

Using Midpoints

The **midpoint** of a segment is the point that divides the segment into two congruent segments. In the figure, M is the midpoint of \overline{AB} . So, $\overline{AM} \cong \overline{MB}$ and $AM = MB$.



Example 1 Point M is the midpoint of \overline{PQ} . Find the length of \overline{PQ} .



First write and solve an equation. Use the fact that $PM = MQ$.

$$\begin{array}{ll}
 PM = MQ & \text{Write the equation.} \\
 3x + 10 = 8x + 25 & \text{Substitute.} \\
 -3 = x & \text{Solve for } x.
 \end{array}$$

Then evaluate the expression for PM when $x = -3$ to obtain $PM = 1$. By the Segment Addition Postulate and the definition of midpoint, $PQ = PM + MQ = 1 + 1 = 2$.

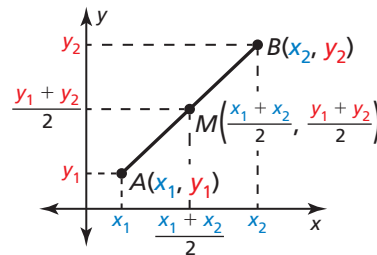
► So, the length of \overline{PQ} is 2.

The Midpoint Formula

The coordinates of the midpoint of a segment are the averages of the x -coordinates and of the y -coordinates of the endpoints.

If $A(x_1, y_1)$ and $B(x_2, y_2)$ are points in a coordinate plane, then the midpoint M of \overline{AB} has coordinates

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



Example 2 The endpoints of \overline{AB} are $A(-4, 7)$ and $B(10, -8)$. Find the coordinates of the midpoint M .

Use the Midpoint Formula.

$$M\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right) = M\left(\frac{-4 + 10}{2}, \frac{7 + (-8)}{2}\right) = M\left(3, -\frac{1}{2}\right)$$

► The coordinates of the midpoint M are $\left(3, -\frac{1}{2}\right)$.

Practice

Check your answers at BigIdeasMath.com.

- Point M bisects \overline{JK} such that $JM = 4x - 5$ and $MK = 3x + 2$. Find the length of \overline{JK} .
- Point M bisects \overline{EF} such that $EM = 7x + 11$ and $MF = 8x$. Find the length of \overline{EF} .

The endpoints of \overline{RS} are given. Find the coordinates of the midpoint M .

- $R(-6, 3), S(-4, 1)$
- $R(0, -2), S(6, -8)$
- $R(13, 2), S(7, 6)$
- $R(-2, 9), S(4, 0)$