

NAME \_\_\_\_\_ DATE \_\_\_\_\_ PERIOD \_\_\_\_\_

# 1-1 Study Guide and Intervention

## Points, Lines, and Planes

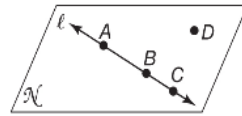
**Name Points, Lines, and Planes** In geometry, a **point** is a location, a **line** contains points, and a **plane** is a flat surface that contains points and lines. If points are on the same line, they are **collinear**. If points are on the same plane, they are **coplanar**.

**Example:** Use the figure to name each of the following.

a. a line containing point *A*

The line can be named as  $\ell$ . Also, any two of the three points on the line can be used to name it.

$\overleftrightarrow{AB}$ ,  $\overleftrightarrow{AC}$ , or  $\overleftrightarrow{BC}$



b. a plane containing point *D*

The plane can be named as plane *N* or can be named using three noncollinear points in the plane, such as plane *ABD*, plane *ACD*, and so on.

### Exercises

Refer to the figure.

1. Name a line that contains point *A*.

$\overleftrightarrow{AB}$ ,  $\overleftrightarrow{AC}$ ,  $\overleftrightarrow{BC}$ ,  $\ell$

2. What is another name for line *m*?

$\overleftrightarrow{BD}$

3. Name a point not on  $\overleftrightarrow{AC}$ .

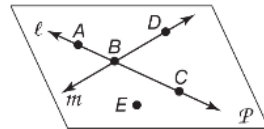
$\cdot E$ ,  $\cdot D$ ,  $\overleftrightarrow{AB}$ ,  $\overleftrightarrow{BC}$ ,  $\overleftrightarrow{AC}$

4. What is another name for line  $\ell$ ?

$\overleftrightarrow{AB}$ ,  $\overleftrightarrow{BC}$ ,  $\overleftrightarrow{AC}$

5. Name a point not on line  $\ell$  or line *m*.

$\cdot E$



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# 1-1 Study Guide and Intervention (continued)

## Points, Lines, and Planes

**Points, Lines, and Planes in Space** Space is a boundless, three-dimensional set of all points. It contains lines and planes. The **intersection** of two or more geometric figures is the set of points they have in common.

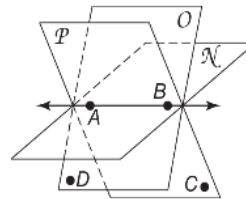
**Example**

a. Name the intersection of the planes  $O$  and  $N$ .

The planes intersect at line  $\overleftrightarrow{AB}$ .

b. Does  $\overleftrightarrow{AB}$  intersect point  $D$ ? Explain.

No.  $\overleftrightarrow{AB}$  is coplanar with  $D$ , but  $D$  is not on the line  $\overleftrightarrow{AB}$ .



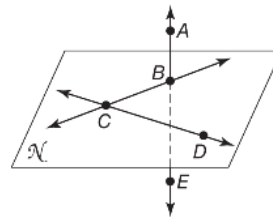
**Exercises**

Refer to the figure.

1. Name the intersection of plane  $N$  and line  $\overleftrightarrow{AE}$ .  **$\cdot B$**

2. Name the intersection of  $\overleftrightarrow{BC}$  and  $\overleftrightarrow{DC}$ .  **$\cdot C$**

3. Does  $\overleftrightarrow{DC}$  intersect  $\overleftrightarrow{AE}$ ? Explain. **NO**



Refer to the figure.

4. Name the three line segments that intersect at point  $A$ .

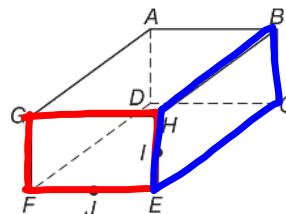
**$\overline{AG}, \overline{AB}, \overline{AD}$**

5. Name the line of intersection of planes  $GAB$  and  $FEH$ .

**$\overline{GH}$**

6. Do planes  $GFE$  and  $HBC$  intersect? Explain.

**yes**

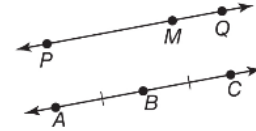


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## 1-2 Study Guide and Intervention

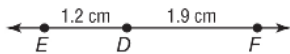
### Line Segments and Distance

**Calculate Measures** On  $\overline{PQ}$ , to say that point  $M$  is between points  $P$  and  $Q$  means  $P$ ,  $Q$ , and  $M$  are collinear and  $PM + MQ = PQ$ .



On  $\overline{AC}$ ,  $AB = BC = 3$  cm. We can say that the segments are **congruent segments**, or  $\overline{AB} \cong \overline{BC}$ . Slashes on the figure indicate which segments are congruent.

#### Example 1: Find $EF$ .

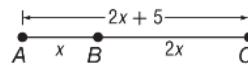


Point  $D$  is between  $E$  and  $F$ . Calculate  $EF$  by adding  $ED$  and  $DF$ .

$$\begin{aligned} ED + DF &= EF && \text{Betweenness of points} \\ 1.2 + 1.9 &= EF && \text{Substitution} \\ 3.1 &= EF && \text{Simplify.} \end{aligned}$$

Therefore,  $\overline{EF}$  is 3.1 centimeters long.

#### Example 2: Find $x$ and $AC$ .



$B$  is between  $A$  and  $C$ .

$$\begin{aligned} AB + BC &= AC \\ x + 2x &= 2x + 5 \\ 3x &= 2x + 5 \\ x &= 5 \end{aligned}$$

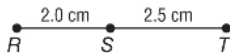
Betweenness of points  
Substitution  
Add  $x + 2x$ .  
Simplify.

$$AC = 2x + 5 = 2(5) + 5 = 15$$

#### Exercises

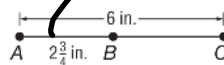
Find the measurement of each segment. Assume that each figure is not drawn to scale.

#### 1. $\overline{RT}$



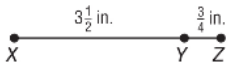
$$RT = 4.5$$

#### 2. $\overline{BC}$



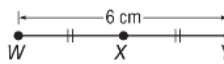
$$\begin{aligned} 6 - 4 &= 2 \\ \frac{6}{4} - \frac{4}{4} &= \frac{2}{4} \\ \frac{1}{2} &= \frac{1}{2} \end{aligned}$$

#### 3. $\overline{XZ}$



$$\frac{7}{2} + \frac{3}{4} = \frac{17}{4}$$

#### 4. $\overline{WX}$



$$WX = 3$$

**ALGEBRA** Find the value of  $x$  and  $RS$  if  $S$  is between  $R$  and  $T$ .

5.  $RS = 5x$ ,  $ST = 3x$ , and  $RT = 48$

$$\begin{aligned} 5x + 3x &= 48 \\ x &= 6 \end{aligned}$$

7.  $RS = 6x$ ,  $ST = 12$ , and  $RT = 72$

$$\begin{aligned} 6x + 12 &= 72 \\ x &= 10 \end{aligned}$$

6.  $RS = 2x$ ,  $ST = 5x + 4$ , and  $RT = 32$

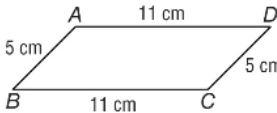
$$\begin{aligned} 2x + 5x + 4 &= 32 \\ x &= 4 \end{aligned}$$

8.  $RS = 4x$ ,  $ST = 4x$ , and  $RT = 24$

$$\begin{aligned} 4x + 4x &= 24 \\ x &= 3 \end{aligned}$$

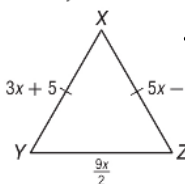
Determine whether each pair of segments is congruent.

#### 9. $\overline{AB}$ , $\overline{CD}$



yes

#### 10. $\overline{XY}$ , $\overline{YZ}$



NO

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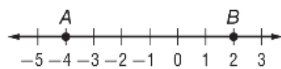
## 1-2 Study Guide and Intervention *(continued)*

### Line Segments and Distance

**Distance Between Two Points** The distance between two points on a number line is the absolute value of the difference between their coordinates. If  $P$  and  $Q$  are on the same line,  $P$  has coordinate  $x_1$ , and  $Q$  has coordinate  $x_2$ ,  $PQ = |x_2 - x_1|$  or  $|x_1 - x_2|$ .

To find the distance between two points in a coordinate plane, you can form a right triangle, and then use the Pythagorean Theorem to find the distance between the two points. If  $P$  and  $Q$  are in the same coordinate plane,  $P$  has coordinate  $(x_1, y_1)$ , and  $Q$  has coordinates  $(x_2, y_2)$ , then  $PQ = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ .

**Example 1: Find  $AD$ .**



The coordinates of  $A$  and  $D$  are  $-4$  and  $2$ .

$$\begin{aligned} AD &= |x_2 - x_1| && \text{Distance Formula} \\ &= |2 - (-4)| && x_1 = -4 \text{ and } x_2 = 2 \\ &= |6| \text{ or } 6 && \text{Simplify.} \end{aligned}$$

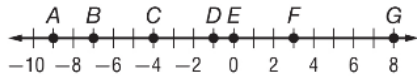
**Example 2: Find the distance between  $C(-1, 3)$  and  $D(3, -5)$ .**

$$\begin{aligned} CD &= \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} && \text{Distance Formula} \\ &= \sqrt{(3 - (-1))^2 + (-5 - 3)^2} && (x_1, y_1) = (-1, 3) \text{ and } \\ & && (x_2, y_2) = (3, -5) \\ &= \sqrt{4^2 + (-8)^2} && \text{Subtract.} \\ &= \sqrt{16 + 64} && \text{Evaluate exponents.} \\ &= \sqrt{80} && \text{Add.} \end{aligned}$$

The distance between  $C$  and  $D$  is  $\sqrt{80}$  or about 8.9 units.

**Exercises**

Use the number line.



1. Find  $BD$ .  $|-4 - (-8)| = 4$

2. Find  $DG$ .  $|-1 - 8| = 9$

3. Find  $AF$ .  $|2 - (-10)| = 12$

4. Find  $EF$ .  $|0 - 3| = 3$

5. Find  $BG$ .  $|-7 - 8| = 15$

6. Find  $AG$ .  $|-9 - 8| = 17$

Find the distance between each pair of points.

7.  $A(-1, 2)$  and  $B(-4, 6)$   $\sqrt{(-4 - (-1))^2 + (6 - 2)^2} = 5$

8.  $C(5, -3)$  and  $D(4, -2)$   $\sqrt{(4 - 5)^2 + (-2 - (-3))^2} = \sqrt{2}$

9.  $M(7, 8)$  and  $N(-3, -8)$   $\sqrt{(-3 - 7)^2 + (-8 - 8)^2} = 2\sqrt{89}$

10.  $X(-2, -1)$  and  $Y(-5, -7)$   $\sqrt{(-5 - (-2))^2 + (-7 - (-1))^2} = 3\sqrt{5}$

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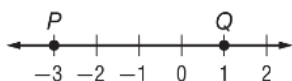
## 1-3 Study Guide and Intervention

### Locating Points and Midpoints

#### Midpoint of a Segment

<b>Midpoint on a Number Line</b>	If the coordinates of the endpoints of a segment are $x_1$ and $x_2$ , then the coordinate of the midpoint of the segment is $\frac{x_1 + x_2}{2}$ .
<b>Midpoint on a Coordinate Plane</b>	If a segment has endpoints with coordinates $(x_1, y_1)$ and $(x_2, y_2)$ , then the coordinates of the midpoint of the segment are $(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2})$ .

**Example 1:** Find the coordinate of the midpoint of  $\overline{PQ}$ .



The coordinates of  $P$  and  $Q$  are  $-3$  and  $1$ .

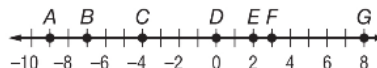
If  $M$  is the midpoint of  $\overline{PQ}$ , then the coordinate of  $M$  is  $\frac{-3+1}{2} = \frac{-2}{2}$  or  $-1$ .

**Example 2:** Find the coordinates of  $M$ , the midpoint of  $\overline{PQ}$ , for  $P(-2, 4)$  and  $Q(4, 1)$ .

$$M = \left( \frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right) = \left( \frac{-2 + 4}{2}, \frac{4 + 1}{2} \right) \text{ or } (1, 2.5)$$

#### Exercises

Use the number line to find the coordinate of the midpoint of each segment.



- |                    |                        |                    |       |
|--------------------|------------------------|--------------------|-------|
| 1. $\overline{CE}$ | -1                     | 2. $\overline{DG}$ | 4     |
| 3. $\overline{AF}$ | -3                     | 4. $\overline{EG}$ | 5 1/2 |
| 5. $\overline{AB}$ | 8                      | 6. $\overline{BG}$ | 1 1/2 |
| 7. $\overline{BD}$ | -3.5 or $-\frac{7}{2}$ | 8. $\overline{DE}$ | 1     |

Find the coordinates of the midpoint of a segment with the given endpoints.

- |                            |                      |                            |                                |
|----------------------------|----------------------|----------------------------|--------------------------------|
| 9. $A(0, 0), B(12, 8)$     | $(6, 4)$             | 10. $R(-12, 8), S(6, 12)$  | $(-3, 11)$                     |
| 11. $M(11, -2), N(-9, 13)$ | $(1, \frac{11}{2})$  | 12. $E(-2, 6), F(-9, 3)$   | $(-\frac{11}{2}, \frac{9}{2})$ |
| 13. $S(10, -22), T(9, 10)$ | $(\frac{19}{2}, -6)$ | 14. $K(-11, 2), L(-19, 6)$ | $(-15, 4)$                     |

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### 1-3 Study Guide and Intervention *(continued)* **Locating Points and Midpoints**

**Locate Points** You can also find points that are other fractional distances from an endpoint of a segment.

**Example 1:** Find the point  $X$  on  $\overline{AB}$  that is  $\frac{1}{3}$  of the distance from  $A$  to  $B$ .

Find the distance between  $A$  and  $B$ .

$$\begin{aligned} AB &= |x_2 - x_1| && \text{Distance Formula} \\ &= |5 - (-4)| && x_1 = -4 \text{ and } x_2 = 5 \\ &= |9| \text{ or } 9 && \text{Simplify.} \end{aligned}$$



To find the point that is  $\frac{1}{3}$  of the distance from  $A$  to  $B$ , find  $\frac{1}{3}AB$ .

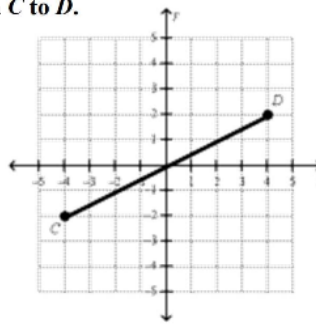
$$9\left(\frac{1}{3}\right) = 3$$

$X$  is 3 units from point  $A$  on  $\overline{AB}$ , so point  $X$  is located at  $-4 + 3 = -1$  on the number line.

**Example 2:** Find the point  $Y$  on  $\overline{CD}$  that is  $\frac{1}{4}$  of the distance from  $C$  to  $D$ .

Find the distance between the  $x$ -coordinates of  $C$  and  $D$ .

$$\begin{aligned} |x_2 - x_1| &= |4 - (-4)| && x_1 = -4 \text{ and } x_2 = 4 \\ &= |8| \text{ or } 8 && \text{Simplify.} \end{aligned}$$



Multiply this distance by the fractional distance:  $8\left(\frac{1}{4}\right) = 2$ .

Add this to the  $x$ -coordinate of  $C$ :  $-4 + 2 = -2$ .

Find the distance between the  $y$ -coordinates of  $C$  and  $D$ .

$$\begin{aligned} |y_2 - y_1| &= |2 - (-2)| && y_1 = -2 \text{ and } y_2 = 2 \\ &= |4| \text{ or } 4 && \text{Simplify.} \end{aligned}$$

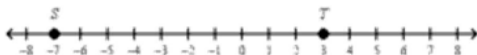
Multiply this distance by the fractional distance:  $4\left(\frac{1}{4}\right) = 1$ .

Add this to the  $y$ -coordinate of  $C$ :  $-2 + 1 = -1$ .

The point  $Y$  is located at  $(-2, -1)$ .

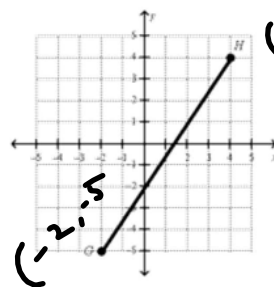
**Exercises**

- Find the point  $X$  on  $\overline{ST}$  that is  $\frac{1}{5}$  of the distance from  $S$  to  $T$ .



$$\begin{aligned} |-7 - 3| &= 10 \\ 10 \cdot \frac{1}{5} &= 2 \quad \checkmark \\ -7 + 2 &= -5 = X \end{aligned}$$

- Find the point  $Y$  on  $\overline{GH}$  that is  $\frac{2}{3}$  of the distance from  $G$  to  $H$ .



$$\begin{aligned} &(4, 4) \\ &\sqrt{(4 - (-2))^2 + (4 - (-5))^2} \\ &= \sqrt{36 + 81} \\ &= \sqrt{117} \cdot \frac{2}{3} \end{aligned}$$

