

**Objectives:** You will be able to find the distance between two points and find the midpoint of a segment.

Calculating the length of a segment on a number line:

**Notation:** If the length of  $\overline{AB}$  is 3 units, we write  $AB = 3$ .



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Remember that distance must always be a positive number. As a result, we define the distance between two points on a number line as:  
 $AB = |a - b|$

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**Midpoint:** The point directly halfway between the endpoints of the segment



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Graph the following points:



A: -11 B: -5 C: -1 D: 3 E: 6 F: 10

Find the lengths of the following segments by counting:

AB: 6 BC: 4 DE: 3 EF: 4  
 -11 -5 -5 -1 -6 -4

Can a generalization be made?

Subtract & absolute value

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Example #1:

If X: 12, Y: -5, and Z: 8, find the following:

XY:  $|12 - (-5)| = |17| = 17$

YZ:  $|-5 - 8| = |-13| = 13$

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On the graph below, plot the following points:



Locate the coordinate of the midpoint and label it M.

How can you find the midpoint?

average



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To find the coordinate of the midpoint on a number line you find the average of the 2 endpts.

Example #2:

If X: 12, Y: -5, and Z: 8, find the midpoint of the following segments.

XY:  $\frac{12 + (-5)}{2} = \frac{7}{2} = 3.5$

YZ:  $\frac{-5 + 8}{2} = \frac{3}{2} = 1.5$

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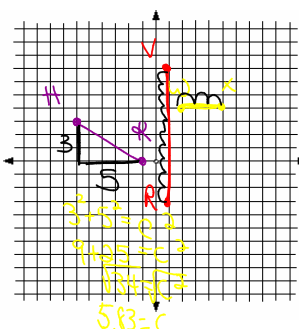
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Calculating the length of a segment in the Coordinate Plane:

Use the coordinate plane to graph the following segments:

WX: W (2,4) and X (5,4) RV: R (1,-3) and V (1,7)

HK: H (-6,3) and K (-1,0)



Find the length of each segment.

WX = 3

RV = 10

What about HK?

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Since we can't 'count' on a diagonal like we can on a number line, we need to use a special formula:

DISTANCE FORMULA:  $D = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$



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Example #3:

If H: (-6, 3) and K: (-1, 0), find HK using the distance formula.

$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$   
 $= \sqrt{(-1 - (-6))^2 + (0 - 3)^2}$   
 $= \sqrt{5^2 + (-3)^2}$   
 $= \sqrt{25 + 9} = \sqrt{34} = 5.83$

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Example #4:

Find the lengths of the following segments:

1. (-5, -7) and (2, -2)

$d = \sqrt{(2 - (-5))^2 + (-2 - (-7))^2}$   
 $= \sqrt{7^2 + 5^2}$   
 $= \sqrt{49 + 25}$   
 $= \sqrt{74} = 8.60$

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2.  $(3, 1)$  and  $(-5, 0)$   
 $x_1, y_1$  and  $x_2, y_2$

$$d = \sqrt{(-5-3)^2 + (0-1)^2}$$

$$= \sqrt{64+1}$$

$$= \sqrt{65} = 8.06$$

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To find the midpoint of a segment on the coordinate plane is still all about calculating an **average**. However, since each point has an x-coordinate and a y-coordinate, the midpoint must also have an x- and y-coordinate.

To find the coordinate of a midpoint on the coordinate plane:

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

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In other words, you average your x-coordinates and average your y-coordinates and express your results as an **coordinate pair**.



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**Example #5:**

Find the coordinate of the midpoint for each of the following segments:

1.  $(-5, -7)$  and  $(2, -2)$

$$\frac{-5+2}{2} \quad \frac{-7+(-2)}{2}$$

$$(-1.5, -4.5)$$

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2.  $(3, 1)$  and  $(-5, 0)$

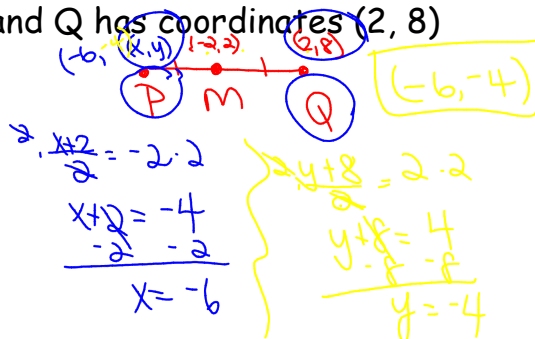
$$\frac{3+(-5)}{2} \quad \frac{1+0}{2}$$

$$(1, 0.5)$$

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**Example #6:**

Find the coordinates of P if M  $(-2, 2)$  is the midpoint of  $\overline{PQ}$  and Q has coordinates  $(2, 8)$

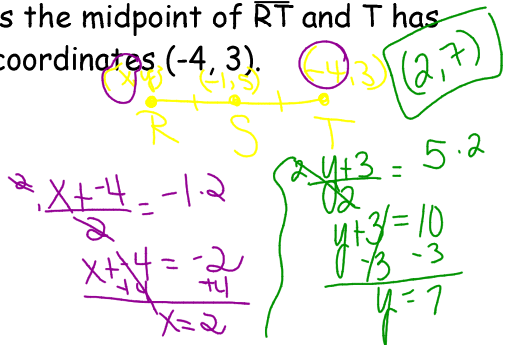


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Example #7:



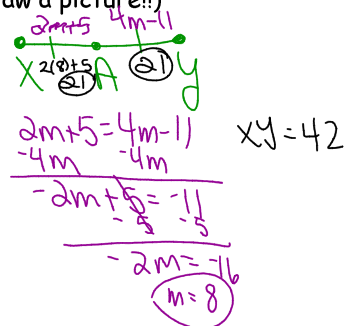
Find the coordinates of R if S(-1, 5) is the midpoint of  $\overline{RT}$  and T has coordinates (-4, 3).



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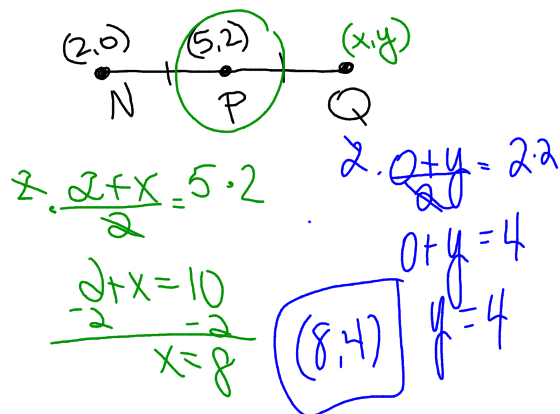
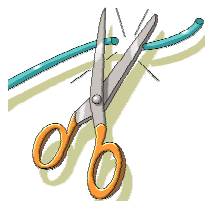
Example #8:

If A is the midpoint of XY,  $AX = 2m + 5$ , and  $AY = 4m - 11$ , find m and XY. (Hint: Draw a picture!!)



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**Bisect:** To cut into 2 equal pieces.



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