Lesson 1-4: Midpoints and Bisectors

Monday, August 29, 2022 9:09 PM

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1.4 Midpoint

Midpoints and Bisectors

Florida's B.E.S.T. Standards for Mathematics

MA.912.GR.3.3

Use coordinate geometry to solve mathematical and real-world geometric problems involving lines, circles, triangles and quadrilaterals.

MA.912.GR.5.2

Construct the bisector of a segment or an angle, including the perpendicular bisector of a line segment.

Content Objective

Students will find midpoints and bisect line segments

Students will find midpoints and bisect line segments.

Learn
Midpoints on a Number Line

The **midpoint** of a segment is the point halfway between the endpoints of the segment. A point is **equidistant** from other points if it is the same distance from them. The midpoint separates the segment into two segments with a ratio of 1:1.

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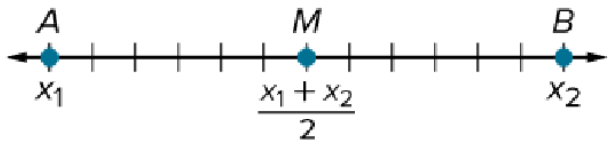
Learn
Midpoints on a Number Line

Key Concept: Midpoint on a Number Line

If $\overline{AB}$ has endpoints at x_1 and x_2 on a number line, then the midpoint M of $\overline{AB}$ has coordinate $M = \frac{x_1 + x_2}{2}$.



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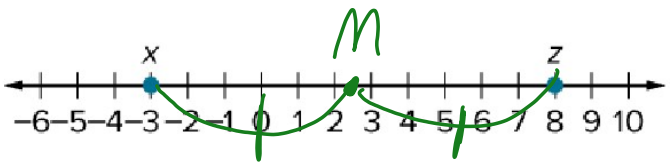
Example 1
Find the Midpoint on a Number Line

Find the coordinate of the midpoint of $\overline{XZ}$.



$$\frac{-3+8}{2} \quad \frac{5}{2} = 2.5$$

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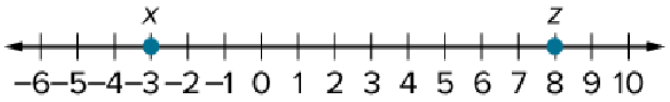
Example 1
Find the Midpoint on a Number Line



$M = \frac{x_1 + x_2}{2}$ Midpoint Formula

$= \frac{8 + (-3)}{2}$ Substitution

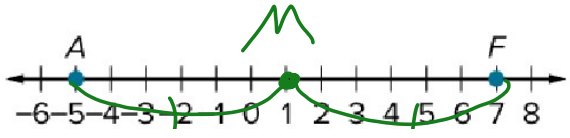
$= \frac{5}{2}$ or 2.5 Simplify.

The coordinate of the midpoint of $\overline{XZ}$ is 2.5.

Example 1
Find the Midpoint on a Number Line

Check

What is the coordinate of the midpoint of $\overline{AF}$?



$-\frac{5+7}{2} = \frac{2}{2} = 1$

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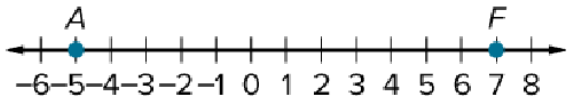
Example 1
Find the Midpoint on a Number Line

Check

What is the coordinate of the midpoint of $\overline{AF}$?



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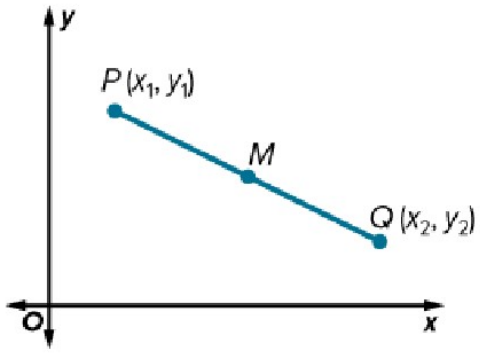
Learn
Midpoints on the Coordinate Plane

Key Concept: Midpoint Formula on the Coordinate Plane

If $\overline{PQ}$ has endpoints at $P(x_1, y_1)$ and $Q(x_2, y_2)$ on the coordinate plane, then the midpoint M of $\overline{PQ}$ has coordinates $M\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$.



Example 3
Find the Midpoint on the Coordinate Plane

Find the coordinates of *M*, the midpoint of $\overline{AB}$, for *A*(−2, 1) and *B*(8, 3).

x_1 y_1 x_2 y_2

$(3, 2)$

$\frac{-2+8}{2}, \frac{1+3}{2}$

$\frac{6}{2}$ $\frac{4}{2}$

$(3, 2)$

Example 3
Find the Midpoint on the Coordinate Plane

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

$$= \left(\frac{-2 + 8}{2}, \frac{1 + 3}{2}\right)$$ Substitution

$$= \left(\frac{6}{2}, \frac{4}{2}\right) \text{ or } (3, 2)$$ Simplify.

Example 3
Find the Midpoint on the Coordinate Plane

Check

Find the coordinates of B, the midpoint of $\overline{AC}$, for $A(-3, -2)$ and $C(5, 10)$.

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Example 3
Find the Midpoint on the Coordinate Plane

Check

Find the coordinates of B, the midpoint of $\overline{AC}$, for $A(-3, -2)$ and $C(5, 10)$.

(1, 4)

Example 4
Find Missing Coordinates

Find the coordinates of A if $P\left(3, \frac{1}{2}\right)$ is the midpoint of $\overline{AB}$ and B has coordinates (8, 3).

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Example 4
Find Missing Coordinates

First, substitute the known information into the Midpoint Formula. Let A be (x_1, y_1) and B be (x_2, y_2).

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

$$\left(3, \frac{1}{2}\right) = \left(\frac{x_1 + 8}{2}, \frac{y_1 + 3}{2}\right)$$ Substitution

Example 4
Find Missing Coordinates

Next, write two equations to solve for x_1 and y_1.

$3 = \frac{x_1 + 8}{2}$ Equation for x_1

$6 = x_1 + 8$ Multiply each side by 2.

$-2 = x_1$ Solve.

$\frac{1}{2} = \frac{y_1 + 3}{2}$ Equation for y_1

$1 = y_1 + 3$ Multiply each side by 2.

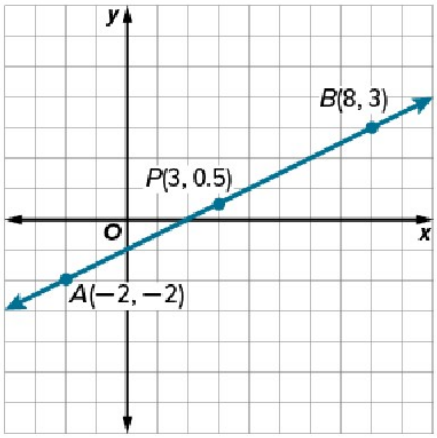
$-2 = y_1$ Solve.

Example 4

Find Missing Coordinates

The coordinates of *A* are (−2, −2).

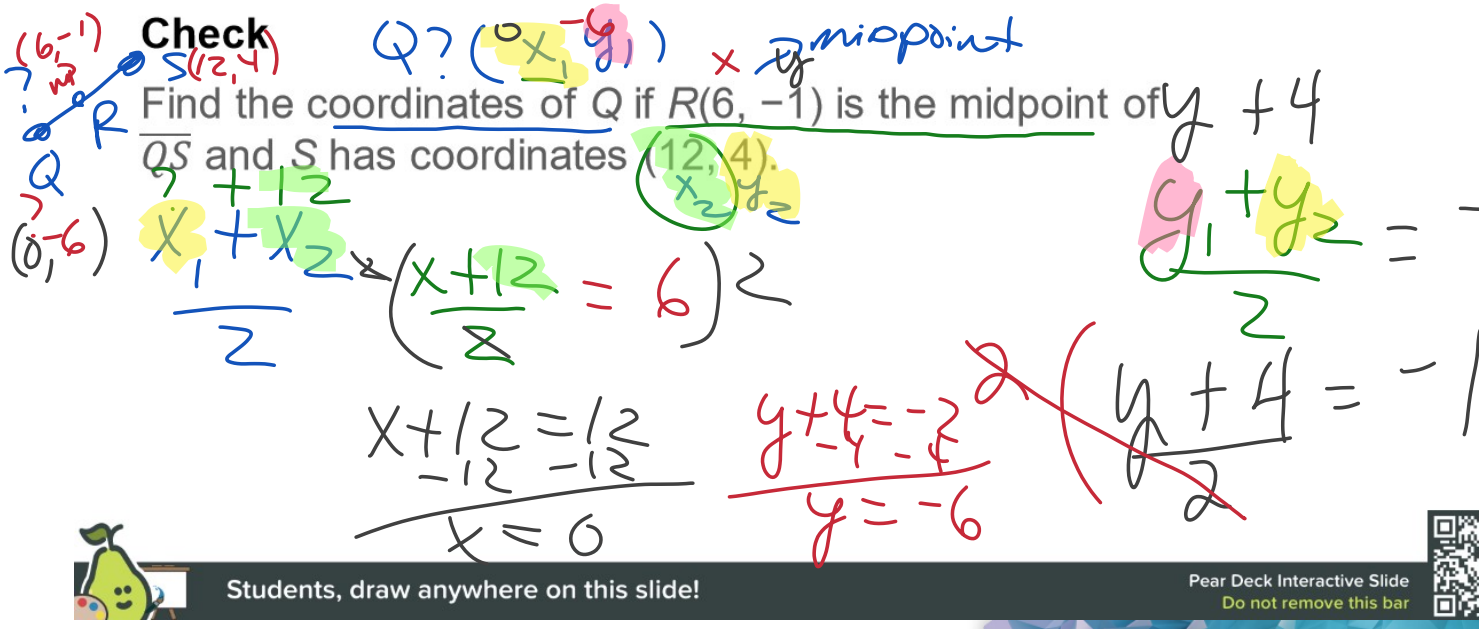
Plot the points on a coordinate plane to check your answer for reasonableness.



Example 4
Find Missing Coordinates

Check

Find the coordinates of *Q* if *R*(6, −1) is the midpoint of $\overline{QS}$ and *S* has coordinates (12, 4).



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Example 4
Find Missing Coordinates

Check

Find the coordinates of *Q* if *R*(6, −1) is the midpoint of $\overline{QS}$ and *S* has coordinates (12, 4).

(0, −6)

Example 5
Find Missing Measures

Find the measure of $\overline{RT}$ if T is the midpoint of $\overline{RQ}$.

$2x + 3 = 4x - 5$

$-2x \quad -2x$

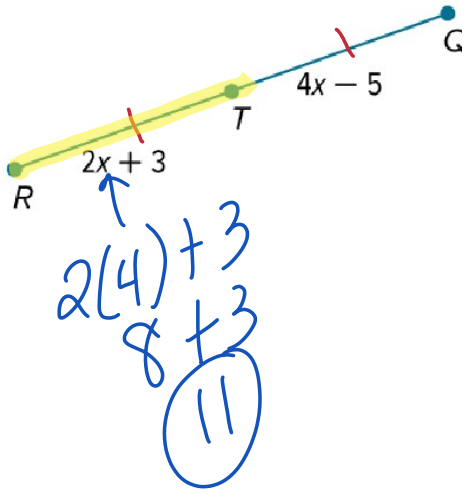
$3 = 2x - 5$

$+5 \quad +5$

$8 = 2x$

$\frac{8}{2} = \frac{2x}{2}$

$x = 4$



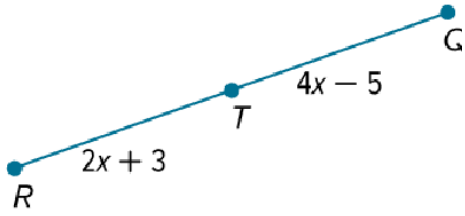
$2(4) + 3$

$8 + 3$

11

Example 5
Find Missing Measures

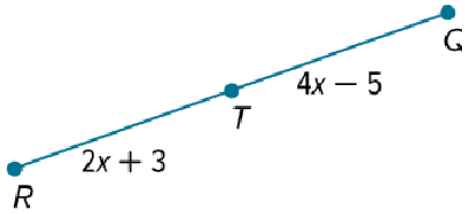
Because T is the midpoint, $RT = TQ$. Use this equation to solve for x.



$RT = TQ$	Definition of midpoint
$2x + 3 = 4x - 5$	Substitution
$3 = 2x - 5$	Subtract $2x$ from each side.
$8 = 2x$	Add 5 to each side.
$4 = x$	Divide each side by 2.

Example 5
Find Missing Measures

Substitute 4 for x in the equation for RT.

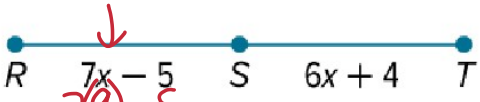


$RT = 2x + 3$	Equation for RT
$= 2(4) + 3$	Substitution
$= 11$	Simplify.

Example 5
Find Missing Measures

Check

Find the measure of $\overline{RS}$ if S is the midpoint of $\overline{RT}$.



A. 56
B. 58
C. 112
D. 116

$7x - 5 = 6x + 4$
$-6x \quad -6x$
$1x - 5 = 4$
$+5 \quad +5$
$x = 9$

$7(9) - 5$
$63 - 5 =$
58

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Example 5
Find Missing Measures

Check

Find the measure of $\overline{RS}$ if S is the midpoint of $\overline{RT}$.

A. 56
B. 58
C. 112
D. 116

Students, select an option!

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Example 5
Find Missing Measures

Check

Find the measure of $\overline{RS}$ if S is the midpoint of $\overline{RT}$.

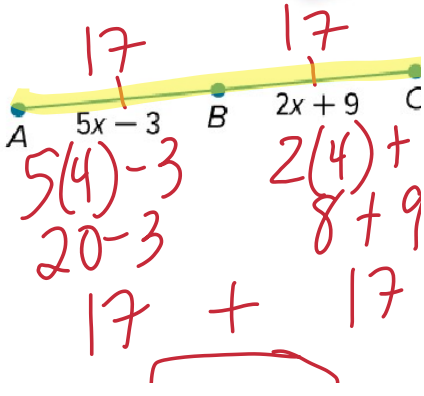
A. 56
B. 58
C. 112
D. 116

B

Example 6
Find the Total Length

Find the measure of $\overline{AC}$ if B is the midpoint of $\overline{AC}$.

$5x - 3 = 2x + 9$
$-2x \quad -2x$
$3x - 3 = 9$



$3x = 12$ | $x = 4$

34

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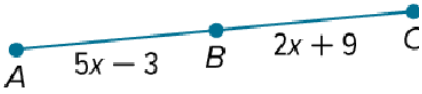
Example 6
Find the Total Length

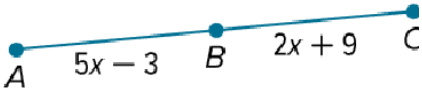
Because B is the midpoint, $AB = BC$. Use this equation to solve for x.



$AB = BC$	Definition of midpoint
$5x - 3 = 2x + 9$	Substitution
$3x - 3 = 9$	Subtract $2x$ from each side.
$3x = 12$	Add 3 to each side.
$x = 4$	Divide each side by 3.

Example 6
Find the Total Length

The length of $\overline{AC}$ is equal to the sum of AB and BC. So, to find the length of $\overline{AC}$, substitute 4 for x in the expression $5x - 3 + 2x + 9$.



$AC = 5x - 3 + 2x + 9$	Length of $\overline{AC}$
$= 5(4) - 3 + 2(4) + 9$	$x = 4$
$= 20 - 3 + 8 + 9$	Multiply.
$= 34$	Simplify.

The measure of $\overline{AC}$ is 34.