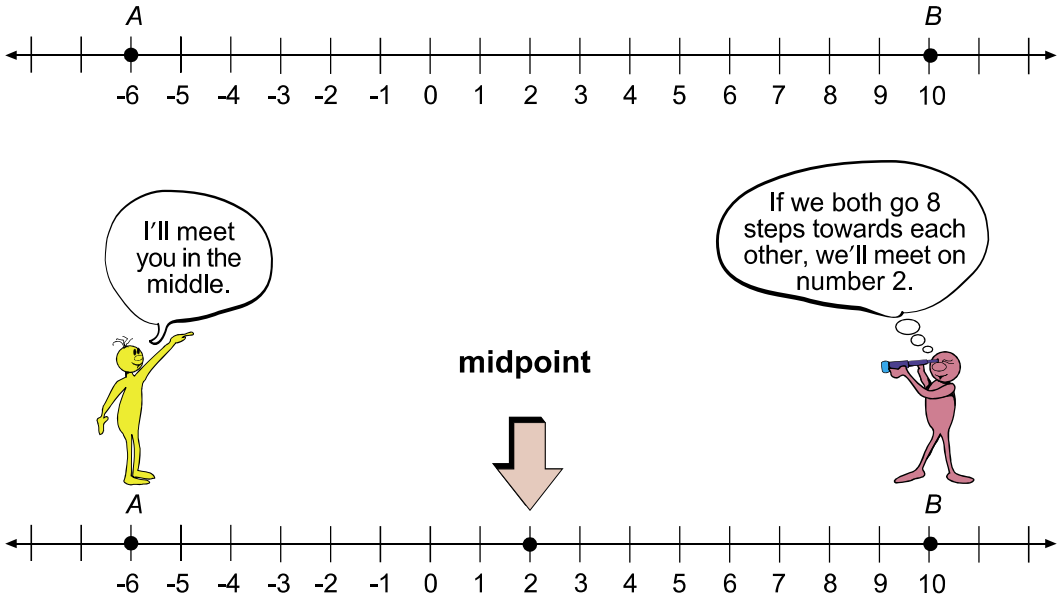
Midpoint

Sometimes it is necessary to find the *point* that is exactly in the middle of two given **endpoints**. We call this the **midpoint (of a line segment)**. What we are actually trying to find are the **coordinates** of that point, which is like the *address* of the point, or its *location* on a coordinate plane or a **number line**.

Finding the Midpoint of a Line Segment Using a Number Line

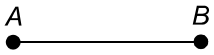
You can find the *midpoint* of a **line segment (—)**, also called a *segment*, in a couple of different ways. One way is to use a *number line*.

On a number line, you can find the midpoint of a *line segment* by counting in from both *endpoints* until you reach the middle.

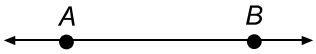


how to use a number line to find the midpoint of a line segment

Remember: If we draw a *line segment* from one point to another, we can call it line segment AB or *segment* AB. See a representation of line segment AB ($\overline{AB}$) below. The symbol (—) drawn over the two uppercase letters describes a line segment. The symbol has no arrow because the line segment has a definite beginning and end called endpoints. A and B are endpoints of the line segment AB ($\overline{AB}$).



On the other hand, the symbol ($\leftrightarrow$) drawn over two uppercase letters describes a line. The symbol has arrows because a line has no definite beginning or end. A and B are points on the line AB ($\overleftrightarrow{AB}$).



Method One Midpoint Formula

Another way to find the midpoint of a line segment is to use the Method One midpoint formula below. To do this, add the two endpoints together and divide by two.

Method One midpoint formula

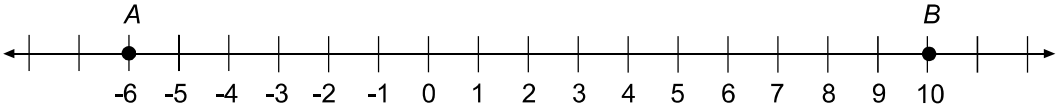
$$\frac{a+b}{2}$$

$$\frac{a+b}{2} =$$

$$\frac{-6+10}{2} =$$

$$\frac{4}{2} =$$

$$2$$



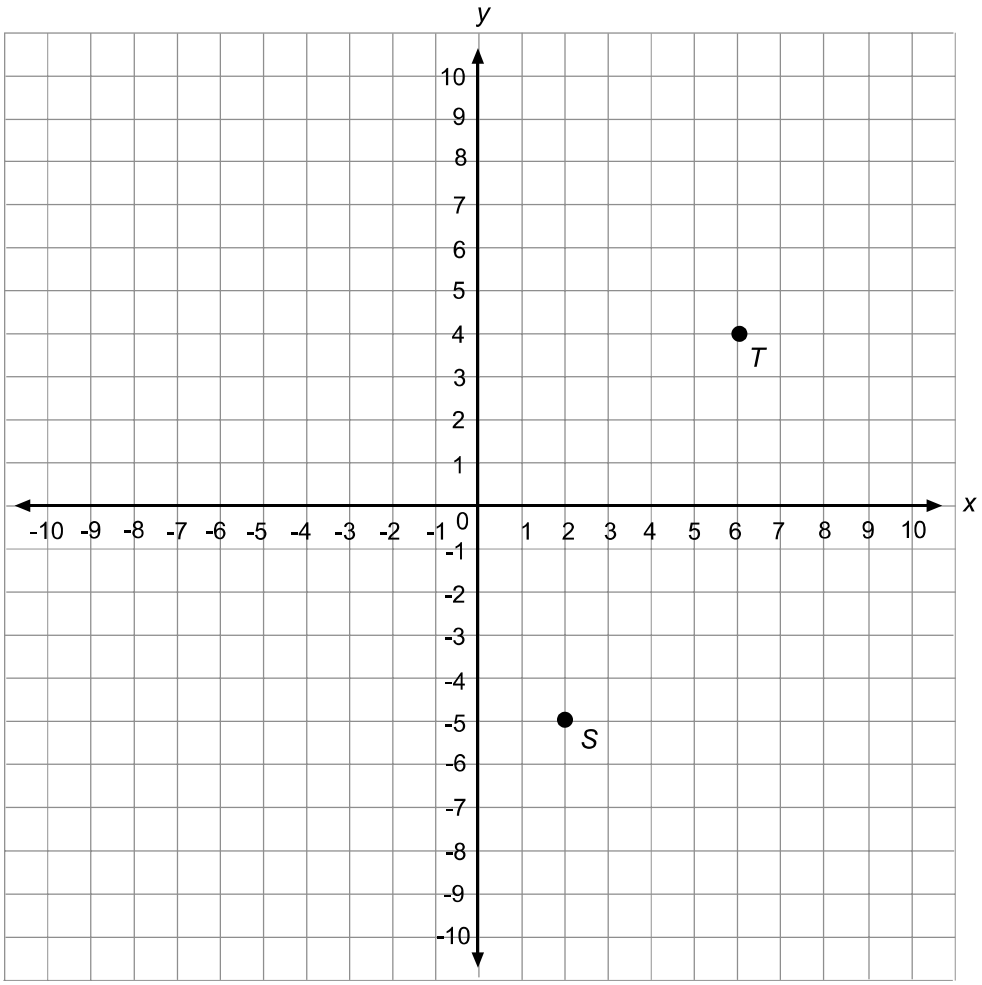
Therefore, for points A and B on the number line, the midpoint is

$$\frac{-6+10}{2} = \frac{4}{2} = 2.$$

Method Two Midpoint Formula

Do you think the process may change a bit when we try to find the midpoint of points *S* and *T* as seen on the graph below?

Graph of Points *S* and *T*



When the points are on a **coordinate plane**, or the plane containing the *x*- and *y*-axes, we have to think in two dimensions to find the *coordinates* of the midpoint. The midpoint will have an ***x*-coordinate** and a ***y*-coordinate** (x, y). To find the midpoint on a coordinate plane, we simply use the Method Two midpoint formula twice—once to find the *x-coordinate* and again to find the *y-coordinate*.

Method Two midpoint formula

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

Let's see how this works.

We see that point S has coordinates (2, -5), and T is located at (6, 4). Use the Method Two midpoint formula to find the exact location of the midpoint of $\overline{ST}$.

midpoint of $\overline{ST} = \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right) =$ find the *average* of the *x*-values, then the average of the *y*-values

$\left(\frac{2 + 6}{2}, \frac{-5 + 4}{2}\right) =$ add the *x*'s then the *y*'s

$\left(\frac{8}{2}, \frac{-1}{2}\right) =$ now **simplify each fraction**

$\left(4, \frac{-1}{2}\right) =$